TIME-DOMAIN ASTRONOMY

Science Case 5: Stellar Flares

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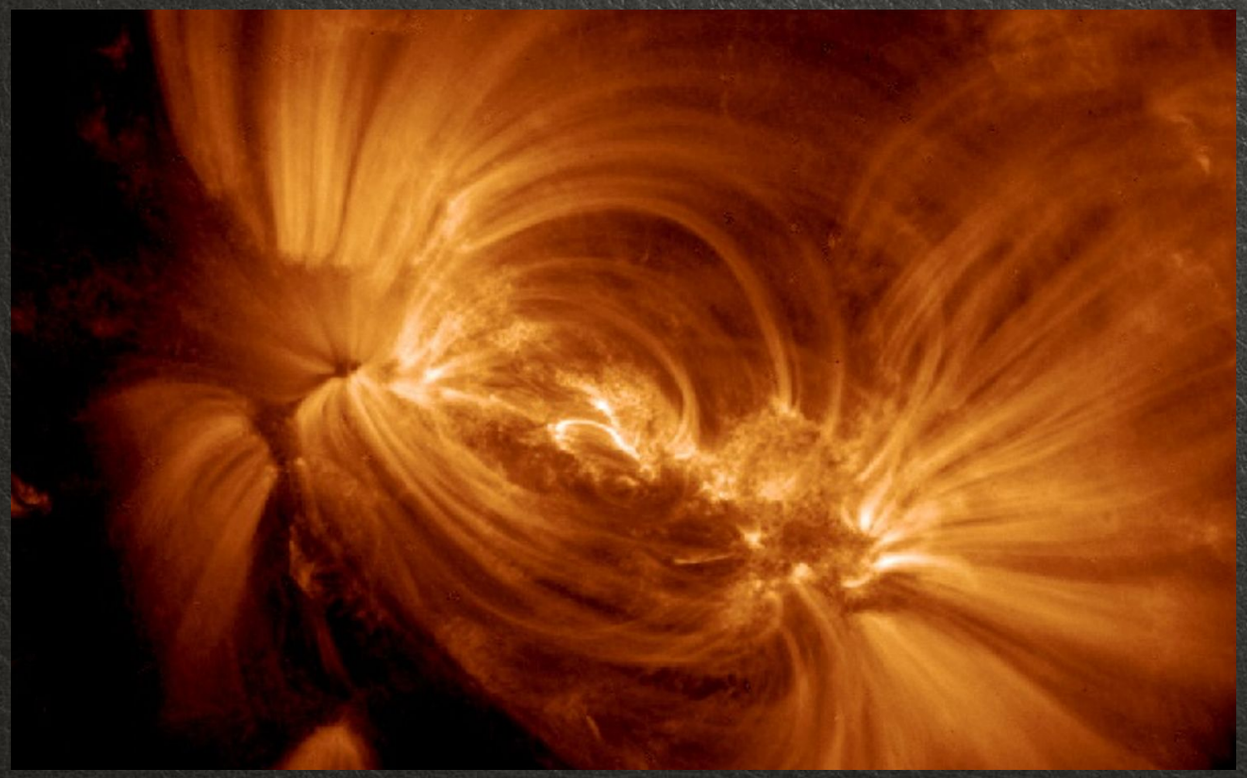
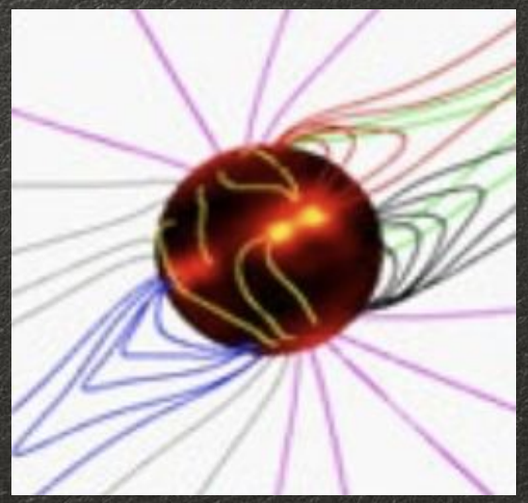
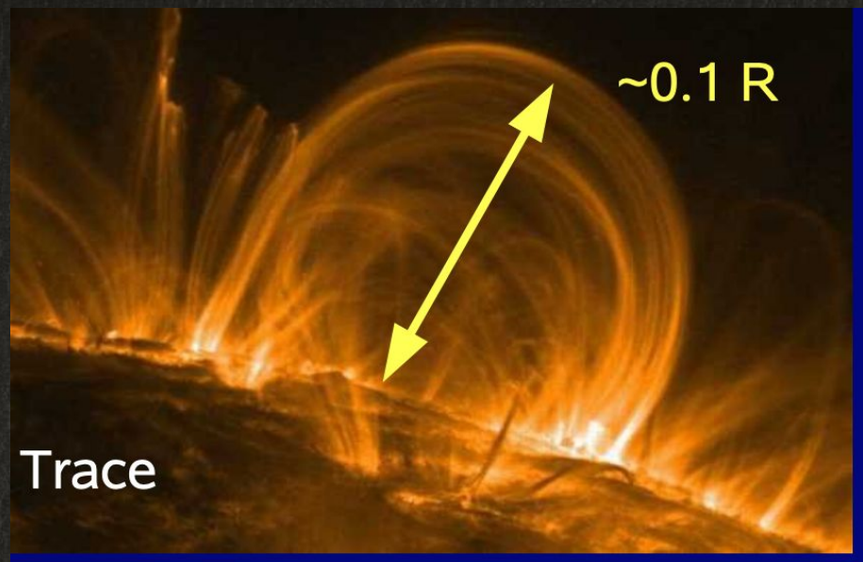
Stellar Flares

