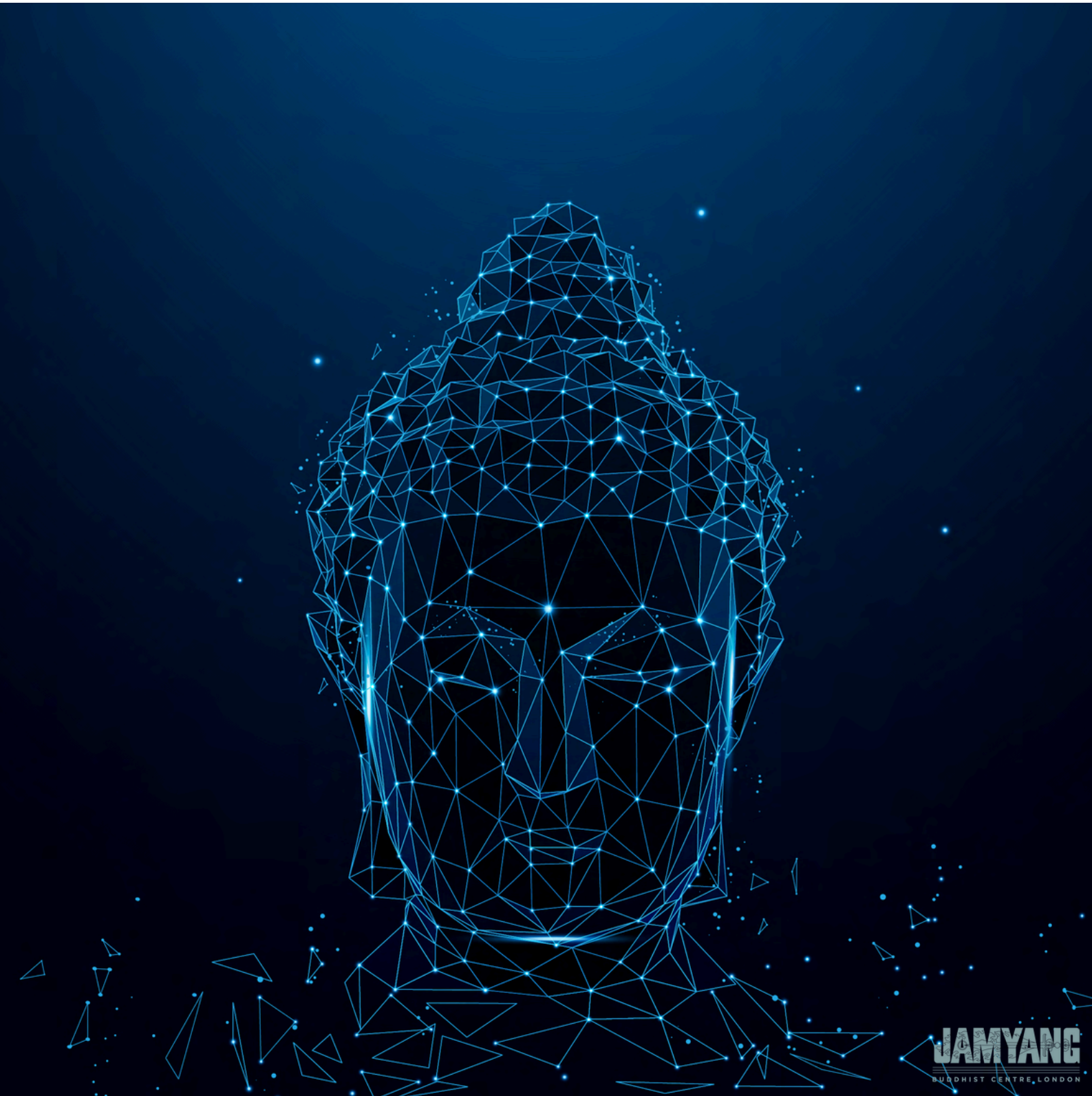
Buddhism & Quantum Physics

Course Handbook



Welcome

We are happy that you are here and that you have decided to embark on a unique e-Learning journey into the worlds of Buddhism and Quantum Physics. Firstly, please know that you are not alone and that we are here for you throughout the course. You are also encouraged to reach out to peer students via our online chat forum, and to join our live Q&A sessions that are held at regular intervals throughout the year

Before you begin, we would like to draw your attention to a few of our learning tools and materials, to help you start this course in the best way.

Students who are new to Buddhism or Quantum Physics might need to do some preliminary research to be able to fully engage with the course materials. If you feel this might be the case, please have a look at these 3 preliminary texts (which you can find in your LearnDash):

- A Short Introduction to Buddhism (10-15 minutes read)
- A Short Introduction to Buddhist Tenets (10-15 minutes read)
- A Short Introduction to Quantum Physics (10-15 minutes read)

You can also get some extra knowledge about either Buddhism or Quantum Physics by watching any of the following (external) videos:

- Introduction to Buddhism: https://vimeo.com/showcase/10475845
- Introduction to Buddhist Tenets (different Buddhist schools):
  - Secular: https://vimeo.com/showcase/9359121
  - Buddhist: https://vimeo.com/showcase/11107631 (Password: Sci-Wiz)
- General Buddhist Mind/Science: https://vimeo.com/showcase/10475852
- Quantum Physics & Buddhism: https://www.youtube.com/watch?v=q8Xg-H-V22A

While you are taking this e-Course, we would recommend that you make good use of:

- Our exclusively tailored "lecture notes" for each module.
- The provided bibliography for any further reading you might find interesting.
- To attend the live Q&A group sessions that are held at regular intervals during the year.
- Check out the chat forum and post any comments or questions you might have, to discuss them with your peers.
- Get in touch with the team for any technical or content related support you might need. Please contact us per email at: hello@sciwizlive.com

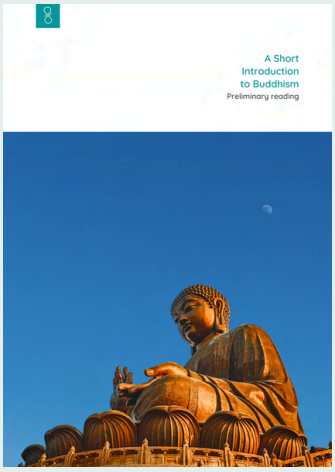
We encourage all our students to take a mindful break after each lesson and module: to stretch, breathe, make yourself a drink, and take a few minutes silence to calm your mind before diving into the next topic.

We very much hope that you will have a transformative learning experience and that this e-Course will provide you with new insights, fresh perspectives, special knowledge, and some practical new meditation tools!

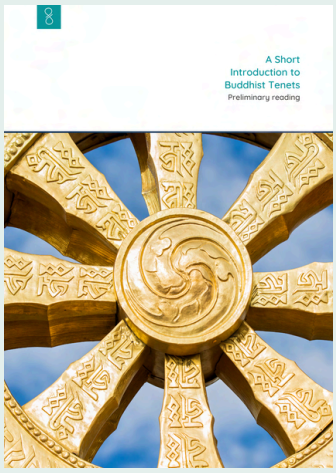
With best wishes,

The teams of:
Science & Wisdom LIVE
Jamyang London Buddhist Centre

Module shortcuts



A Short Introduction to Buddhism



A Short Introduction to Buddhist Tenets

A Short Introduction to Quantum Physics

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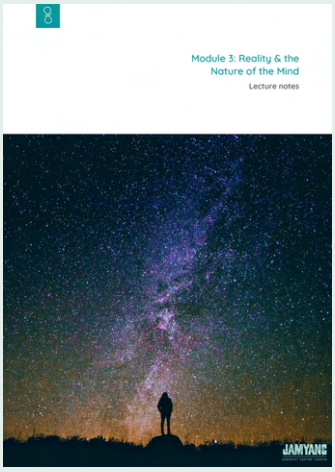
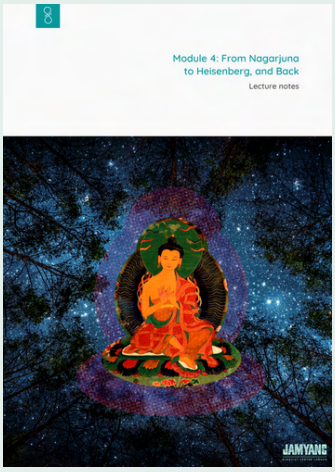


Module 3: Reality & the Nature of the Mind



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A Short Introduction to Buddhism

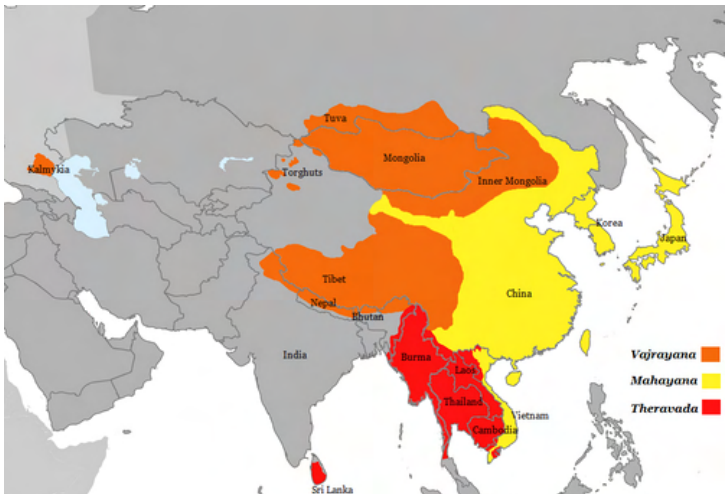
Preliminary reading

Introduction

If this is your first encounter with Buddhist philosophy, many of the ideas discussed in this course may sound new or unfamiliar. While it would be impossible to faithfully present two and a half millennia of philosophical inquiry in just a few pages, these notes will help you to grasp the fundamental concepts that you will encounter throughout the course. After a general introduction to the history and fundamental ideas of Buddhism, this document focuses on the Mahāyāna tradition (one of the three main branches in Buddhism). In particular, the key concepts of emptiness and dependent origination are explained according to Nāgārjuna's Middle-Way philosophy, which is the interpretation of Buddhism most often discussed during the course. You can find more information on other Buddhist schools in a separate document, *A Short Introduction to Buddhist Tenets*.

Historical Background

Modern scholars estimate that Siddhartha Gautama, who later became known as the historical Buddha (the awakened one), lived in India around the 5th century BCE. According to traditional accounts, Gautama was moved by his deep compassion for the suffering of all beings, who repeatedly experienced cycles of birth, ageing, sickness, and death (a cycle that, due to reincarnation, he perceived as endless). After years of intense study, meditation, and ascetic practices, he is said to have achieved enlightenment and completely broken free from the cycle of suffering and rebirth (*saṃsāra*). Following his enlightenment, he founded a monastic community (*Sangha*) and devoted his life to teaching the path to liberation and enlightenment (*Dharma*).



The teachings of the Buddha were transmitted by his disciples, first orally and then in writing. During the centuries, this led to the development of different schools and traditions. Today, there are three main branches of Buddhism: Theravāda, Mahāyāna, and Vajrayāna. Of these, Theravāda Buddhism is considered to be the oldest and, in many ways, the most conservative, as it rejects the authenticity of Mahāyāna sutras (later Buddhist scriptures, appearing after around the 1st century BCE) and only recognises the teachings included in the so-called Pāli Canon. By contrast, Mahāyāna Buddhists consider as canonical not only the early scriptures of the Pāli Canon, but also the later sutras expounding the Mahāyāna path. This doctrine focuses on the Bodhisattva ideal, the wish to achieve enlightenment to be able to free all sentient beings from their suffering, and on the Perfection of Wisdom (*Prajñāpāramitā*), a method of liberation based on the direct realisation of emptiness (*Śūnyatā*; see section on emptiness below). The third branch, Vajrayāna Buddhism, complements the Mahāyāna approach with tantric methods as a help to achieve Buddhahood.

After the death of the Buddha, numerous scholars and practitioners expanded and developed his teachings, leading to the development of different schools of thought. One of the most influential early Mahāyāna philosophers was Arya Nāgārjuna (c. 150–250 CE). He is considered to be the founder of the Middle-Way school (*Mādhyamaka*), and his ideas have been profoundly influential in the development of Indian and Tibetan Buddhism. A key aim of his work is to clarify the Buddha's teachings on emptiness (*śūnyatā*), the idea that all phenomena lack an intrinsic and independent existence (see also the section below).

Another major figure in the development of Mahāyāna Buddhism is Dignāga (c. 480 – c. 540 CE), considered to be one of the founders of Buddhist logic. His philosophical work addresses the question of epistemology, that is, how one can acquire valid knowledge about the world through perception and reasoning. Dignāga ideas were further developed by Dharmakīrti (6th or 7th century CE), whose work on valid cognition is discussed in more detail by Prof. John Dunne in Module 3. The epistemology of Dignāga and Dharmakīrti was integrated in the Middle-Way doctrine of Nagarjuna by Śāntarakṣita, who also contributed to the diffusion of Buddhism in Tibet in the 8th century CE

Nāgārjuna [c. 150 – c. 250 CE]

Dharmakīrti [c. 600* - c. 660 CE].

Digňaga [c. 480 – c. 540 CE]

Sāntarakṣita [c. 725–788 CE]

The Four Noble Truths

A central idea to Buddhist philosophy and practice is that our experience of suffering arises from a distorted perception of reality, which is the fundamental cause of all negative emotions. By bringing our understanding more closely in tune with reality, we can overcome mental suffering and be able to live more meaningful and constructive lives, and eventually achieve enlightenment and abandon suffering altogether. According to tradition, the Buddha's first teaching expounded his ideas about suffering in what are known as the Four Noble Truths:

- **The truth of suffering**. All sentient beings inevitably experience many types of suffering, such as the suffering of birth, aging, sickness and death, as well as the suffering of being separated from what is pleasant, encountering what is unpleasant, and not being able to fulfil one's desires. As long as we have misperceptions about reality, we cannot achieve long-lasting happiness.

- **The truth of the origin of suffering**. Like any other phenomenon, suffering is seen as arising from specific causes and conditions. Ultimately, it is not the result of misfortune nor a punishment from a divine/supernatural entity, but it arises from ignorance – that is, lack of an appropriate understanding of reality. Ignorance gives rise to mental fabrications and conceptual thought, which lead to craving, grasping, and attachment to sensory objects and self. Craving and attachment, in turn, are the main causes behind saṃsāra, the endless cycle of birth, ageing, and death.

- **The truth of the cessation of suffering**. This core presentation of the Buddhist teachings might, at first glance, appear somewhat grim or pessimistic, yet the fundamental message of the Noble Truths is a profoundly optimistic one: suffering is not random, causeless, or arising from the will of a supernatural entity, but it arises from causes and conditions. Therefore, it can be ended by eliminating its causes. This is the third Noble Truth: the complete and permanent extinguishing of suffering is possible.

- **The truth of the path to the cessation of suffering**. In the fourth Noble Truth, the Buddha explains how to achieve cessation of suffering. By realising the wisdom of emptiness (i.e., through a direct perception of the ultimate nature of reality), ignorance is destroyed. This, in turn, brings an end to the craving behind the endless cycle of suffering and rebirth. In Nāgārjuna's words:

> 'With the cessation of ignorance, conceptualities will not arise... The entire mass of suffering thereby completely ceases.' [1]
>
> — Nāgārjuna

This last point is particularly important, as it makes understanding the nature of reality not merely a scholarly inquiry, but the very condition for individual liberation and enlightenment.

[1] Nāgārjuna, quoted in Westerhoff, Jan (2009). Nagarjuna's Madhyamaka: A Philosophical Introduction. *Oxford University Press*. ISBN 9780199705115

Emptiness

As seen in the second Noble Truth, the real cause of suffering is our ignorance of the fundamental nature of reality. What does this exactly mean, and in what way do we misperceive reality? According to Buddhism (as well as other contemplative traditions, such as Advaita Vedanta), our minds project a sense of intrinsic and independent existence (*svabhava*) unto ourselves and the objects around us. The Sanskrit term, *svabhava*, can be translated as 'essential nature' and refers to an intrinsic essence which is unconditioned, uncaused, and not dependent on other entities.

Mahāyāna scholars argue that all phenomena (objects, people, perceptions, ideas, etc.) lack *svabaha*: they are empty of an unconditioned, uncaused, and independent intrinsic essence. This lack of intrinsic existence is referred to as *śūnyata*, which is frequently translated to as "emptiness" or "voidness". This idea is a recurrent theme in the Perfection of Wisdom sutras (including the Heart Sutra) and is the foundation of Nāgārjuna's philosophy. Here, wisdom (as the opposite of ignorance) refers to a deep meditative state in which there is a direct, non-conceptual realisation of emptiness. This state is considered to be the doorway to enlightenment. The meditator understands that all phenomena have the same nature of a mirage, a drop of dew, a water bubble, or a cloud, and is therefore free from a mistaken perception of reality.

It is important to clarify that – as Nāgārjuna and other Middle-Way scholars clearly emphasise – emptiness is not the same as nothingness. The statement that "all phenomena are empty" simply means that, whatever phenomenon is considered, it is impossible to find an intrinsic, independent essence. In other words, this understanding of emptiness can be thought of as form of radical relativity: it does not deny existence, but independent existence. Therefore, all phenomena and views are seen as relative. Thus, the "Middle Way" avoids both the extreme of nihilism (thinking that nothing exists at all) and the extreme of absolutism (thinking that something exists intrinsically).

Dependent Origination

Like modern science, Buddhist thought recognises that phenomena are inextricably linked together in chains of causes and effects. According to Buddhist thought, all phenomena (objects, people, perceptions, ideas, etc.) arise in dependence upon other phenomena, which in turn depend on prior causes. It follows that, if the causes cease to exist, so do their products. Thus, the Buddha taught that all dependently arisen phenomena are impermanent, that is, they are subject to change and transformation.
In Mahāyāna Buddhism, dependent origination is closely connected with emptiness of independent existence. The fact that phenomena arise in dependence on their causes, and do not exist without something causes them, proves that they are in fact empty of inherent/intrinsic existence. Again, in Nāgārjuna's words:

> 'Since nothing has arisen without depending on something, there is nothing that is not empty.' [2]
>
> — Nāgārjuna

In the next preliminary reading, *A Short Introduction to Buddhist Tenets,* you will find more detailed explanations about emptiness and dependent origination, and how these concepts have been understood by different schools of Mahāyāna Buddhism. Throughout the course, and especially in Modules 4 and 5, the concepts of emptiness and dependent origination will be discussed in greater detail. The key takeaway is that emptiness refers to the lack of an intrinsic nature, while dependent origination (or interdependence) refers to the arising of (relative) phenomena through the law of cause and effect.

[2] Nāgārjuna, quoted in Westerhoff, Jan (2009). Nagarjuna's Madhyamaka: A Philosophical Introduction. *Oxford University Press.* ISBN 9780199705115

A Short Introduction to Buddhist Tenets

Preliminary reading

Introduction

"*Tenet: a principle, belief, or doctrine generally held to be true, especially one held in common by members of an organization, movement, or profession.*"
(Merriam-Webster dictionary)

As your learned in the previous document, *A Short Introduction to Buddhism*, the teachings of the Buddha gave rise to many different systems and interpretations. All Buddhist scholars share some fundamental beliefs, such as the four noble truths, emptiness/selflessness, and the possibility to find enlightenment and liberation. However, different schools of thought have come up with gradually more nuanced and subtler ways of interpreting these concepts. This, in turn, led to the development of different systems of tenets. This is similar to the evolution of scientific theories: throughout the centuries, scientists have developed different models of reality, which have been developed and refined through experimental and theoretical research.

One key theme here, which will recur throughout the course, is the difference between reality and appearance: what is fundamentally real? And what is just an illusory appearance, a projection of the mind? Another key concept is that of "selflessness": what does it mean that there is no self? What is the basis through which our experience of a solid self arises?

This document outlines how four different Buddhist schools have tried to answer these questions: the Great Exposition school, the Sutra school, the Mind-Only school, and the Middle-Way school. You do not need an extensive knowledge of all these theories in order to complete the course: this outline is meant as a roadmap to help you navigate the different points of view discussed throughout the course.

In reading this text, it is useful to keep in mind that these schools adopt gradually subtler views of reality. The first two schools have a *realist* outlook, as they believe in the existence of elemental entities. While denying the existence of the self ("selflessness of persons"), they believe in an objective existence of physical phenomena. The Mind-Only school, on the other hand, considers the mind to be real, while objects do not have any independent existence. Therefore, it is an *idealist* school. The Middle-Way school, finally, claims that the mind, too, is a relative entity, *transcending both idealism and realism*. In addition to the selflessness of persons, the last two schools argue that phenomena themselves do not possess an intrinsic existence ("selflessness of phenomena").

The Great Exposition School (Vaibhāṣika)

According to this interpretation, the world is ultimately composed of infinitesimally small particles. These are the only concrete and inherently existing entities: on the contrary, mental processes and physical objects have no intrinsic nature (*svabhāva*). They arise from the elemental components through the process of dependent origination and therefore exist “in name only”.

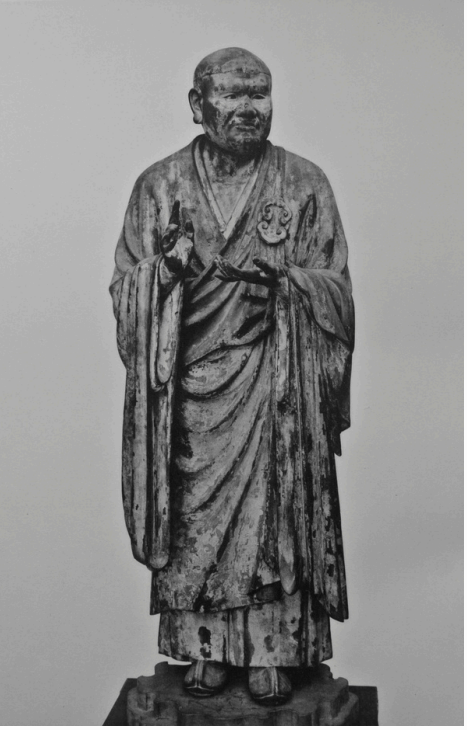
This view is somewhat similar to classical physics, which sees material particles (neutrons, protons, electrons) as the fundamental building blocks of nature. You may be familiar, for example, with the typical representation of an atom with seemingly solid electrons orbiting in definite trajectories around a central core.

But unlike classical physics, this interpretation of the Great Exposition School also extends to mental phenomena. According to Great Exposition scholars, every experience can be partitioned into shorter and shorter fragments, until a “quantum” of consciousness is reached that cannot be partitioned any further. This includes also the experience of a "self", which is considered to be a relative perception, an illusion projected upon a stream of (elemental) experiences.

The Sutra School (Sautrāntika)

The Sutra school developed from the Great Exposition school around the 2nd or 3rd century CE. As hinted by its name, this school relies on canonical Buddhist scriptures (*sutra*) as an ultimate source of authority in philosophical matters. One of this school's major contributions is the development of Buddhist logic and epistemology through the works of Dignāga and Dharmakīrti (whose ideas you will encounter in Module 3).

Like the Great Exposition School, the Sutra School can be considered *realist*: it asserts that objects exist "out there" and are the cause of our perceptions. The world exists independently of the minds that perceive it, but the categories that we use to think about it are pure mental fabrications. They are not inherently existing properties of real objects, but only artifacts of our cognition. For example, labels such as "hot" or "cold" do not have an intrinsic existence in reality, but are projected by our minds unto existing entities such as fire or ice. Similarly, what we perceive as our "self" is only an idea, a mental fabrication projected upon existing phenomena (the body and the mind).



The Mind-Only School (Yogācāra or Cittāmatra)

The name of the Mind-Only school comes from an early Mahāyāna sutra, the Saṃdhinirmocana Sūtra, which states that the objects of perceptions are not different from the mind that perceives them: they are *citta-mātra*, "only mind". What we perceive as external objects are purely mental phenomena, and they do not exist independently from cognitive processes.

Like other schools, proponents of the Mind-Only schools see external and internal phenomena as arising through dependent origination from causes and conditions; but unlike the Great Exposition and Sutra schools, they argue that these causes are mental, rather than physical, in their nature.

The central idea of this school is that our everyday dualistic experience of ourselves as separate from the world is just an illusion. Objects and other people appear to be "out there", separate from our consciousness; but according to Mind-Only philosophers, all phenomena are fundamentally one with the consciousness that apprehends them. They are "empty" of existing independently from the mind, and this emptiness is seen as a "thoroughly established phenomenon".

