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Search for a Dark Photon with the PADME experiment

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In spite of the variety of attempts to create dark matter at accelerators, up-to-now, none of the conducted experiments has produced any evidence.
This elusiveness of dark-matter has then triggered innovative and open-minded approaches spanning a wide range of energies with high-sensitivity detectors [1].
In this scenario is inserted the Positron Annihilation into Dark Matter Experiment (PADME) ongoing at the Laboratori Nazionali di Frascati of INFN. PADME is searching a Dark Photon signal [2] by studying the missing-mass spectrum of single photon final states resulting from positron annihilation events on the electrons of a fix target. Actually, the PADME approach allows to look for any new particle produced in $e^+ e^-$ collisions through a virtual off-shell photon such as long lived Axion-Like-Particles (ALPs), proto-phobic X bosons, Dark Higgs ...
After the detector commissioning and the beam-line optimization, PADME collaboration collected in 2020 about 5×10^{12} positrons on target at 430 MeV. These data have been used to evaluate the cross-section of the process $e^+ e^- \rightarrow \gamma\gamma(\gamma)$ at $\sqrt{s}$=20 MeV with a precision of 5% [3].
PADME has also the unique opportunity to confirm/disprove the particle nature of the X17 anomaly observed in the ATOMKI nuclear physics experiments studying de-excitation of some light nuclei [4].
The PADME 2022 data taking has been precisely conducted with this scope. About 1010 positrons have been stopped on the target for each of the 47 beam energy values in the range 262 - 298 MeV. This precise energy scan is intended to study the reaction $e^+ e^- \rightarrow X17 \rightarrow e^+ e^-$.
The talk will give an overview of the scientific program of the experiment and of the data analyses ongoing.

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] F. Bossi et al., Phys. Rev. D 107 (2023) 1, 012008.
[4] L. Darmé et al., Phys. Rev. D 106 (2022) 11, 115036.

Collaboration

PADME

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