- Many late-type stars are known to frequently produce flares.
- These phenomena are thought to be generated in the stellar corona.

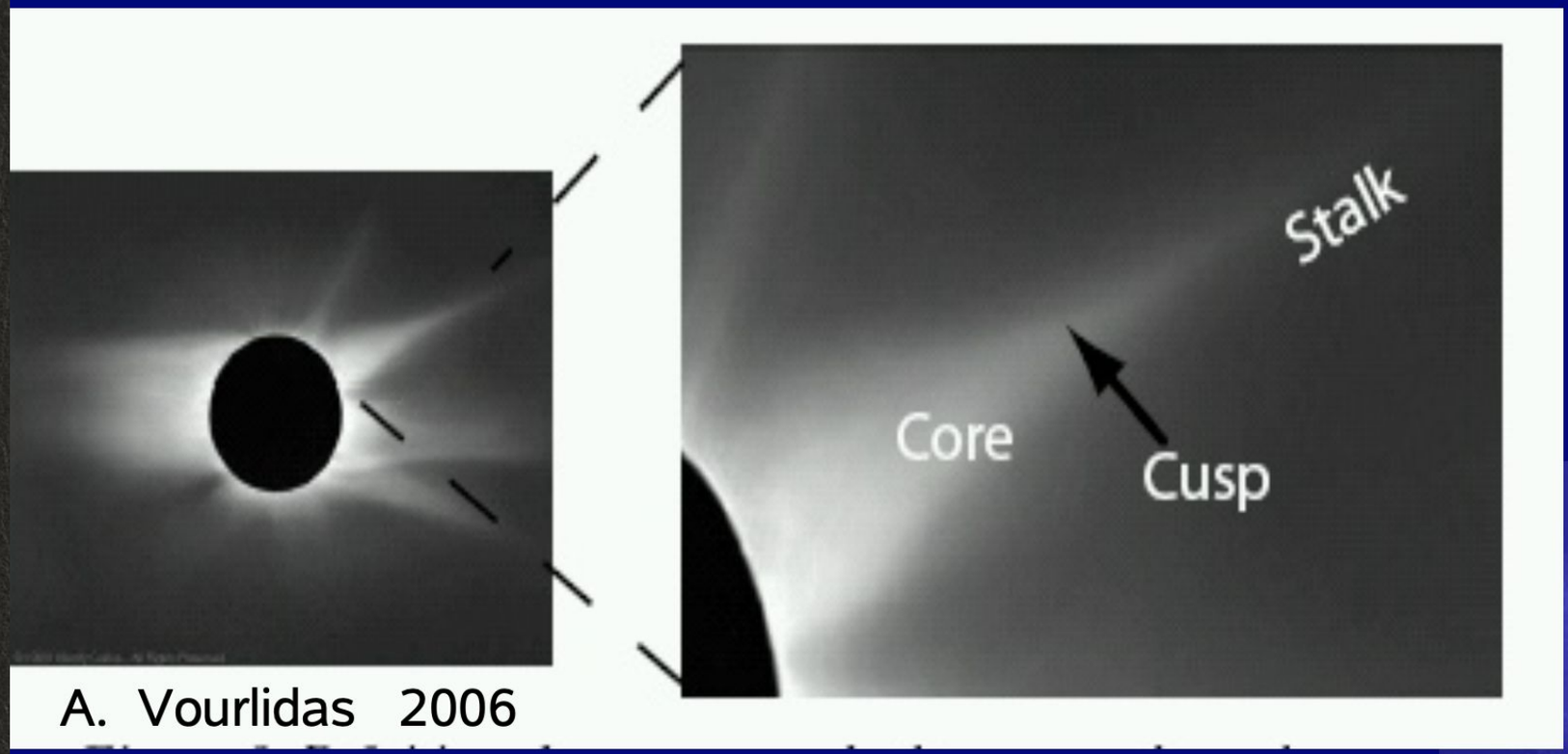






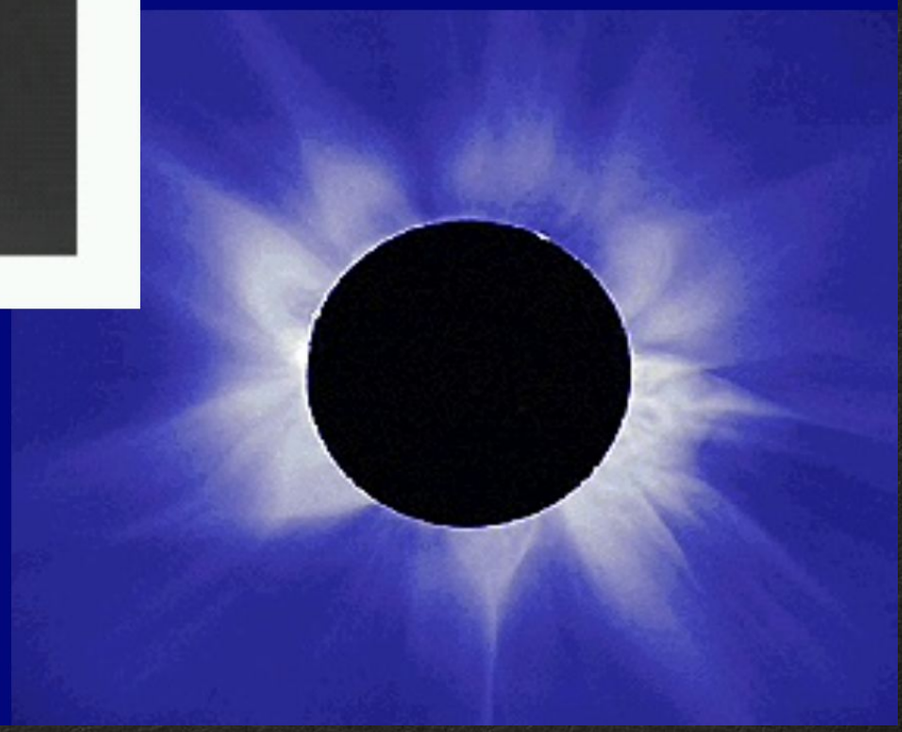
closed arc-like magnetic structures with size smaller than a solar radius

At large scale one observes much larger structures:
The helmet streamers: transition from closed to open field regions.



