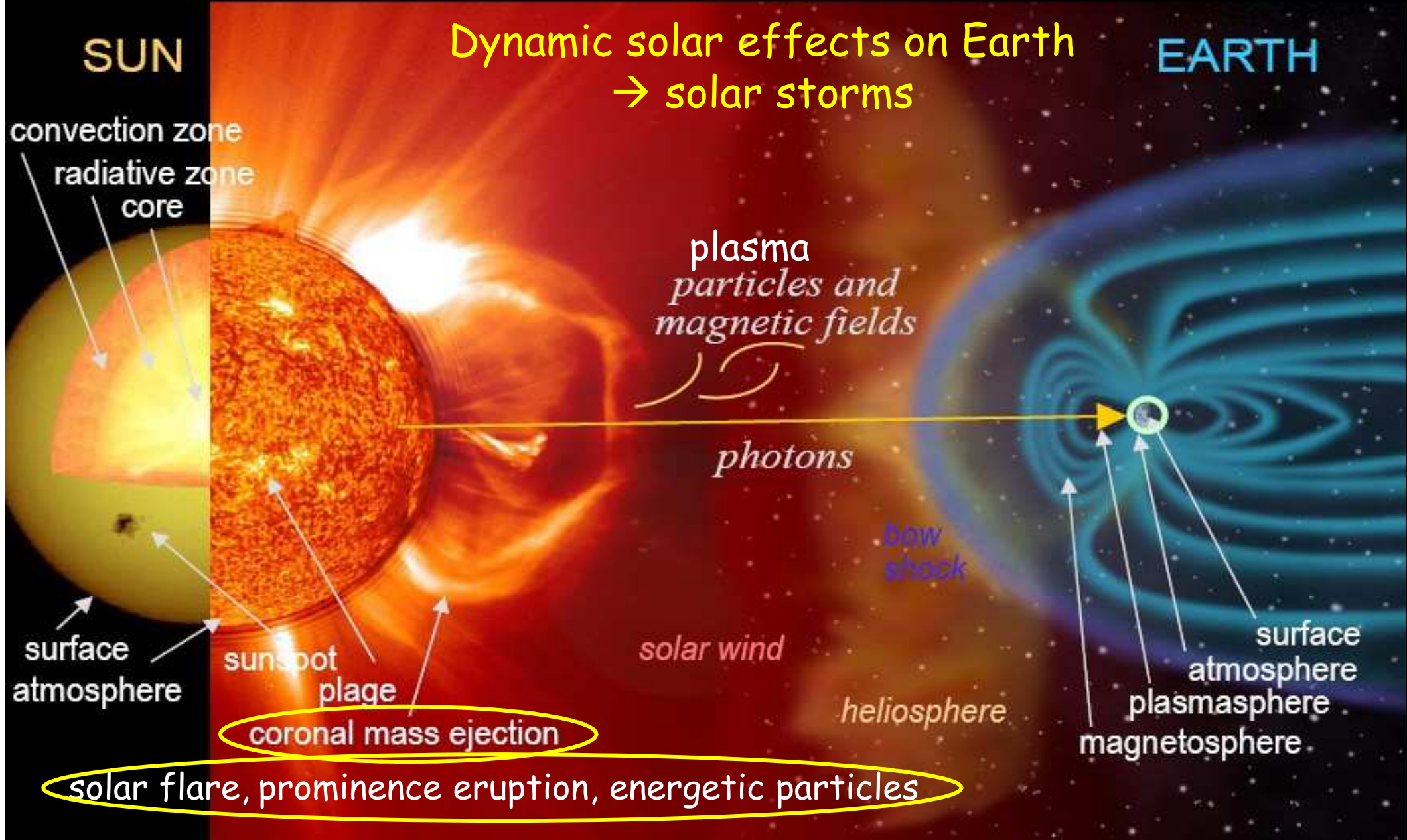


Dynamic solar effects on Earth → solar storms



Solar Explosions

1970's -now: **X-Ray Disk Observing**
-No! Flares are coronal explosions

19th Century: **Visual Disk Observing**
-Flares are photospheric explosions

21st Century: **Full Sun Observing (almost)**
-Both are magnetic field explosions

