Types of Variability

I. Intrinsic Variability

Star variable "by itself" → variability caused by physical changes of star

- **pulsation variable ✔**
- **Eruptive ✔**
- **Rotationally induced variables**

II. Extrinsic variability

Star not variable by “itself”→ variability generated by external influences

- **Binary stars ↔ eclipsing variables**
- **Accretion disks ↔ like T Tauri**
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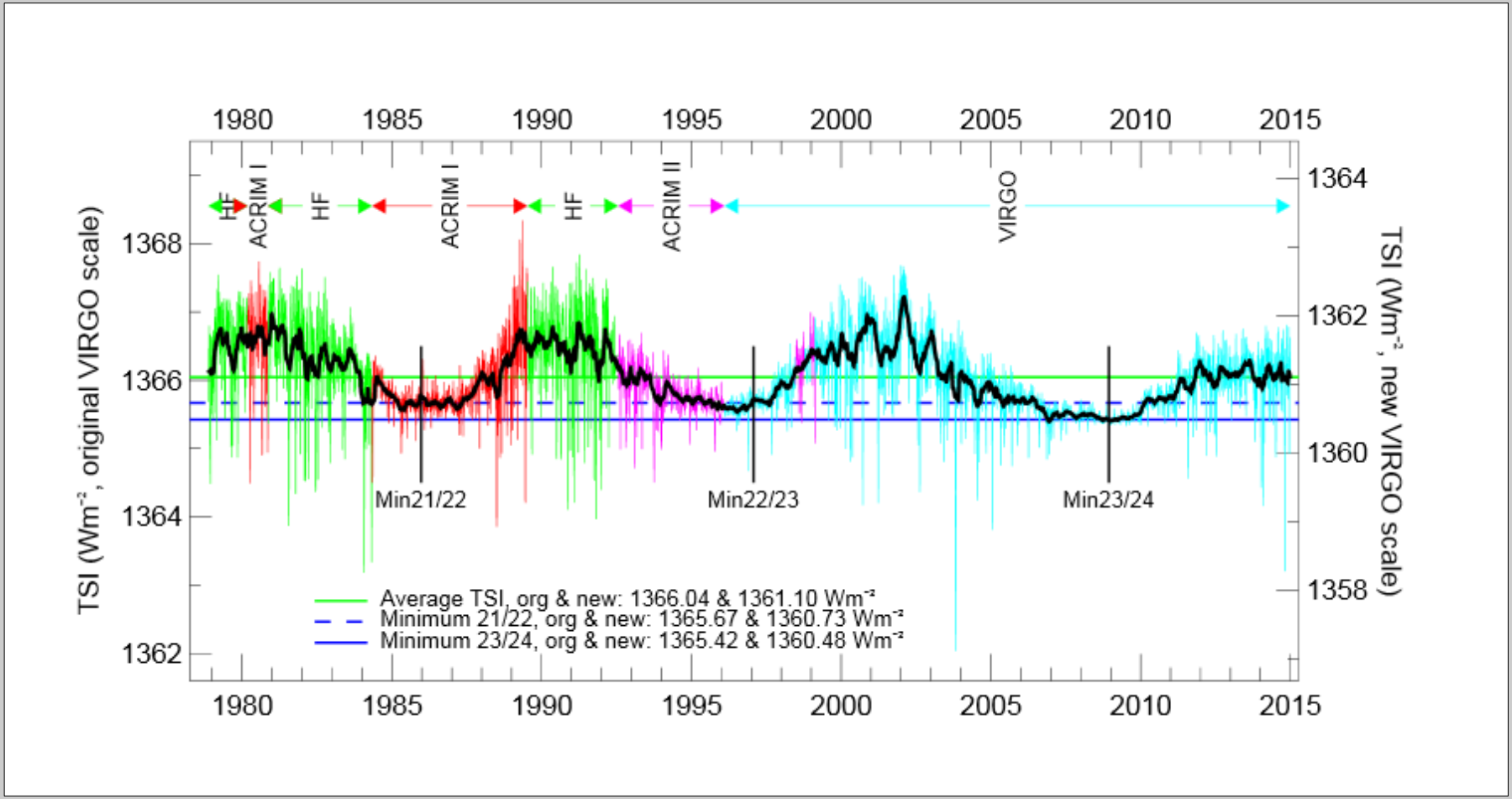
Star

Spots

The light curve of the sun



Total Solar Irradiance (TSI)

Power of the total solar electromagnetic radiation per unit area.