A. Vourlidas 2006

LASCO coronagraphs show structures to 30 solar radii



Dynamical Corona

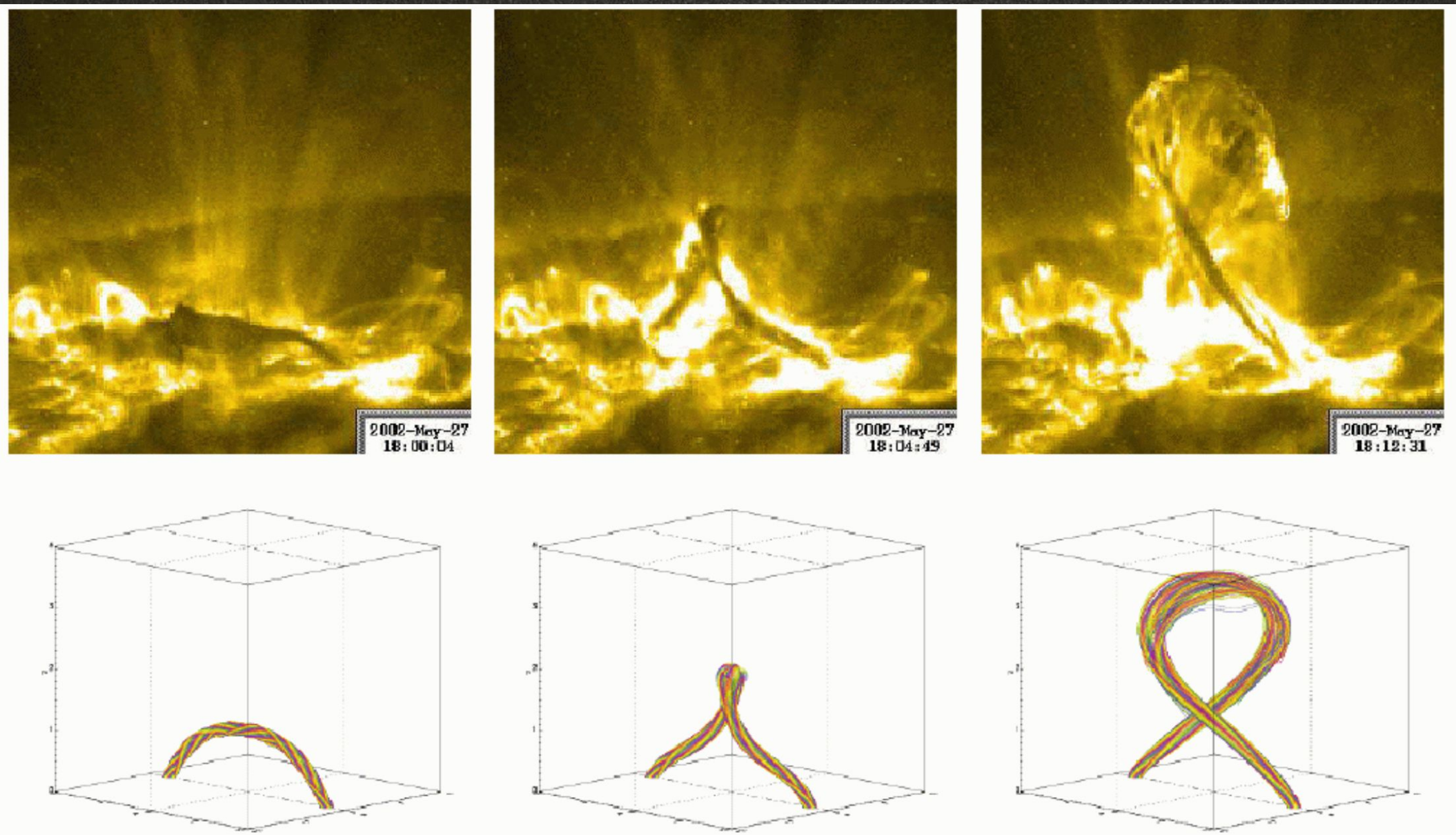
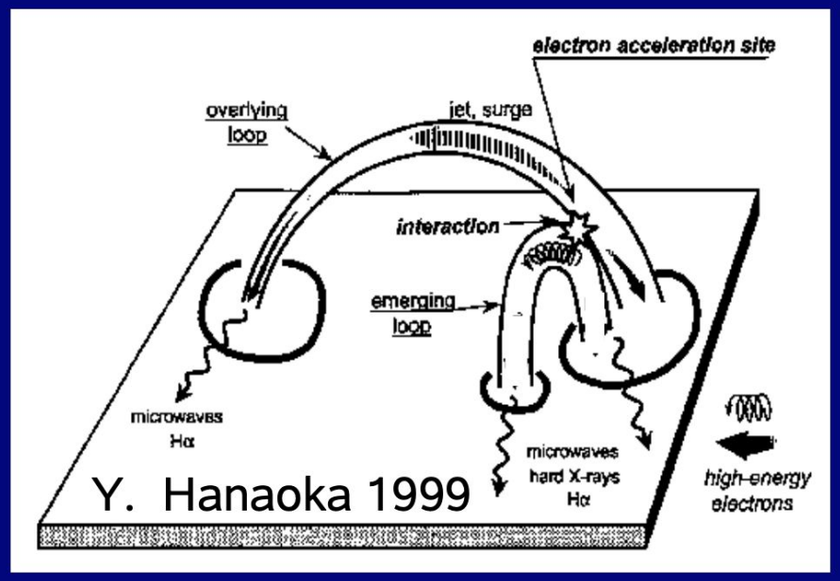
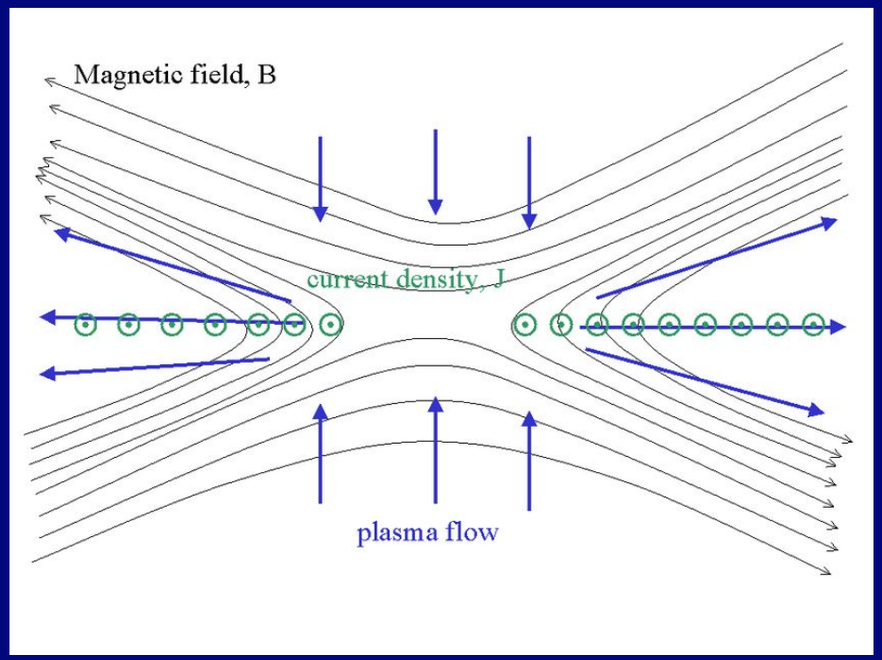