To a certain extent, this view can be linked to some interpretations of quantum mechanics that will be discussed during the course, such as QBism or the Van Neumann-Wigner interpretation. More broadly, the difference between the Mind-Only school and realist schools (*Sutra* and Great Exposition) can be compared to the difference between quantum and classical physics. While classical physics considers the world to exist independently from observation, in quantum physics the observer plays a key role in determining the properties of physical systems, as you will learn during the course

The Middle-Way School (Mādhyamaka or Mādhyamika)

The "middle way" in this school's name refers to taking a balanced view which is free of two extreme viewpoints: absolutism (the idea that phenomena exist in an intrinsic and independent way) and nihilism (the idea that nothing exists at all). Middle-Way scholars avoid these two extremes by stating that nothing exists independently, but phenomena still exist in the nature of dependent origination. As all that exists is dependently arisen, all phenomena are empty of independent existence.

The Middle-Way school recognises three different levels of interdependence: dependence on parts and collections of parts (which is also recognised by other schools), dependence on causes and conditions, and dependence on the mind, that projects a label unto parts and the causes that brought them together.

All other schools of tenets take some entity as intrinsically and independently existing, such as elementary particles (Great Exposition school), external phenomena (Sutra school), or thoroughly established phenomena (i.e., emptiness/selflessness - the Mind-Only school).

According to Middle-Way scholars, all other schools fall into the extreme of absolutism because they claim that reality has a concrete, solid, substantial foundation. By contrast, the Middle-Way school argues that nothing can exist without depending on something else. This is also true of "universal" categories, such as space, time, or causation, and even emptiness itself is considered to be empty of existing intrinsically.

The ideas that properties of the world are not independently existing, but arise through the relation between physical systems, is central to Prof. Carlo Rovelli's interpretation of quantum mechanics, which will be discussed during this e-Course. This interpretation resonates deeply with Middle-Way philosophy, and Prof. Rovelli himself was deeply influenced by the works of the founder of the Middle-Way school: Nāgārjuna.

A Short Introduction to Quantum Physics

Preliminary reading

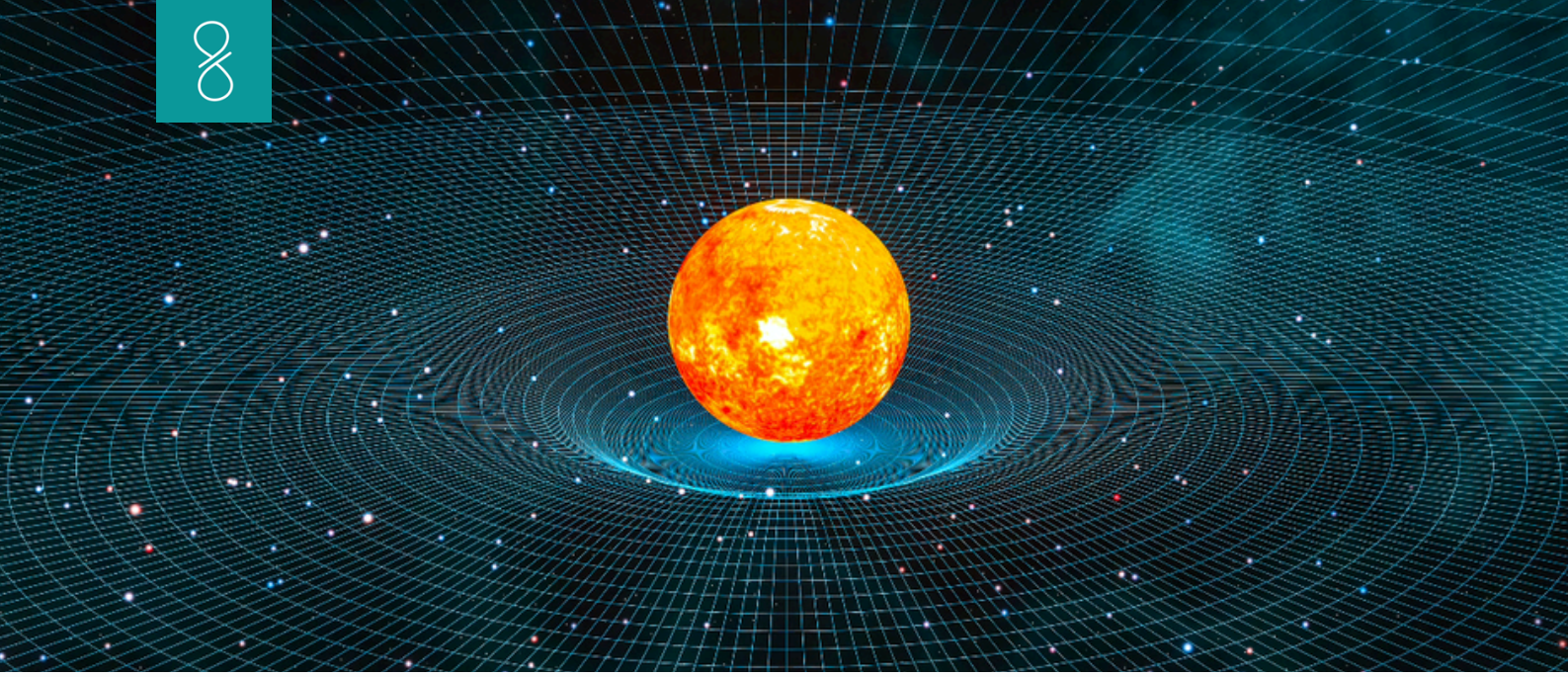
Introduction

A major revolution took place in the sciences towards the end of the 19th century and the beginning of the 20th century, as many of the predictions that scientists made about the natural world turned out to be wrong or inaccurate. The mainstream theory of physics at that time was what is now known as classical physics: a theory of how objects behave in the macroscopic world we inhabit. Classical physics is a deterministic theory: it assumes that if the position and velocity of an object and all the forces acting on it are known, this is sufficient to fully predict its position and velocity at any future moment.

Classical physics works well for "everyday" speeds and sizes: it is an excellent theory for describing the motion, say, of a person riding a bicycle, or the impact between the balls used in a pool game. However, as physicists begun to realise at the beginning of the 20th century, its predictions are less reliable when the theory is applied to very small or very massive objects and to extremely high speeds. These limitations led to the formulation of two more accurate theories of physics: quantum mechanics, which deals with the microscopic world, and Einstein's relativity theory, which deals with very massive objects and/or objects moving at speeds comparable to the speed of light.

Unlike relativity theory, quantum mechanics was not discovered by a single scientist. Rather, it was developed as a collective effort by many theorical and experimental physicists throughout much of the 20th century, with the most concentrated period of pioneering activity taking place during the 1920s. In this short introduction to quantum mechanics, you will learn about the fundamental ideas of this new kind of physics, which, to date, is the most accurate theory of how matter and energy behave on a microscopic scale. Most of the concepts touched upon here will be expanded in greater detail in Module One.

The Solvay Conference on Electrons and Photons, (colourised version) **1927**.Back to front, left to right:**Back**: *Auguste Piccard, Émile Henriot, Paul Ehrenfest, Édouard Herzen, Théophile de Donder, Erwin Schrödinger, JE Verschaffelt, Wolfgang Pauli, Werner Heisenberg, Ralph Fowler, Léon Brillouin.* **Middle***: Peter Debye, Martin Knudsen, William Lawrence Bragg, Hendrik Anthony Kramers, Paul Dirac, Arthur Compton, Louis de Broglie, Max Born, Niels Bohr.* **Front**: *Irving Langmuir, Max Planck, Marie Curie, Hendrik Lorentz, Albert Einstein, Paul Langevin, Charles-Eugène Guye, CTR Wilson, Owen Richardson.*



What is a quantum?

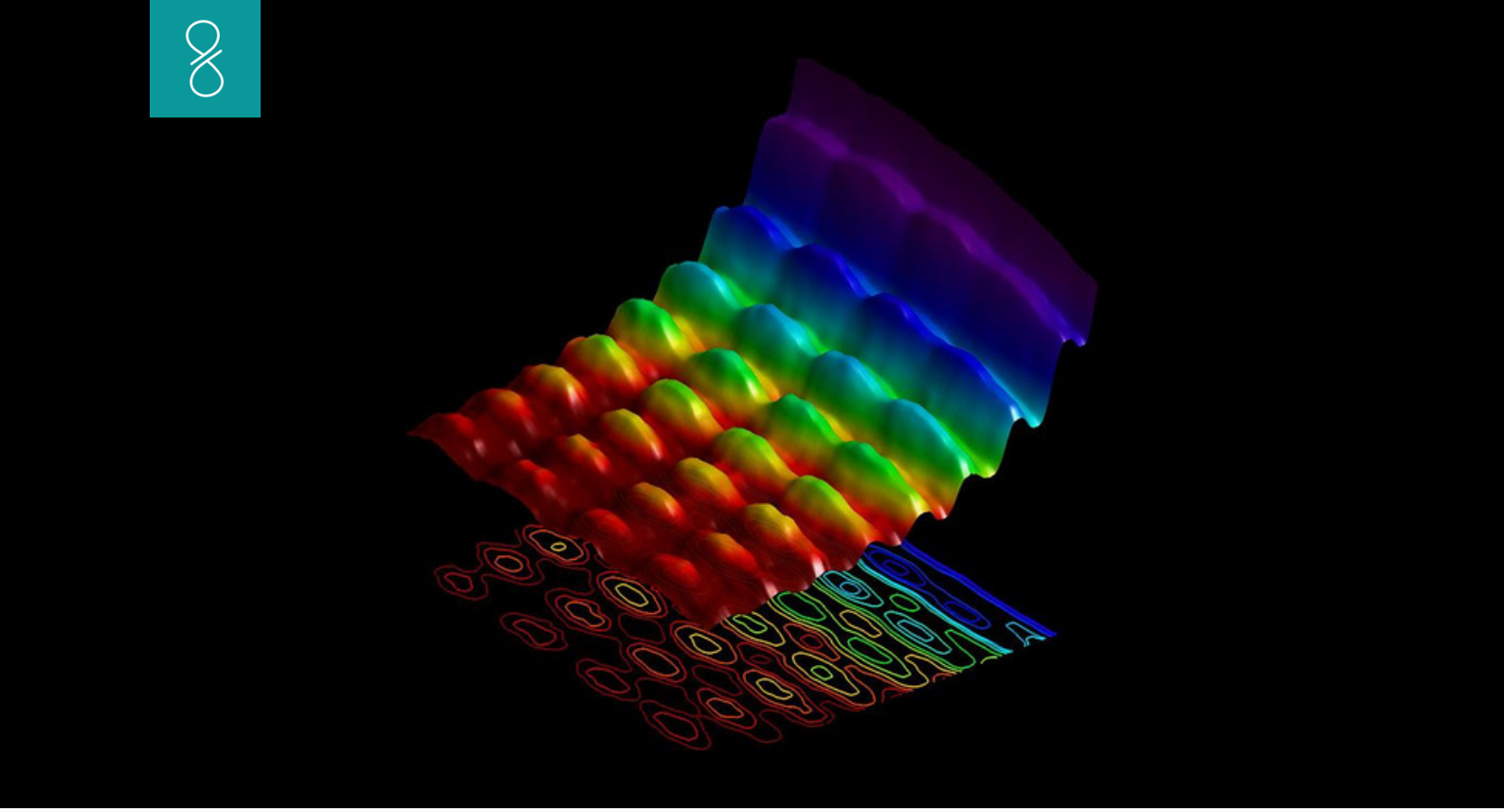
Towards the end of the 19th century, scientists had begun to realize that matter is not a continuous, uniform entity: rather, it is composed of localised units, which were called atoms (from the Greek word for "indivisible"). As it eventually turned out, atoms could in fact be divided in more elementary entities: a nucleus composed of protons and neutrons, where most of an atom's mass is concentrated, surrounded by electrons, very light particles with a negative electric size. In turn, protons and neutrons can be subdivided into smaller elementary particles, named quarks. While many schoolbooks still depict protons, neutrons and electrons as solid spheres, nothing could be further from the truth – which is something that has been revealed by quantum physicists during the 20th century.

In 1900, Max Planck, one of the fathers of quantum physics, suggested that not only matter, but also energy was not a continuous entity, but that it was rather localised in discreet units, which he called "quanta" (hence the name quantum mechanics/physics). Later, in 1905, Albert Einstein applied this idea to light, demonstrating that it had a "particle nature". This result was somewhat puzzling, as light also possesses a wave-like nature[1]; however, experiments clearly demonstrate that under certain conditions, it behaves as if composed of material particles instead. Each of these particles, a "quantum of light", is known as photon, and this is the smallest amount of light of a certain energy that can be emitted: the "fundamental unit" of light. Under certain conditions, light behaves as if made up of many of these discreet photons, manifesting a particle-like behaviour. Under other conditions it reveals its wave-like nature, showing behaviours that are typical of waves, such as interference and diffraction.

Wave or Particle?

Einstein demonstrated that a wave-like phenomenon, like light, had a particle-light nature too. In 1923, another physicist, Louis de Broglie suggested that the opposite was also true: he speculated that material particles, like electrons or protons, could – under certain conditions – behave like waves. As absurd as this might seem, this prediction was in fact confirmed by experiments in the following years: this principle of wave-particle duality is now accepted as a key feature of all entities at the microscopic quantum level.

[1] In physics, the term wave is used to refer to all phenomena that display properties similar to those of a wave propagating on the surface of a liquid. Wave-like phenomena, such as light, manifest certain behaviour that are not displayed by particles, such as interference (the process of interaction between two waves) and diffraction (what happens to a wave as it spreads out through a small opening).



Probability and uncertainty

In 1925, Werner Heisenberg, together with Max Born and Pascual Jordan, provided the first mathematical description of quantum mechanics. One year later, Erwin Schrödinger formulated an independent mathematical description of quantum mechanics, based on what later became known as the "Schrödinger equation". From these two formulations, two paradoxical properties emerged:

1) Heisenberg's Uncertainty Principle states that it is impossible to know, with arbitrary accuracy, the position and the velocity of a particle at the same time. In classical physics, in principle, these two quantities can be measured simultaneously, and particles move along well-defined trajectories that can (again, in principle) be accurately calculated. But in quantum physics, the concept of trajectory breaks down: if the velocity of a particle is known with great accuracy, there will be an increasingly great uncertainty about its position, and vice versa. This principle also applies to other couples of variables, such as the energy of a physical process and the time at which it took place.

2) Schrödinger's equation describes the world as probabilistic rather than deterministic. Rather than assigning well-defined properties to a system (say, a certain position and velocity), it describes the evolution of probability waves: that is, the probability of observing certain features of a physical system. When an observation is made, this cloud of probabilities collapses into a single value (the result of a measurement), but it is impossible to know in advance which value it will be. A puzzling consequence of this theory (which has been validated through experiments) is that a physical system can be in multiple states at the same time, and it is only when a measurement is performed that one of these states manifests (you might have heard of the thought experiment known as "Schrödinger's cat", which illustrates this paradox).

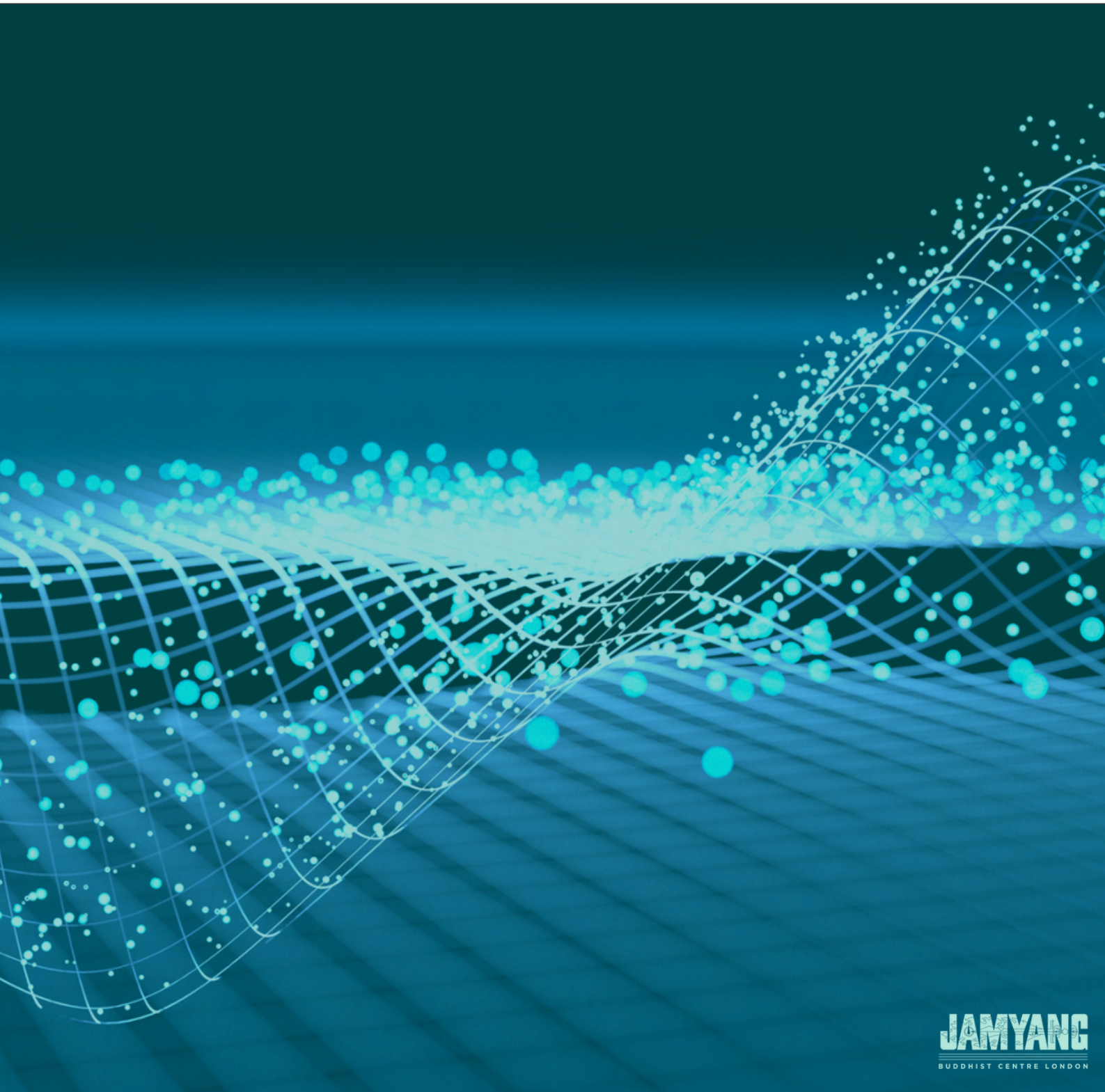
Quantum Entanglement

Many physicists found it hard to abandon a deterministic description of nature in favour of a probabilistic one. Among them was Albert Einstein, who unsuccessfully tried to illustrate how quantum theory would lead to internal contradictions. In 1935, with his colleagues Podolsky and Rosen, he devised a thought experiment later known as "EPR paradox", inadvertently predicting the phenomenon of *quantum entanglement*. This phenomenon involves the instant communication between two "entangled" systems, which may be separated by enormously large distances. Measurements on the first system immediately involve a change in the quantum state of the second, and vice-versa. While Einstein and his colleagues thought this phenomenon to be impossible, and therefore prove the inconsistency of quantum theory, it has since been rigorously verified by repeated experiments – confirming the predictive power of quantum theory instead, while at the same time adding to the list of paradoxical behaviours displayed by quantum systems.

In Module 1, you will learn in more detail about such unintuitive behaviours and acquire enough knowledge of quantum mechanics to understand the material discussed throughout the rest of the course. In addition, you will encounter several different interpretations of quantum physics: the different ways scientists and philosophers tried to interpret the mathematical theory to make sense of the anomalies of the quantum world.

Module 1: A Beginner's Guide to Quantum Mechanics

Lecture notes



JAMYANG
BUDDHIST CENTRE LONDON

Module 1: A Beginner's Guide to Quantum Mechanics

Introduction

Quantum mechanics (or Quantum Physics – the two terms are used interchangeably) is the most accurate and advanced physical theory for describing how matter and energy behave at microscopic levels. In this first module, we will give you a *comprehensive introduction* into this profound and sometimes paradoxical theory of reality.

Lesson 1:

Lesson 1 of this module gives an overview of some of the key concepts of quantum physics, including the uncertainty principle, wave-particle duality, and non-locality. It also looks at how quantum mechanics differs from classical physics – which describes the macroscopic world of our everyday experience – and the paradoxical way that the quantum and classical realms relate to each other.

Lesson 2:

Lesson 2 discusses some of the interpretations that scientists have developed to try to understand and make sense of what is going on in the quantum world. While the mathematical foundations of quantum mechanics are strongly supported by experiments and universally accepted by physicists, there are a number of different ways of interpreting these equations and the entities they describe. The vast number of different interpretations indicates how difficult it is to understand the role of consciousness in shaping the behaviour of the physical world.

Key Concepts

Wave-particle duality; uncertainty principle; classical physics; quantum physics; double-slit experiment; Schrödinger's cat; nonlocality; entanglement; Copenhagen Interpretation; QBism.

Key Thinkers

Richard Feynman; Erwin Schrödinger; Eugene Wigner; Albert Einstein; Galileo Galilei; Werner Heisenberg; Niels Bohr; David Bohm; Prof. Carlo Rovelli.

Critical Thinking Questions

1. Why should reality behave so differently on very small scales compared to the scale of everyday experience?
2. Do you think the human mind plays a significant or an active role in determining reality? What about the mind of a rabbit or a fly?
3. Does Schrödinger's thought experiment with a cat demonstrate that there is something fundamentally wrong with our understanding of quantum mechanics?
4. How would you describe what an electron "actually" is?
5. Does it strike you as "spooky" that particles are able to instantaneously affect each other over potentially vast distances? What do you think this phenomenon says about the nature of reality?
6. Which interpretation of quantum mechanics do you prefer and why?

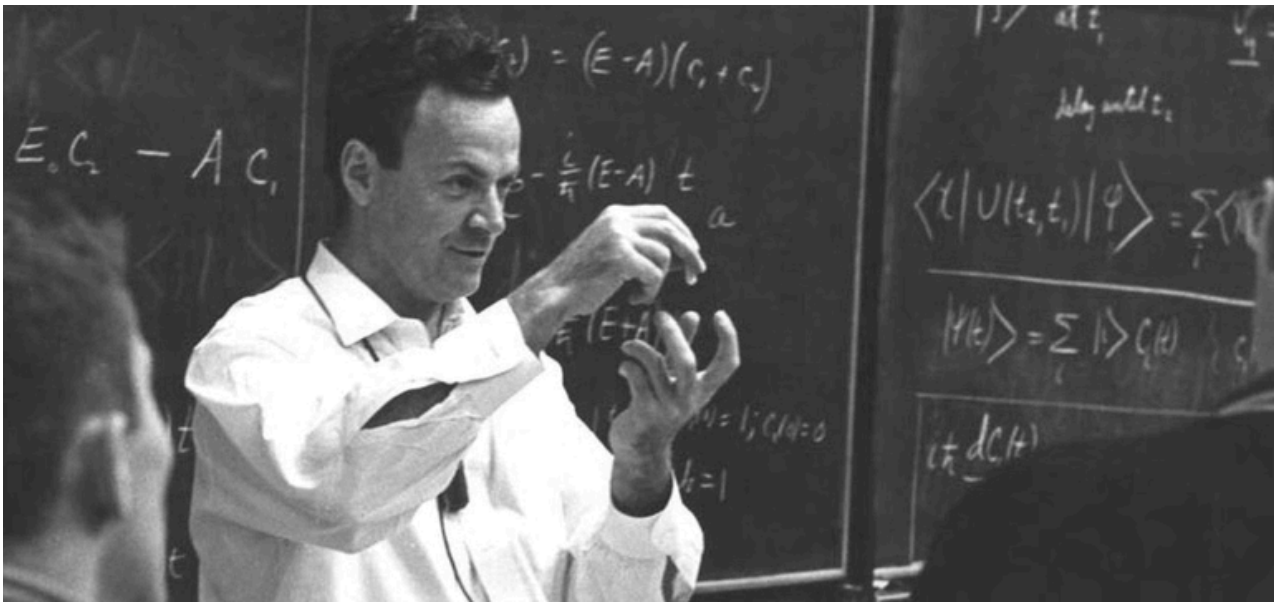
Lesson 1: What Is Quantum Mechanics?

