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High Angular Resolution Satellite Array for Dark Matter Annihilation Gamma Ray Detection

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Future high-sensitivity observations of possible dark matter annihilation signals from dwarf galaxies will benefit from large-area (10-100 m^2 or greater) and high-angular resolution (˜mrad) gamma ray observation. The angular resolution is necessary to further improve the signal-to-background for faint gamma signals. Large areas will allow for significant gains in candidate gamma events statistics from sources.

It would be possible to create the new telescope by flying many thin-plane detectors as coordinated arrays of satellites. The perpendicular dIstances between detector planes could range from 10 m to 1 km or more. The effective area of a telescope array could be incremented by adding satellites laterally. This would require the flying of satellite-based detector planes in coordination, and accepting only gamma events from a very narrow-angle observation region. The inherent modularity of the design and potential for incremental improvement in array performance match well with the much-improved assembly-to-launch cadence in modern satellite campaigns.

The detector active target materials would take advantage of the highly anisotropic acceleration of electromagnetic shower development in detector crystals such as Lead Tungstate (PbWO4) [see contribution #77 by L. Bandiera et al.] . This can be exploited to provide enhanced angular resolution for signal vs background determination and enhance gamma signal flux sensitivity.

The gamma ray direction, energy shower reconstruction, and particle background rejection would be based on hit geometry and signal timing in multiple widely spaced planes. The detector planes are populated by large scintillator crystal pixels (>3 cm linear dimension), which also act as the gamma conversion medium.

Eligibility for ”Best presentation for young researcher” prize

No

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