AGPhil 11: Particle Physics 2

Time: Wednesday 17:00–18:30 Location: PTB SR AvHB

AGPhil 11.1 Wed 17:00 PTB SR AvHB

Is the Planck scale more than a mere choice of units? — •Caspar Jacobs — Leiden University, Leiden, Netherlands

It is often asserted that quantum gravity becomes noticeable at the Planck scale, defined by c = G = h = 1. Behind this claim lies a 'simple dimensional argument' (Isham and Butterfield 1999), but as Weinstein and Rickles (2023) point out: 'the details of these dimensional arguments and the role of the Planck scale are calling out for a closer analysis'. It is unclear what elevates the Planck scale from a convenient choice of units to a physically relevant scale.

Baez (2000) justifies the Planck scale on the basis of mini black holes, but Meschini (2007) dismisses this as speculative physics. Instead, I propose to look at our current theories: effective field theories. Here, we see that fundamental constants are relevant to the procedure of renormalisation. This procedure only succeeds when coupling constants have certain dimensions. Although these dimensions are often expressed as powers of energy, they are in fact functions of c, G and/or h. It is only when the latter are set to 1 that the dimensions simplify. Planck units thus indicate when effective field theories become non-renormalisable.

Therefore, what matters are not Planck units, but what I will call Planck dimensions. Unlike a mere choice of scale, such a set of dimensions has physical content.

AGPhil 11.2 Wed 17:30 PTB SR AvHB

Theoretical Virtues and the Pursuit of Ugly Models — •Martin King — MCMP, LMU Munich

The lack of new physics discoveries at the LHC has changed the field of particle physics in a number of significant ways. One is that many of the long-cherished principles, such as naturalness, that guided model development for decades are falling to the wayside. Physicists are increasingly turning to model-independent methods and to models that do not exemplify epistemic theoretical virtues considered by some philosophers as being important or even necessary. Simple, unifying models with large empirical scope, like supersymmetry, are being increasingly passed over in favour of effective models with narrow scope that are relatively easy to assess with existing data. I argue that this is a reasonable response to the current situation and that what should be pursued in this research context are models that are easy to test or that take radically novel approaches.

AGPhil 11.3 Wed 18:00 PTB SR AvHB

The Operationalist Take on Scientific Concepts — •Nurida Boddenberg — University Bonn, Bonn, Germany

Exotic quarkonium" serves as an umbrella term to describe states in particle physics that have been increasingly detected since 2003 and share some characteristics with conventional quarkonium (theorized as a state constituted of a heavy quark and its antiquark), along with some exotic features. Although various theoretical models like tetraquarks, hadron-quarkonium, and hadronic molecules have been proposed, there is no consensus on a definitive model to describe and categorize these exotic states.

For this matter, I propose a different route for classification. Instead, I will focus on the experimental signatures that are associated with the respective states and their overlap. This approach enables an operational assessment and the construction of a network of uses*various ways in which a scientific concept can be used.

This endeavor draws inspiration from a revised operationalism that allows defining the meaning of scientific concepts when a theoretical framework is absent, or multiple models are competing. This can be useful for scientific discovery, but also for redefining conventional concepts such as those of temperature or even black holes.