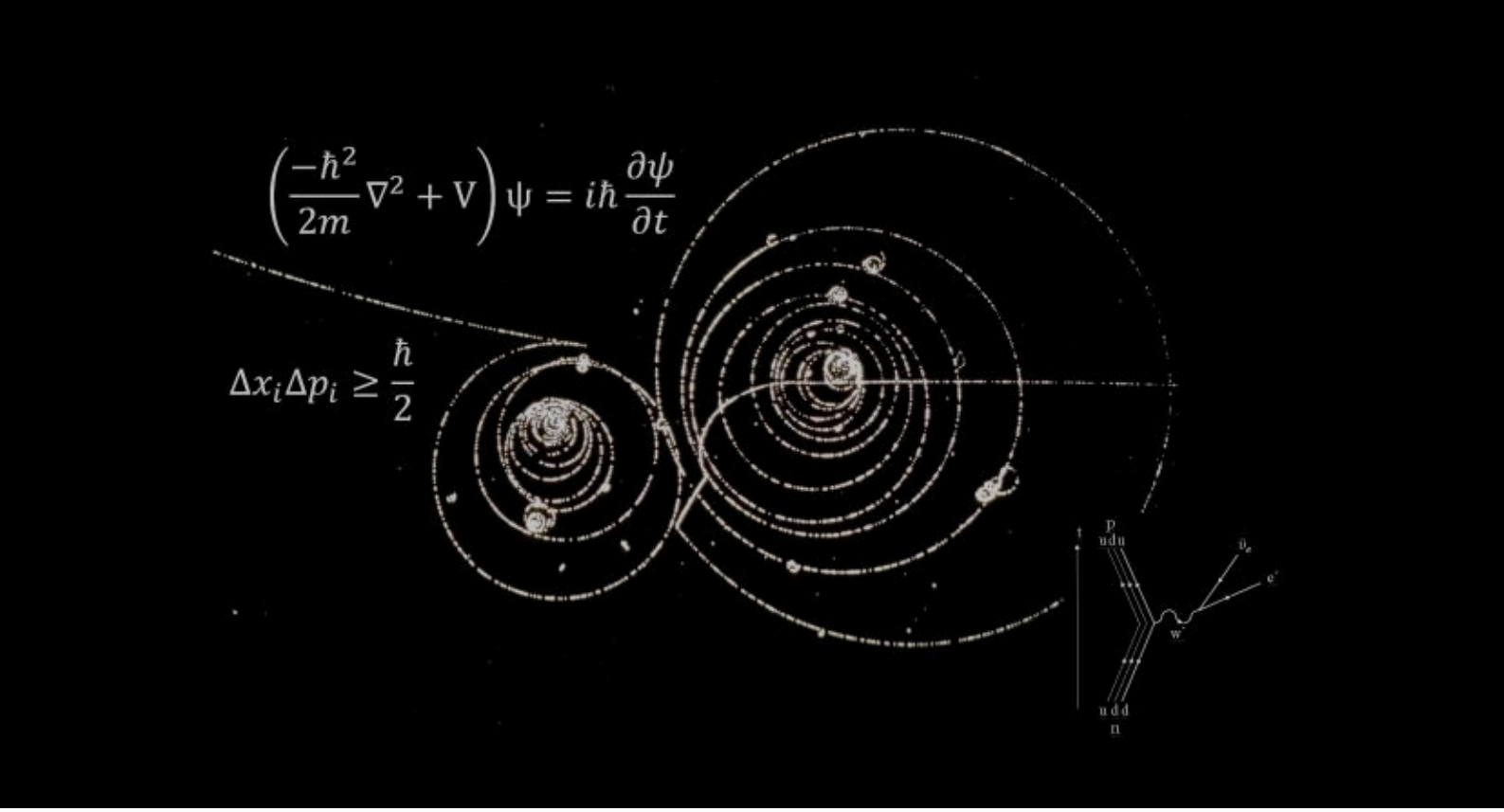
1a. Introduction

An understanding of Quantum Mechanics is potentially relevant to meditators and contemplative practitioners who are interested in gaining a deeper insight into the nature of reality. One important point is that, at the microscopic quantum level, the solidity and stability of our experience of the world seems to break down, and interactions begin to play a more prominent role than individual entities (such as material things or particles). Similarly, in deep meditation, it is possible to experience reality as deeply interconnected, rather than separate from our observations of it, and the "self" is experienced as fluid rather than stable and unchanging.

Physicist **Richard Feynman (1918-1988)** famously said: 'If you think you understand Quantum Mechanics, then you don't understand Quantum Mechanics!'. This is because matter and energy behave in a highly counterintuitive way at the microscopic level, even though this is what makes up the world we experience at the everyday level. In this lesson, some of the key differences between classical physics (which describes macroscopic, everyday objects very accurately) and quantum physics (which describes the behaviour of microscopic entities, such as atoms, electrons, and quarks) are discussed and explained.

> 'If you think you understand Quantum Mechanics, then you don't understand Quantum Mechanics!'
>
> — Richard Feynman





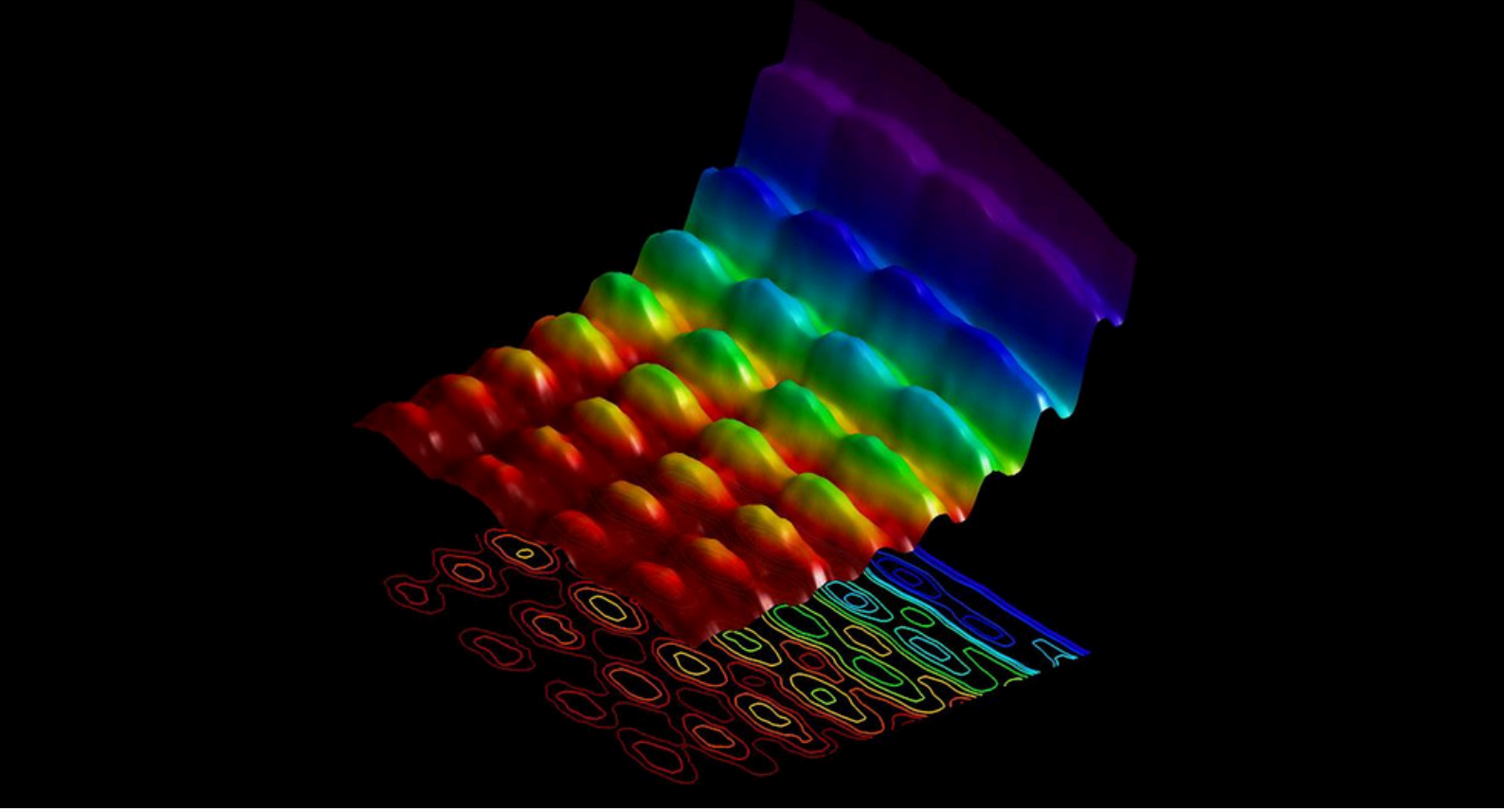
1b. Foundations of Quantum Mechanics: The Uncertainty Principle

In classical physics, both the position and momentum of an object can in principle be known simultaneously with complete accuracy. If we know both the initial position of an object and its momentum (i.e. its mass and velocity in a particular direction), then we can predict its trajectory and exactly where it will be at a future point in time.

But at the quantum level, this is not possible, even in principle: the more accurately we know either the velocity or momentum of a particle, the less accurately we will know the other of these quantities. Or we might know roughly where a particle is and roughly how fast it is moving in a particular direction, but not know either of these quantities with any degree of certainty.

So, at the quantum level, particles do not have a defined trajectory, only a "probabilistic" one. There are only likelihoods that they exist with certain properties at a certain time and place. This uncertainty is not caused by limitations in our measurement tools but is an intrinsic property of any quantum system. Quantum particles simply do not exist in the definite way we are used to with everyday objects.

> 'Uncertainty is not "I don't know." It is "I can't know." "I am uncertain" does not mean "I could be certain.'
>
> — Werner Heisenberg



1b. Foundations of Quantum Mechanics (continued)

Describing Quantum States

The probabilistic behaviour of quantum systems forces us to abandon the deterministic description of the world that was employed by classical physics. Instead, quantum mechanics adopts a probabilistic description based on wave functions, that are related to the probability of finding a system in a certain state, for example, the probability of moving with a certain velocity, or of being found in a certain position (to be exact, this probability is given by the square of the amplitude of the wave function, a result known as Born rule).

Erwin Schrödinger (1887-1961), one of the fathers of quantum mechanics, formulated an equation (which was named after him) to describe how the probability of quantum states changes in time. One of the most important consequences of Schrödinger's equation is a puzzling mathematical prediction: before measurement, the system is in a combination of multiple states, all of which are a possible solution to Schrödinger's equation. It is as if the probabilities of different states co-exist simultaneously until a measurement is performed or, in other words, as if the system is in multiple states at the same time!

1b. Foundations of Quantum Mechanics (continued)

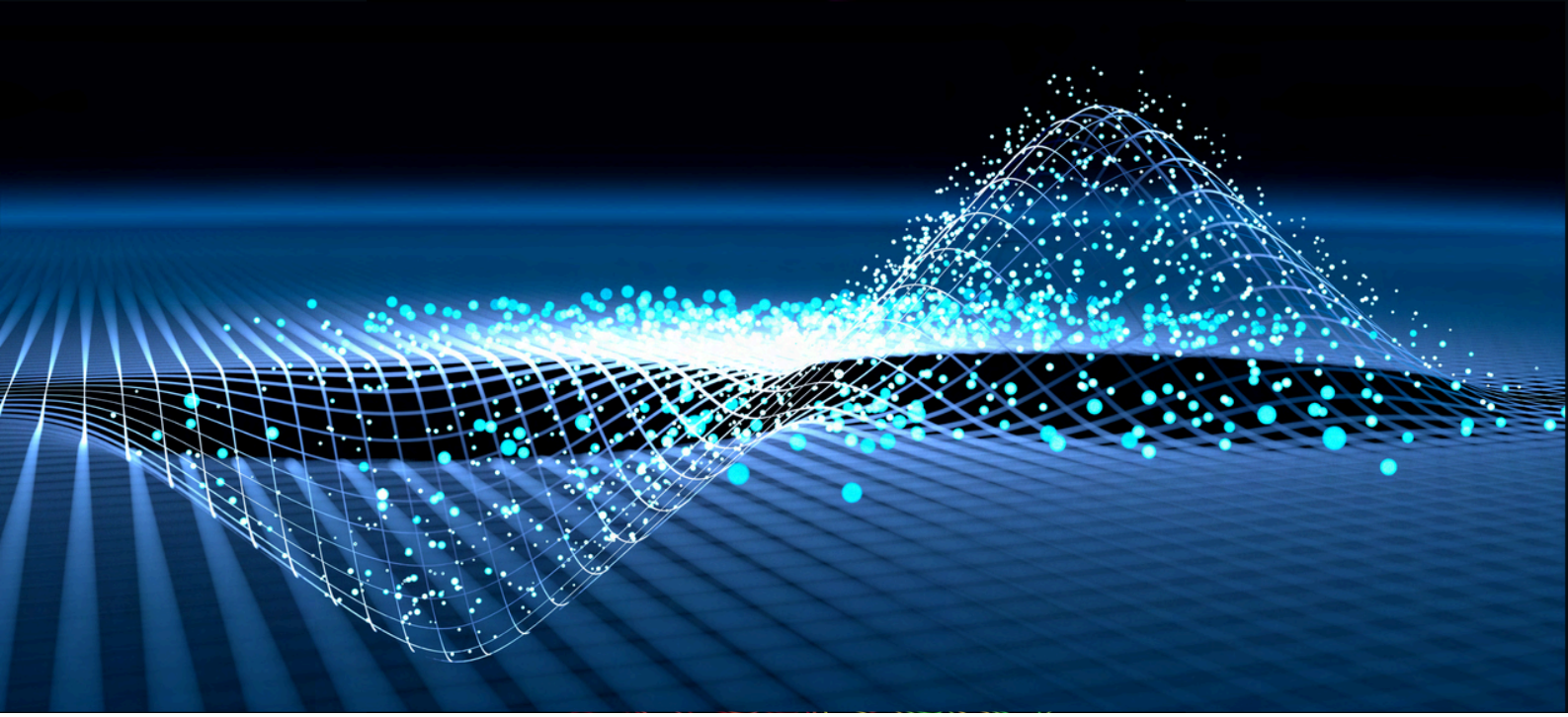
Schrödinger's Cat

To illustrate the paradoxical consequences of this result, Schrödinger devised a provocative thought experiment to highlight the paradoxical nature of quantum behaviour. He imagined a radioactive atom which can be in two different states: in the first state, the atom decays, emitting radiation; in the second, it does not decay. Since atoms are quantum systems, these two possible states are not exclusive; they exist simultaneously as two superimposed states, which coexist until an observation causes one or the other possibility to "collapse", thereby resolving the ambiguity.

In the context of quantum mechanics, this description agrees with the results of experiments on atoms and subatomic particles. But what would happen if we were to couple a quantum system to a macroscopic, classical system? In order to illustrate the difficulties in reconciling quantum theory with our everyday experience, Schrödinger described the following imaginary experiment. He imagined that the radiation potentially emitted by the radioactive atom was set up to hit a detector. In the presence of radiation, this detector would trigger the release of a hammer which would in turn break a glass bottle containing lethal poison. All of this takes place inside an enclosed box with a cat inside it.

The paradoxical result is that, since the atom is both emitting radiation and not emitting radiation, the detector is both triggered and not triggered; the poison released and not released; and therefore, the cat inside the box is described as being both alive and dead at the same time. This remains the case until someone opens the box and "collapses" the quantum system into one state or other. At this point, they would either find a dead cat or a living cat inside the box. However, according to a traditional interpretation of quantum mechanics, until then the system exists in both states simultaneously. This imaginary experiment reveals how difficult it is to apply the logic of quantum systems to the classical world we perceive through our senses.

Image: Schrödinger's cat by ArtistMopic

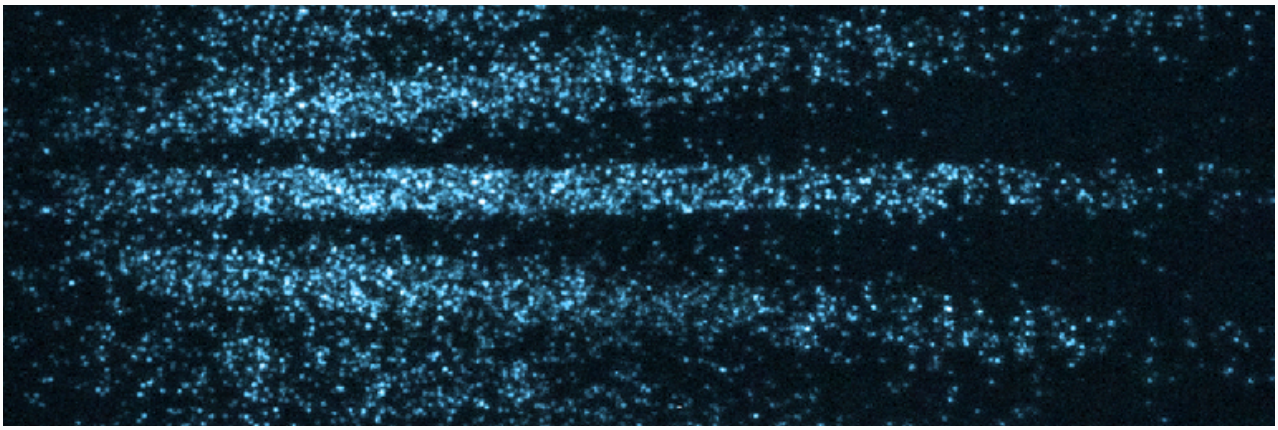


1b. Foundations of Quantum Mechanics (continued)

Wave-Particle Duality & Double-slit Experiment

In classical physics, if particles pass through one slit in a screen, they hit a background screen in an area corresponding to the shape and size of the slit they have passed through. Similarly, if particles pass through two slits in a screen, then they will land on a background screen in two areas: the shape and size corresponding to the shape and size of the two slits. However, in quantum physics, when particles pass through two slits in a screen, they form an "interference" pattern on a background screen. Such a pattern is characteristic of waves because the "peak" of one wave cancels out the "trough" of another wave but amplifies the "peak" of another. So, it is as if a particle passes through both slits at the same time, with two states of that particle being simultaneously "superimposed" on each other like colliding waves. Therefore, at the quantum level, entities can and do exhibit the properties of both particles and waves at the same time.

Even stranger is what happens when a measurement is made next to either slit to "detect" which slit the particle "actually" passes through. When a detector is used to perform this measurement, the result of the experiment changes! Instead of an interference pattern, two lines appear on the background screen, just as in the case of classical physics. One of the two superimposed states has collapsed. This shows that the observations made of a quantum system seem to be integral to how it behaves.



1c. Other Quantum Paradoxes

The Measurement Problem (Wigner's Paradox)

Eugene Wigner (1902-1995) formulated a more nuanced version of Schrödinger's thought experiment. He imagined that a quantum experiment takes place in a laboratory in which the superimposition of two quantum states (for simplicity, we will call the two possibilities "heads" and "tails") is resolved by observation. However, from the perspective of another experimenter, who is waiting outside the laboratory door, the outcome of the experiment is unknown and so, for them, the quantum system still exists in two different superimposed states. This presents a seeming paradox concerning whether the quantum state is really one of "heads" or "tails": different observers would perceive two different realities at the same time, one where the quantum state is either heads or tails, and another where the two quantum states are still superimposed ("heads" and "tails"!).

Nonlocality and Entanglement (Einstein-Podolsky-Rosen Paradox)

There are different kinds of properties that a quantum particle can have but, to keep the explanation simple, we can imagine that a quantum particle can be either "red" or "blue" with 50% probability. Now, it is possible for quantum particles to become correlated or "entangled" such that the properties of one automatically define the properties of its entangled "twin". For example, when one particle has the property "red", the other will always have the property "blue", and vice versa.

Experiments have shown that it does not matter how far apart two such entangled particles are for them to instantaneously affect each other like this, even across astronomical distances. **Albert Einstein (1879-1955)** called this effect 'spooky action at a distance'. His theory of relativity maintains that no particle or information can travel faster than the speed of light, but entanglement effects are instantaneous. This is an example of "nonlocality" and is another important feature of quantum behaviour.

Lesson 2: Interpretations of Quantum Mechanics

2a. Introduction

Galileo Galilei (1564-1642) pioneered the use of the scientific method to deduce "facts" about an "objective" external world. This approach works well for classical physics but seemingly breaks down at the microscopic quantum level where the distinction between "objective" reality and the process of observation is not so clear cut. Whilst the foundational equations that describe quantum systems and events are not disputed (and indeed have proven to be the most powerful and accurate equations we have for any scientific theory) there remains much debate about how these equations should be interpreted. What is it really that they describe? What is the actual "ontological status" (or way of existing) of quantum "particles"? Do they "really" exist, or do the equations simply offer a way of describing certain indefinable processes? Does an "observer" really affect the outcome of quantum experiments?

The Copenhagen Interpretation

According to this interpretation, devised by **Werner Heisenberg (1901-1976)**, **Niels Bohr (1885-1962)**, and others, measurement plays a key role in changing quantum states. It utilizes the concept of the "Heisenberg cut" which divides quantum systems into the "observed system" (described in terms of quantum mechanics) and the "observing system" (which consists of the measuring device and the agent that acquires knowledge about the measurement outcome). The observing system impacts the observed system through the process of measurement. In the Conventional Copenhagen Interpretation, the "cut" is objective and the same for all observers: all observers are placed on the "classical side" of the cut. But, as we have seen, it is unclear where the "cut" is to be placed, which leads to problems like Wigner's paradox. In the Neo-Copenhagen Interpretation, the positioning of the "cut" is subjective and depends on the observer; different observers can, in principle, partition the world in different quantum and classical regions.

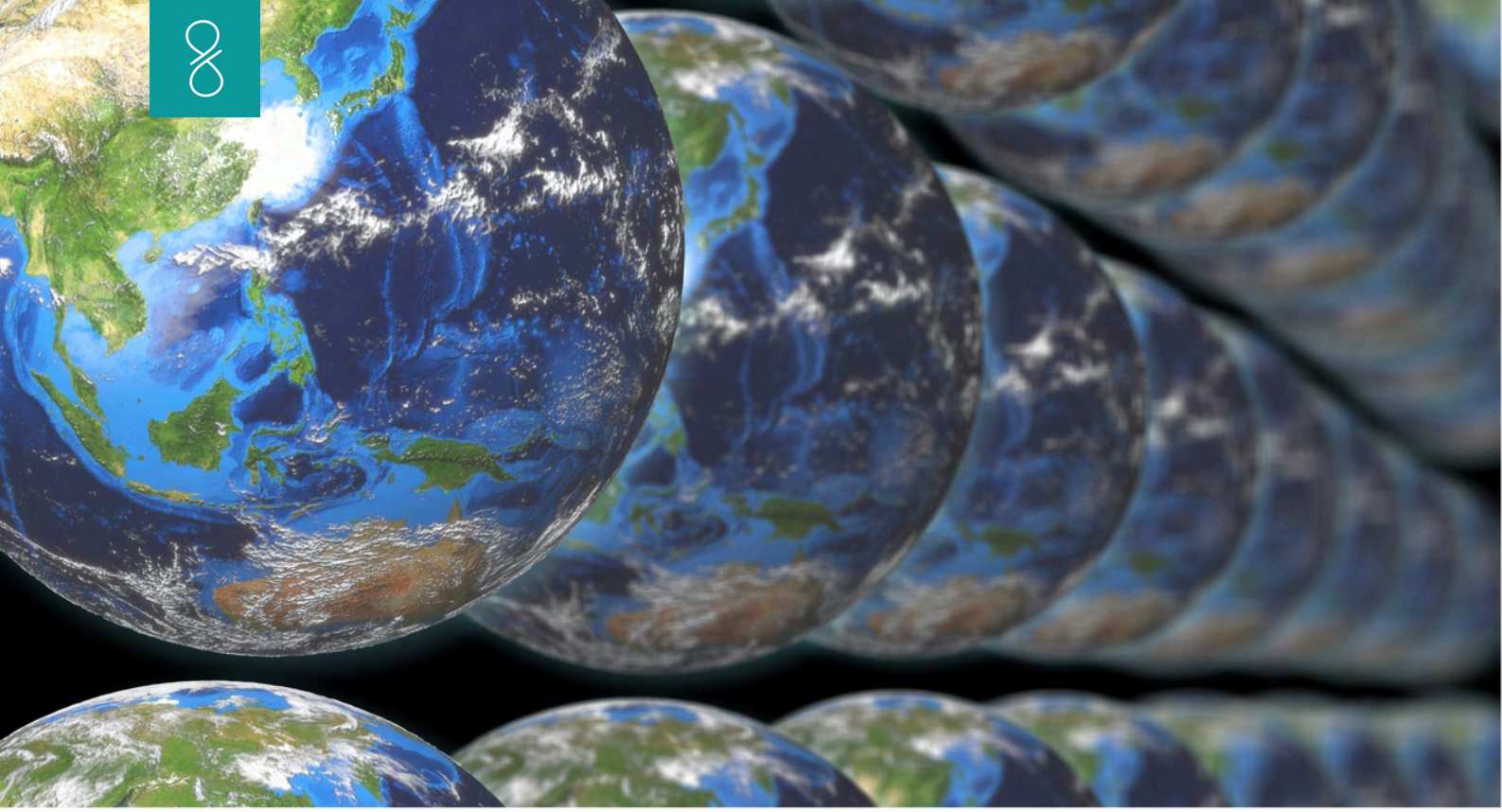
2b. The Different Interpretations of Quantum Mechanics

Realist or Non-Realist Interpretations?

