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Torsional oscillations seen in the record of cosmogenic isotopes?

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The sunspot record since 1610 shows irregular 11-year cycles of activity; they are modulated on longer timescales and were interrupted by the Maunder minimum in the 17th century. Fortunately, alternative solar activity proxies can be reconstructed from cosmogenic radionuclides expanding the history of solar activity for many thousands of years. There are many open questions in solar magnetism. One of them is what determines the length of the solar cycle. Another unanswered question is the presence of many other periodicities, which are clearly manifest in the long time series of cosmogenic radionuclides: (1) The existence of many Grand Minima, periods of extended ($\sim$100 y) low activity similar to the Maunder Minimum. (2) The tendency of Grand Minima to occur in clusters separated at $\sim$ 2200 y intervals. (3) Fourier analysis identifies a number of significant periodicities, namely around 2200 y (Hallstatt), 980 y (Eddy), 500 y, 350y , 208 y (de Vries), 150 y, 130 y, 104 y and 88 y (Gleissberg). In the past many workers have investigated the existence of torsional oscillations in the Sun (e.g. Wal ´en (1949); Cowling (1941); Plumpton & Ferraro (1955); Layzer, Krook & Menzel (1955); Davila & Chitre (1996)). In the work of Wal ´en (1949), Layzer, Krook & Menzel (1955)), the estimated fundamental oscillation happened to be of the order of 100 to 1000 years. Here we put forward the idea that the observed periodicities in cosmogenic isotopes could be a manifestation of solar free torsional oscillations of a large scale poloidal magnetic field.