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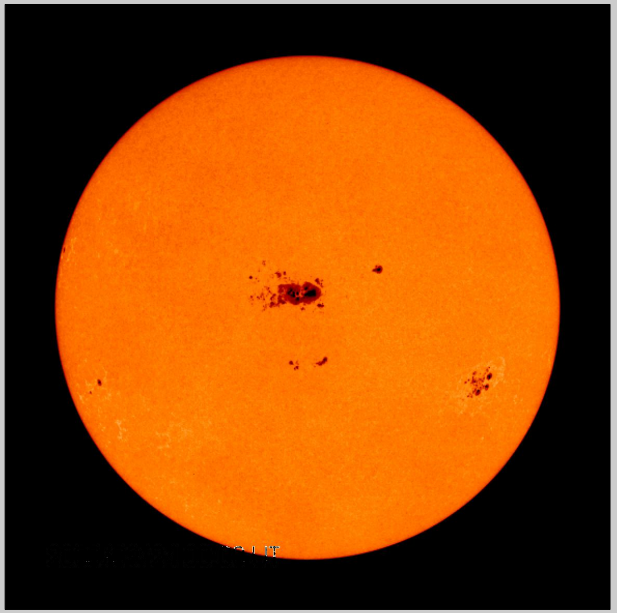
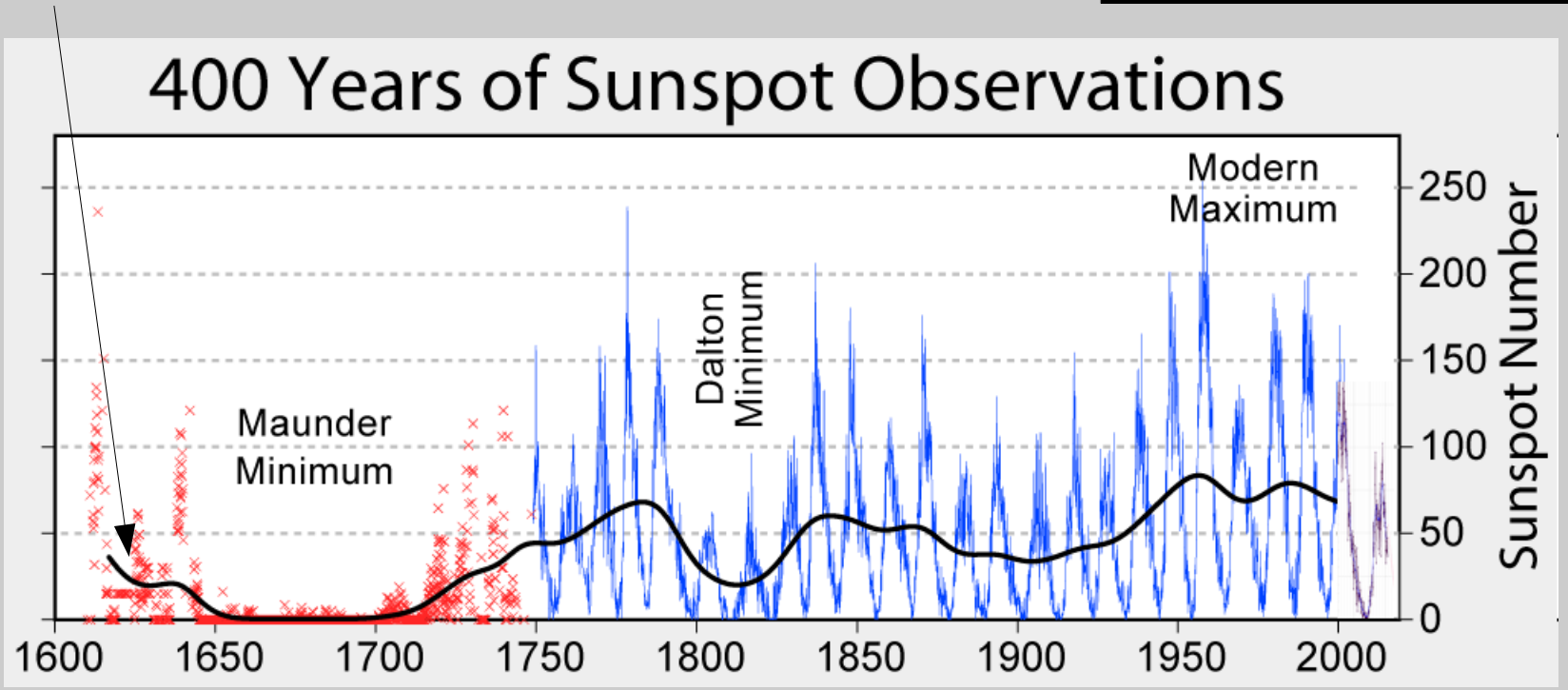
Example sun spots