One important way of distinguishing different interpretations of Quantum Mechanics is whether they are "realist" or not. There is an old philosophical question that asks: if a tree collapses in a forest, but nobody is around to observe it, does it make a sound? A realist would say "yes", because according to a realist there is a "real" world "out there" that exists independent of any observation; whereas a non-realist would say that there is no sound if nobody can hear it and therefore that reality is in some sense dependent on the people, or sentient minds, that observe it.

In Quantum Mechanics, Einstein was a realist who saw the quantum world as operating deterministically; this while Bohr was comfortable seeing the world as operating in an anti-realist, indeterministic way, because of which “Copenhagen” interpretations were named after his hometown. The most popular version of the Copenhagen interpretation has both realist and anti-realist elements: the observer makes a difference, but there is a real world for them to make a difference to. A more extreme version, called the Van Neuman-Wigner interpretation, goes further, and explicitly posits that it is consciousness itself that causes the collapse of the wave-function.

Whilst Copenhagen interpretations of Quantum Mechanics remain popular, many scientists do not like the idea that the mind plays an active role in the outcome of experiments and so, like Einstein, they prefer alternative "realist" interpretations. It is important to realize that such other interpretations exist and that they say quite different things about the nature of reality. The next three examples described below offer different kinds of “realist” interpretations.



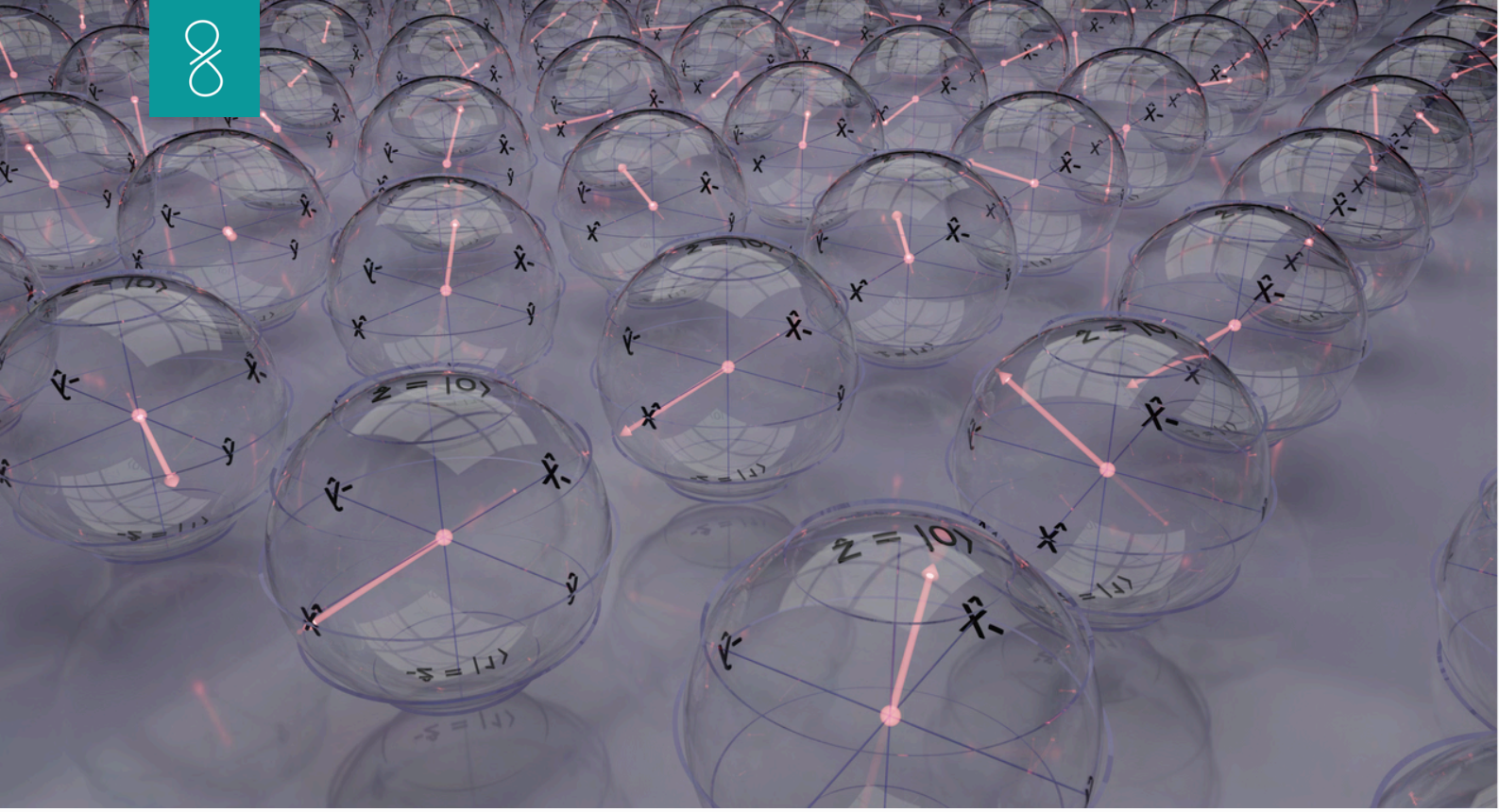
2b. The Different Interpretations of Quantum Mechanics (continued)

Bohemian Mechanics

Bohm's interpretation does not accord such an important status to the observer or the process of measurement. It sees no boundaries between the quantum and classical systems. Instead, the whole universe is considered to be a single quantum state, of which the observer is a part. His conception is "deterministic" but relies on the existence of hidden, unseen variables or "quantum potential". Rather than viewing the equations of quantum mechanics as describing a set of probabilities, Bohm interprets them as describing an actually existing potential impacting actually existing particles. However, each particle in the universe is influenced by, and in turn influences, every other particle, via this "quantum potential". His conception is therefore highly "non-local" and represents a "theory of the universe", rather than just a theory of any particular system.

Many-Worlds Interpretation

This interpretation is also deterministic and describes the entire universe as a single quantum system, of which observers are a part, and in which everything is "below the cut". However, observers have a role in that their observations are the basis for defining the branching structure of the global quantum state. Whereas under other interpretations a quantum wave function "collapses" into one or other possibility, which then becomes the "actual" state of that system, with the "Many Worlds" interpretation, there is no collapse. Instead, every single possibility actually exists in a different universe. Each observation or measurement triggers many whole new universes which "branch out".



2b. The Different Interpretations of Quantum Mechanics (continued)

Relational Interpretation

This interpretation was developed by **Prof. Carlo Rovelli (1956-)** among others and takes a different stance with respect to observers. As in Einstein's Special Theory of Relativity, the properties of a system are not seen in absolute terms, but rather vary according to a chosen "frame of reference". Similarly, here there is nothing special about the observer; this can be any physical system, rather than a conscious observer. No properties are absolute, including the "outcome" of a measurement or observation, which depends on which system is taken as a frame of reference and its relationship to the measured system.

QBism

This stands for "Quantum Bayesianism", referring to the statistical interpretation known as Bayesian probability. It does not concern itself with the ontological status of quantum entities or other "objective" features of reality, but is rather a "normative" interpretation, that is, a framework to be used by individual observers to help them make decisions and navigate the world. According to this view, the equations of quantum mechanics only reflect the knowledge and beliefs that a certain observer has about reality, given a certain amount of limited information available to them, rather than saying anything inherent about entities in the "external" world. From the perspective of any observer, only they themselves are "above the cut"; all other agents are below it.

> 'No properties are absolute, including the "outcome" of a measurement or observation, which depends on which system is taken as a frame of reference and its relationship to the measured system.'

Module 2: Metaphysics, Buddhism, and Quantum Physics

Lecture notes

Module 2: Metaphysics, Buddhism, and Quantum Physics

Introduction

Throughout the centuries, scholars and scientists have tried to understand the true nature of reality, beyond what appears to our senses. Different thinkers, however, have approached this question from different angles and, consequently, have answered the question in a multitude of ways. It is worthwhile to explore these here, so that we get a clearer sense of what is at stake. This second module explores the concepts of *appearance and reality* from the points of view of Western philosophy, Buddhism, and modern physics. By discussing the development and evolution of scientific thought throughout the centuries, in this module **Prof. Michel Bitbol (1954)** argues that the view of reality presented by quantum physics is in (almost perfect) alignment with the understanding of Buddhist philosophy.

Lesson 1:

Lesson 1 of this module explores the development of the concepts of appearance and reality in ancient Greek and European philosophy, and their role in the evolution of scientific thought. This lesson summarises the fundamental stages of this development, starting with Plato and other ancient Greek philosophers, and continuing with more recent European philosophers (such as Kant and Husserl) and the birth of modern science.

Lesson 2:

Lesson 2 focuses on the important role played by the concepts of appearance and reality in both Buddhism and modern science, although these are to be understood in complementary ways by two different schools of thought. Science describes fundamental reality as a series of patterns that are hidden beyond appearances and that can often be described by mathematical laws. By contrast, Buddhist philosophy suggests that our perception of reality is distorted by the superimposition of artificial structures and labels onto experience. In this module and throughout the course, you will learn how the latter view is in alignment with contemporary interpretations of quantum mechanics, such as **Prof. Christopher Fuchs**' QBism and **Prof. Carlo Rovelli**'s relational interpretation of reality – both discussed in this lesson.

Module 2: Metaphysics, Buddhism, and Quantum Physics

Key concepts

Reality; appearance; ancient Greek philosophy; Mādhyamaka school; birth of modern science; quantum physics.

Key thinkers

Dr. Michel Bitbol; Plato; Aristotle; Pierre Hadot; Heraclitus; J.W.F. Goethe; Friedrich Nietzsche; Democritus; Isaac Newton; Immanuel Kant; Edmund Husserl; Erwin Schrodinger; Asha Peres; Carlo Rovelli; Bas Van Fraassen; Nagarjuna; Christopher Fuchs; Jacques Pienaar.

Critical thinking questions:

1. Do you think the world is fundamentally different than what appears to our senses?
2. Do you believe that there is an "objective" reality which is independent of the subject observing it?
3. Can strong emotions and habitual ways of thinking distort our perceptions of reality?

   If so, how can we cultivate a more objective, impartial mind?

Lesson 1: Appearance and Reality in Western thought

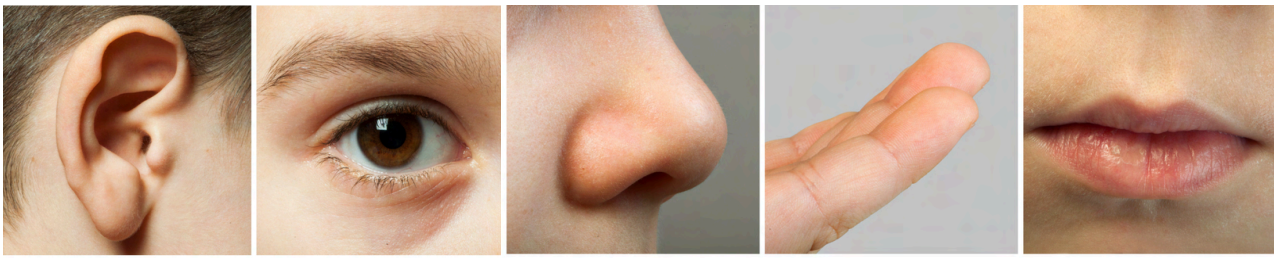
1a. Plato and the Origins of the Reality/Appearance Dualism

Western philosophy, the foundation of modern scientific thought, was largely influenced by Plato's division of reality into two fundamental domains: the sensible world and the world of intellectual things – later called by Immanuel Kant the *phenomenon* and the *noumenon*. In this division, **Plato (428-7 to 348-7 BC)** believes that sensible things (the objects or "phenomena" that appear to our senses) are nothing more than the copies of intellectual things (the so-called Platonic Ideas, or "noumena", which are basically a generality of the specific, sensibly existing things in our visible world). In other words, the sensible phenomena of our world only exist as the manifestation of transcendental ideas, concepts, and mathematical entities.

According to Plato, a material table can have different shapes and uses – for example, a low or a high table, a round or a square table, or a marble or a wooden table. One can think of small, high, round tables only used for drinking glasses during a reception, or long, rectangular, study tables that are used in most peoples' houses as a dining table. In this way, we can understand that when we say 'table', this does not yet specify the exact table, although most people will understand what we mean by it. According to Plato, this more general "meaning" is generated by an "Idea" of "the Table". This "Idea" is not the same as the sum of all the individual tables and their possibilities. Rather the opposite: according to Plato, it is the universal "Idea" that is the essence of all tables, undefinable in words, yet existing in all our minds as the underlying reality of each particular, sensed table.

Aristotle (384-322 BC) too believed that reality incorporates certain generalities, such as mathematical forms. He believed that science was based on these mathematical forms, thus taking science away from the changeable, sensible world and situating it closer to Plato's notion of the world of Ideas. This idea of science was carried on all the way to modern times, for example by **Arthur Eddington (1882-1944)**, who describes the 'Nature of the Physical World' as having two realities: the nature of the sensible table in your room, with colour and material, and the "scientific table" which is 'mostly emptiness. Sparsely scattered in that emptiness are numerous electric charges rushing about with great speed.' [From: 'The Nature of the Physical World', page 2 of the *Introduction* by Eddington himself.]

> 'The sensible phenomena of our world only exist as the manifestation of transcendental ideas, concepts, and mathematical entities.'



1b. Heraclitus & Democritus: Appearance & Reality in Ancient Greece

However, not all Greek philosophers shared the same view of reality as those of Plato and Aristotle, making a distinction between an intelligible and a sensible reality. The concept of reality described by Greek philosophers is not always easy to understand; this is partly because of the subjective interpretation of translations of ancient texts. For instance, a famous statement by Greek philosopher **Heraclitus (540-480 BC)** is often translated as 'Nature loves to hide'. Following this idea, Western scientists and philosophers from Galileo to the Romantic period have discussed reality as something that is veiled, behind the "ordinary reality" - a bit like a mysterious book, written in mathematical or esoteric symbols that needs to be deciphered. Interestingly, **Pierre Hadot (1922-2010)** translated Heraclitus' statement as 'What is born tends to die'. This translation suggests that Heraclitus thought of reality as continuously changing (a concept that resonates with the Buddhist idea of impermanence) rather than as a "veiled" realm that exists objectively behind our visible reality. This radical shift can also be found in the writings of both **Johann Wolfgang von Goethe (1749-1832)** and **Friedrich Nietzsche (1844-1900)**, who both emphasised the importance of change and the impermanent nature of reality, and denounced the idea that there is something like a veiled reality behind the appearance of our everyday world.

Another statement that has led to several interpretations of reality is attributed to **Democritus (460-370 BCE)**: 'Sweet exist by convention, bitter by convention, colour by convention, atoms and Void (alone) exist in reality'. Democritus believed that features of the world beyond appearance (such as atoms) could only be inferred through reasoning based on what appears to the senses, and advocated for not losing sight of the essential connection between the sensible things of the world and our experiences of them, and our reasoning, deducting mind.

1c. The Birth of Modern Science: Newton, Kant, and Husserl

All of these ancient philosophical ideas had a profound impact on western thought and on the development of modern science. **Isaac Newton (1643-1727)**, one of the fathers of modern physics, developed a new concept of science that has shaped the way that both scientists and philosophers of the 18th century and onwards investigated reality. According to Newton, we should not formulate a hypothesis of the essential nature of the world. Instead, we should reason about phenomena and the patterns that link them through mathematical laws, without speculating about the so-called "deeper", or more fundamental nature of phenomena themselves.

Another key figure in the development of western thought was **Immanuel Kant (1724-1804)**. This German philosopher described the idea of the objective and the real as two independent concepts. While "objective" is a universal, inter-subjective connection between phenomena (hence Kant's use of the word *phenomenon*), reality, in itself, is independent of subjects (and therefore Kant called it *noumenon*). This is why Kant would argue for the famous "Ding an Sich", which literally means the "thing in itself". This thing in itself corresponds to what Kant would term the world of the noumenon: a reality that exists independently from the perception of the senses. In other words, Kant brought the original Platonic distinction between the world of the senses and the world of the Ideas back in a modern form, albeit with significant differences.

Edmund Husserl (1859-1938), the founder of the philosophical discipline called "phenomenology", countered this interpretation of the two worlds by Kant while still using the distinction between the reality of things and those of appearances. Husserl used the two German words "Real" and "Reell" to further decipher the nature of reality, whereby "Real" is similar to the world of objects and things, the mode of reality of things, and their fundamental nature. However, in contradistinction to Kant, Husserl argued that lived experience of those things, that which he called "Reell", is what is undoubtedly existent: the lived experience of the appearance, according to Husserl, cannot be questioned, while the "Real" (the world of objects) can be doubted. For example: how can we know if an object is real or a dream, real or a hologram, et cetera.

> 'The lived experience of the appearance, according to Husserl, cannot be questioned, while the "Real" (the world of objects) can be doubted.'

Lesson 2: Buddhist Epistemology & Quantum Physics

2a. Buddhist Epistemology: Mind-Only and Middle Way Schools

In this lesson, **Dr. Michel Bitbol** discusses the concepts of appearance and reality through the lenses of Buddhist epistemology and quantum physics, which are very different from the earlier discussed Western philosophical ideas of reality. Buddhist epistemology states that singular moments of appearance (*svalaksana*) are the only realities, in opposition to fabricated generalities and conceptual superimpositions (*samânŷlaksana*). According to a Buddhist school known as *Cittamātra/Yogacăra*, which is similar to Western idealism (beginning with Plato and then on to Kant/Hegel), external things do not exist independently from our mind; they are not made of a different "substance" than that of our conscious experience. In other words, according to this Buddhist school, what is real is the mind, the "light" through which things come into existence.

Notably, the Buddha has said 'The three realms of existence are merely mind'. (The three domains of existence, were, according to the Buddha: the desire realm, which is the sensible world, where one's mind is involved with the objects of sensual desire; the form realm, where one is absorbed in meditative bliss; and the formless realm, where one transcends even meditative bliss, to abide in a state of equanimity and non-conceptuality.)

Finally, the *Mādhyamaka* tradition takes these ideas even further, suggesting that there is no "substantial" mind and that nothing exists inherently, as an independent entity.

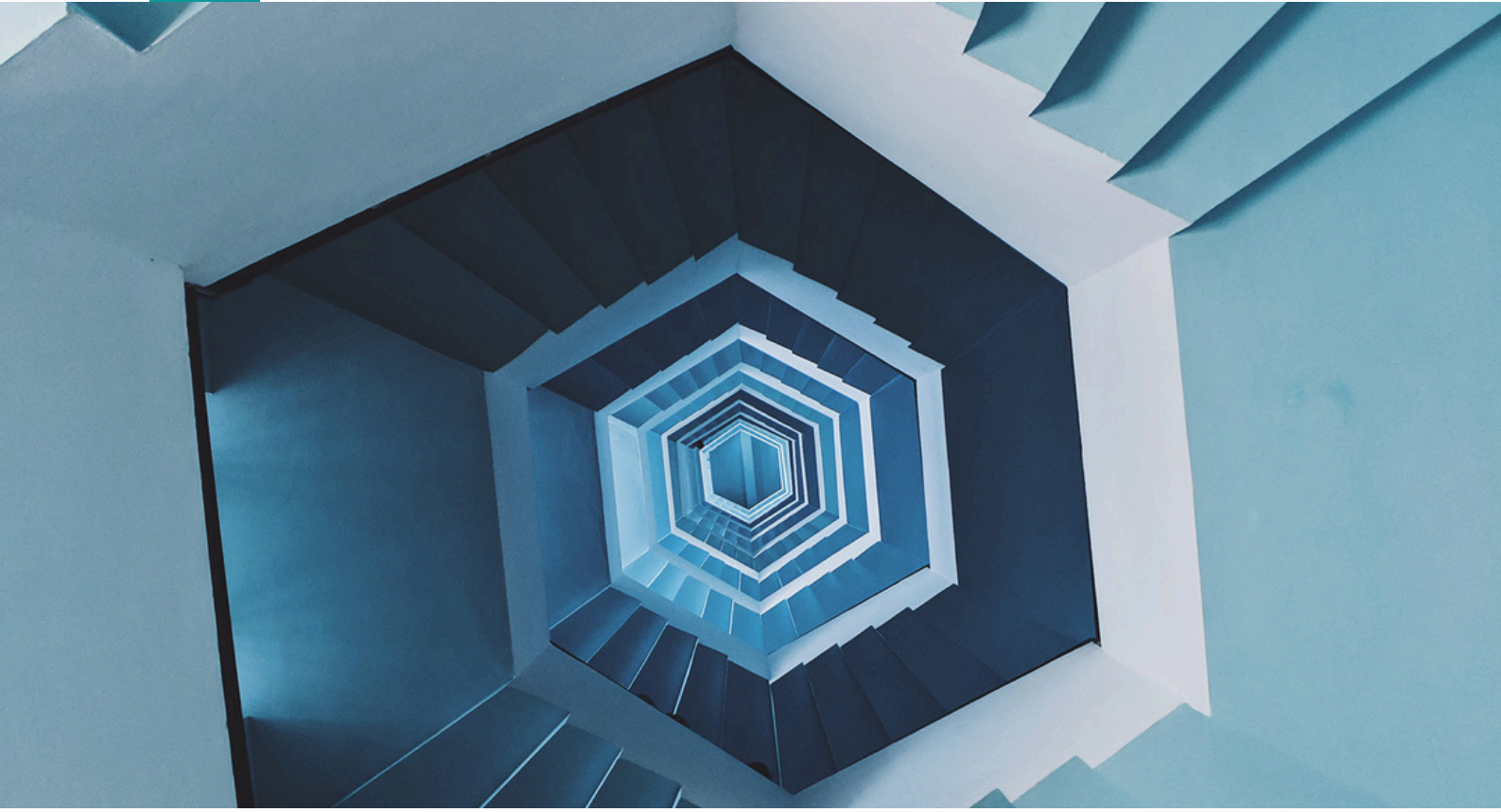
> 'In reference to the seen, there will be only the seen. In reference to the heard, only the heard. In reference to the sensed, only the sensed. In reference to the cognized, only the cognized. That is how you should train yourself. When for you there will be only the seen in reference to the seen, only the heard in reference to the heard, only the sensed in reference to the sensed, only the cognized in reference to the cognized, then, Bāhiya, there is no you in connection with that. When there is no you in connection with that, there is no you there. When there is no you there, you are neither here nor yonder nor between the two. This, just this, is the end of stress.'
>
> — Gautama Buddha, Bāhiya Sutta

2b. The Paradox of Quantum Reality

We now turn to the view of appearance and reality in modern science – more specifically, as explained by Quantum Physics. As will be discussed in greater depth in Module 4 and 5, quantum physics uses mathematical language to describe the behaviour of matter and energy on a microscopic scale. The equations of quantum mechanics are extremely accurate and have strong experimental support; however, the entities described by those equations are not unequivocally defined, and multiple interpretations of quantum mechanics have been proposed during the years to explain various "quantum paradoxes".

A famous example is the paradox of "Schrodinger's cat": a mental experiment formulated by **Erwin Schrodinger (1887-1961)** in 1935 where the logical consequences of quantum mechanics are brought to their extreme. This results in the paradoxical statement that an (imaginary) cat can be both alive and dead at the same time. However, the paradox only arises if we believe that quantum states describe reality as it actually is, rather than just the appearance of reality. The same goes for the concepts of "non-locality" or "entanglement": the idea that there is a non-local influence between two objects (at an arbitrary distance), or, in other words, that something can influence something else instantaneously at any distance. Again, this only becomes a paradox if it is applied to reality instead of the appearance of reality. In Schrodinger's own words, this should prevent us from naively accepting 'a blur model as a representation of reality'. Or in the words of Prof. Carlo Rovelli: 'Quantum Mechanics does not violate locality.' All of this well summarised by the conclusion of theoretical physicist **Asher Peres (1934-2005)**, who stated that:

> 'Paradoxical interpretations of quantum mechanics are the result of "the misuse of quantum concepts, guided by pseudo-realistic philosophy, which leads to paradoxical results."'



2c. Interpretations of Quantum Mechanics

Therefore, caution is needed to interpret reality through the lens of quantum mechanics, and we should correct the wrong view that mathematics describes a reality that is beyond appearances or is more real than the appearances – which is often called the 'absolutist view of physics'. In his relational interpretation of quantum mechanics, **Prof. Carlo Rovelli (1956-)** proposed a new interpretation on the reality of events, dismantling this "absolutist" view of physics. Relational quantum mechanics, thus, interprets quantum mechanics as a theory about physical facts (not about states), where there are no absolute facts, only relative facts:

> 'Events (or physical facts) are realized in interactions between any two physical systems and are relative to these systems.'
>
> — Prof. Carlo Rovelli

Hence, there are no "absolute" properties of reality: only relationships between different phenomena, through which those properties arise, resulting in something that is always a relative state. As Rovelli very importantly emphasises:

> 'Reality is relation. It is not the things that can enter into a mutual relation, but it is the relations that give rise to the notion of "thing".'
>
> — Prof. Carlo Rovelli

This new concept has been a seed of fruitful discussions, leading to more questions about the nature of reality, for example around the question if such a description would be observer-independent (i.e. not relative to any observer) - which is a question asked by philosopher **Bas Van Fraassen (1966-)** in relation to Rovelli's ideas.