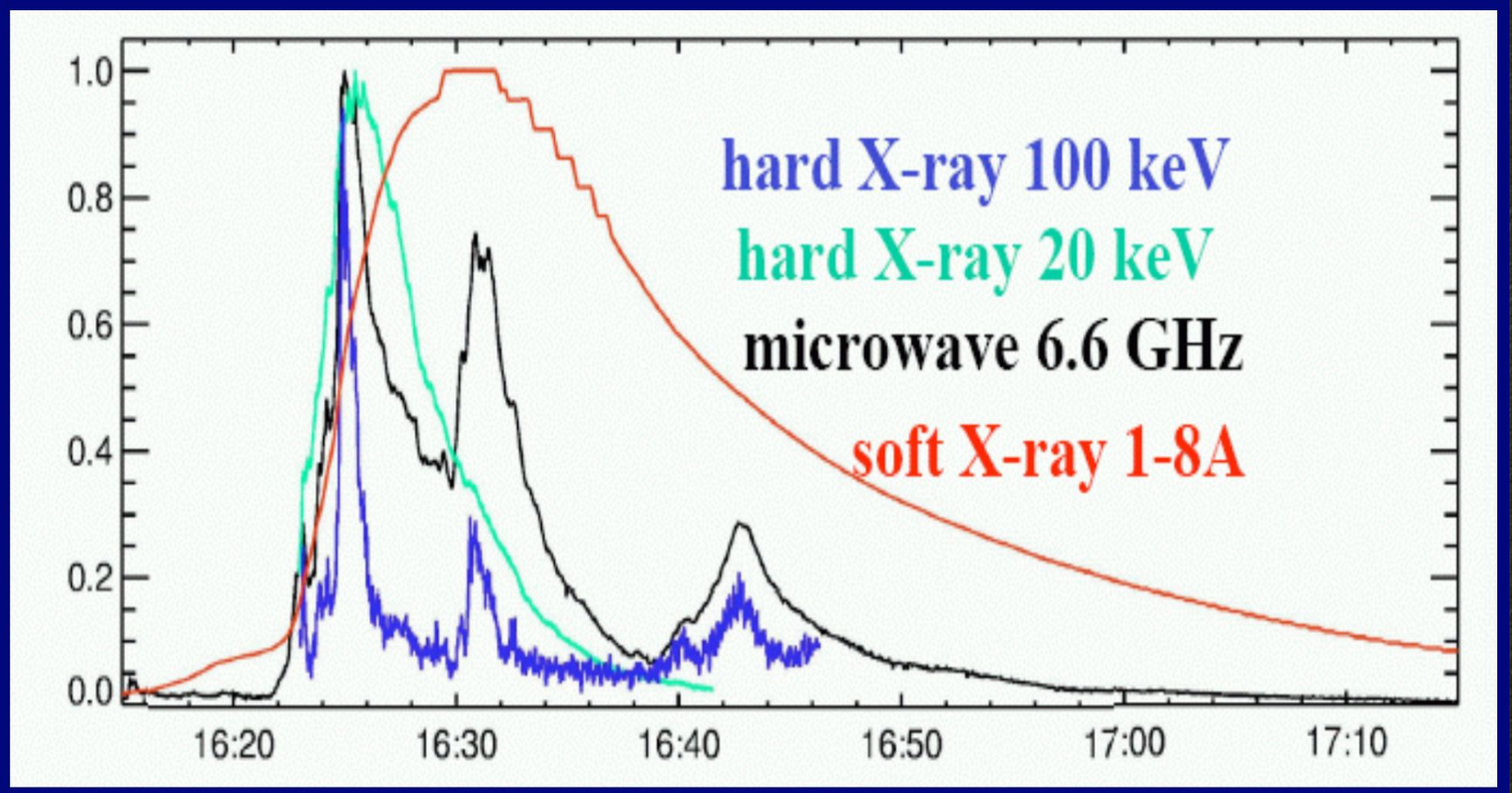
Figure 9. **Top:** TRACE 195 Å images of the confined filament eruption on 2002 May 27. The right image shows the filament after it has reached its maximum height. **Bottom:** magnetic field lines outlining the kink-unstable flux rope reproduced with 3D MHD simulations (Török & Kliem 2004).

