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Search for Light-Feebly Interacting Particles with the PADME experiment

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The elusive nature of dark matter has prompted innovative and open-minded experiments across a broad spectrum of energies employing high-sensitivity detectors, but despite the numerous attempts none has yielded up to now any evidence [1]. Inserted into this landscape is the Positron Annihilation into Dark Matter Experiment (PADME) at the Laboratori Nazionali di Frascati of INFN [2].

PADME is currently investigating a Dark Photon signal by analyzing the missing-mass spectrum of single photon final states resulting from positron annihilation events on electrons within a fixed target. The PADME approach not only enables the search for a Dark Photon signal but also allows for the exploration of any new particle produced in e^+e^- collisions, including long-lived Axion-Like-Particles (ALPs), proto-phobic X bosons, Dark Higgs, and more.

Significantly, the PADME setup offers the unique opportunity to validate or disprove the particle nature of the X17 anomaly observed in ATOMKI nuclear physics experiments that study the de-excitation via Internal Pair Creation of light nuclei [3]. The data-taking conducted by the PADME collaboration during 2022 was conceived to collect approximately 10^11 positrons-on-target, 10^10 for each of the 47 beam energy values ranging from 262 to 298 MeV, in order to produce resonantly the X17. This fine energy scan aims to identify the reaction $e^+e^- \to X17 \to e^+e^-$.

The talk will provide an overview of the experiment's scientific program and the ongoing data analyses.

References
[1] P. Agrawal et al., Eur. Phys. J. C 81 (2021) 11, 1015.
[2] P. Albicocco et al., JINST 17 (2022) 08, P08032.
[3] L. Darmé et al., Phys. Rev. D 106 (2022) 11, 115036.

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