

AMORE

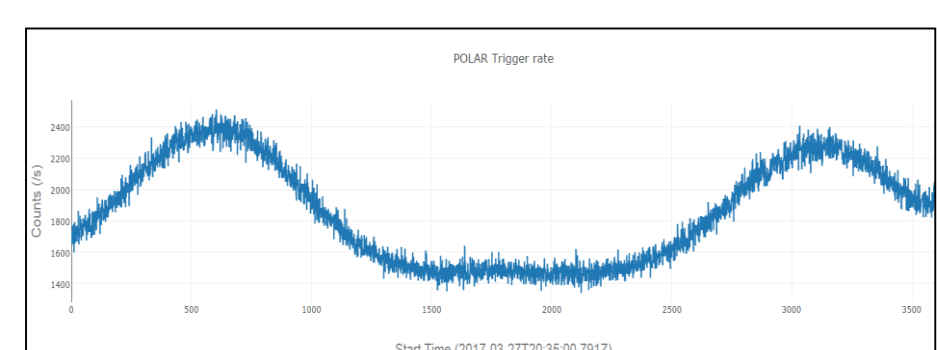
Aerospace Measurements Of Radiation Environment

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Abstract

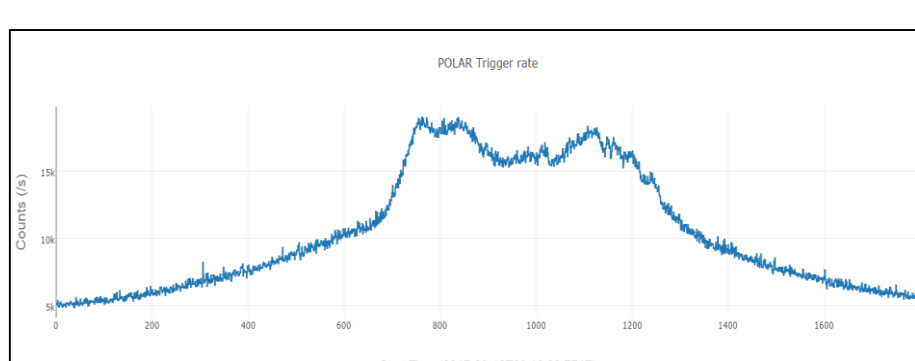
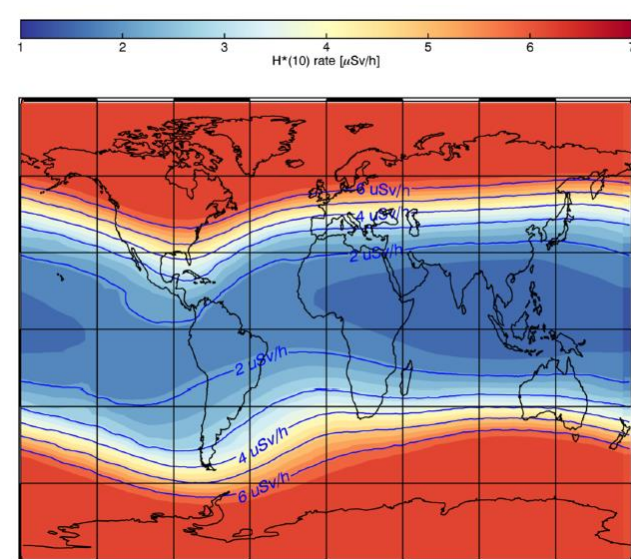
Solar events and induced geomagnetic storms relate not only to the high variability of the Earth radiation belts but have large impact on processes in the atmosphere. Dynamic propagation of the radiation environment observed e.g. in the inner belt and around magnetic poles toward the Earth surface strongly correlates with measurements from the global neutron monitor network on-ground.

The intermediate region is studied less systematically using either bulky or simplified instrumentation placed as a payload on the high-altitude balloons. We discuss development of the small, low-power radiation environment detector for such aerospace applications. The instrument aims to provide time-resolved maps of radiation environments based on particle-separated, directional and spectroscopic measurements. .



