Solar Activity

Putting things together:

More detail on observations - Quick review of line spectra for perspective, i.e., what are we actually observing.

Review of important concepts from the solar activity section.

Onward to:
Magnetohydrodynamics - The fluid treatment for plasmas, describing the average motion of charged particles under the influence of electric and magnetic fields (and some other forces like gravity).
Solar Activity

Observing Spectra

Gamma Rays, X-Rays and Ultraviolet Light blocked by the upper atmosphere (best observed from space).

Visible Light observable from Earth, with some atmospheric distortion.

Most of the Infrared spectrum absorbed by atmospheric gases (best observed from space).

Radio Waves observable from Earth.

Long-wavelength Radio Waves blocked.

Courtesy of NASA-IPAC
Lines come from electrons moving from/to excited states, where

\[ E = \frac{hc}{\lambda} = h\nu \]
Solar Activity

Observing Spectra Hydrogen’s ‘fingerprint’

Courtesy of UTK
Solar Activity

Observing Spectra - line splitting from the Zeeman effect

Strong B-field splits spectral lines according to strength
Review: Differential Rotation

Solar Rotation Rates:
- Polar regions = 36 days
- 60 Degrees = 31 days
- Equatorial Regions = 26 days

Courtesy of NASA
Because of this, the topology of sunspot magnetic fields is:
1. They come in pairs
2. Start and mid-latitudes and move equator-ward during solar cycle
3. Opposite field direction for leading spot in N-S hemisphere
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Review: Differential Rotation - Solar Activity

After a reversal, the wrapping of the field begins again, with time:
1. More and more sunspots are visible, and at lower and lower latitudes.
2. Frequency of CMEs increases closer to solar maximum (1/week to 3/day).
3. Increase in X-rays emitted closer to solar maximum.
Magnetohydrodynamics

The fluid treatment for plasmas, describing the average motion of charged particles under the influence of electric and magnetic fields (and some other forces like gravity).

Moving from the cartoon to physics…