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Dark Matter searches with the PADME experiment

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The parameters space for Weakly-Interacting-Massive-Particles as possible explanation for Dark Matter, is shrinking more and more. This triggered new attempts to create dark matter at accelerators. This alternative approach represents an innovative and open-minded way to broaden this research field in a wider range of energies with high-sensitivity detectors [1].
In this panorama is inserted the Positron Annihilation into Dark Matter Experiment (PADME) ongoing at the Laboratori Nazionali di Frascati of INFN. PADME was conceived to search a Dark Photon signal [2] by studying the missing-mass spectrum of single photon final states resulting from positrons annihilations with the electrons of a fixed 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. A fraction of 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]. This is the first measurement ever done at this energy, that detected the two final state photons, making it the first measurement allowing to define stringent limits to processes beyond Standard Model.
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 was conducted with this scope. About 10^{10} 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 / Activity

PADME

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