Magnetic Reconnection





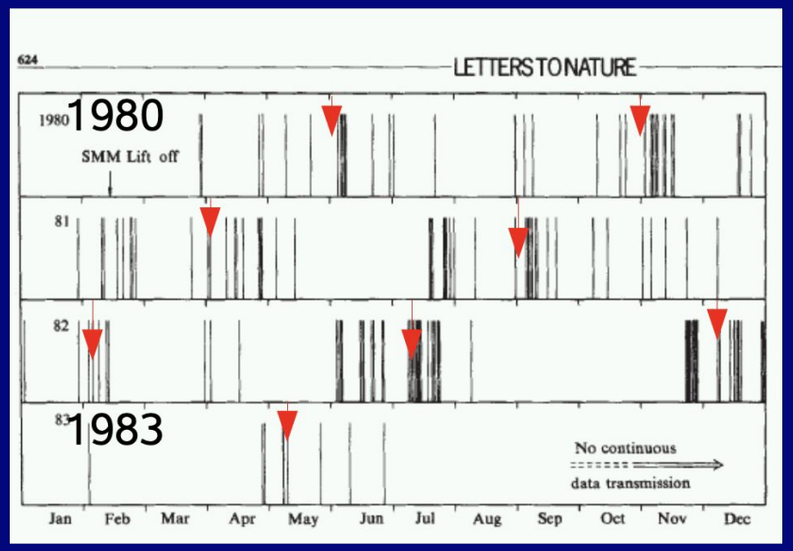
FLARE



Are flare “periodic”?