2d. Quantum Mechanics & Buddhism

Relational quantum mechanics seems to be in alignment with the two stages of the Mādhaymaka school, a Buddhist tradition influenced by the philosopher **Nāgārjuna**. In Mādhyamaka philosophy, dependent arising (*pratītyasamutpāda*) occurs with "paratantra" (literally, woven-of-the-other) and "parapasiddha" (established by one another). In the words of Prof. Carlo Rovelli, it is a striking feature of Nāgārjuna's theory that 'relations are also relative, that emptiness (of own-being) is empty (of own-being)'. This echoes Nāgārjuna's own statement that: 'For whomever emptiness is a view, that one has accomplished nothing'. In other words: do not make the negation of absolutes into an absolute view, nor the idea that the world is a network of relation into an absolute view.

Another interpretation of quantum mechanics known as QBism (developed by **Christopher Fuchs** and others), presents striking parallelisms with the Buddhist view of reality. In QBism, quantum mechanimechanics is considered to be a tool that conscious observers can use to evaluate, based on their past experience, the probabilistic expectations for subsequent experiences. **Jacques Pienaar**, another theoretical physicist who contributed to the development of QBism, states that, in this particular interpretation, an element of reality is an experience.

> 'For whomever emptiness is a view, that one has accomplished nothing'
> — Nāgārjuna

> 'Experience is thus taken to be the fundamental "building block" of reality, and the pairing of an experiencing subject with an experienced object is called an event.'

Dr. Michel Bitbol concludes his presentation by stating that contemporary science no longer makes a strong distinction between appearance and reality, as during the time of Plato; instead we tend to adhere exclusively with the lived experience, without trying to go beyond it. This strategy, Dr. Bitbol states, links in to the transition from classical to quantum physics, which led to a new scientific understanding of reality that is more in line with the view of ancient Buddhist philosophy.

Module 3: Reality & the Nature of the Mind

Lecture notes

Introduction

In this third module, **Prof. John Dunne (1961-)** discusses two of the most important schools of Buddhist thought, the "Pramana" (Sanskrit for "Valid Cognition") and "Mādhyamaka" (Sanskrit for "Middle Way") schools, and how these traditions describe and understand the fundamental nature of reality. More precisely, Prof. Dunne explains the method proposed by the influential Buddhist philosopher Dharmakirti to study reality. In this module, you will learn how, according to certain schools of Buddhist philosophy, our perception of reality is a mental construction created by our cognitive processes. In this light, the separation of the self and the world is an illusory, arbitrary concept.

Lesson 1:

The first level of analysis discussed in this lesson examines what is real, what impacts the senses. It involves the conceptual process of experiencing the world and engaging with it, acting based on what we know or infer from our experiences. This process involves what is experienced in the moment and, at the same time, a prediction of what will happen in the future, which can potentially validate our previous inferences about a certain object or phenomenon.

Lesson 2:

In the second lesson, Prof. Dunne discusses how our current conceptualisation of the world – our judgements of the objects and phenomena that we perceive – is always based on our past experiences. As Dharmakirti would put it: when we are experiencing the world, we do so because we want to engage with the world (there are things we want to get and things we want to avoid). In other words: the mere presence of a mental event is not of interest for us, unless it is being interpreted in such a way that we are able to act on what we are knowing and/or experiencing.

Lesson 3:

Prof. Dunne starts this lesson by using two optical illusions (the Kanizsa triangle and Checker shadow illusion) to show how mental models and projections can impact our perception of reality. These kind of experiments show us that our perception of the world is constrained, opening us up to the question of where exactly these constraints arise from, and how we can recognise them. Prof. Dunne ends this module by pointing out that Dharmakirti makes it clear that the recognition of these patterns and the cognitive separation of mind and world lies at the very basis of our obscured reality, since all of these are – in a way – illusions: based on structures, patterns, and concepts that have their basis in the separation of subject and object, mind and world.

Module 3: Reality and the Nature of the Mind

Key concepts

Pramana; Mādhyamaka; causality; conceptualization; mental models.

Key thinkers

Prof. John Dunne; Dharmakirti; Digňaga; Nāgārjuna; Sāntarakṣita; Prof. Carlo Rovelli.

Critical thinking questions:

1. Do you think that we see the world as it really is, or rather as based on our own subjective experience?
2. Can you think of a time when you had a mistaken perception of reality, when your conception of reality turned out to be flawed?
3. How do you think your perception of reality influence your interactions with others in your daily life?
4. Do you think that the concepts that we use to describe reality are universal or subjective? Do you think these concepts change in every part of the world? And what about other sentient beings, such as animals, do you think they see reality in the same way as we do?

Lesson 1: Buddhist Epistemology

1a. An Introduction to Dharmakirti's & Shantarakshita's philosophy

In this module, reality and the nature of the mind will be analysed through the lens of the "Pramana" tradition, particularly according to the work of the 6th and 7th century Buddhist philosopher **Dharmakīrti (died 660 AD)**.

Dharmakīrti's epistemological work was inspired by his predecessor, **Digňaga (480-540 AD)**, and had a great impact on the development of the Madhyamika, or 'Middle way', school founded by **Nāgārjuna (c. 150- c. 250 AD)**, another important Buddhist philosopher whose ideas are discussed throughout this e-course. Notably, the current Madhyamika tradition is a synthesis of Dharmakīrti's and Nāgārjuna's epistemology.

Another key concept in Buddhist philosophy comes from **Sāntarakṣita (725-788 AD)**, an 8th century philosopher who established the first Tibetan Buddhist monastery and developed a method to investigate reality according to different levels of analysis. The starting point of this analytical approach is experience itself, commonly known as "Sat". The Sanskrit term "Sat" refers to "what is present in front of you", or, one could say: "what is real". The approach of Sāntarakṣita can be summarised as "to be real is to be present", or, in other words, what is perceived is said to be real – what impacts one's mind and manifests one's consciousness.

> 'The Sanskrit term "Sat" refers to "what is present in front of you", or ... "what is real". The approach of Sāntarakṣita can be summarised as "to be real is to be present".'

Nāgārjuna [c. 150 – c. 250 CE]

Dharmakīrti [c. 600* - c. 660 CE].

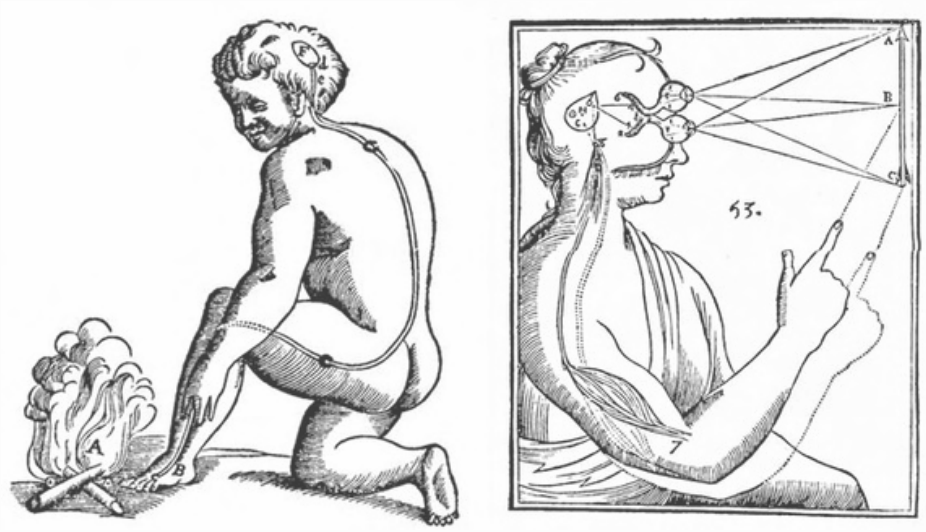
Digňaga [c. 480 – c. 540 CE]

Sāntarakṣita [c. 725–788 CE]

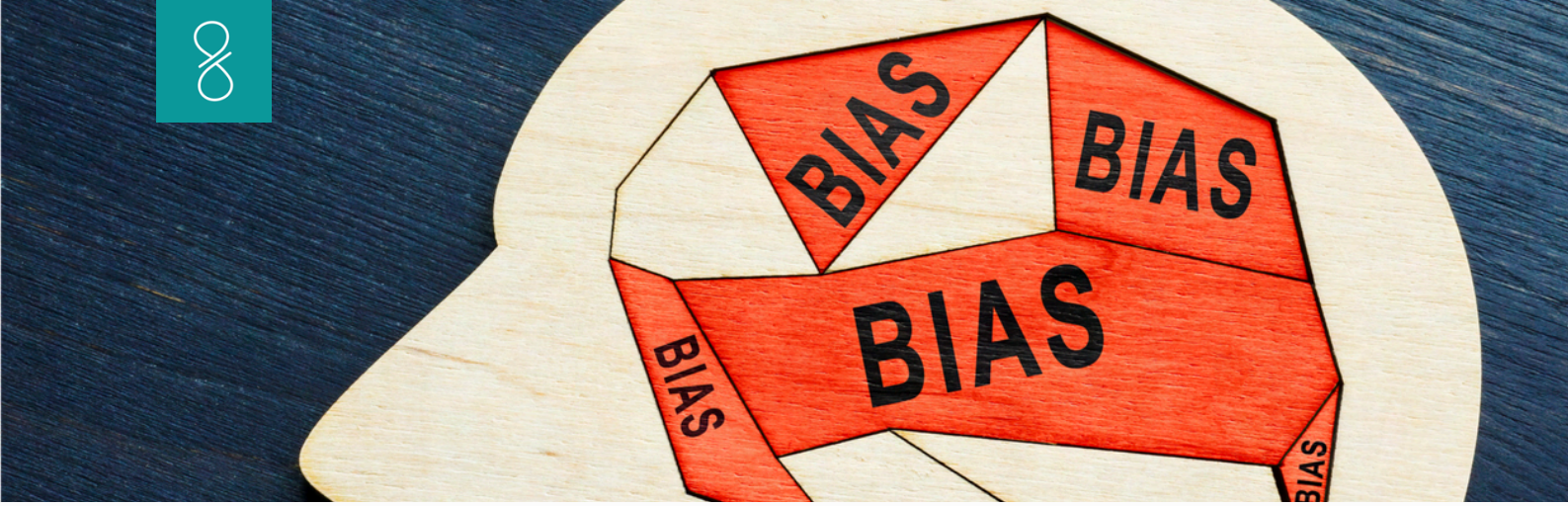
1b. Causality, Cognition, and Reality

In Sāntarakṣita's philosophy, mental events are the evidence for the existence of a certain phenomenon. This is why causality is a key element here: to state that something is real, is to state that it has causal efficacy and that it has an impact on one's cognition and consciousness through causality. In other words: to be real is to be the cause of cognition (its effect).

Cause and effect, or causality, is the evidence for "anything" to be "something". Every mental event, in other words, indicates the presence of a cause-effect relationship. Prof. Dunne therefore concludes: for us to consider something as real, there first needs to be a causal relationship, either directly or indirectly, mediated by our senses.



> 'For us to consider something as real, there first needs to be a causal relationship, either directly or indirectly, mediated by our senses.'



Lesson 2: Models of the World

2a. The Mind, Discrimination, and Mental Models

The first level of analysis discussed in Lesson 1 examined what is real, what impacts the senses. It involves the conceptual process of experiencing the world and engaging with it, acting based on what we know or infer from our experiences. This process involves what is experienced in the moment and, at the same time, a prediction of what will happen in the future, which can potentially validate our previous inferences about a certain object or phenomenon.

In this second lesson, Prof. Dunne discusses how our current conceptualisation of the world – our judgements of the objects and phenomena that we perceive – is always based on our past experiences. As Dharmakirti would put it: when we are experiencing the world, we do so because we want to engage with the world (there are things we want to get and things we want to avoid). In other words: the mere presence of a mental event is not of interest for us, unless it is being interpreted in such a way that we are able to act on what we are knowing and/or experiencing.

For example, a person sees fire on the far side of a field, and because they are feeling cold, they conceptualise this fire as something that can make them warm, causing them to walk over and warm themselves up by the fire. In other words, for the real to be causally efficacious it is based on a prediction of what one will be able to do (getting warm) when one takes action and walks over to the fire at the other side of the field. Another example could be: a pencil in my room is not part of my field of awareness until I identify it as a pencil, because of my need for a pencil and me becoming aware of it in my room and identifying it as something that can function to fulfil my need for a pencil.

In this process of conceptualization, we thus make a judgment about something being fire or an object being a pencil. In order to do that, we leave "Sat", bare experience, behind, and time travel mentally to past experiences. All these past experiences go into the moment of conceptualising a certain entity as a pencil, which is separate from the direct perception of the object (the "Sat" or bare experience, that which is present and/or real).

Prof. Dunne emphasises that according to the Madhyamika view, and all Mahayana Buddhism, things that are real are immediately present (or "Sat"), and therefore, all conceptualizations (such as our conceptualisation of the fire or the pencil as explained above) are unreal, or mere mental fabrications. In other words, according to the Madhyamika view, the "concept pencil" can be deployed in an action, but the reality of the pencil itself is "Sat", immediately present, and therefore not a concept.

2b. Do Patterns Truly Exist in Nature?

According to the Madhyamika view, conceptualization brings us out of what is immediately present to us and enables us to manipulate the experience of a thing (such as a pencil or a fire), but it is not telling us what is real anymore. This view within the Mahayana Buddhist lineage therefore states that the active conceptualisation is not picking out a pattern of reality (like a Platonic Idea of the "pencilness" of all existing pencils), but rather obscures what a thing actually is, or what reality actually is: it takes us away from "Sat" into the world of concepts, thereby obscuring reality. In other words: there is no existing pattern in reality that says what "is" a pencil.

One of the key aspects of Dharmakirti philosophy is the recognition that all our acts of conceptualization that involve a certain pattern of recognition, are the result of our own subjective perspective: the patterns that we see in the world (the "pencilness" of the pencils) are created through our conceptual process, and therefore these patterns do not exist inherently according to the Madhyamika view (thereby flipping Platonic philosophy on its head). In other words, the patterns that we see in the world are only the reflection of a concept, an ideal identification, a fabrication. These patterns, or any ideal entity like the "pencilness" of all pencils are nothing more than fabrications of our cognitive system.

> 'Those which exist only when the conceptuality [apprehending] exists and do not exist when conceptuality does not, are without question definite as not established by way of their own nature, like a snake imputed to a coiled rope.'
>
> — Chandrakirti

If this is true, however, is there any reason why conceptualisations of the world should be in any way constrained? Why can we not arbitrarily put any conceptualisation on any object, for example, calling a pencil an elephant instead?

2c. What Constrains our Models of the World?

Conceptualization is not completely arbitrary: it does have some constraints, there are reasons why we cannot simply call a pencil an elephant. Professor Dunne explains that our models of the world are constrained by what is impacting our experience, and our predictions of experience, as well as our senses and our consciousness. Therefore, one cannot arbitrarily attribute any property to a given object or phenomenon: whatever model we create of the world, it must be based on what is impacting our consciousness, which subsequently constrains that model of the world.

While there are no objective, real patterns in the world, there are constraints arising from causal properties and/or features (of objects like a pencil) and the interaction of matter with our sensory system is what enables ones future actions and predictions of any future actions. What is the nature of these constraints, and how do we determine what those constraints are? Is matter the basis of these constraints or do we need another model, or might there even be a point where these models all break down? These are the kind of key questions that Prof. Dunne extracts from the Madhyamika view in Buddhist philosophy discussed here (starting with Dharmakirti).

As Prof. Dunne emphasises, one of the aspects of this Buddhist epistemological philosophy started by Dharmakirti is to eliminate any idiosyncratic knowledge inherent to a particular subjective experience of one person, in some way, to "unlearn" the belief that "I" (a subjective individual) determines reality, or that the world is dependent on "my" subjective perceptions: it is not up to me to say what is real and not. So, this philosophy moves towards a kind of objective stance, which embraces an intersubjective world by teaching us to no longer be caught up in one's own, subjective concepts of the world.

> 'When the blind men had each felt a part of the elephant, the king went to each of them and said to each: "Well, blind man, have you seen the elephant? Tell me, what sort of thing is an elephant?"'
>
> — Buddha, Tittha Sutta

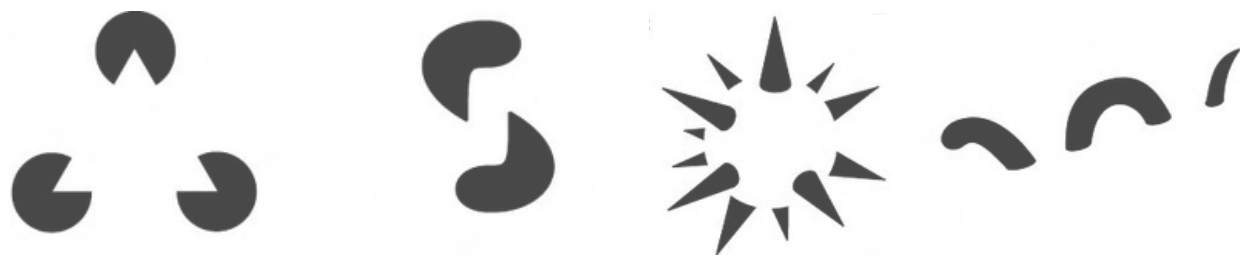
Lesson 3: Illusion & Reality

3a. Reality as a Mental Construct

Prof. Dunne starts this lesson by using two optical illusions (the Kanizsa triangle and Checker shadow illusion) to show how mental models and projections can impact our perception of reality. These kinds of optical experiments show us that our perception of the world is constrained by a certain perspective, opening us up to the question of where exactly these constraints arise from, and how we can recognise them. There might be some constraints that arise from the interaction with our senses that we are able to successfully recognise and identify – as in the case of optical illusions, which are a product of our visual system. But other constraints might arise directly from the nature of human mind, something that is internal to ones cognitive system. The latter could not be recognised without stepping out of human consciousness – an obviously impossible task!

In other words, through these experiments – an undoubted appearance of a triangle, or two squares of (apparently) different colours that are actually the same - we can recognise what is creating the constraints in the images is our visual system. We are therefore able to separate the constraints that are features of the human mind or cognition, and constraints that come from somewhere else, such as matter or our visual system. Through this process, we seem to reach out towards the possibility of an objective account of the world: a model that would be completely free of all human constraints (in which all constraints that come from the human mind would be absent, as we are trying to model reality itself).

> 'We are therefore able to separate the constraints that are features of the human mind or cognition, and constraints that come from somewhere else, such as matter or our visual system.'



3b. Is there an Ultimate Model of Reality?

However, a model that would be free of all human constraints would also be a model that no human can know. Therefore, Prof. Dunne emphasises that this kind of pure objectivity seems to be an impossibility, or at least, it would not be a model that human beings could do anything with.

But there is a second key issue: on the one side we can think about these kinds of constraints, but on the other, there is also another aspect. Namely, there are also constraints that are built into the human mind – constraints that human cognition could not recognise, constraints that we cannot escape, yet cannot detect either. These constraints are associated with the very process of conceptualisation, through which mental models are created.

This is also a main feature of Dharmakirti's philosophy, which relates to the fact that we see patterns in the world and engage in actions in the world according to those patterns. Dharmakirti believes that such universal patterns are intrinsic to human cognition: that we cannot escape them, because they are an integral part to thought itself. Dharmakirti also argued that those patterns cannot be real, but that believing them to be universal and inherently existing is the main cause of our experience of suffering.

> 'A model that free of all human constraints would also be a model that no human can know. This kind of pure objectivity seems to be an impossibility, or at least, it would not be a model that human beings could do anything with.'

3c. The Illusion of Separation: Conceptuality, Suffering, and Wisdom

Dharmakirti argued that suffering arises from a state of confusion (ignorance), which can be counteracted by seeing things as they really are (with wisdom). Dharmakirti says that this ignorance comes about because we have great difficulty abandoning these built-in constraints, or even seeing the process of pattern recognition itself. Dharmakirti therefore said that ignorance is conceptuality – ignorance is seeing patterns in the world, and although useful for acting in the world, these conceptual patterns are an illusion, and obscure us from seeing the reality of our world.

Moreover, the very capacity to be able to create models is based upon self and world: there is a world, and there is a mind modelling that world. And again, Dharmakirti makes clear that this is also an illusion, because these models are structures based on the separation of subject and object, mind and world. Although these models of pattern recognition are built into our cognitive system (and it is impossible for us to make it go away), according to Dharmakirti, these models and the separation they presuppose do lie at the basis of all our ignorance and our deceptions by creating the illusion of what we take as our reality. So, at a second level of analysis, the capacity to create models is based upon the duality between self and world, which is modelled by the mind. According to Dharmakirti, this separation of self and world is the ultimate illusion that is inherently built into every human's cognitive system.

'According to Dharmakirti, this separation of self and world is the ultimate illusion that is inherently built into every human's cognitive system.'

All of this points to the fundamental question: what are the puzzles of quantum physics (such as non-locality and entanglement) telling us? Because clearly models are only helpful to understand the constraints on our cognition and our consciousness. So, the question is: are these puzzles the result of what is out there (matter), of human consciousness or the interaction between the two? This leads us straight into our next lesson on Quantum Physics, and Prof. Carlo Rovelli's ideas of non-locality and entanglement – questions that, according to Prof. Dunne, also need to be turned towards the human mind itself.

Module 4: From Nagarjuna to Heisenberg, and Back

Lecture notes

JAMYANG
BUDDHIST CENTRE LONDON

Module 4: From Nagarjuna to Heisenberg, and Back

Introduction

How can the insights arising from meditation and contemplation complement our scientific understanding of reality? In this fourth module we explore how both Buddhism and modern science point to an understanding of reality as both dynamic and interdependent. This contrasts with how we see our everyday experience where people and object appear as solid, (relatively) unchanging, and existing independently from each other.

This module explores the connections between quantum mechanics and Buddhist philosophy through a dialogue between **Geshe Tenzin Namdak (1970-),** a renowned Buddhist scholar, and **Prof. Carlo Rovelli (1956-)**, one of the foremost living theoretical physicists.

The dialogue explores the connections between modern physics and the worldview of ancient Buddhist contemplatives, drawing from the philosophy of Nāgārjuna (c. 150 – c. 250 CE), an Indian scholar who laid the foundations of the Madhyamaka (or "Middle Way") school of Buddhism. Clarifying the Buddha's teachings on emptiness and dependent origination, Nagarjuna argued that reality has no fundamental ground, as all phenomena exist in a state of interdependence. This "radical relativity" - the emptiness of any inherent or independent entity – is, according to Nagarjuna, the ultimate reality.

In this module, you will learn how Nagarjuna's insights can help us to better understand the physical world and the mysterious behaviour of quantum phenomena

Lesson 1:

This lesson explores Dr. Carlo Rovelli's relational interpretation of quantum mechanics and how Nagarjuna's teachings on the nature of emptiness are relevant to modern physics. This lesson also includes an explanation of the three levels of dependent origination and the relationship between the observer and what is observed.

Lesson 2:

This lesson begins with an explanation of the differences between quantum and classical models of reality, discussing how to overcome bias by more accurate and realistic worldviews. You will learn the difference between conventional reality and the Buddhist view of conventional reality, juxtaposed with scientific discourse on the nature of reality

Key concepts

Quantum physics, relational interpretation, observer and observed, relative and ultimate reality, dependent origination, emptiness, bias.

Key thinkers

Albert Einstein; Geshe Tenzin Namdak; Carlo Rovelli; Nāgārjuna; Werner Heisenberg;

Critical thinking questions:

1. What is real and what is not? How can we tell the difference?
2. How does Nāgārjuna describe the nature of reality?
3. What do Buddhists mean by "ultimate reality" and "relative reality" respectively?
4. What is interdependence?
5. Define "emptiness" in Buddhism as you understand it?
6. What are the three levels of dependent origination?

1a. The Observer and The Observed: The Relational Interpretation of Quantum Mechanics

In his book *Helgoland*, **Prof. Carlo Rovelli (1956-)** suggests that the Buddhist view of emptiness and interdependence is a useful tool for understanding quantum physics and he explains why the philosophy of Nāgārjuna, formulated almost two millennia ago, is still relevant today.

Nagarjuna's exposition of the Buddha's teachings is grounded in the idea that all phenomena – objects, persons, mental processes – do not have their own independent, self-sufficient existence, but arise as relational entities through the process of dependent origination. Therefore, they are said to be "empty" of any autonomous and independent essence or "self" (*svabhāva*). This emptiness (*śūnyatā*), according to Nāgārjuna, is the ultimate reality of all things: the complete lack of inherent, non-relational existence.

