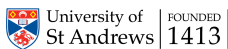


Variation of the solar magnetic flux distribution over the solar cycle using HMI data.

Callan Noble, T. Neukirch, C. E. Parnell

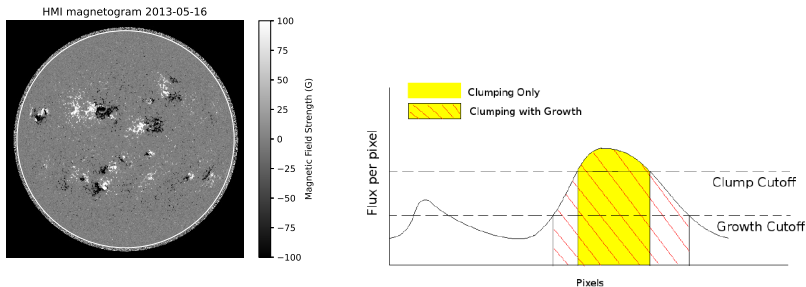
University of St Andrews

16th European Solar Physics Meeting, Sept 2021



- We want to investigate how the distribution of photospheric magnetic flux varies over the course of a full solar cycle.
- Hopefully gain insight into the mechanism behind the generation of the Sun's magnetic field.
- Look at long-term variation to see how the processes change over the solar cycle.

- To do this we use full disk magnetograms from SDO's HMI instrument.
- Analyse magnetograms from midnight on the 1st and 16th of each month from May 2010 – March 2021
- Use "Clumping" algorithm to detect "magnetic features"¹



¹Parnell, "Nature of the magnetic carpet-I. Distribution of magnetic fluxes".

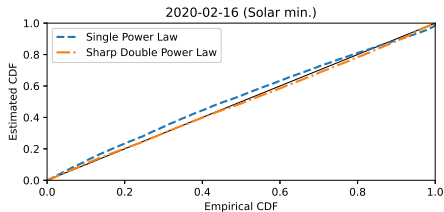
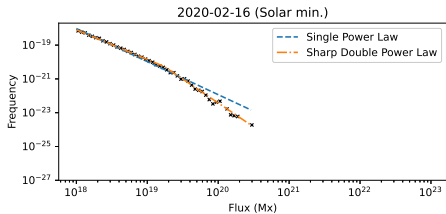
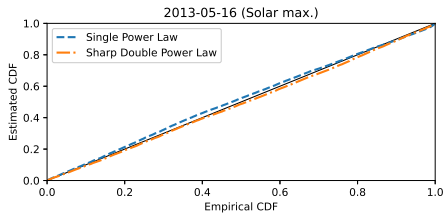
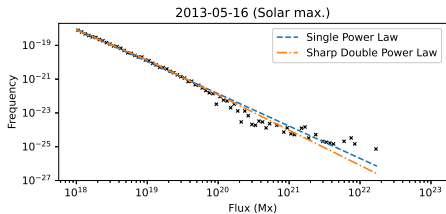
- Look at the frequency of the magnetic features against magnetic flux
- Select most probable model using PP-Plots and Kolmogorov-Smirnov Statistic
- Single Power Law

$$f(x) = \frac{\alpha - 1}{x_0} \left(\frac{x}{x_0} \right)^{-\alpha}, \quad x_0 \leq x$$

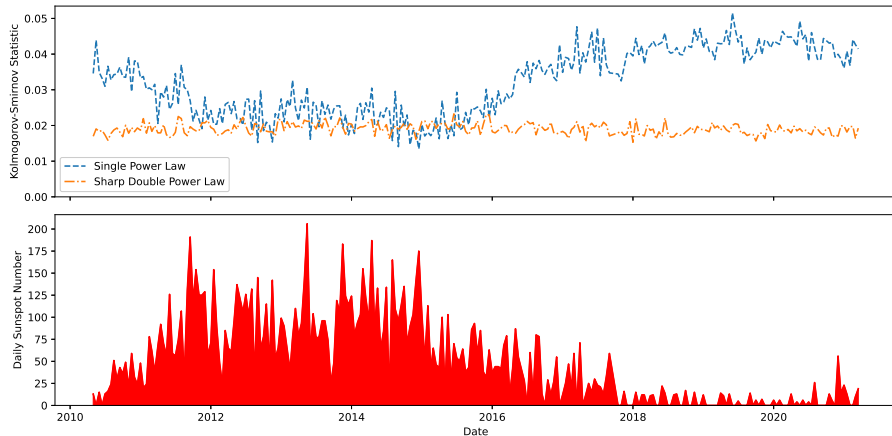
- Sharp Double Power Law

$$f(x) = \frac{(1 + \alpha)(1 + \beta)}{x_c \left(\beta - \alpha - (1 + \beta) \left(\frac{x_0}{x_c} \right)^{1+\alpha} \right)} \begin{cases} \left(\frac{x}{x_c} \right)^\alpha, & x_0 \leq x \leq x_c \\ \left(\frac{x}{x_c} \right)^\beta, & x > x_c \end{cases}$$

Results



● KS Stat over solar cycle



- Single power law is suggestive of one generative mechanism creating magnetic features at all scales
- Double power law is bi-modal → suggestive of two separate mechanisms
- The double power closely resembles single power law at solar maximum → may suggest there is actually only one mechanism

- Unfortunately it is still difficult to say what is actually going on

- How do the power law indices change over time?

