It is true that from the highest point of view the Sun is only one of a multitude – a single star among millions-thousands of which, most likely, exceed him in brightness, magnitude and power.

He is only a private in the host of heaven. But he alone, among the countless of myriads, is near enough to affect terrestrial affairs in any sensible degree; and his influence upon them is such that it is hard to find the word to name it.

It is more than mere control and dominance

-Charles A. Young, 1896
Rotational modulation on total solar irradiance

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Solar Rotation Measurement

**Tracer Tracking Method** – Sunspot, plages, filaments, coronal holes, faculae etc.

**Spectroscopic Method** – Doppler Shifts of selected solar spectral lines near the solar limb.

**Flux Modulation Method** – Intensity variation of disk integrated flux and images (radio and x-ray). Now TSI
Motivation for this work

• Established clearly the utility of flux modulation method

• Variability of coronal rotation, Hale period, Altitude gradient

• Differential rotation as a function Latitude; Radio and X-Ray

• North-South asymmetry

• Asymmetry changes sign with solar activity cycle

• Here we discuss the rotational modulation on Total Solar Irradiance and compare these with other observations and analysis using the same procedure
Space time plot of Sidereal rotation period from radio images at 17 GHz. This shows that northern hemisphere rotates slower than southern.
Space time plot of Sidereal rotation period from X-ray images of Yohkoh. This shows that northern hemisphere rotates slower than southern.
Space time plot of Sidereal rotation period from X-ray images of Yohkoh. This shows that southern hemisphere rotates slower than northern.

Asymmetry sign change; southern hemisphere slow rotator in cycle 22 and faster rotator in cycle 23.
Radio flux at 2.8 GHz 2003 - 2010

Day of the year

- Disk Integrated Solar Radio Flux
- Penticton Flux at 2.8 GHz (10.7 cm)
- 1947 - present
Radio flux at 2.8 GHz 2003 - 2010

Autocorrelation Coefficient

Lag (in days)

\[ S_{ip} = \frac{S_{yp} \times 365.25}{S_{yp} + 365.25} \]

\[ P_x(l) = P_x(-l) = \frac{\sum_{k=0}^{n-1} (x_k - \bar{x})(x_{k+1} - \bar{x})}{\sum_{k=0}^{n-1} (x_k - \bar{x})^2} \]
The Solar Radiation and Climate Experiment (SORCE)

http://lasp.colorado.edu/sorce/tsi_data/daily/
Autocorrelation Coefficient

\[ S_{ip} = \frac{S_{yp} \times 365.25}{S_{yp} + 365.25} \]

\[ P_x(l) = P_x(-l) = \frac{\sum_{k=0}^{n-l-1} (x_k - \bar{x})(x_{k+1} - \bar{x})}{\sum_{k=0}^{n-1} (x_k - \bar{x})^2} \]
Modulation varies from 9 – 42 %
Si. Rot. Period varies from 22.5 to 30.5 days
Mean ~ 25.3 days
Sidereal Rotation period (days)

Year


2.8 GHz

X-ray

17 GHz

IMF

SORCE

Average 24.8 days

SORCE  25.3
IMF     25
X-ray   24.9
2.8 GHz 24.7
17 GHz  24.3
Summary

1. Total solar irradiance has rotational modulation

2. During 2003 – 2011; TSI Modulation varies from 9 – 42 %

3. Sidereal Rotation period varies from 22.5 to 30.5 days

4. Mean S R P ~ 25.3 days

5. This represents photospheric rotation

6. Comparison S R P decreases with height

7. Temporal variability of S R P may be responsible due to differential rotation of the features in the different regions of solar atmosphere
Thank you very much

