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Galactic Cosmic Ray Modulation at Mars and beyond measured with EDACs on Mars Express and Rosetta

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Galactic Cosmic Rays (GCRs) are an intrinsic part of the heliospheric radiation environment, and an inevitable challenge to long-term space exploration. Here we show solar cycle induced GCR modulation at Mars in the period 2005-2020, along with GCR radial gradients, by utilising Mars Express and Rosetta engineering parameters compared to sunspot number time series. The engineering parameter used is called EDAC (Error Detection And Correction), a cumulative counter which is triggered by charged energetic particle causing memory errors in on-board computers. EDAC data provides a new way of gaining insight into the field of particle transport in the heliosphere, allowing us to circumvent the need for dedicated instrumentation as EDAC software is present on all spacecraft.

This data set can be used to capture variations of GCRs in both space and time, yielding the same qualitative information as ground-based neutron monitors. Our analysis of the Mars Express EDAC parameter reveals a strong solar cycle GCR modulation, yielding an anticorrelation coefficient of -0.5 at a time lag of ~5.5 months. By combining Mars Express with Rosetta data, we calculate a 5.3% increase in EDAC count rates per astronomical unit, attributed to a radial gradient in GCR fluxes in accordance with established literature.

The potential of engineering data for scientific purposes remains mostly unexplored. The results obtained from this work demonstrates, for the first time for heliophysics purposes, the usefulness of the EDAC engineering parameter, data mining and the utility of keeping missions operational for many years, providing complimentary data to nominal science instruments.