Contribution ID: **971** Type: **Talk**

Time-Dependent Measurements of Absolute Spectra for Elements up to Fe by SuperTIGER as a Probe of Solar Modulation, Atmospheric and Geomagnetic Rigidity Effects

Tuesday 22 July 2025 16:05 (15 minutes)

SuperTIGER (Super Trans-Iron Galactic Element Recorder) is a large-area, balloon-borne cosmic-ray experiment designed to measure the galactic cosmic-ray abundances of elements from Z=10 to Z>30 at energies from ∼0.8 to ∼10 GeV/nuc. Measurements of ultra-heavy elements (Z>30) requires precise calibration from Z<30 elements, and we will report energy spectra at this meeting. SuperTIGER flew over Antarctica for 55 days in 2012-2013, and it flew a second flight of 32 days in 2019-2020. The long, separate flights allow the measured spectra to be used to examine solar modulation, atmospheric, and geomagnetic effects. The first flight occurred when the solar modulation parameter was ∼520–650 MV, between solar minimum and solar maximum based on ACE/CRIS measurements, and during the second flight, it was ∼200-250 MV, near solar minimum. We will show the effects of solar modulation at the lowest energies measured by SuperTIGER. Additionally, during the first flight, the instrument circumnavigated Antarctica, drifting between 74.9 to 86.6 degrees South latitude, while during the second flight, the instrument drifted between 69.5 to 77.9 degrees South latitude. The northern reach of the second flight raises the possibility of probing vertical cutoff rigidities with low energy intensities in the flight data, and we will compare results of both flights with vertical cutoff rigidity maps calculated for both flights. Finally, the atmospheric overburden (a measure of altitude) during the first SuperTIGER flight varied between 3.64 and 6.65 g/cm^2, and it varied between 3.76 and 8.34 g/cm^2 during the second flight. We will compare elemental intensity variations, measured at the top of the instrument, vs. atmospheric overburden, and we will compare these results with atmospheric survival fractions vs. element and energy as calculated by Geant4 simulations.

Collaboration(s)

SuperTIGER

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Session Classification: CRD

Track Classification: Cosmic-Ray Direct & Acceleration