Mid-20th Century: **H-alpha Disk Observing**
-No! Flares are chromospheric explosions

1980's -now: **Visual Coronal Observing**
-No! CMEs are the real explosions

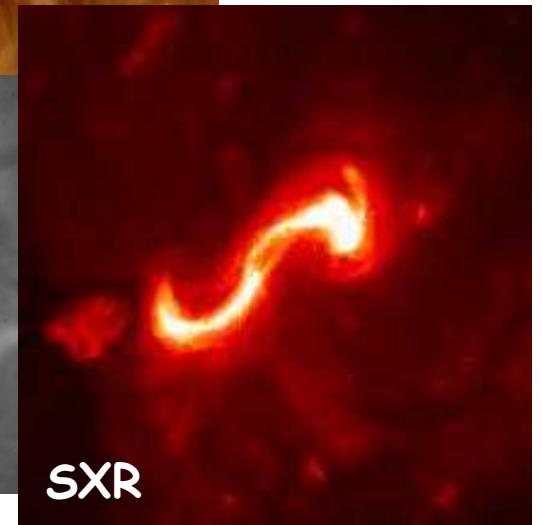
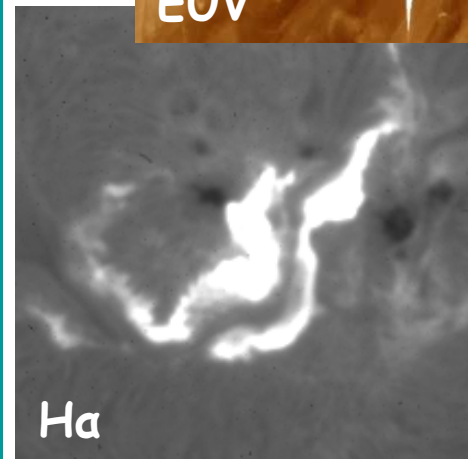
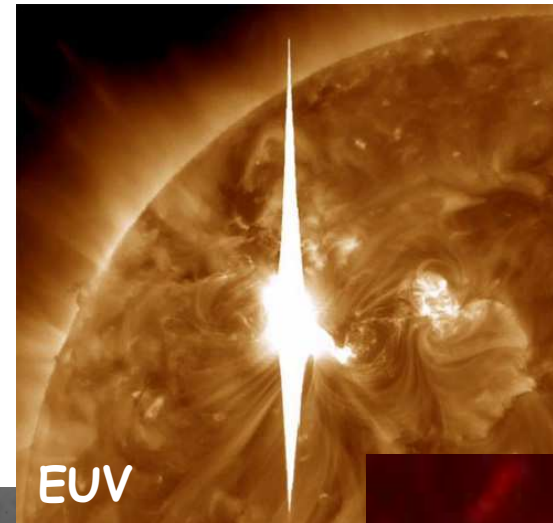
Solar Flare

A sudden, rapid, and intense variation in brightness seen on the Sun

Sudden release of magnetic energy ($10^{27} \sim 10^{32}$ ergs in ~ 10 -1000 seconds) built up in the solar atmosphere
(worldwide energy consumption per year = 10^{27} ergs)

Heating and accelerating particles (up to 100s of MeV for electrons, 10s of GeV for ions)

Emitting radiations from radio, through optical to X-ray and γ -ray



energy storage & release, particle acceleration

microflare ($10^{27} \sim 10^{30}$ ergs), nanoflare ($10^{24} \sim 10^{27}$ ergs) \rightarrow coronal heating?