Observation

- Number and size of spots varies
- Spots come and go
- Rotation of the star/sun determines variation time

individual spots rotation time = 27.28 days
additional accumulation of spots within the solar cycle = 11 years





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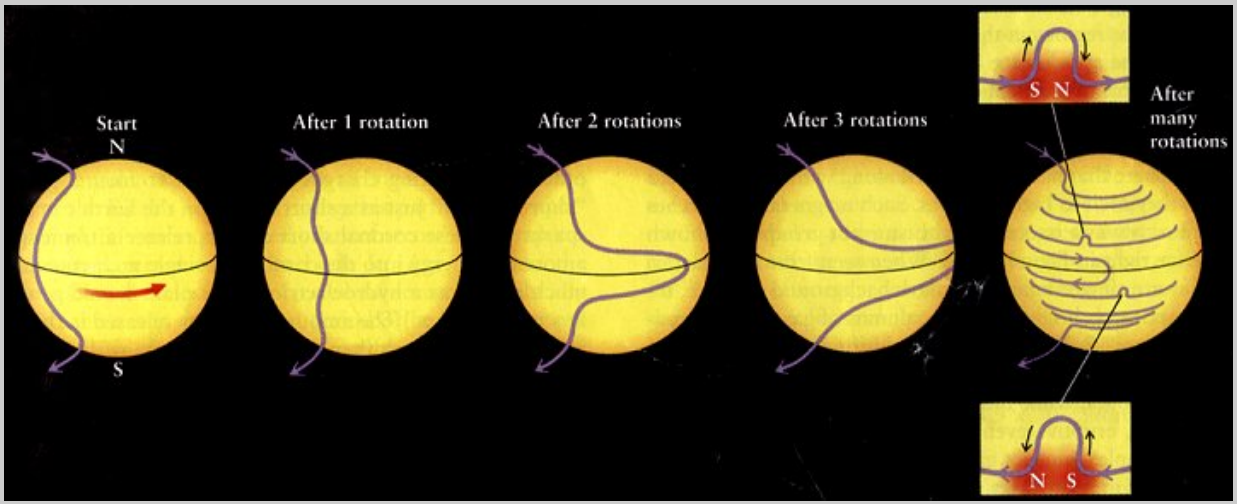
sun & sunspots - stars & star spots

some stars – like the sun have **spots** ↔ these are regions of **lower temperature**, with $L=4\pi\sigma r^2T^4$ → **lower brightness**

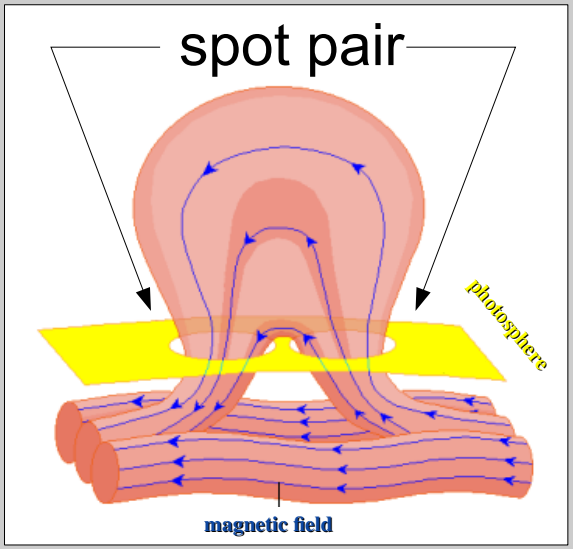
necessary are **a magnetic field, convective surface** and **rotation**