It must be pointed out that emptiness should not be seen as an absolute entity or a fundamental ground of reality, nor should it be taken as an absolute absence, or void. Like everything else, emptiness itself is empty of inherent existence and only arises in relation to phenomena themselves. This is stated in one of the most important Mahayana scriptures, the *Heart of the Perfection of Wisdom Sutra*:

> 'Form is emptiness, emptiness is form. Emptiness is not other than form and form is also not other than emptiness.'

The idea that certain properties of physical systems arise relationally, rather than existing inherently, is pervasive in 20th and 21st century physics. Many of the categories that were assumed to be fundamental, such as time, space, matter, and energy, have been shown to be strongly interrelated. According to Albert Einstein's General Relativity Theory of 1915, the universe has no fundamental, "objective" frame of reference. Even time, space, matter, and energy are not separate and independent entities, as had previously been assumed, but relate to and influence each other very closely. In fact, they can only be said to have definite qualities relative to each other. In addition, certain dualistic concepts seem to break down at a deeper level: space and time are part of a single, four-dimensional reality, whilst matter and energy can be converted into each other, as shown in Einstein's famous equation $E=mc2$).

> 'Anyone who isn't shocked by quantum theory hasn't understood it.'
>
> — Niels Bohr

1a. The Observer and The Observed: The Relational Interpretation of Quantum Mechanics (continued)

Prof. Rovelli's relational interpretation of quantum mechanics applies a similar principle to explain the properties of quantum phenomena. According to this interpretation, the state of a quantum system is not unequivocally defined but is dependent on the observer: there is no universal frame of reference according to which "objective" properties can be determined. Different vantage points may lead to different measurements of the same system. In other words, the relation between the observer and the observed is what leads to the emergence, or observation, of certain features in what is observed; these features do not exist inherently but arise as a result of interdependence. Therefore, the properties of quantum entities can only be determined and observed during an interaction, in that the interaction itself makes those properties manifest. In each case, the act of observation, or the act of interaction, affects the reality of the quantum entity in question. Both Rovelli's interpretation of quantum mechanics and Nāgārjuna's exposition of emptiness place strong emphasis on the role of the observer, while clarifying how observers are themselves complex, relational systems.

1b.Without Foundation: Nāgārjuna and Quantum Physics

The Buddha prescribed a "middle way", which he applied in various contexts: in practice, he advocated a path between the extremes of self-indulgence and self-mortification; and philosophically, he perceived a middle way between the extremes of existence and nonexistence, or between permanence and nihilism. Developing and clarifying the Buddha's teachings, Nāgārjuna argued that our experience of suffering is rooted in the belief in *svabhāva* (own being), or "intrinsic existence". This is the belief that things are autonomous, independent, and unchanging; and to hold this belief is to succumb to the mistaken extreme of permanence. It is equally mistaken, however, to believe that nothing exists at all – the extreme of nihilism. The "middle way", then, is to see emptiness as the true nature of reality, where emptiness is not the absence of existence but the absence of intrinsic existence. Another way of expressing this is to say that, because entities lack an intrinsic existence of their own, they can only be said to exist in relation to other entities. Therefore, a "middle way" understanding of "emptiness" (*śūnyatā*) is also an understanding of relationality.

This understanding of "relationality" can also be applied to mundane objects, for example in a scenario of an observer looking at the reflection of a chair in a mirror. The chair's reflection does not exist autonomously, by itself; instead, it arises as a result of different, interrelated parts: the chair, the mirror, and the observer's mind. These entities themselves are also not autonomous, but interact with each of the other elements to cause the reflection to appear. Without the chair, there would be no reflection of a chair to observe; without the mirror, there would be nothing to reflect the chair; and without the mind of the observer, there would be nothing to experience the reflection. These considerations may appear trivial when applied to a reflection; yet, as discussed in the following section, a similar reasoning can be applied to "real" objects to demonstrate their lack of intrinsic existence.

> 'Because entities lack an intrinsic existence of their own, they can only be said to exist in relation to other entities. Therefore, a "middle way" understanding of "emptiness" (sunyata) is also an understanding of relationality.'

1c. Emptiness and Three Levels of Dependent Origination

Dependent Origination (*pratītyasamutpadā*) is the Buddhist doctrine of causality. It maintains that all entities are brought into existence by other entities, which in turn have been caused, or brought into existence, by other entities. No entity emerges out of nothing ("ex nihilo"); rather, they arise from the complex interconnection of multiple causes and conditions. In the words of an early sutra from the Pali canon:

> 'When this is, that is. From the arising of this comes the arising of that. When this isn't, that isn't. From the cessation of this comes the cessation of that.'

Because entities only come into being through causes and conditions, rather than existing inherently or autonomously, dependent origination is closely interrelated to the idea of emptiness; they can be seen as two sides of the same coin. In Nāgārjuna's words: 'That which originated through dependent origination, this you [the Buddha] maintained to be empty'. Moreover, there is a clear and definite link between dependent origination, the nature of reality, and the Four Noble Truths taught by the Buddha:

> 'Whoever sees dependent arising, also sees suffering and its arising, and its cessation, as well as the path.'
>
> — Nagarjuna

According to Nāgārjuna (and Buddhist philosophy in general), things are mutually dependent – or "dependently originated" – in three distinct ways, on three different levels:

1)The first level is that of causes and conditions. This is the sense in which dependent origination is described above: everything comes into existence because of the presence of other entities and circumstances. For example, a sprout comes into being from a seed when the appropriate levels of moisture, heat, and nutrients are present.

2) The second level is by seeing that everything is composed of parts, and nothing is a single unitary thing. For example, an entity can be seen as composed of smaller components; or as having parts in the sense of a house having a roof, walls, windows, and doors, which themselves can be broken down into smaller component parts; or as possessing numerous different qualities, and so forth, such that in numerous ways a thing is dependent on its parts.

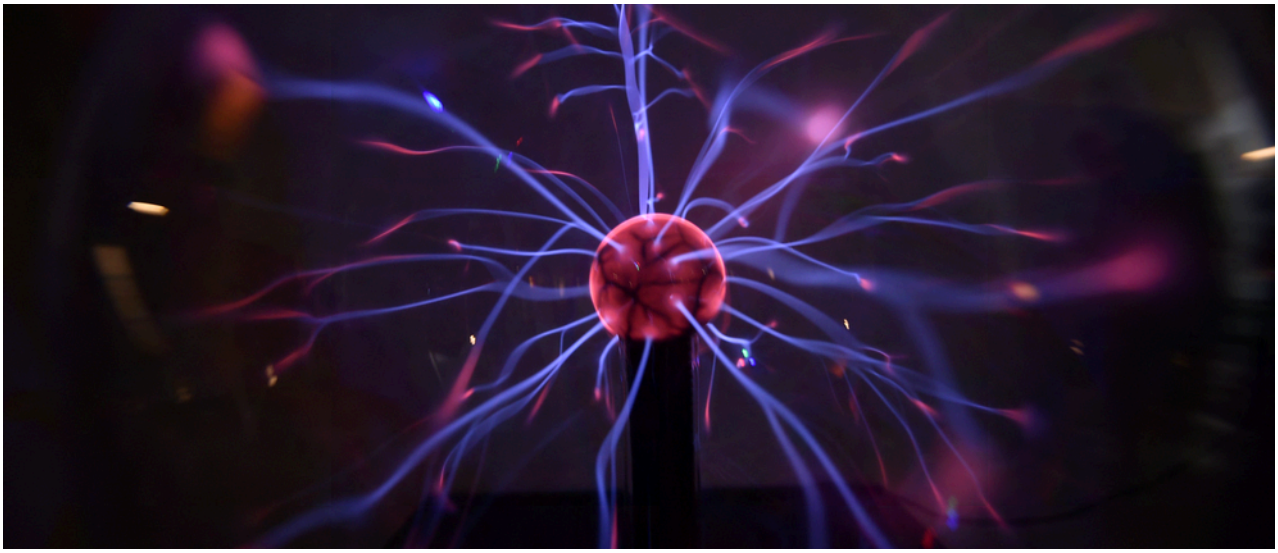
3) The third level involves an analysis of how the mind encapsulates those causes and conditions, parts and collections of parts, by creating a mental concept and applying a label. In this sense, everything exists in dependence on the mind or consciousness that perceives it and labels it according to its preconceptions. There is a sense in which independent objects only exist once they have been conceptualised and labelled as such: for example, until a cloud is seen and labelled a "cloud", it is merely a patch of water vapour; in turn, vapour itself is just a label applied to a collection of water molecules in a gaseous state, "water molecule" is a label given to certain configurations of atoms of hydrogen and oxygen, and so on.

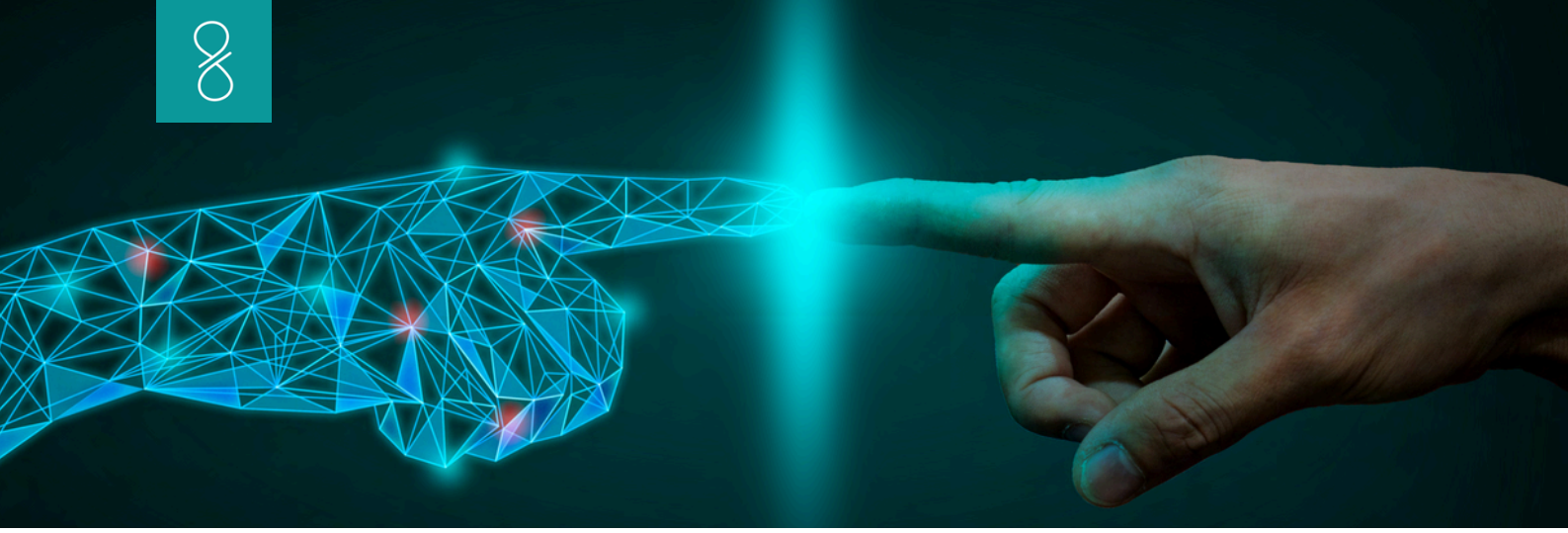
2a. Models in Classical and Quantum Physics

According to Prof. Carlo Rovelli, Buddhism is often a preferred religion for scientists because of its open-minded, critical inquiry into the nature of reality. Nāgārjuna's philosophy is particularly strong in this regard because it questions aspects of reality that seem superficially obvious, but which reveal deeper truths on closer inspection, as is often the case with scientific investigation. However, this relationship between science and Buddhism is reciprocal: it is not just Buddhism that can help science, but the reverse is also true. For example, some Tibetan Buddhist monks and nuns have been instructed by HH Dalai Lama to study quantum mechanics to better understand emptiness, and he himself complements his daily meditation with the study of quantum physics.

In this module, Geshe Tenzin Namdak expresses how he finds it helpful to apply the theories of quantum mechanics to ideas of karma, cause and effect, and emptiness, so that one can start to observe the similarities and the connections between them, as well as the differences. More generally, he believes that practitioners can and should learn from other interpretations outside the traditional canon of Buddhist texts. According to Buddhism, the main cause of suffering is a profound lack of clarity and understanding, caused by our long habituation to mistaken patterns of thought – mistaken in that they lead us to apprehend things as inherently existing. In other words, according to Geshe Namdak, the more different forms of epistemological reasoning we apply, and the more empirical verifications we undertake, the better we can break free of ingrained habits of thought that prevent us from realizing how things really exist.

> 'There are moments of learning that resonate more than others, and my encounter with Nāgājuna was a major one.'
>
> — Prof. Carlo Rovelli





2a. Models in Classical and Quantum Physics (continued)

More broadly speaking, our understanding of objects and concepts is influenced by habitual ways of thinking, leading to deeply ingrained patterns of thought and ways of seeing reality. Most schools of Buddhist philosophy agree on the fact that our cognitive bias is influenced by previous mental conceptions. By cultivating a deeper awareness of our habitual ways of thinking and an attitude of non-attachment towards our views and prejudices, Buddhist practice can be a help to us in overcoming the obstacles that often prevent us from asking the necessary questions, in science as well as in life. Nāgārjuna's insight that entities do not have any real existence outside of their relative relationship with other entities can thus help us to overcome our "metaphysical prejudices" or biases, such as the conviction that everyday objects (or subatomic particles) exist solidly and independently from the rest of the universe. This understanding is integral to Prof. Rovelli's relational interpretation of quantum mechanics (as well as Einstein's *Theory of Relativity*).

2b. Ultimate and Conventional Reality

Nagarjuna's philosophy is grounded in the notion of the "Two Truths", which describes how our view of the world can be approached from the two perspectives of conventional and ultimate reality. If one examines the true mode of existence of any entity, it becomes clear that everything exists in dependence on something else – in other words, any phenomenon is comprised of other elements that are not "itself". Phenomena do not have an inherent existence of their own and are therefore said to be empty of an autonomous self. On an ultimate level, this emptiness of inherent existence is the only mode of being that can withstand logical analysis.

On the other hand, our everyday life experience (e.g., "here is my pen") is also real, albeit in another sense – on a conventional level. Although the pen is ultimately empty (i.e., empty of inherent existence), it nevertheless exists relatively and has an everyday, conventional usefulness in relation to other relatively existing objects (like a piece of paper). Another example to explain this difference: in conventional reality a pair of glasses exists on a mundane level, as they can be seen, worn and experienced. In terms of ultimate reality, however, the question arises: in what sense do the glasses actually exist? Nagarjuna's answer would be that they do not: if one tries to find what we conventionally refer to as "glasses", this entity eludes and defies rational analysis, as the glasses are themselves made up of glass, metal, molecules, etc – and therefore are not an independently existing self, but rather something relatively existing. (This way of reasoning will be explained in more detail in the third section of this module, "Emptiness and three levels of dependent origination".)

2b. Ultimate and Conventional Reality (continued)

While the distinction between ultimate and conventional is fundamental to Nāgārjuna's philosophy, it is important to recognise that he was not referring to two different realities; instead, he described one reality that can be considered from these two different perspectives, each of which is entirely valid on its own terms; in that sense, they co-exist. The "Two Truths" could be said to echo the duality of the classical and quantum realms, both of which describe the same reality but from different perspectives; objects appear relatively solid and unchanging from our everyday perspective, while the quantum behaviour of their subatomic components reveals how that apparent stability is but an illusion.

Nagarjuna's approach can therefore help in overcoming the natural bias towards seeing objects and concepts as separate and solid, i.e., mistaking their relative appearance for their ultimate nature. Whereas a chair may conventionally appear as a solid, unitary, and unchanging entity, that apparent stability is revealed to be an illusion through deeper analytical reasoning. Similarly, scientists would agree that, despite appearances, a chair is not fundamentally solid, nor unitary, nor unchanging. At the quantum level, entities lack the same kind of "solidity" as objects at the macroscopic level. They are certainly not the billiard-ball-like particles depicted in a typical representation of an atom. Instead, they can be seen as mutually interacting "potentials" that exist in a probabilistic state of uncertainty. They are as much "energy" as they are "matter". They are, in some sense, reliant on interactions with other entities, or observers, before they "manifest" whatever qualities they possess. They can also be characterised as excitations in quantum fields, and possess a wave-like aspect, stretching out to infinity, as well as a particle-like aspect focused on a single point in space and time. In all these senses, quantum entities can be described as "empty".

As discussed in the previous lesson, the third level of dependent origination takes place on a cognitive level, as the mind puts a label on a collection of parts brought together by causes and conditions and projects inherent existence unto it. Similarly, in quantum mechanics, the *observer* plays a crucial role in determining the properties of the observed system, as the very process of measurement is thought to cause the collapse of the wave function to a single state. In module 5, Prof. Rovelli and Geshe Namdak talk about the role of the mind in quantum mechanics and Buddhism, discussing the nature of consciousness and the connections between the brain and mental processes.

Module 5: Mind, Matter & the Quantum World

Lecture notes

Introduction

Quantum mechanics describes the world in a way which is intimately connected with the process of observation. The equations of quantum mechanics only predict the probability of observing a system with certain physical properties as the outcome of an experimental measurement. They do not specify a) what an observer is, nor b) the properties of a system in between measurements, nor c) how to draw the line between the observed phenomenon (i.e., quantum world) and the observer. What is it, exactly, that causes the collapse of the wave function (describing the superposition of several quantum states) to a single experimental measure? Given the primary role of observation in shaping the physical properties of phenomena, what is the relation between the awareness of conscious observers and the physical world?

As discussed in the previous modules, numerous interpretations of quantum mechanics have been formulated to answer these questions. In the "von Neumann–Wigner interpretation", it is consciousness itself that causes the collapse of the wave function, although most physicists would not be comfortable with such an explanation. According to this interpretation, the experimental devices used to study quantum phenomena are of the same nature as the rest of the physical world. The mind, on the other hand, is described as a non-physical phenomenon existing outside the material universe, with a causal impact on the collapse of the wave function. This view, therefore, assumes a non-physicalist ontology of mind – in other words, that the mind is non-material in nature.

Another possible interpretation is that of QBism (short for "Quantum Bayesianism"), which is concerned with epistemology (what we know) more than ontology (what is real). So, rather than trying to define quantum entities objectively, and consider them as inherent, objective facets of the external world, the focus with QBism is on the limited knowledge, actions, and experiences of the observer themselves. It follows that the equations of quantum mechanics are seen to reflect and describe the degrees of belief that an observer has about the possible outcomes of quantum measurements, rather purporting to describe the external reality itself. Accordingly, some have criticized this view as anti-realist, but it is more accurately described as a form of participatory realism, reflecting the important – but not exclusive – part that the observer plays in the quantum system. QBism is related to Copenhagen Interpretations but aims to make them sharper and more consistent.

Conversely, other interpretations of quantum mechanics, such as **Prof. Carlo Rovelli**'s relational interpretation, posit that any physical system itself can be considered as an observer, regardless of its conscious awareness (or lack thereof). This is because even if a physical system is not itself conscious, it still "fixes" the surroundings of a quantum system in a particular way, such that the quantum system must behave consistently in relation to those defined surroundings.

Understanding the relationship between consciousness and the physical world might help to explain why mental processes are so strongly correlated with physical changes in the brain. Is the mind completely reducible to neuronal activity, or does it have a causal influence on the physical processes taking place in the brain? Drawing on their expertise in quantum mechanics and Buddhist philosophy, in this module, Geshe Tenzin Namdak and Prof. Carlo Rovelli discuss the nature of the self, the interaction between consciousness and physical reality, and the relation between the mind and the brain.

Lesson 1:

Is there a fundamental level of reality? This lesson contrasts the views of reality put forward by different philosophical systems and discusses parallels between consciousness, as seen by the Yogācāra school, and the observer in quantum mechanics, before investigating the nature of the mind as seen through Buddhist Philosophy.

Lesson 2:

Some interpretations of quantum mechanics (such as von Neuman-Wigner's and QBism) assert the crucial importance of conscious observers. Prof. Carlo Rovelli, on the other hand, tried to formulate an interpretation which could disentangle the complexities of quantum mechanics from the complexities of consciousness. His hope, in doing so, was to bring some clarity on the nature of quantum phenomena as being something independent from human consciousness. This relational interpretation does not confer a superior role to human consciousness: any physical system can be the 'observer' relative to which the properties of another physical system emerge. In this lesson we will explore if this relational interpretation can help reconcile the scientific understanding with our 1st-person, lived experience of the mind.

Key words

Mind, consciousness, materialism, idealism, dualism, karma, disintegratedness.

Key thinkers

Nagarjuna; Carlo Rovelli, Geshe Tenzin Namdak; Asaṅga; Vasubandhu; Albert Einstein; Daniel Dennett; Bernardo Kastrup; David Chalmers

Critical thinking questions:

1. Compare the Yogacara view of a "storehouse consciousness" with the Mādhyamika view of "disintegratedness" (*Svabhava*). Do you feel that one or other of these concepts seems a more plausible mechanism for a being's karma to influence their rebirth and subsequent lives? If so, why?
2. Consider the "extremes" of materialism and idealism – do you see any disadvantages in adopting either position? If so, what are they?
3. Simplified approximations of the laws of physics, such as Newton's law of gravity, are accurate enough for our everyday lives. What benefits can come from further analysis of how our mind and consciousness perceive phenomena?

Lesson 1: The Nature of the Observer

1a. Introduction to the Yogācāra (Mind-Only School) of Buddhist Philosophy

Most Eastern and Western philosophical systems assume the existence of a "fundamental level" of reality, whose nature is either:

A) **mental** (e.g., Metaphysical Idealism, which asserts that the physical universe is, ultimately, a product of mind or consciousness) most famously advocated in the West by Bishop Berkeley in the eighteenth century;

B) **material** (e.g., Physicalism/Materialism, according to which conscious experiences can be totally reduced to physical entities and interactions), which is the dominant view among scientists today (although the fact that many scientists tend to "default" to a materialist position is partly because scientific instruments are only capable of measuring material properties);

C) **both** physical and mental substances (called "Cartesian Dualism", named after René Descartes), which most closely reflects our "everyday" intuition of feeling our minds to be distinct from our bodies; or:

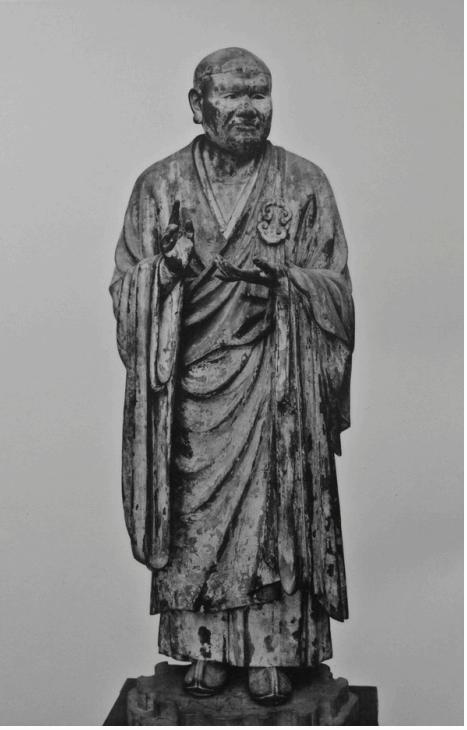
D) **neither** mental nor material (e.g., dual-aspect monism, whereby both mind and matter are seen as manifestations of an undifferentiated, underlying reality)

There are also various other "shades" in-between these four main positions (including relational understandings as discussed below) forming a rich spectrum of possibilities. In Buddhist philosophy, the first position is most closely represented by the *Yogācāra* (or Mind-Only) school, based on the idea that the nature of physical objects is not different from the awareness that perceives them. However, Yogācāra is not identical to Western idealism and might in fact be better related to "phenomenalism". Whilst Yogācāra maintains that we must always rely on the mind for the interpretation of perceptual data, this does not necessarily mean that everything "out there" is itself made of "mind-stuff". In other words, *the way that things exist*, is more important in this Buddhist school of thought than the question of what actually *is*. Nonetheless, the status of the mind ("what is the mind") is extremely important in Yogācāra. As stated in the *Daśabhūmika Sūtra* (Ten Stages Sutra), an influential Mahayana Buddhist scripture:

> 'These three realms are only mind.' [1]

Similarly, the *Dhammapada*, one of the oldest surviving Buddhist scriptures (which predates Yogācāra thought by hundreds of years), begins with the following statement:

> 'All phenomena have mind as their fundamental nature.'