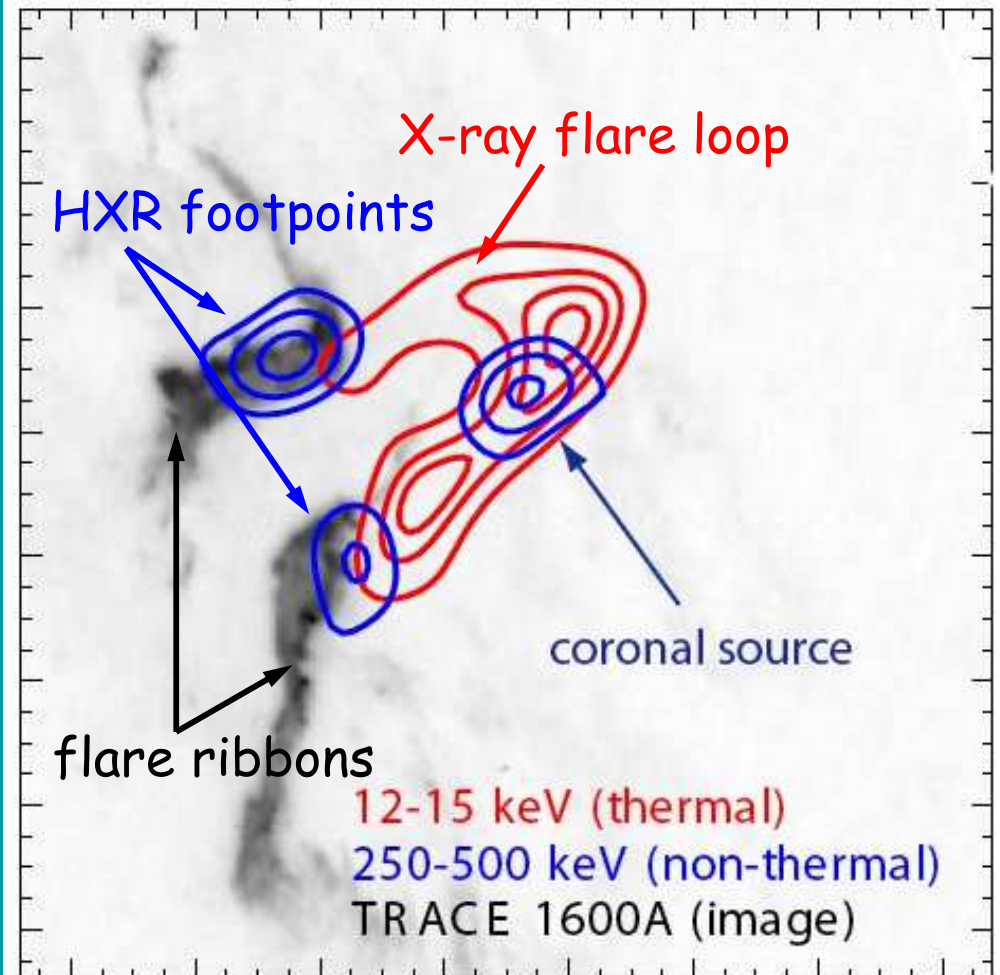
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