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Characterization of the DIMS system based on astronomical meteor techniques for macroscopic dark matter search

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Nuclearites are SQM conglomerates that are hypothesized as possible candidates of macroscopic dark matter. When impacting the Earth's atmosphere, they should undergo quasi-elastic collisions with the air molecules and emit black-body radiation, thus generating atmospheric luminous events similar to meteors. However, nuclearites could be distinguished from meteors mainly by their altitude, velocity, and motion direction of the bright flight. For instance, nuclearites of galactic origins are expected to have a typical velocity of 220 km/s, whereas meteors observed in the Earth's atmosphere are bounded to 72 km/s. In the case of meteoroids of interstellar origin, this value may be exceeded but, considering the stellar velocity distribution in the vicinity of the Sun, only by several kilometers per second. The DIMS (Dark matter and Interstellar Meteoroid Study) experiment was designed to search for such fast-moving particles by observing the sky with wide-field, high-sensitivity CMOS cameras. We derived the calibration of the DIMS sensors by astrometry and photometry techniques applied to observed stars in the FOV and assessed the achieved positional precision and sensitivity levels. Since nuclearites and meteor events feature quite distinct observational conditions, we designed simulations to optimize the DIMS setup and analysis pipeline. Nuclearites may also have a certain spectrum of mass and velocity. We consequently evaluated the variability of nuclearites' dynamics in the atmosphere in this respect and assessed its impact on the search algorithm performances for such events, in comparison to standard meteor trigger schemes. In this contribution, we will present the current status of this work.

Collaboration

Keywords

macroscopic dark matter; strange quark matter; nuclearites; meteorites, meteors, meteoroids; interstellar meteoroids.

other Collaboration

DIMS

Subcategory

Experimental Methods & Instrumentation

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