„ A 154-day periodicity in the occurrence of hard flares ?“

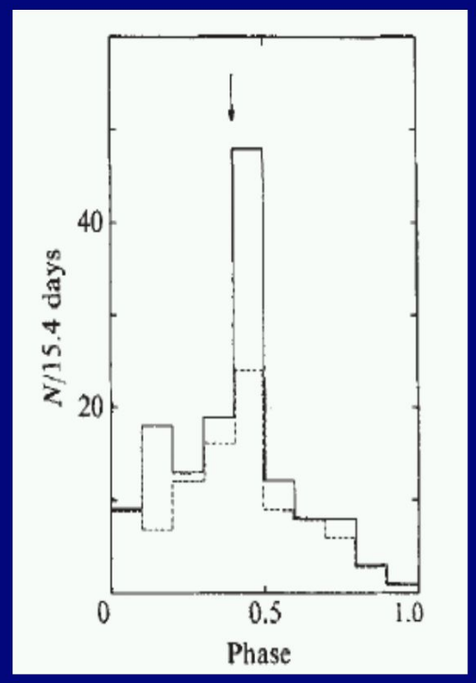
Rieger et al. Nature 1984



„ We also note that the flares tend to occur in groups which are spaced by about 5 months“

Folding of flare-event times with a period of 154 days and a bin size of ~ 15 days ----------> PHASE HISTOGRAM

The periodicity involves 35% of all flares observed



Are flare “periodic”?

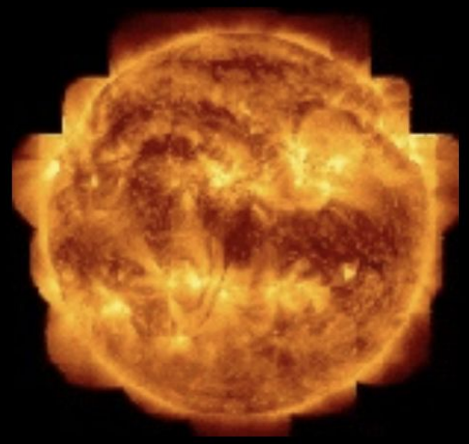
- Our Sun shows that:

  1. Sunspot groups are periodically formed every time in different regions.
  2. Sunspots groups are periodically formed within already existing sunspot groups.

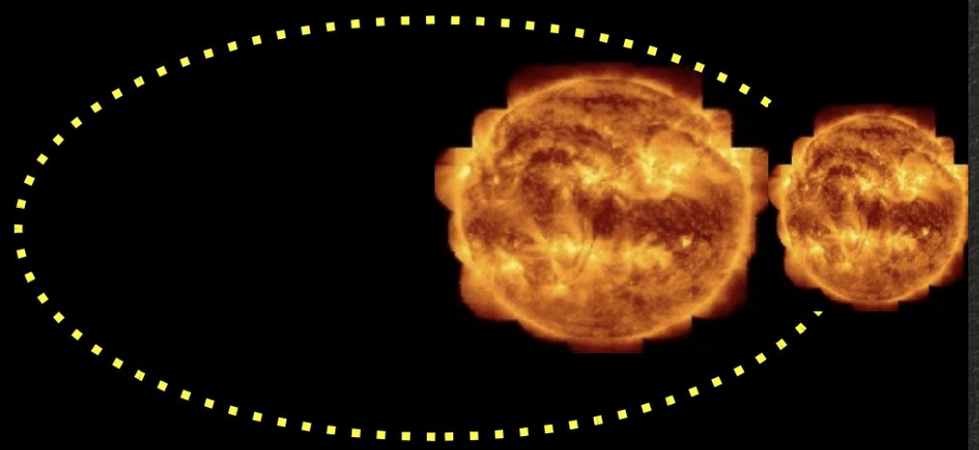
- Being in close binaries might be also play a role.

