



Contribution ID: 11

Type: Oral Presentation

Solar Total Irradiance Behaviour during Cycle 23-24

Friday, 8 July 2016 11:50 (20 minutes)

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Solar total (integrated over all wavelengths) irradiance measurements by the VIRGO experiment on the SOHO satellite have been analysed during cycle 23-24, covering the period 1996 till 2014. The most recent minimum of solar activity was deeper and longer than any previous period as evidenced by various indicators of solar activity (e.g. sunspots, geomagnetic indices) as well as total solar irradiance (TSI). Solar activity levels during solar maximum are considerably different from those during the declining or minimum phases of a solar cycle. Daily mean TSI measurements are used to identify how several harmonics of the 27-day recurrent period change during cycle 23-24, applying a 95% confidence level. Spectral analysis using Lomb-Scargle and Morlet wavelet techniques of TSI data showed that during the solar maximum of cycle 23 the 27-day recurrence period is dominating, while during the anomalously low minimum of cycle 23-24 the 13.5 and 9.0-day periods corresponding to the 2nd and 3rd harmonics of the synodic solar rotation period, are prominent above the 95% confidence level. An investigation of the power spectra showed that the spectra fit a power law with different scaling exponents at solar maximum (2001) and solar minimum (2008), highlighting the self-affine properties of the TSI time series. It will also be shown, using Pearson correlations, that the detection of different recurrence intervals can be traced to an unusual combination of the sectorial spherical harmonic structure in the solar magnetic field and the tilting of the solar dipole field. It is therefore reasonable to conclude that the recent minimum 23-24 was characterised by the solar dynamo obtaining a state of unusual asymmetry.

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Session Classification: Space Science

Track Classification: Track D2 - Space Science