

Exploring the dark universe: the experimental quest for axions and ALPs

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Axions and axion-like particles (ALPs) are hypothetical particles predicted in extensions of the Standard Model (SM) of particle physics. Originally proposed as a solution to the strong CP problem in strong interactions, axions have since gained prominence due to their potential role as dark matter candidates. ALPs, more broadly, arise in various beyond-the-SM theories, such as string theory. Both are characterized by extremely low masses and weak couplings to ordinary matter, making them elusive yet fundamental to understanding the universe's hidden structure.

Experimental searches for axions and ALPs span a diverse range of techniques. Haloscopes, helioscopes, and laboratory-based experiments use cutting-edge technologies to detect faint axion signals, while astrophysical and cosmological observations provide indirect constraints. These efforts leverage advances in resonant cavities, magnet technology, and high-intensity lasers to probe unexplored parameter space. The ongoing quest for axions and ALPs is not only a test of theoretical models but a potential gateway to groundbreaking discoveries in physics.

In this talk we will review the landscape of axion and ALP searches introducing the various types of experimental setups employed to look for these hypothetical particles. We will also discuss current results and outline future prospects.

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Session Classification: Invited Overview Talks / Hauptvorträge