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Measuring Heavy and Ultra-heavy Galactic Cosmic-Ray Abundances with TIGERISS

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The Trans-Iron Galactic Element Recorder for the International Space Station (TIGERISS) is the upcoming successor to the TIGER and SuperTIGER balloon-borne missions, which have measured the abundances of ultra-heavy galactic cosmic rays (UHGCRs) over a series of successful Antarctic campaigns. UHGCRs are a unique probe of the galactic cosmic-ray reservoir and the material produced in extreme environments. Beyond 28Ni, elements must largely be produced in the slow and rapid neutron capture processes (s-process and r-process, respectively). Existing single-element resolution measurements up to 40Zr have shown a strong consistency with production and shock acceleration in OB associations and compositional enhancements from heavy stellar winds and modeled supernova yields. Recent SuperTIGER results, however, demonstrate that this model breaks down above 40Zr, potentially indicating the presence of an additional source of UHGCRs. The detection of a kilonova in follow-up electromagnetic observations to the GW170817 binary neutron star merger gravitational wave event demonstrated clear evidence of r-process nucleosynthesis, and the Astro2020 decadal review highlighted the identification of r-process sites in the galaxy as a high-priority science target.

TIGERISS will extend the measurements by SuperTIGER up to 82Pb or beyond with single-element charge resolution, a vantage point above the atmosphere, and a large potential exposure. The instrument uses a combination of silicon strip detectors (SSDs) and Cherenkov light-integrating detectors to measure the charge with high fidelity and a de-coupling of the ionization signal from the incident particle velocity. The project is in design and engineering development unit testing, with a planned launch in 2026 for a nominal one-year operational period. Accumulated statistics will rival those of SuperTIGER in the UHGCR range, with sensitivity to lower and higher-charge elements with no detector saturation. TIGERISS measurements will be combined with modeled yields to constrain the contribution of different sources to the galactic r-process budget.

Collaboration

TIGERISS

Role of Submitter

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