1a. Introduction to the Yogācāra (Mind-Only School) of Buddhist Philosophy (continued)

The Yogācāra school, started by **Asaṅga (300-370 AD)** and **Vasubandhu (ca. 316-396 AD)**, was very influential in the development of Mahayana philosophy and is seen as part of the "third turning" of the Buddha's teaching (whereas Mādhyamika or the "Middle Way" school is part of the "second turning"). It was partly a reaction to a (mainly misplaced) feeling that emptiness (*śūnyatā*, as understood by the Mādhyamikas) was too nihilistic, so instead the Yogācāra school set about presenting the mind in positive, dynamic terms. From a Mādhyamika perspective, however, its statements should not be interpreted as claiming that the mind itself is a self-established entity, nor that it constitutes the fundamental ground of reality. However, it is helpful to see Yogācāra school, with its emphasis on mind and meditation, as complementary to the Mādhyamika, with its emphasis on logic and analysis (indeed, there was a syncretistic school called Yogācāra-Mādhyamika that later developed).

In pursuing its approach to mind, the Yogācāra school came up with several important innovations. In its analysis, it added two additional levels of consciousness, called, respectively, the "defiled mind" (responsible for delusion and ego-clinging) and the "storehouse consciousness" (accounting for the continuity of personality through death and periods of unconsciousness). The Yogācāra school also came up with the idea of the "three natures" as another way of describing reality and how we see it. They re-characterized emptiness as the transcendence of subject-object duality (i.e., being "empty" of duality), as well as what is left when that duality is removed, i.e., an ineffable but positively existing "thusness" (although for the Mādhyamikas only emptiness, *śūnyatā,* can be the final, definitive description of ultimate reality). The Yogācāra school also helped systemize the features of Buddhahood into the "three-body doctrine" of Nirmāṇā-kāya, Saṃbhoga-kāya, and Dharmakāya.

1b. Consciousness and Quantum Mechanics

Certain interpretations of Western Philosophy's schools of Idealism seem to point to an inherently existing consciousness, a fundamental, self-established, witnessing awareness. According to the Mādhyamaka school, however, consciousness itself is only a relative entity, rather than the ultimate nature of reality. This finds a parallel in Prof. Carlo Rovelli's relational interpretation of quantum mechanics, which does not privilege the consciousness of the observer in the way Copenhagen interpretations do. This is somewhat analogous to how the Mādhyamika school of Buddhist philosophy does not privilege consciousness in the way the Yogācāra school does. Indeed, Prof. Carlo Rovelli credits the work of Nagarjuna, the principal founder of the Mādhyamika school, with helping him develop his relational interpretation.

As discussed in the previous module, the relational interpretation utilizes the same principles that govern Albert Einstein's *Special Theory of Relativity* (of 1905), maintaining that the quantum state of a system must always be interpreted relative to another physical system. In other words, the state of the quantum system is observer-dependent because the state is the relation between the observer and the system. This means that different observers may (quite correctly) give different accounts of the same system since there is no privileged account that is more "real" than any other. This clearly resonates with the Mādhyamika understanding of emptiness. It is important to also note that in the relational interpretation, an "observer" can be any arbitrary physical system and does not have to be a conscious observer like a human being. Therefore, a "measurement event" can be any physical interaction in which two systems become correlated with each other. The "observer" system has the effect of restricting the degrees of freedom that a particular quantum system can exercise, whether or not that "observer" is itself a conscious being or a physical system.

Nagarjuna points out that is that there is a circularity in nature; there is no need to posit the existence of an ultimate level from which everything else originates. Both material and physical phenomena emerge from a complex set of cause and effect relationships. Consciousness and the mind, too, manifest as part of a greater network of interdependent phenomena, all of which arise through relations in the process of dependent origination, rather than existing inherently as independent entities.

1c. Dependent Origination and the Nature of the Mind

Buddhism offers powerful tools to investigate the nature of mental phenomena, showing how they too exist in a relational way, rather than as inherently existing and independent entities. The logic of dependent origination, explained in the previous module, can be applied not only to physical objects, but also to our cognitive processes, including our perception of a "self". In Module 6, you will learn how to use this analysis practically during meditation, in Scott Snibbe's experiential meditation workshop.

For now, seen from a more theoretical point of view, it is important to know that the fundamental aspects of the interdependent nature of the mind are analogous to the analysis of physical entities:
1) the mind is composed by parts and collections of parts;
2) cognitive processes originate from a number of causes and conditions, and
3) "Mind" is the label given to a wide range of dynamic and ever-changing processes

1) The mind is made of parts and collection of parts

As will be discussed in greater detail in Module 6, Buddhist philosophy subdivides mental activity in a number of different processes, which include feeling (our sense of like, dislike, or neutrality towards a certain person or object), discrimination (our ability to recognise objects and people), mental volition (the different impulses and mental factors that motivate and influence our actions – this is sometimes referred to as compositional factors), and consciousness (the presence of "bare" awareness, the "fact" of knowing and experiencing, regardless of the content of experience itself). None of these processes is static or unchanging; all of them are dynamic entities, with new feelings, thoughts, volitional impulses, and experiences constantly arising and ceasing. Where, among them, is the mind to be found? In which specific moment of consciousness, temporary thought, arising and ceasing feelings can the mind reside?

1c. Dependent Origination and the Nature of the Mind (continued)

2) Cognitive processes arise out of causes and conditions

As well as being composed by different parts, rather than being a unitary entity, our mind is constantly being shaped by external and internal factors. For example, our thoughts and feelings when we meet a specific object are influenced by our memories and previous life experiences, the state of our body, as well as the way in which our brains and nervous systems have evolved. Similarly, the way we perceive the world, our attention, and the direction of our will, depend crucially on our mental and physical state. In addition, awareness itself arises in an interdependent manner, because it requires an encounter between a sense faculty and a specific phenomenon. As stated by Nagarjuna in his *Hymn to the World Transcendent*: 'Without being known, it's not an object of knowledge; without that, there is no consciousness as well. Therefore, the knower and the known possess no intrinsic reality.'

3) "Mind" as a label

When we analyse the numerous parts that make up the mind and the numerous causes and conditions that give rise to, and influence, mental activity, it becomes clear that "Mind" is just a label that we assign to a complex multitude of dynamical processes, rather than a unitary, unchanging, solid entity. Through the meditations you will experience in the next module, one can learn to see the mind as an entity that is inter-dependent and profoundly dynamic, rather than inherently existing, solid and static.

> 'Without being known, it's not an object of knowledge; without that, there is no consciousness as well. Therefore, the knower and the known possess no intrinsic reality.'
>
> — Nagarjuna

2a. The Nature of Consciousness

As previously discussed, some interpretations of quantum mechanics (such as von Neuman-Wigner's and QBism) assert the crucial importance of conscious observers. Prof. Carlo Rovelli, on the other hand, tried to formulate an interpretation which could disentangle the complexities of quantum mechanics from the complexities of consciousness. His hope, in doing so, was to bring some clarity on the nature of quantum phenomena as being something independent from human consciousness. As previously explained, the relational interpretation does not confer a superior role to human consciousness: any physical system can be the "observer" relative to which the properties of another physical system emerge. Can this relational interpretation help reconcile the scientific understanding with our first-person, lived experience of the mind?

Some philosophers, such as **Daniel Dennett (1942-)**, have argued that consciousness is simply an illusion produced by our brains, or otherwise consciousness could possibly be an "epiphenomenon": not an illusion as such, but still "something" that lacks any substance or influence, alike a shadow. This is the "default" view taken by many neuroscientists today, who very often assume a philosophical position of "physicalism" (also called "materialism"). This is the philosophical view that everything in reality can ultimately be described in physical terms (and therefore described by the laws of physics). As a consequence, consciousness is seen as ultimately describable in physical terms, in particular by the physical workings of the brain.

However, it is important to remember that such reasoning is an assumption, not an experimental observation, and can therefore be legitimately questioned. When correlations are observed between mental states and brain states, physicalists assume that the brain causes those mental states, but this is not necessarily the case – correlation is not the same as causation. Whilst it may be possible to isolate certain regions of the brain that activate when we see the colour "red", for example, this neural correlation does not explain the subjective experience of the "redness of red" (also known as "qualia") or indeed many other kinds of subjective experience. There is no known theory of how unconscious brain matter could even give rise to the subjective experience that we all feel in every moment, but physicalists hold out hope (rightly or wrongly) that such a theory will be devised one day.

> 'The relational interpretation does not confer a superior role to human consciousness: any physical system can be the "observer" relative to which the properties of another physical system emerge. Can this relational interpretation help reconcile the scientific understanding with our first-person, lived experience of the mind?'

2a. The Nature of Consciousness (continued)

An alternative view, known as Metaphysical Idealism, asserts that consciousness is not only an intrinsically existing entity, but the very foundation of reality itself. In other words, proponents of this philosophical view argue that the nature of reality is, ultimately, mental. All experience arises within consciousness itself. Our minds abstract certain properties of experience as the physical world and label them as "matter"; the laws of physics, in this context, are not inherent properties of an existing physical reality, but regularities within the patterns of experience that can be described through mathematical laws. This position has much in common with the Yogācāra school of Mahayana Buddhism discussed above.

"Idealism" has long been out of favour in Western Philosophy, since Bishop Berkeley first pioneered it in the eighteenth century, but it is starting to find backing again from thinkers such as Bernardo Kastrup. Kastrup's view is that there is only one cosmic consciousness and that individual human (and animal) minds are "dissociated alters" of this cosmic consciousness, surrounded by its thoughts. The inanimate world we see around us is the extrinsic appearance of these thoughts, not a separate substance. Philosophically, this is an example of a "monist" position, meaning that it sees reality as ultimately made up of only one kind of "stuff", namely consciousness. Physicalists are also monists, but at the other end of the spectrum: they also maintain that ultimately reality is made up of only one kind of "stuff" but, in their case, this "stuff" is matter. Various other positions in-between these two "monist" positions have been proposed

A middle ground between these two positions views consciousness as a dynamic process that is correlated with brain activity, but not completely determined by it; at least, not in the way that a reflection of an object in a mirror is determined by the object itself. According to this view, mind and brain are different ways of describing the same complex phenomenon, but the "mind aspect" and "brain aspect" remain ontologically distinct. It is difficult to indicate which specific view in Western philosophy of the mind most closely represents the "Buddhist" position, but an "in-between" or "middle way" approach would be the best candidate. A purely physicalist account would not work from a Buddhist

2a. The Nature of Consciousness (continued)

perspective, given Buddhism's understanding that reality is deeper than mere physical matter and its corresponding belief in rebirth or reincarnation. However, a purely idealist view could be questioned as contradicting the reality of an external physical world.

"Cartesian Dualism" is in-between these two poles, but this view sets out a very rigid distinction between matter and mind. This contrasts with the Buddhist view, which sees these as much more closely related and intimately interacting with each other. Also, from a Buddhist view, neither matter nor mind are solid "substances" in the way Descartes envisaged, but are dynamic, evanescent processes that lack any autonomous "self" of their own. In this sense, the best description, at least from an early Buddhist perspective, would be something like a very dynamic form of "process dualism". But since Mahayana philosophy sees ultimate reality as non-dual and empty, there is also a sense in which the Mahayana Buddhist view could ultimately be seen as closer to "Dual-aspect Monism". There are other "in-between" possibilities as well as different forms of dualism, such as non-reductionist emergentism and panpsychism, each of which shares some similarities with Buddhist thought, particularly a wish to avoid the "extremes" of physicalism and idealism respectively.

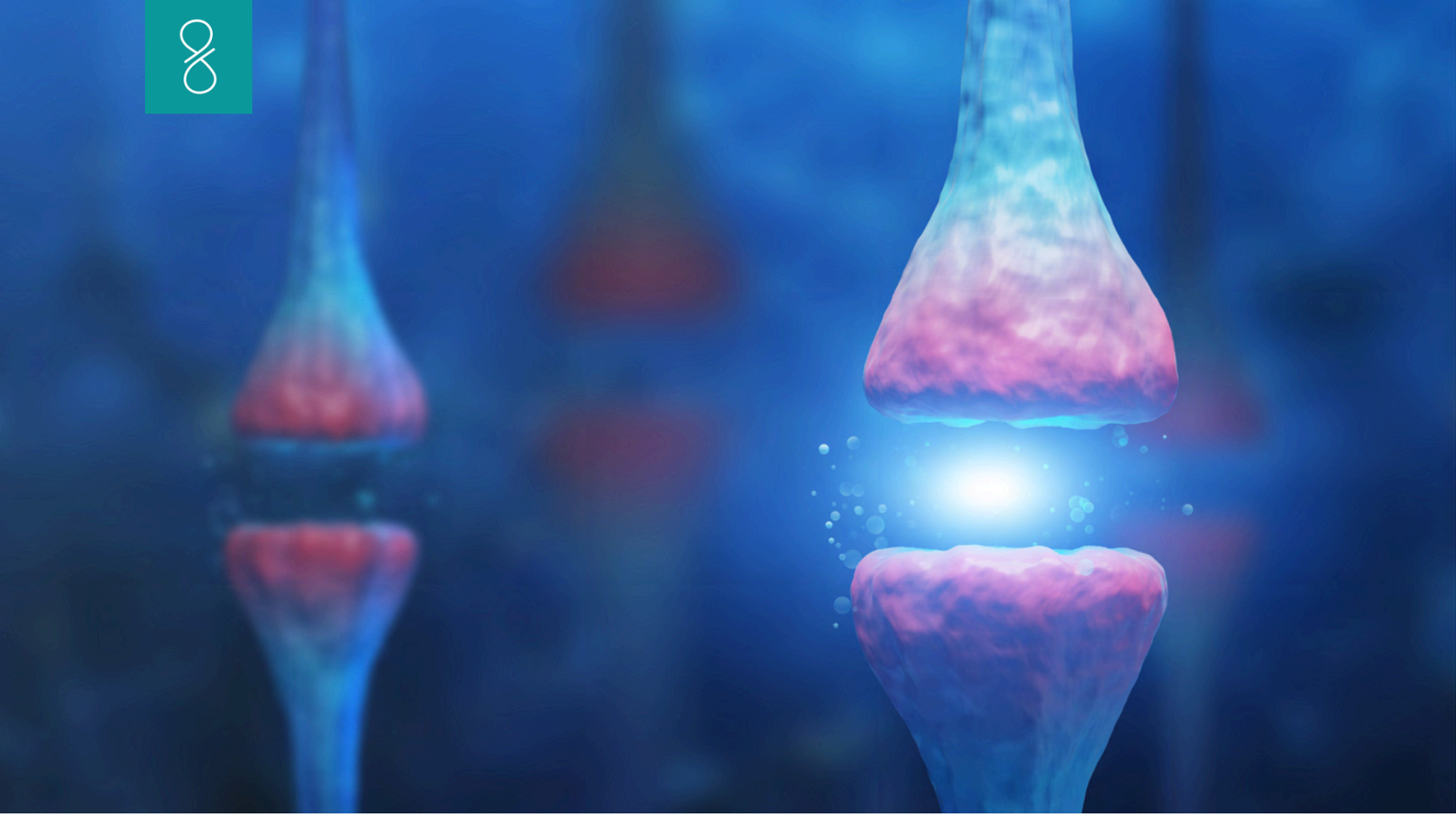
2b. What is the Relation between Mind and Matter?

One of the great aims of modern neuroscience and the cognitive sciences is to bridge the gap between subjective experience (our mind as seen from a first-person perspective) and the dynamic changes in the physical nature of our brain, which can be measured through the third-person perspective of science. However, the profound difference between our understanding of matter and experience (which seems to be of a completely different nature than matter) make this "explanatory gap" a major scientific and philosophical challenge.

> 'If matter is the fundamental nature of reality, and consciousness is purely a by-product of neural activity, how can physical interactions give rise to experience?'

This "hard problem of consciousness", as it was labelled by **David Chalmers (1966-)**, can be stated as follows: if matter is the fundamental nature of reality, and consciousness is purely a by-product of neural activity, how can physical interactions give rise to experience? This is the same question discussed above and, as we have seen, there are a a number of possible responses to it. All of these responses, apart from physicalism, take the reality of consciousness seriously and try to incorporate its reality, one way or another, into our overall picture of the universe. It may well be that consciousness is fundamental to the universe in some sense (similar to the way that "space", "time", "energy" and "matter" all seem to be fundamental) and is therefore not just an illusion or an accidental, ineffectual by-product of physical brain activity.

Such a conclusion would fit well with a Buddhist understanding, although mainstream neuroscience remains largely wedded to physicalist models and mainstream science generally operates on materialist assumptions (at least in public!). However, **Prof. Carlo Rovelli**'s approach to the hard problem again



2b. What is the Relation between Mind and Matter? (continued)

resonates with the Mādhyamika Buddhist approach outlined above. Fundamental to Rovelli's understanding is the idea that neither mind nor matter are concrete entities in their own right, but are relative conditions that arise relationally. Consciousness is not a "thing" but a complex process. Cognitive scientists and neuroscientists are discovering this in relation to the mind/brain just as physicists have discovered it in relation to matter. Since both mind and matter lack "concrete" substance (or "self" in Buddhist terms), the hard problem "softens" to a large degree, although it might not completely evaporate. It is only when matter and mind are thought of as separate, concrete substances that a seemingly irresolvable conflict between them arises.

In fact, Rovelli does not think that the mind and the brain are separate but rather sees them as different ways of describing the same richly multifaceted mind-brain reality, though he acknowledges that the exact relationship between them is extremely mysterious. Moreover, from the perspective of Mādhyamika analysis, the moment-to-moment changing process-nature mind and matter respectively means that, despite having different properties, they share much in common at a fundamental level - an understanding which also helps to "bridge the gap" presented by the hard problem.

Research into mind-training and meditation shows that it is possible for the mind to physically change the brain (as observed with respect to the phenomenon of neuroplasticity) just as it is the case that the physical brain supports the mind. So, whatever kind of distinct ontological status may be accorded to mind, there is certainly a "two-way traffic" at work. This is clearly in accord with the general Buddhist approach to mind-training and shows that various Buddhist practices are correlated with real neurophysiological states

2c. Do Laws of Nature exist Beyond the Mind?

There is a debate in the philosophy of science as to whether the so-called "laws" of nature are prescriptive or descriptive. The first implies a law-giver or designer (such as the Creator God of the major monotheistic religions), i.e., a being who set up the laws in the first place so that, in a sense, they are imposed from the "outside", and are also immutable or "written in stone". By contrast, the second sees the term "law" as a human misnomer, the use of an anthropomorphic term (think police forces, judges and parliamentarians) to describe something which is really just an observed regularity in nature, onto which humans have imputed their own idea of "law" with all of its associations. In this view, things are not "set up". Instead, they just exist in a regular, rather than irregular, way and this regularity can be approximated by law-like propositions that humans impose for their own convenience.

In addition, many such "laws" turn out to be only approximations of deeper underlying laws or regularities. A very famous example of this is the way that Isaac Newton's law of gravitation was usurped by Einstein's *General Theory of Relativity*, which gave a more detailed and comprehensive description of the phenomenon of gravity. Newton's laws still work well at the everyday level, but no-one today doubts that Einstein's description is the more accurate of the two. Moreover, we should reasonably expect our current understanding of physics to change again and, in fact, we know that our current models, or understanding of physical laws, is not the final picture and, sooner or later, will give way to a deeper and more complete understanding. It is therefore questionable whether we can even talk about a law existing in the first place with any certainty: there is a law only for so long as it is not "trumped" by an even deeper law.

> 'We know that our current models of physical laws, is not the final picture and, sooner or later, these will give way to a deeper and more complete understanding.'

> 'From the perspective of philosophical idealism, it is possible to take this idea even further and ask: do the laws or regularities of nature exist at all or are they literally just products of mind?'

2c. Do Laws of Nature exist Beyond the Mind? (continued)

From the perspective of philosophical idealism, it is possible to take this idea even further and ask: do the laws or regularities of nature exist at all or are they literally just products of mind? Most physicists would see this as an extreme view, but lots of these ideas are common currency in modern physics. This also relates to the question in quantum physics of "realist" interpretations (like David Bohm's "hidden variables", Carlo Rovelli's relational interpretation or the "many worlds" interpretation), which take mind or consciousness out of the picture, and "anti-realist" interpretations (like "Copenhagen" and "QBism"), which make mind or consciousness integral to their understanding of quantum systems. But even if full-blown idealism is not correct, there still may be compelling reasons for thinking that mind or consciousness is more than just an illusion and that it plays an important and active role in the workings of the world.

Buddhism itself posits the existence of laws that govern our lives and experiences. These are not physical laws but relate to human experience. They primarily operate at the level of mind, but also impact the material world. The Buddha did not invent these laws but is seen to have been the first (in our era at least) to have discovered them and taught them primarily for the benefit of human beings. The main law-like principle in Buddhism is that of karma, or "cause and effect": simply speaking, how intentionally positive actions ripen into positive results and intentionally negative actions ripen into negative results (in each case both for the doer of the action and for others who are affected by it). No such action is "wasted" but will eventually bear fruit, even if it might take a long time for such "seeds" to ripen, even if their results are modified or muted (including by other intervening intentional actions) along the way.

The above can also be expressed in terms of karmic "information" which is never lost, but rather accumulates a "potential" or "probability" of manifesting or "ripening" at an appropriate point in the future. It is important to note that the operation of karma is seen as very complex, subtle and sophisticated, such that only a fully enlightened being is thought to be able to decipher its workings; it is not the only determining factor in bringing about particular conditions but rather exerts a contributory influence on future circumstances and events. Karma is far removed from the idea of "fate", but is instead a natural process at work, much like physical laws such as gravity or electromagnetism.

Given the central importance of karma to the Buddhist worldview, a lot of effort has gone into understanding and describing the mechanism by which it is seen to operate – how the "ripening" happens, in effect – and different philosophical schools within Buddhism have articulated different ideas. The key question is: how do karmic "seeds" get passed from one life to the next, especially as there is no "soul" or "self-essence" or "substance" to carry them? This is closely connected to the perennial question in Buddhism of what it is that gets reborn in the process of rebirth. Some schools have posited that there is a real "continuity of the mind" that carries karmic seeds like a conveyor belt. Others see the whole collection of aggregates that make up a person as carrying over from life to life, while still others restrict this to just the subtle mental consciousness (but no other aggregates) which passes. As briefly mentioned above, the Yogācāra school came up with the idea of a deeper level of "storehouse consciousness", beneath our ordinary level of consciousness, that acts as a "repository" of karmic seeds and carries them both during and between lives.

2c. Do Laws of Nature exist Beyond the Mind? (continued)

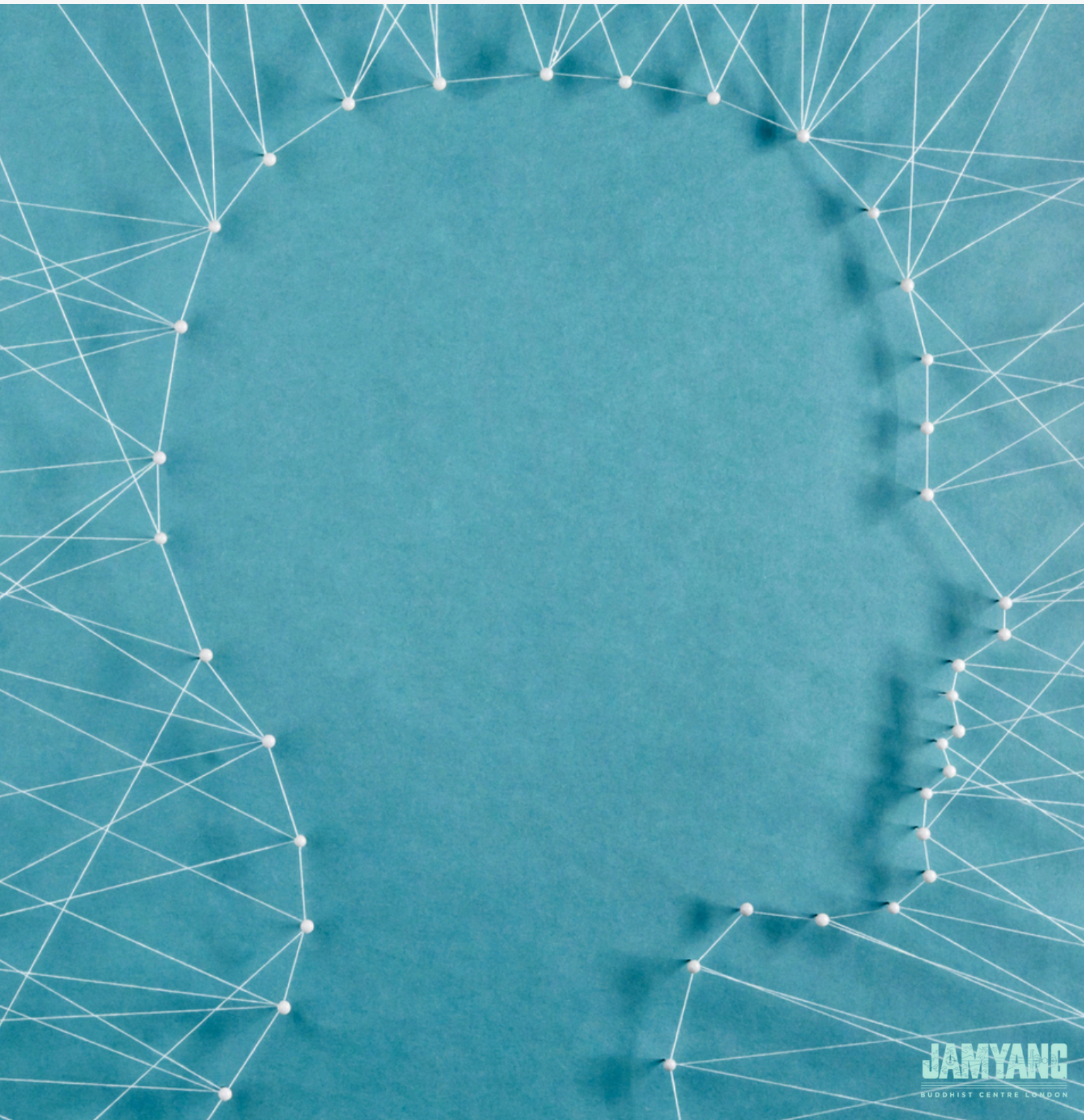
However, the (Prāsaṅgika) Mādhyamika school views such ideas as too essentialist and running contrary to the underlying principle of *śūnyatā*, the self-emptiness of all phenomena. Under analytical scrutiny, they insist, no essential "self" of any kind can be seen to exist, it is only useful as a relative designation or label to apply to a bundle of impermanent attributes that combine to make up what we think of as a "person". However, even karma and karmic "seeds" are similarly empty of self-essence. So, the Mādhyamikas articulated the idea of "zhig-pa" or "disintegratedness" to describe the process by which karma is passed from life to life. Since (as most Buddhist schools would agree) things arise, abide and cease simultaneously, rather than in a sequential order, everything in every moment is always "ceasing". This means that, in sense, everything is "imprinted" with its "having ceased" (which is the logical indication of its "having been"). This "having ceased-ness" is what is meant by "disintegratedness".

