



Contribution ID: 131

Type: Oral Presentation

#9-131 Performance evaluation and comparative analysis of new NM-2023 neutron monitors within the global cosmic ray monitoring network

Friday, June 13, 2025 10:00 AM (20 minutes)

This paper presents an analysis of initial operational data from three newly developed ground-level neutron monitors, the NM-2023, and compares them with established monitors reporting to the Neutron Monitor Database (NMDB). The NM-2023s are deployed at the Camborne Met Office Observatory in Cornwall, United Kingdom, Lancaster University, United Kingdom, and the University of Rome Tor Vergata, Italy. Neutron monitors operate in a globally distributed network that deduces the primary cosmic ray flux in the upper atmosphere based on variations in cosmic ray and solar energetic particles at the Earth's surface. While most neutron monitors follow the 1964 NM-64 design by Carmichael, the NM-64 is large, costly, and reliant on toxic boron trifluoride gas-filled proportional counter tubes. The NM-64s are configured in 3, 6, 9 or 18 tube configurations. After evaluating various detector options, based on operational experience, experiments and simulations, a new design was conceived which exploits the established supply chain serving nuclear safeguards and security. The new NM-2023 monitors offer similar count rate performance to a 6-NM-64 but features a compact, cost-effective design with a 64% smaller footprint, 80% smaller volume, and 55% less mass. Optimised for helium-3 gas-filled counters and increasing the counter packing density, eliminating the air-void and the lead rings seen in the NM-64 design, resulted in an easier and cheaper design to fabricate. The NM-2023 design was optimised using experimentally validated Monte Carlo simulations. Data from the 4-NM-2023 at Camborne shows similar count rates to a 6-NM-64 at a similar altitude and latitude. The 1-NM-2023 monitors at Lancaster and Rome exhibit proportional performance to one-quarter of a 4-NM-2023. Several months of NM-2023 data are consistent with the NM-64 monitors considered by this study and confirms the NM-2023's promise for more complete time series analysis in future work.

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Session Classification: #09 - Environmental and Medical Sciences

Track Classification: 09 Environmental and Medical Sciences