Resolving the Origin of Positrons in the Inner Galaxy with GALE

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Abstract

The origin of Galactic positrons remains one of the longest-standing mysteries in high-energy astrophysics. Although the 511 keV annihilation line is the brightest steady gamma-ray line signal in the Galaxy, it remains unclear whether the positrons in the inner Galaxy originate from a population of unresolved compact sources or from truly diffuse processes. Resolving this question is essential for identifying the dominant positron sources and assessing potential contributions from exotic scenarios such as dark matter. In this talk I will present the Galactic Annihilation Line Explorer (GALE) mission concept, a proposed balloon-borne coded-aperture telescope designed to directly address this problem and provide a powerful complement to future MeV gamma-ray missions. GALE combines a high-resolution CZT imaging calorimeter with a coded-aperture mask to achieve an angular resolution of _˜10 over a 10 degree field of view and energy resolution of 1–2% over the 50–800 keV band. Through pointed observations of the inner Galaxy, GALE will provide the sensitivity and spatial resolution needed to search for discrete 511 keV annihilation sources and determine whether the Galactic positron signal originates from unresolved compact objects or diffuse emission. I will discuss the instrument concept, expected performance, and its potential to resolve one of the most enduring mysteries in gamma-ray astronomy.

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