Hence, just because an action ceases does not mean that there is nothing left after it has ceased; instead, a disintegratedness remains. Of course, that disintegratedness also immediately ceases, which gives rise to its own disintegratedness, and so on in an unending process. Therefore, disintegratedness can be seen as a kind of energy that connects an action with its result, although the result will not come to fruition until all the necessary causes and conditions have come together in the right way to enable it to do so.

The Mādhyamika school does not see this as a negation, or as nihilistic, but actually the opposite, since this process is what enables an interconnected reality to operate and exist at all. In other words, the "production" of a disintegratedness by the ceasing of an action implies that the action had an existence (or at least that it did not not have an existence). In the language of philosophical logic, this highlights the difference between an affirming negative and a non-affirming negative. Hence, from such a perspective, there is no need for a "storehouse" consciousness, because there is nothing to be "stored". The benefit of this Mādhyamika approach is to completely eradicate any substantial locus that encourages our tendency to cling to things – which is seen, according to this philosophy, as the ultimate cause of our suffering.

Module 6:
How Things Exist

Meditation workshop



JAMYANG
BUDDHIST CENTRE LONDON

Meditation 1 - Dependent Origination

Introduction:

This meditation uses the Buddhist logic of Dependent Origination to analyse how things exist. Any object can be described as a collection of different parts (nothing is unitary), each of which has its causes. Our minds isolate the different parts of a collection of parts (and their causes) and gives them a label, creating the appearance of solid, unchanging, independently existing objects.

According to the Buddhist view of reality, any phenomenon or object can be described according to three levels of analysis: its causes, its parts ("elements" of a larger whole), and the mind that sees the parts and causes as singular separate identity (mental labelling). In this meditation, we go from an intellectual to an experiential understanding of objects and phenomena. Ultimately, this practice helps us to change the way we think, connect, and react to material objects. As a focus for this meditation, we can choose any object in relation to which we experience a feeling of attachment: our phone, car, house, favourite meal, etc. Here, we use a mobile phone as an example.

Meditation outline

Grounding

- Sit in your favourite meditation posture, either cross-legged on the floor or sitting on a chair with a straight spine. You can keep your eyes half-open or closed, and your hands in your lap or on your knees.
- Focus on your breath for one minute to stabilise the mind, paying attention to your nostrils or abdomen.
- If your mind wanders throughout the meditative practice, bring your attention back to the breath.

Analysis of the parts

- Bring to mind an object you have an emotional attachment for. For example, a phone, gadget, car, house, etc.
- Examine the parts of the object. Start with the bigger individual parts and try to find the essence of each individual part.
- Analyse the different components which make the individual parts of the object and try to find an essence on each component.
- Break your object down further to the atomic level and examine whether there is an essence in any of the particles and atoms which form the object.
- Try and see if the same emotional attachment to this pile of elements arises as you have for the object as a whole.
- Zoom back and see the object simultaneously as a whole and as the combination of particles and atoms.

Meditation Outline (continued)

Analysis of the causes

- Recall an object to which you feel attached.
- Reflect on the different people which made this object possible, who have designed, manufactured, delivered the object as it is.
- Think further back and acknowledge the evolution of science, technology, agriculture, commerce, and society itself which made the collection of raw materials possible.
- Contemplate the dawning of life on earth and further back the birth of our star and solar systems, the big bang and explosion of earlier starts which gave rise to elements of life on earth and all the particles and atoms.

Analysis of the mind

- Now focus on the mind and all the labels the mind creates.
- Think about all the causeswhich brought together countless trillions of particles grouped into molecules, cells, and organs and contemplate how the mind imposes the continuity of particles and causes and label them as your object of attachment.
- Try and see this label in your mind applying the label as an equal participant in the existence of your object.
- Recall again how you ordinarily see the object as singular, independent, and unchanging.

Conclusion

- Pull back and zoom back to your meditation posture and the breath.
- Make an aspiration to continue seeing things this way, as richly changing interdependent objects, especially when strong feelings of attachment or aversion to objects arise.

Guided Meditation 1: Dependent Origination

Analysis of the parts

Bring to mind an object you experience a strong emotional attachment for. First, acknowledge that this object has a beneficial factor: that it brings advantages to our life, and that we are grateful for that. To dive deeper and to understand reality better, we examine the parts of our object. We start with the bigger parts of our object, and we try to find an essence within this part.

Is the phone found in its screen, chip, battery, case, etc? Can you find your phone in any one of those parts or the collection of the parts? Reflect on the parts and investigate whether the object is identified with any of those parts for one minute.

To go more deeply, examine the human made materials of the glass, plastic, electronic components, capacitors, wires, and sensors. As we consider these parts of the object, are we coming closer to find the essence of the object that attracts us? Meditate silently for one minute and search to see if you can find the essence of the object in those individual parts.

Going deeper to the atomic level, we meditate on the elements that make the object. The phone contains almost every element on the periodic table. Indium, tin, and oxygen coat the touch screen display. The processor is made of silicone, phosphorous, antimony, arsenic, boron, indium, and gallium. The screen glass is made of silicon dioxide, aluminium, magnesium, sodium, and potassium. The electronic components of the phone are made of gold, silver and copper, tantalum, gadolinium, praseodymium, neodymium, terbium, dysprosium, europium, lithium, cobalt, and nickel. For a minute, try and conjure the same emotional attachment to this pile of elements as you have for the object.

Do the parts themselves have the same allure as when they are all combined? Is our love for the object a love of all parts individually? If we cannot find the object in any of the individual parts, how is it possible it can be found in the sum of them? Meditate on this for one minute.

When we picture the different elements, they still have qualities: colours, textures, tastes, smells, and sounds. When we focus our mind to the atomic level, we arrive at the invisible level of the subatomic where there are no colours, textures, tastes, smells, and sounds. Atoms are almost entirely empty space with their subatomic particles in the form of electrons, protons, and neutrons zipping around at an incredible speed. Even at the subatomic level, particles do not exist as we think. They seem to be more like probabilities. They exist relationally and are only observed and measured by other things and minds. For a moment, try and picture your object as an incredible living cloud of energy and particles whatever those are and, ultimately, try to imagine the probabilistic coming in and out of existence of quanta energy, which is constantly changing and moving mostly in empty space. Focus on how your object exists at this level of quantum reality. Meditate on this for one minute.

Now pull back and zoom back to the conventional level, where the illusion of your object appears to the senses and see if you can observe the object simultaneously in both ways: firstly, the conventional way of appearance with form, colour, texture, taste, smell and sound. At the same time, see the object through its molecules and elements and, further, as subatomic particles of quantum probabilities. Does this view soften the edges of the strong feelings you have towards your object? Does it give you a deep sense of

awe and wonder of how things truly exist? For one minute, hold the two realities simultaneously: the reality of the senses and the subtlest underlying reality of the elements.

Analysis of the causes

Now we think about the causes which bring these parts together. In the first instance and on the immediate causes, imagine the people who have designed, manufactured the different components, and transported them across the different countries to your house.

Think further back to deeper causes, to the evolution of science, technology, agriculture, commerce and society itself which made the collection of raw materials possible. Think back to the evolution of intelligent life on earth which led to human beings being able to work together. Now, back to the dawn of life on earth 4 billion years ago. Then, further back to the birth of our star, of our solar system. Back further to the explosion of earlier stars which led to the formation of the heavy elements, like carbon and oxygen, which form most of the elements of life on earth. Additionally, think back to the start of the universe when simpler elements like hydrogen and helium formed. See how the object you are thinking about is connected to the entire history of the universe, not only in the past but at this moment. See how each particle in your object feels the gravitational pull of every other particle in the universe and also interacts, at the quantum level, with other nearby particles.

Analysis of the mind

Now we move from causes to the mind which labels these causal parts and we consider the role of the mind in reality. The collection of parts, of countless trillions of particles grouping into molecules, cells, and human made cells. Think about all the causes which brought them together. Then notice how your mind projects onto the continuity of particles and causes this strong label of phone. Try and see this label in your mind applying that label as equal participant in the existence of your object. When we do this, we can also see that other people might not see our object as we do. Other types of minds and beings might not even see it as a separate distinct object the way we do. Now you see the object in this much richer interdependent changing way, for a moment recall again how you ordinarily see it as singular, independent, and unchanging.

Conclusion

Things do exist, but they exist in this interdependent and ever-changing way as entities composed of parts brought together by uncountable causes and labelled by the mind, for a time, as a certain object. It is possible that your strong feeling of attachment might be reduced through seeing reality in this way. The illusion of an independent object, which has the power on its own to bring us pleasure or pain, transmutes into a lighter more interdependent way of experiencing reality of the object.

As you come out of this meditation, you can make an aspiration to continue seeing things this way, as a rich and ever-changing collection of interdependent objects, especially when strong feelings of attachment or aversion arise which is only objectified through our mind temporarily by imposing a label on it.

Guided Meditation 1 - Dependent Origination (continued)

As a final reminder, from a Buddhist perspective, this practice softens our mind, it awakens us to our interdependent role in the universe and gives a sense of responsibility to see how every action and thought has new effects on the world. Carefully attending to the web of cause and effect.

Meditation 2: The Five Aggregates

Introduction:

What is the nature of the "self"? Here, we use the logic of Dependent Origination to look at our body and mind and analyse the way perception of our "self" is construed. Using a traditional Buddhist outline, the body-mind complex is divided into five separate factors, or aggregates. The first is the body (or form), while the other four (feeling, discrimination, volition, and consciousness) refer to the different layers of the mind.

Meditation outline

Grounding

- Sit in your favourite meditation posture, either cross-legged on the floor or sitting on a chair with a straight spine. You can keep your eyes half-open or closed, and your hands in your lap or on your knees.
- Focus on your breath for one minute to stabilise the mind, by paying attention to your nostrils or abdomen.
- If your mind wanders, bring your attention back to the breath.
- Recall a time where you experienced a strong afflictive emotion, for example a sense of injustice arising from being strongly or falsely criticised. Meditate for one minute on how you experienced yourself at that time.

Body form

- Bring that sense of the indignant, kind of self-righteous self into the corner of your mind and start to examine and search for that self among the different gross parts of your body, from the feet, legs, kidneys, and brain.
- Investigate for one minute quietly whether you are your brain or any other gross parts of your body.
- Go further, deeper to the cellular level and examine whether you can find a self in any of the cells of your brain and body.
- Further down to the atomic level, probe whether there is a self in each atomic particle which make up your body gross parts.
- Search for the self among your body parts and ask whether you are any one of them or the collection of all of them?

Mind

- Bring that sense of the indignant, kind of self-righteous self into the corner of your mind and start to search for a separate self in the mind.
- Probe the various parts of the mind which respond to the sensory and mental phenomena and whether there is a self in any of them. Meditate on this for one minute.

Meditation outline (continued)

Feeling

- Now start to search for a separate self in each of the feelings which arise.
- Further investigate the feelings and analyse whether the feeling arose in response to a sensory or mental event. Investigate whether you are each moment of a feeling or all of them combined.
- Watch the feeling grow, sustain and then, disappear. Dissect the sub moments infinitely into smaller moments of a feeling and probe for a self in each of them for one minute.

Perception

- Now search for a separate self in the mental factor, perception.
- Investigate if there is a self among the labels the mind gives to reality for one minute.
- Probe all the sensory experiences associated with the label and see if you are your perception, the mind's ability to interpret a multitude of different sensory experiences as a single object.

Volition or mental formation

- Then focus on other mental experiences, such as the mental formation of jealousy or pride or love or compassion or even democracy or justice.
- Give yourself a moment to probe any of your mental experiences and probe if the self can be found in any of them for a few moments.

Awareness

- Finally, search for a separate self in the consciousness or mental experience which is separate from other mental factors.
- Allow your attention to move away from the contents of your mental experience to the container of your mental experience. Probe the qualities of your mind, of your consciousness: luminosity, darkness, clarity, and spaciousness, and pay attention to where thoughts and feelings emerge from and where they dissolve back to. Can you divide consciousness down to its fundamental constituents?
- Investigate whether you find a self within any of these moments of consciousness.

Causes

- Probe all elements that made your body as well as the external elements in the form of intellectual influences from family, friends, and society, for instance.
- Trace your body back further and dissect it through the lenses of evolution, the origin of life on earth, and the big bang and investigate the role of the mind and labels in the construction of the self.
- Release all the complex analysis, concepts, and even all non-conceptual understanding of yourself which transcends the ego, labels any part of you or the collection of parts. Relax into the experience and the feeling of interdependence to know yourself as you truly are. Meditate on this for one minute.

Meditation outline (continued)

Conclusion

- Pull back and zoom back to your meditation posture and the breath.
- Make an aspiration to continue seeing yourself this way, as a much more alive, changing and interdependent being.

Guided Meditation 2: The Five Aggregates

Grounding

Sit in your favourite meditation posture, either cross-legged on the floor or sitting on a chair with a straight spine. You can keep your eyes half-open or closed, and your hands in your lap or on your knees. Focus on your breath for one minute to stabilise the mind, by paying attention to your nostrils or abdomen. If your mind wanders, bring your attention back to the breath. Recall a time where you experienced a strong afflictive emotion, for example a sense of injustice arising from being strongly or falsely criticised. Meditate for one minute on how you experienced yourself at that time.

Body form

Bring to mind a time where you were strongly or falsely criticised and felt a sense of injustice. Meditate on this for one minute.

Now, bring that sense of the indignant, kind of self-righteous self into the corner of your mind and start to examine and search for that self among its parts. First, we search for the indignant self in our body and starting with the gross parts of your body you can ask yourself: can I find the self in my feet? Is that self which is being criticised found in my feet or my legs, torso, liver heart, or lungs? Can I find this inherent I in my kidneys, hands, arms, or neck? When we get to our head, we can ask if this inherent I can be found among the sense organs, which give rise to our many sensory perceptions? Am I in my eyes, ears, nose, tongue or skin? What about my blood that circulates through my body, do I find the self there or in any of the cells of my body? Can I find the self in the electrical and chemical signals passing through my neurons and limbic system? Or do I find the self in my DNA, my microbiome of billions of cooperating bacteria inside of me? Can I find the self in my brain? Is this where the self can be found? And if you find it in your brain, where exactly is that self? On the left side or right side? Is it possible to find a "self" neuron, some single neuron where the self resides? Do I find the self in the collection of all neurons in my brain? And if I am in all, why can I not be in one? Just ask yourself this question and probe for a minute quietly whether you are your brain or any other gross parts of your body?

Now go further below the cellular level to the individual molecules. Our bodies are mainly made of water. Are we the water? Or are we the electrolytes or the carbohydrates, lipids, proteins, and vitamins? Then descend to the atomic level: are we the oxygen, carbon, nitrogen, calcium and phosphorus which make up our body's main elements? Now it can be useful to imagine once again some heaps composed by all those elements that make you who you are. Or are we the sub atomic particles, the electrons, protons and neutrons exchanging at enormous speed within our bodies' matter? Or are we the empty space between the particles? Atoms are made almost entirely of empty space, so on a technical level most of our body is empty space too. We can go even further and ask if we are the finer particles we know as

gluons, muons, quarks and bosons? Are these the fundamental building blocks of the universe which can be broken down no further, is this where we find the self? Search for the self among your body's parts and ask: am I any one of them or the collection of them?

Mind

Now we move on to search for the separate self in the mind. First, make sure that the slightly annoying indignant sense of self is still there in your mind so you can probe it. In case it is not, bring it back using the above mentioned technique of remembering a time where you were criticised. Now start by probing the various parts of the mind which respond to the sensory and mental phenomena.

Feeling

The first aggregate after form is feeling. Feeling is the way we respond with pleasant feelings to an experience we like, unpleasant feelings to experiences we do not like and indifferent feelings to the rest.

Am I the pleasant feeling I experience when I hear kind words, see beautiful sights, and when I smell and taste foods that I love? Am I the good feelings that arrive through my skin and muscles to hugs and kisses from people close to me? Am I the good feeling from my body which arises when I take a walk or workout? Or, do I identify with unpleasant feelings like those I have when I am uncomfortable, when my body hurts, when I am criticised, attacked, blamed or ignored? Do I identify with the neutral feeling of indifference which I have when I pass a stranger or when I am served by a clerk at a store?

Try not to let your analysis stop at the feelings, making them solid, but see if you can further break down the feelings. If you look closely at your mind, can you see if there is a moment when a feeling arose in response to some sensory or mental event? You can watch the feeling grow, be sustained and then diminish and disappear. Are you any of these sub moments of a feeling? If you are not any single moment, are you all of them combined? Do these moments become indivisible at some point or can you divide them infinitely into smaller and smaller moments of a feeling?

Perception

Next, we see if we can find ourselves in the third aggregate: the mental factor of perception. This is the part of the mind which takes a bundle of reality and labels it. For example: a collection of carbohydrates and proteins and lipids on a clay plate as our dinner; a collection of plant cells as a flower; or a collection of metal and glass and almost all elements on earth which come together as a phone. Are we this aspect of our mind which takes the continuity of invisible electromagnetic reality and, through the senses, labels it with colours, forms, tastes, smells, sounds and tactile sensations? Note these senses exist absolutely independently from the mind. Are you your perception, the ability of your mind to wrap bundles of sensory experiences with the label of home, phone, dinner or me?

Guided Meditation 2: The Five Aggregates (continued)

Volition or mental formation

Feeling and perception are two of the most powerful mental factors operating in our mind but there are dozens more categorized in the fourth aggregate: volition or mental formation. One way of thinking about this aggregate is our will, the thing which drives us to action. So, you can ask yourself if you are any of the mental experiences in your mind which differentiate between the intricacies of reality. Are you your mental experience of jealousy or pride or love or compassion or even democracy or justice?

If you do identify strongly with one of these mental phenomena, then what happens to the self when one mental experience dissolves into a new one? Give yourself a moment to probe any of your mental experiences to see if the self can be found in any of them for a few seconds.

Awareness

The last element of this five-part analysis of the aggregates is the fifth aggregate: awareness itself. The space of consciousness or mental experience which is separate from the mental factors that go through it. Let your attention move away from the contents of your mental experience to the container of your mental experience. As you relax into the space of your mind, does it appear to have any qualities? Does your mind feel large and spacious or small and confined? Does it have qualities of luminosity or darkness? Does it have a clarity to it or is it fuzzy and obscure? Does the mind have a sense of knowing or reflection of what appears to it or is it indifferent to the mental factors that arise within its space?

Inevitable thoughts and feelings arise within the spaciousness of the mind but pay attention to where these thoughts and feelings emerge from and where they dissolve back to. What is the ground from which the other mental factors emerge within the mind? You may experience some intuitive sense of the space of your mind and relax into this experience for a moment. Is this the ultimate place where the inherent I can finally pin itself upon this pleasant space of the mind? If you decide this is who you ultimately are, this open space of the mind, inquire further. If we divide the space of our mind in half, am I to be found on one side or the other? What if we sub divide the space of the mind into little cubes of mental space, can you find the self in any of them? If this seems absurd and unfindable, can you definitely find the self in the collection of all these little cubes of mental space? The mind also has a temporal aspect, where individual moments of consciousness arise, grow, sustain, diminish and, finally disappear. Some of these have mental factors writing within them, others are free from thought and remain in the direct experience of an unobstructed mind itself. Whether combined or free from mental factors, do you find the self within any of these moments of consciousness? Maybe you find the self within the present moment of consciousness but what happens to the self when this moment of consciousness disappears? Does the self continue on with that moment of consciousness which has disappeared? If it does, where does it go or when does the self jump into the next moment of consciousness? Or is the self separate from any moment of consciousness? Am I in the prior or next part? Can you find a quantum of consciousness where you cannot divide anymore? Or can you divide forever and what does that mean? Is it almost like transcending time itself? Do we find the self in that realization, that experience?

Guided Meditation 2: The Five Aggregates (continued)

Causes

The physical and mental parts that make up our self all have causes. So, we move on to meditate on causes to see whether the self is as independent as it seems. Our body began with small bits of our mother and father and then incorporated food and nutrients and oxygen to grow itself, initially inside our mother and then outside of her. As we grew, this process continued turning non-me elements into me. With our mind we can notice all the words, concepts, skills, beliefs, and opinions we have learnt came from outside ourselves: from our teachers, parents, friends, and society. We can go back in time and trace our bodies and minds through generations of humans who created the languages, civilizations, technologies and religions which brought us to where we are today. Further back through evolution, millions of years evolving back through apes and mammals and fish to tiny sea creatures, and even further back to the origin of life on Earth, about 4 billion years ago. All the elements that make up life on earth came from earlier stellar explosions, which created the heavy elements of life, such as carbon and nitrogen. Ultimately, we can trace our physical body back to the big bang and the beginning of matter and energy and even time itself in our universe. Then, come back to the present and realise how, at the physical level, every atom in your body is moved by the gravitational attraction of every other particle in the universe. Gravity's reach has no limit. In this way, the galaxies we can see 1.4 billion light years away exert a tiny influence on every particle of our body. Even now we are interconnected with the entire visible universe.

Then, we look at the role of the mind in constructing the self. We are uncountable collections of parts brought together by innumerable causes, stemming back to the origin of the universe. The mind wraps these causes and parts with a label. It is a provisional label, but we become so attached to it that we often feel a surge of excitement or fear when someone says our name. However, we are not our name: this is just a label placed upon a collection of causes and parts. Try to see yourself in this way in your daily life, existing not independently but dependently and constantly changing, made of countless parts produced by an infinite stream of cause and effect. Your mind can be seen in the same way too: your opinions, beliefs, and thoughts are dependent on everything you have learnt, and on our whole civilization. If you always saw yourself this way, would it change how you responded to criticism, blame, craving or praise? Who is being criticised? Am I even the same person who is praised or blamed one second ago? So, try for a moment to abandon all the complex analysis and concepts, letting go of a non-conceptual understanding of yourself which transcends the ego, labels and any part of you or the collection of parts. Allow yourself to relax into the experience and feeling of interdependence, and to know yourself maybe for the first time as you truly are.

Conclusion

Now return to conceptual thinking. See how you do indeed exist. You have not negated yourself in any way, only expanded the boundaries of how you understand your body and mind. Independent, unchanging parts as views of the self are so limiting, narrow and inaccurate. The separateness that arises from this incorrect view of the self is unnecessary when we become aware of our interdependent, changing self which is composed of countless physical parts and mental moments. We are much more alive and interdependent than our narrow ego imposes on us.

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E-Course 1: Buddhism & Quantum Physics

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The project managers of Science & Wisdom LIVE
Dr. Marco Colnaghi
Dr. Sajda van der Leeuw

Colophon

Prof. Carlo Rovelli	Keynote speaker during Science Day II: Appearance & Reality
Prof. John Dunne	Keynote speaker during Science Day II: Appearance & Reality
Prof. Michel Bitbol	Keynote speaker during Science Day II: Appearance & Reality
Geshe Tenzin Namdak	Keynote speaker during Science Day II: Appearance & Reality
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