Rotation

→ the orbital period is **faster** at the **equator** than at the **pole**



→ distorted magnetic field
→ changes energy transport
→ changes temperature
→ changes brightness



- Spots come in pairs ↔ magnetic field lines
- The number and size of spots varies
  ↔ magnetic field & rotatio
- Spots come and go ↔ rotation

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From spots to Flares

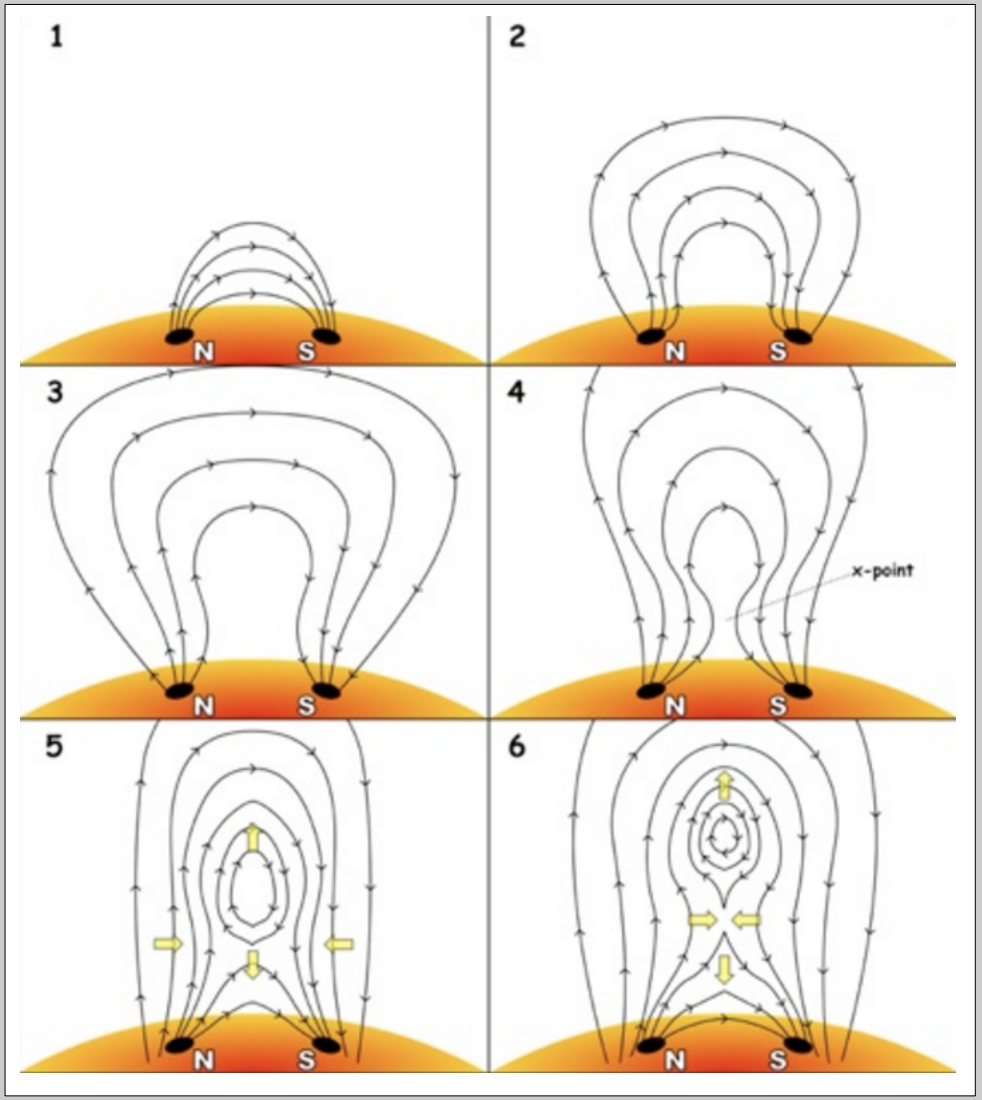
1 field lines in the spots
2-5 field lines can grow
6 forms larger narrow loops