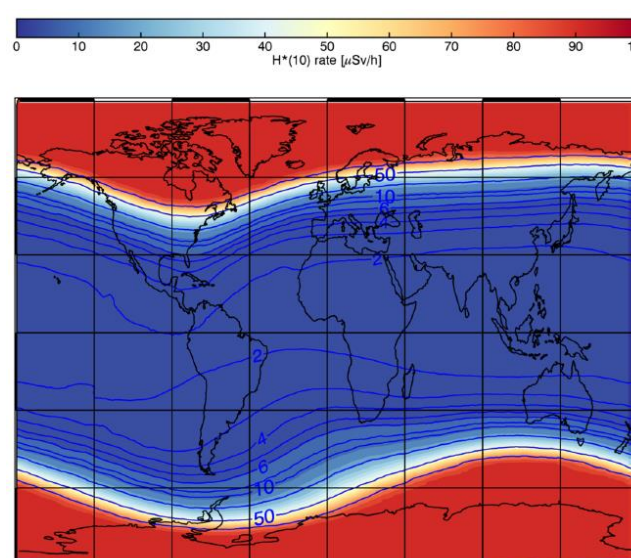
Quiet period

up: 600 km, eight: 12 km



Storm event

up: 600 km, right: 12 km



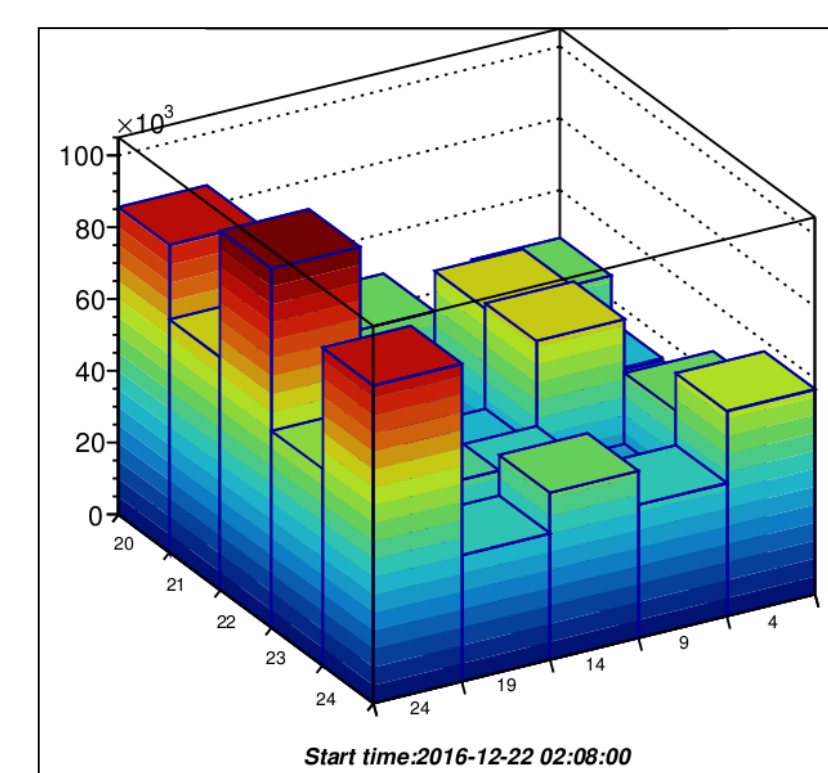
Stormy magnetosphere

- Variety of transport processes in the magnetosphere seen e.g. by POLAR
- Complex, dynamic changes observed even at low latitudes around 40°
- Large variety of events identified: rise time, duration, direction, magnitude
- Measurements linked with radiation dose increases at aircraft altitudes
- Enhancement by more than order of magnitude easily possible
- Similar correlations seen with ground-based neutron monitors
- Importance of synchronized studies:

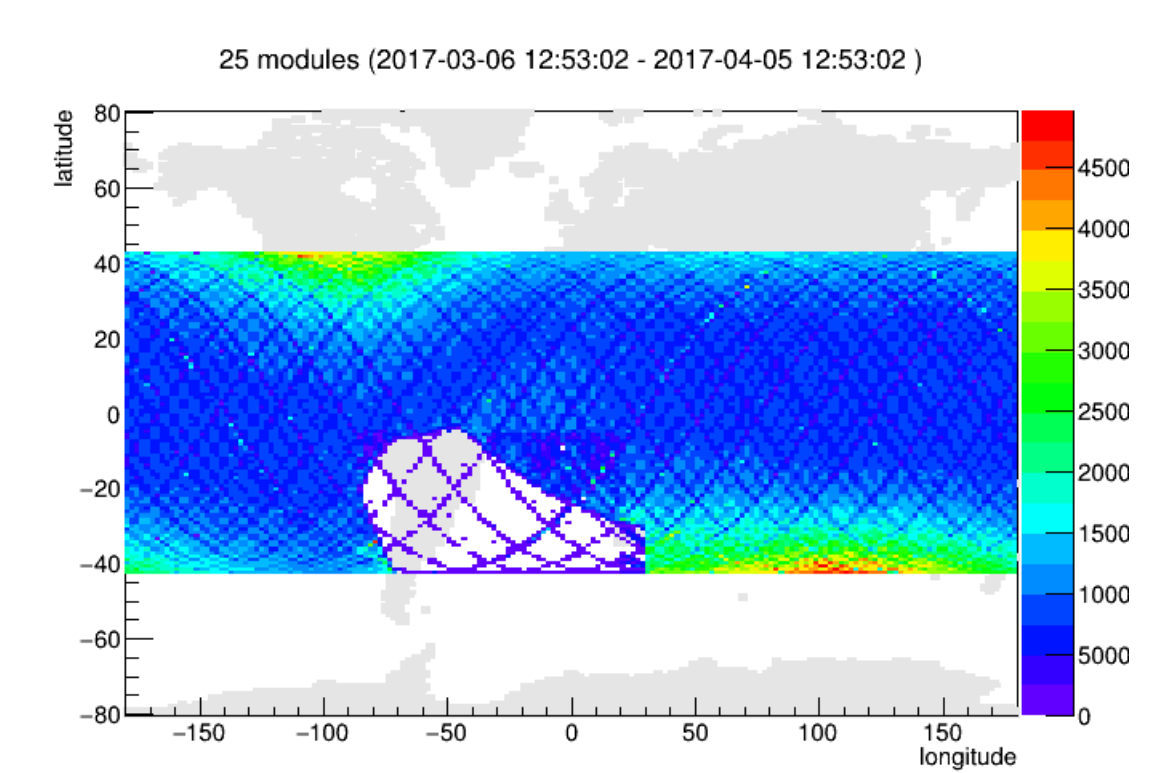
Sun, space, magnetosphere, atmosphere, ground

Observations

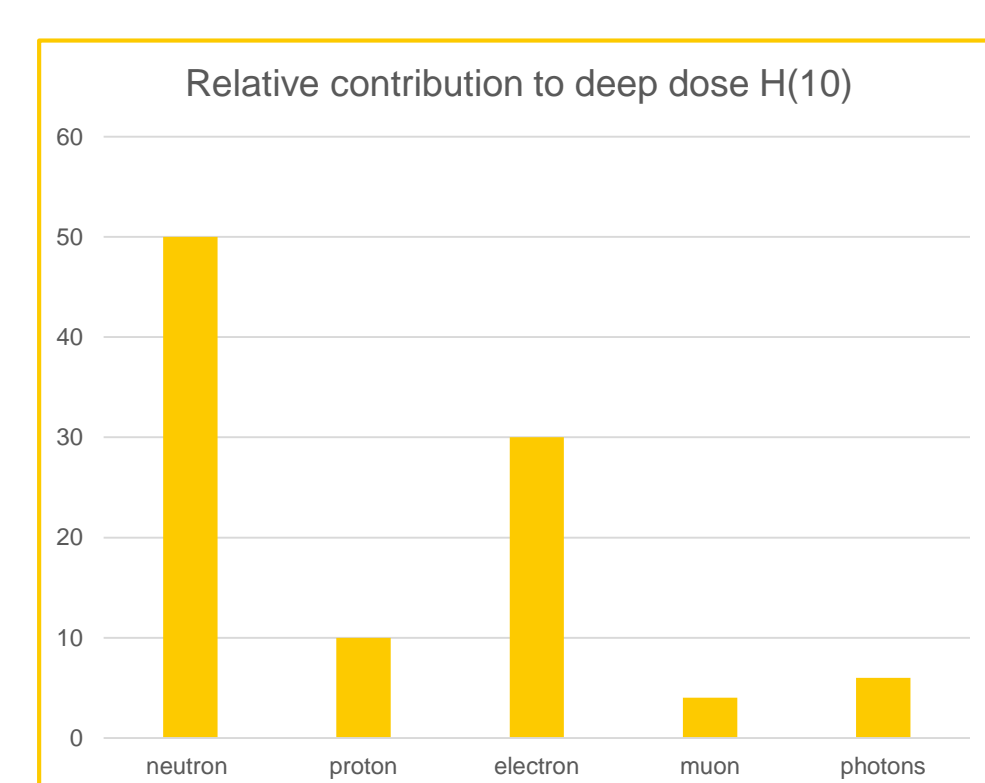
- About 12 correlated storms per month seen in 2016/2017
- Many more uncorrelated events observed (pure electrons?)
- Data attributed to relativistic electrons ($E_{thr} \sim 300-500$ keV)
- Most measurements at latitudes $\geq 35^\circ$, both north and south
- Particle fluxes exhibit high levels of directionality
- Large increases expected during solar maximum