Flaring periodicities

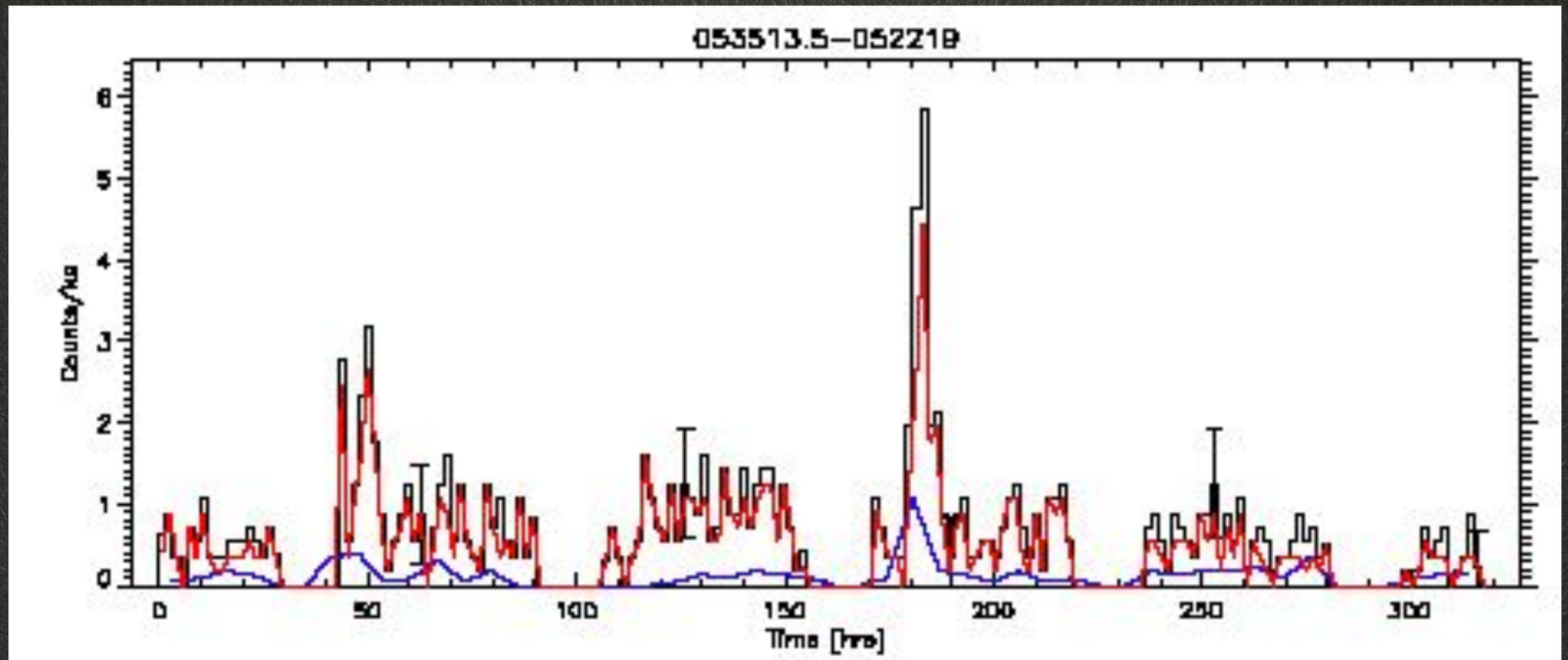
Rieger-type periodicities: not only a solar phenomenon



Inter-binary collisions (binary systems)



Notebook: Stellar Flares



REFERENCES AND DEEPENING

Kostantin Getman

The Astrophysical Journal Supplement Series, 160:353–378, 2005 October

MEMBERSHIP OF THE ORION NEBULA POPULATION FROM THE *CHANDRA* ORION ULTRADEEP PROJECT

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ABSTRACT

The *Chandra* Orion Ultradeep project (COUP) observation described in a companion paper by Getman et al. provides an exceptionally deep X-ray survey of the Orion Nebula Cluster and associated embedded young stellar objects. Membership of the region is important for studies of the stellar IMF, cluster dynamics, and star formation. The COUP study detected 1616 X-ray sources. In this study we confirm cloud membership for 1315 stars, identify 16 probable foreground field stars having optical counterparts with discrepant proper motions, and classify the remaining 285 X-ray sources, of which 51 are lightly and 234 heavily obscured. The 51 lightly obscured sources without known counterparts fall into three groups: (i) 16 are likely new members of the Orion Nebula Cluster; (ii) 2 with unusually soft and nonflaring X-ray emission appear to be associated with nebular shocks, and may be new examples of X-rays produced at the bow shocks of Herbig-Haro outflows; (iii) the remaining 33 are very weak uncertain sources, possibly spurious. Out of 234 heavily absorbed sources without optical or near-infrared counterparts 75 COUP sources are likely new embedded cloud members (with membership for 42 confirmed by powerful X-ray flares), and the remaining 159 are likely extragalactic active galactic nuclei seen through the molecular cloud, as argued by a careful simulation of the extragalactic background population. Finally, a few new binary companions to Orion stars may have been found, but most cases of proximate COUP sources can be attributed to chance superpositions in this crowded field.

Subject headings: binaries: general — open clusters and associations: individual (Orion Nebula Cluster) — stars: pre–main-sequence — X-rays: stars

On-line material: machine-readable tables