→ acceleration
→ detachment / recombination
→ plasma along magnetic field
is carried away and transported
into the corona.

this leads to irregular variability

flares or

Coronal **M**ass **E**jection **CME**



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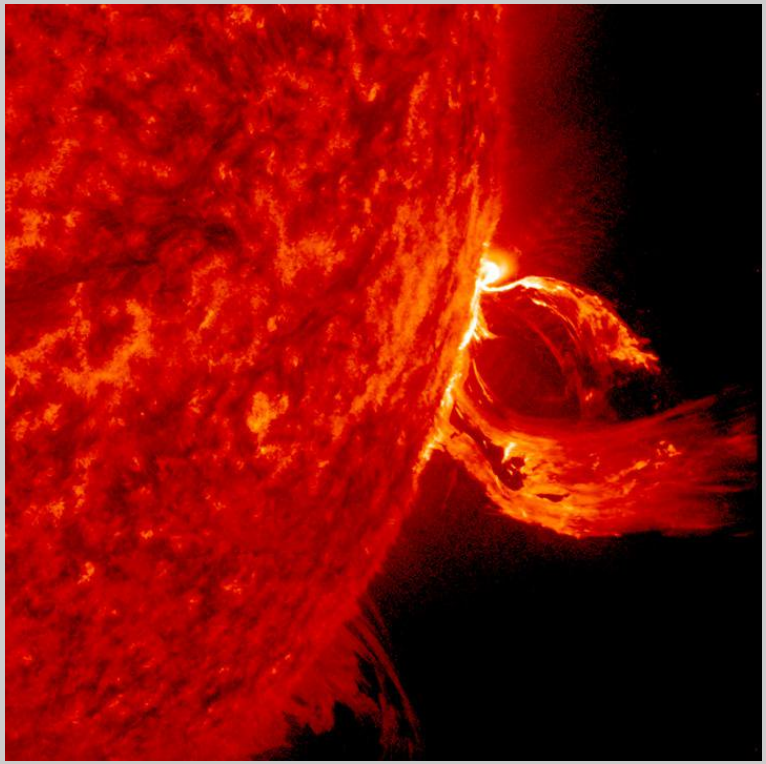
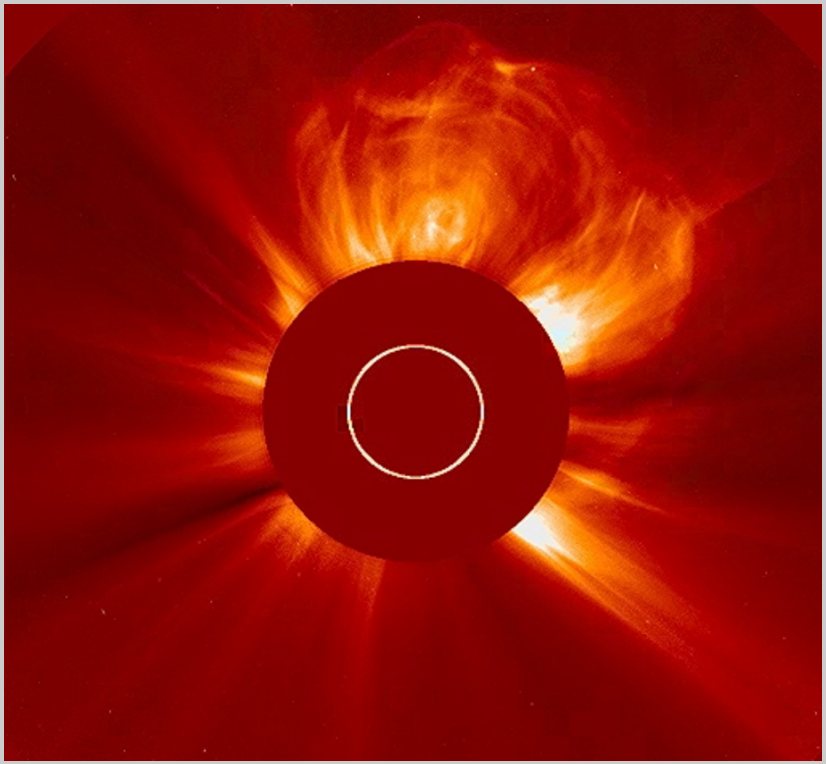
Coronal Mass Ejections





