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## The Variable Nature of the Galactic and Solar Cosmic Radiation over the past 1000 years

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### Abstract content

The galactic and solar cosmic radiation in the inner solar system has left indelible records of their varying intensities over the past millennia in ice cores, tree rings, and meteoritic material. While this was previously well known, atmospheric, meteorological, and other factors have hindered the use of these data in quantitative studies of the cosmic radiation. This is no longer so due to two recent and independent developments. They are (1) the use of mathematical codes based on GEANT, modern signal processing, and global climate models to understand the rigidity responses, and reduce the geomagnetic and atmospheric interference with the cosmic ray signal; and (2) the use of the instrumental record 1933-2006, and our theoretical knowledge of the heliosphere and the cosmic ray modulation, as a “Rosetta Stone” to decipher the paleo-cosmic ray record.. Together, these have shown that the intensity of the <10GeV galactic cosmic radiation (GCR) has varied strongly over the last

10,000 years. The intensity of the GCR has been very low since 1954, while it was much higher as recently as 1895AD. The intensity in ~1450 AD was consistent with the local interstellar spectrum being incident on Earth (i.e., no modulation). Over the past decade it has been established that large solar energetic particle (SEP) events have left discernible records in the nitrate content, and more recently, the  $^{10}\text{Be}$  content of ice cores. Analyses of these data since 1572 reveal a counter-intuitive result- that large SEP events were more common at times of relatively weak solar cycles (e.g., circa 1895) compared to the present epoch. The solar magnetic flux is estimated to have been 50% of its present-day value in ~1895AD , suggesting that the Alfvén velocity in the corona was half its present day value, resulting in more efficient acceleration of solar energetic particles. Solar and geomagnetic studies suggest that there will be a “Gleissberg Minimum” (i.e., several decades of lower solar activity) in the near future and it is predicted that then (1) the GCR intensities will be threefold higher at 1GeV and (2) the frequency of occurrence of large SEP events will increase six-fold.

**If this papers is presented for a collaboration, please specify the collaboration**

**Summary**

**Reference**

**Primary author(s) :** Prof. MCCRACKEN, Kenneth G. (IPST, University of Maryland)

**Presenter(s) :** Prof. MCCRACKEN, Kenneth G. (IPST, University of Maryland)

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