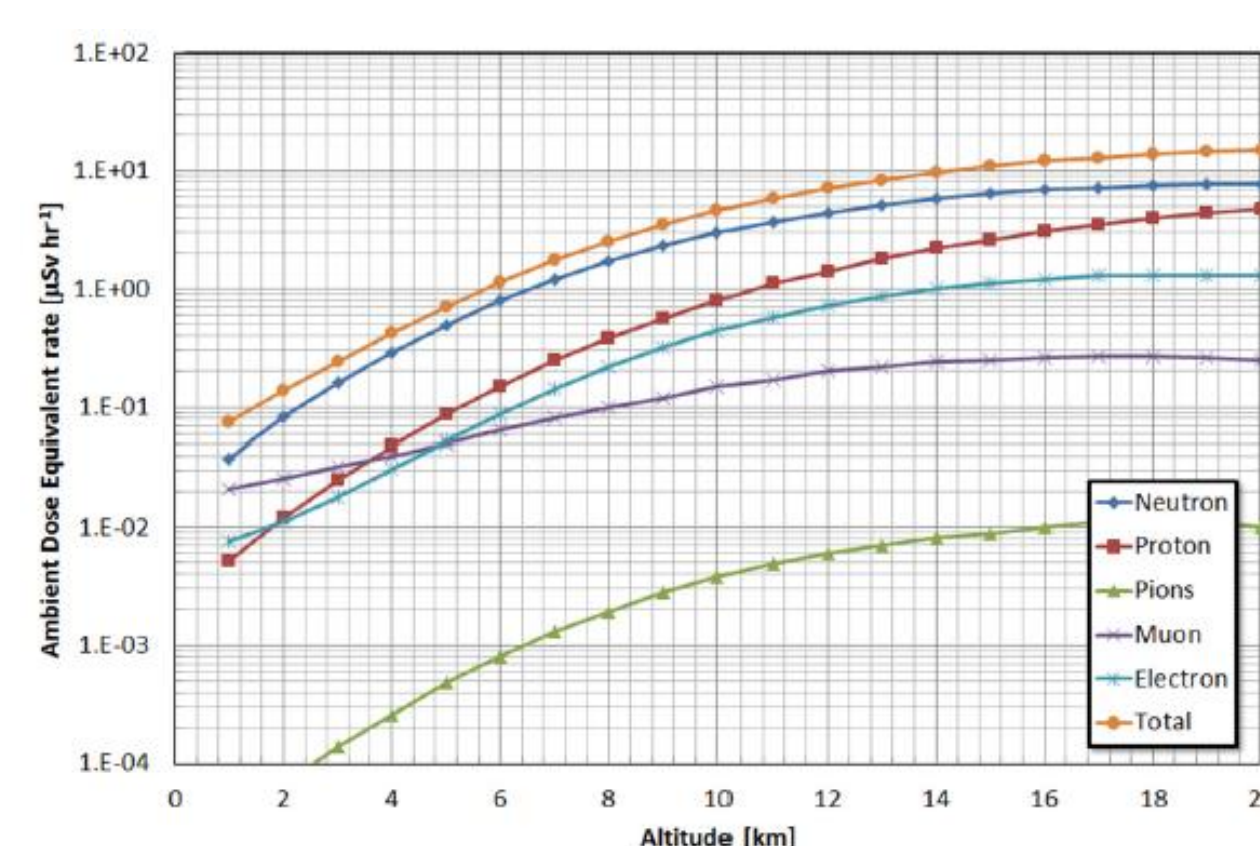
Rate distribution



Total rate map



Relative radiation types at penetrating depths



Model radiation levels in function of altitude

Radiation composition

- POLAR separates between charged and neutral only
- Radiation composition more complex: γ , μ , e^- , p^+ , n , H^1
- Low S/C orbits dominated by dynamic electrons
- Airspace levels dominated by energetic neutrons
- Only rare data on spatial and fast level correlations
- Temporary impact observed but measurements scarce

Instrument

- AMORE - novel airspace radiation environment monitor
- Energy measurement and particle identification
- Electron spectra threshold: 0.35+ MeV
- Proton spectra threshold: 9+ MeV
- Compact, low power design, autonomous operation
- Utilizing scintillators and ASIC DRS4 (PSI)
- Laboratory tests ongoing, flight tests under preparation