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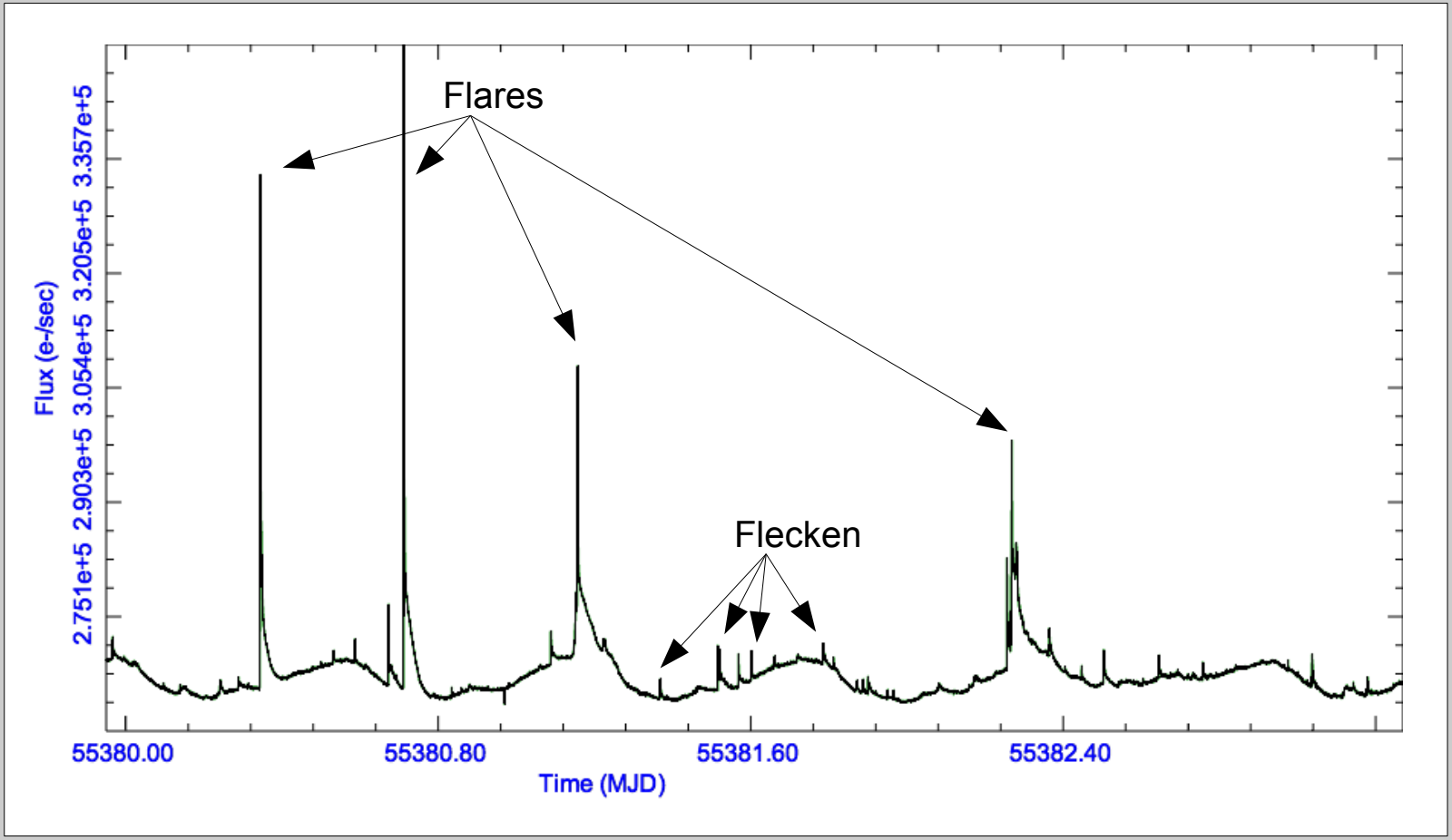
Spots and Flares

Light curve of GJ 1243 (M star)



Besides the sun there are other stars that have spots and flares

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