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Indirect Dark Matter searches and fundamental physics with present- and next-generation Cherenkov telescopes

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Very-high energy (VHE, E>~50 GeV) gamma rays of cosmic origin can reveal unique information on paramount open issues of fundamental physics while also providing a complementary probe to laboratory experiments and particle accelerators. In fact, the search for VHE gamma-ray signatures from the annihilation or decay of dark matter (DM) particles is a promising method for identifying DM, understanding its intrinsic properties, and mapping its distribution in the universe. Furthermore, VHE gamma rays can be used to search for evidence of Lorentz invariance violation (LIV) associated with possible quantum gravity effects on space-time at the Planck scale.

Nowadays, the most prominent instruments suited for searches at the VHE gamma-ray regime are Imaging Atmospheric Cherenkov Telescopes (IACTs). The present-generation of IACTs, which includes MAGIC, HESS and VERITAS, has been pursuing fundamental physics programs for almost two decades, in synergy with space-borne gamma-ray telescopes. These instruments will soon be superseded by the Cherenkov Telescope Array (CTA), the next-generation ground-based observatory for gamma-ray astronomy with an energy window ranging from 20 GeV to more than 300 TeV. With ~120 telescopes of 3 different sizes (small-sized, ~4 m; medium-sized, ~12 m; large-sized, ~23 m) located in two sites in the northern and southern hemispheres, CTA will provide full-sky coverage and achieve an improvement in sensitivity by a factor of five to twenty, as well as improved energy and angular resolutions, with respect to the current major gamma-ray facilities. Such unprecedented performance will make CTA an outstanding gamma-ray instrument with a considerable potential for discovery in the area of fundamental physics.

In this talk, I will present an overview of some fundamental physics topics in VHE gamma-ray astronomy that can be addressed by present- and next-generation IACTs. The focus will be given to the current status of indirect DM searches in the VHE gamma-ray regime, and in particular within the Weakly Interacting Massive Particles (WIMPs) scenario. The capabilities to contribute to this field by the ASTRI mini-array, a CTA pre-production facility of nine small-sized telescopes, proposed to be deployed and operated as a pathfinder sub-array at the CTA Observatory southern site, will be also discussed.

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