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miniTRASGO: A Compact Muon Detector for Global Cosmic Ray Monitoring and Space Weather Studies

The miniTRASGO is a compact, cost-effective secondary cosmic ray detector optimized for studies in solar activity, cosmic rays, and atmospheric physics. Based on Resistive Plate Chambers (RPCs), it provides stable detection rates and high sensitivity. This was demonstrated by its successful measurement of Forbush Decreases in March and May 2024 at the Madrid station, which, at the time, hosted the only deployed miniTRASGO unit. These results highlight the detector's reliability despite its limited active area.

Due to its design and location, miniTRASGO also complements nearby neutron monitor stations from the NMDB, such as CaLMa, which is geographically close to Madrid. By detecting the secondary muon component of cosmic rays, it adds a valuable observational channel to conventional cosmic ray monitoring.

By early 2025, additional units are deployed in Warsaw, Puebla, and Monterrey, each situated at distinct latitudes and characterized by different geomagnetic cutoff rigidities. This expansion establishes miniTRASGO as a scalable platform for a global muon monitoring network, enabling detailed studies of cosmic ray modulation and space weather phenomena.

In addition to global flux monitoring, miniTRASGO supports angular-resolved studies of cosmic ray variability. It applies atmospheric corrections and analyzes rate dependence on arrival direction, facilitating investigations into geomagnetic effects, solar modulation, and cosmic ray–atmosphere interactions. These capabilities significantly enhance its utility for coordinated, multi-site cosmic ray research.

Author: SONEIRA LANDIN, CAYETANO (Complutense University of Madrid)

Co-authors: UDÍAS MOINELO, José Manuel (Complutense University of Madrid); FRAILE PRIETO, LUIS MARIO (Universidad Complutense)

Presenter: SONEIRA LANDIN, CAYETANO (Complutense University of Madrid)

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