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Dark matter detection - an experimental overview

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A major challenge of modern physics is to decipher the nature of dark matter. Astrophysical observations provide ample evidence for the existence of an invisible and dominant mass component in the observable universe, from the scales of galaxies up to the largest cosmological scales. The dark matter could be made of new, yet undiscovered elementary particles, with allowed masses and interaction strengths with normal matter spanning an enormous range. Axions, produced non-thermally in the early universe, and weakly interacting massive particles (WIMPs), which froze out of thermal equilibrium with a relic density matching the observations, represent two well-motivated, generic classes of dark matter candidates. Dark matter axions could be detected by exploiting their predicted coupling to two photons, where the highest sensitivity is reached by experiments using a microwave cavity permeated by a strong magnetic field. WIMPs could be directly observed via scatters off atomic nuclei in underground, ultra low-background detectors, or indirectly, via secondary radiation produced when they pair annihilate. They could also be generated at particle colliders such as the LHC, where associated particles produced in the same process are to be detected. After a brief introduction to the phenomenology of particle dark matter detection, I will discuss the most promising experimental techniques to search for axions and WIMPs, addressing their current and future science reach, as well as their complementarity.

Primary author: Prof. BAUDIS, Laura (University of Zurich)

Presenter: Prof. BAUDIS, Laura (University of Zurich)

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