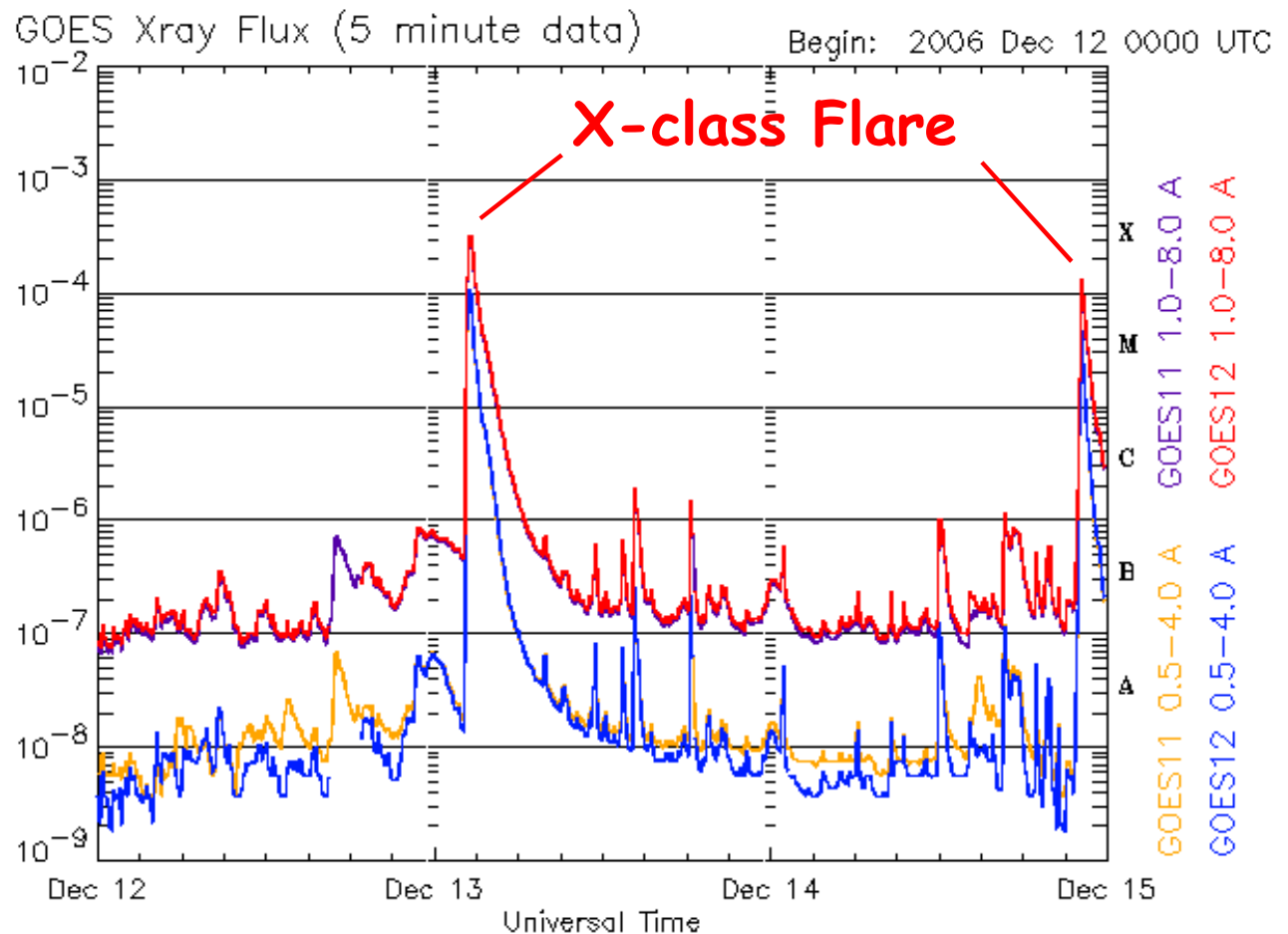
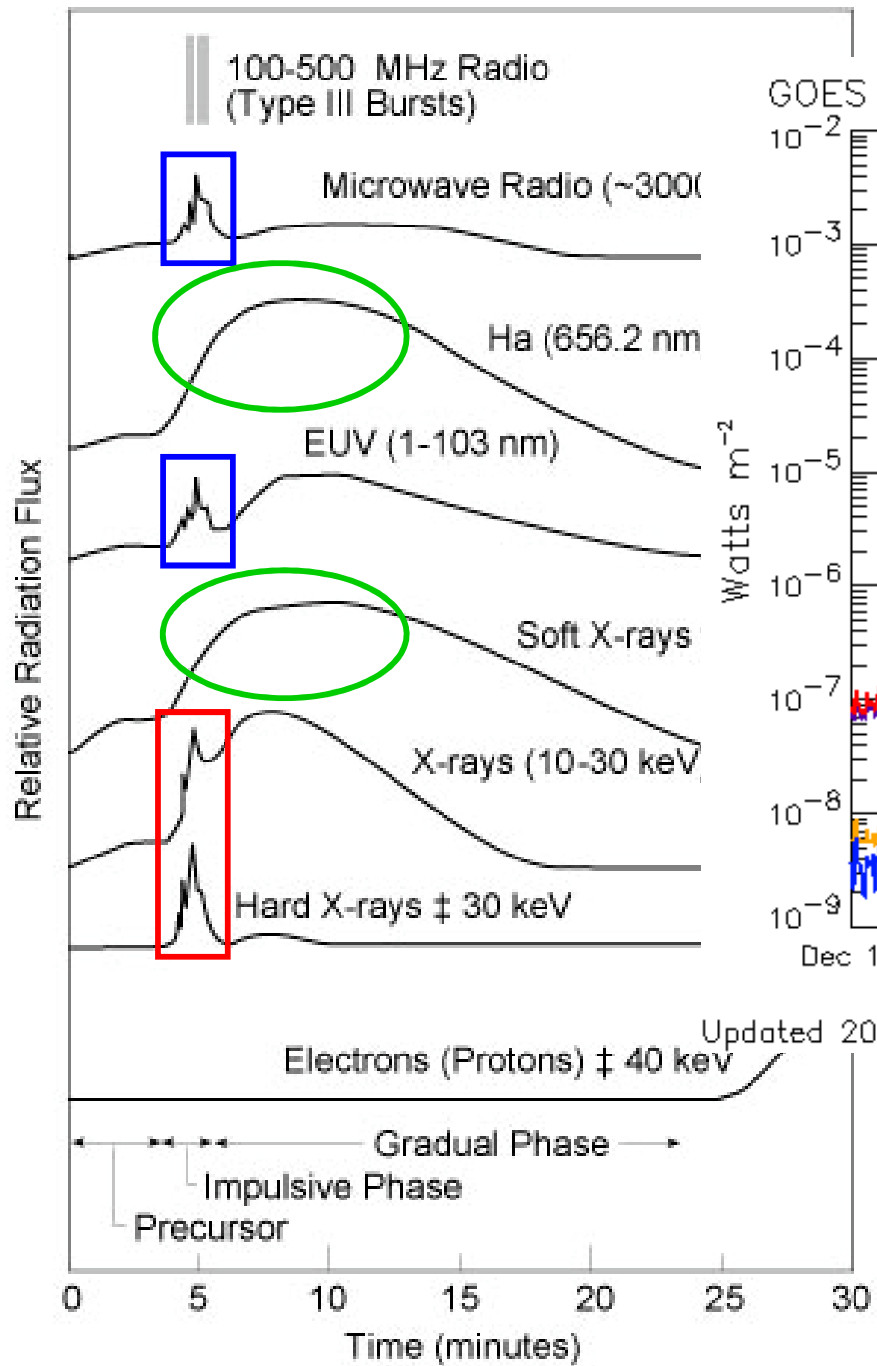
Heating and accelerating particles (up to 100s of MeV for electrons, 10s of GeV for ions)

