axions++ 2023

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LAPTh

Programme Scientifique

The search for axions is one of the most topical and interdisciplinary subjects in fundamental physics.

From a theoretical point of view, the axion stands as an elegant solution to some of the clearest conceptual and phenomenological limitations of the Standard Model. For example, the axion solves the strong CP problem -- the absence of CP violation in strong interactions. Moreover, it provides a particle explanation to the existence of Dark Matter through different possible mechanisms. The discovery of axions would not only offer key insights into the fundamental forces and particles that govern our universe, but also have far-reaching implications for our understanding of astrophysical processes (for example, stellar cooling), cosmic evolution, and the formation of large-scale structures.

While the standard (i.e. QCD) axion is expected to be naturally light and to couple feebly to ordinary matter, a less constrained, yet plausible framework is that of the more general Axion-Like-Particles (ALPs). Interestingly, ALPs can be constrained in a number of collider setups, e.g. their couplings to different matter generations can be probed through rare decays of mesons. ALPs can also address a wider range of astrophysical phenomena -- for instance, the explanation of an observed cooling anomaly in white dwarfs.

More generally, axion and ALP properties can be investigated in a vast array of experimental setups, using direct-detection methods based on resonant cavities, astrophysical datasets of stellar cooling, supernova explosions or Galactic and extragalactic particle messengers of astrophysical processes as well as high-precision measurements at colliders.

This makes for a very interdisciplinary subject of research, brimming with genuinely new ideas -- some of which may lead to a breakthrough.

The workshop aims at capturing these ideas and their intersections.