Contribution ID: **471** Type: **Poster**

Ultra-Heavy Galactic Cosmic Ray Propagation and Atmospheric Corrections for SuperTIGER.

SuperTIGER (Super Trans-Iron Galactic Element Recorder) is a balloon-borne instrument designed to directly measure ultra-heavy galactic cosmic-ray (UHGCR) nuclei. SuperTIGER had two successful Antarctic flights: one in 2012 for 55 days and one in 2019 for 32 days. Stratospheric float altitudes varied between ˜36-40 km for both flights. The elemental abundances measured by SuperTIGER must be corrected for propagation through the atmosphere and material above the active instrument, averaging ˜ 5.6 and 4.2 g/cm^2 of material for the first and second flights, respectively. To obtain top-of-atmosphere (TOA) elemental abundances of UHGCR nuclei, the observed measurements are corrected using Geant4 simulations to understand the nuclear interactions and energy losses cosmic-ray nuclei experience propagating through the atmosphere. Matrices are created to describe charge-changing losses or gains of elemental nuclear species. For each species, a TOA minimum energy to trigger the acrylic Cherenkov detector (320 MeV/n) is found as a function of incidence angle. Galactic cosmic-ray source (GCRS) abundances are found from TOA abundances by propagating assumed GCRS abundances through the interstellar medium via the leaky-box model with a Fisk-model correction for solar modulation and comparing the results with SuperTIGER TOA abundances. The assumed GCRS abundances are iteratively modified based on the propagation results until the GCRS abundances produce TOA abundances that match those measured by SuperTIGER.

Collaboration(s)

SuperTIGER

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Session Classification: PO-1

Track Classification: Cosmic-Ray Direct & Acceleration