Emitting radiations from radio, through optical to X-ray and γ -ray



energy storage & release, particle acceleration

microflare ($10^{27} \sim 10^{30}$ ergs), nanoflare ($10^{24} \sim 10^{27}$ ergs) \rightarrow coronal heating?



Updated 2008 Dec 14 23:56:07 UTC

NOAA/SEC Boulder, CO USA

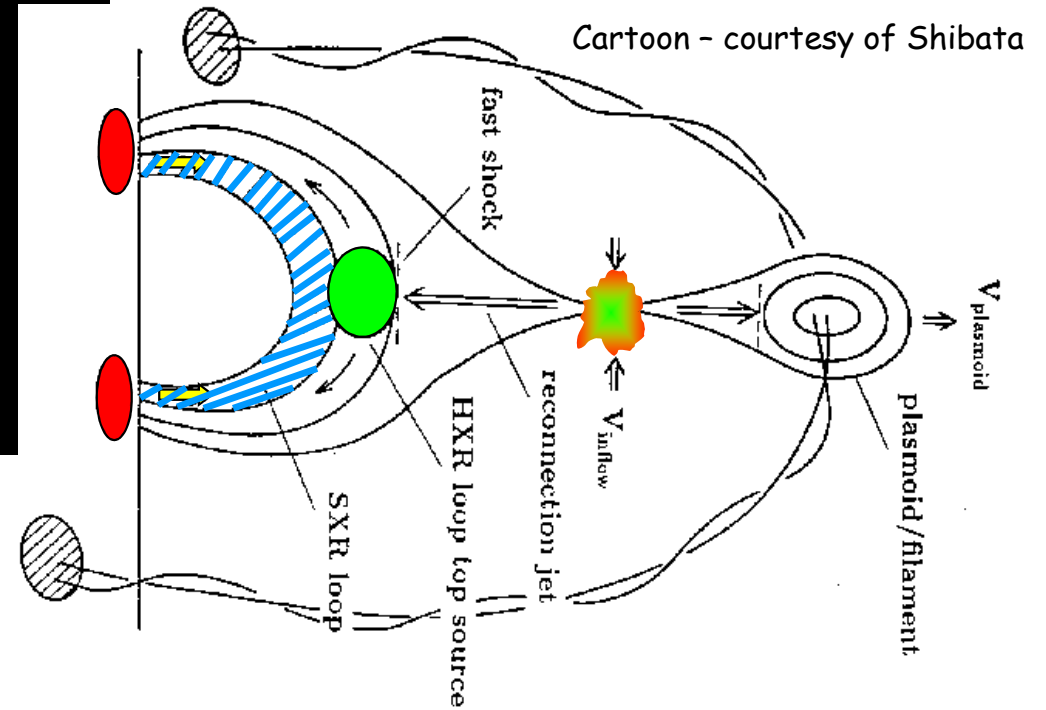
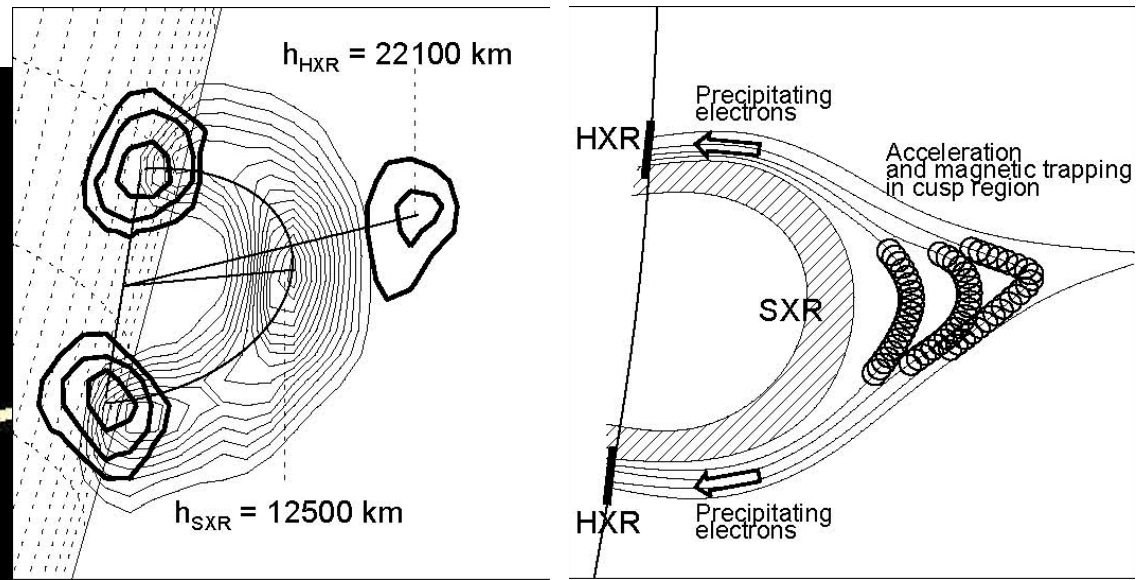
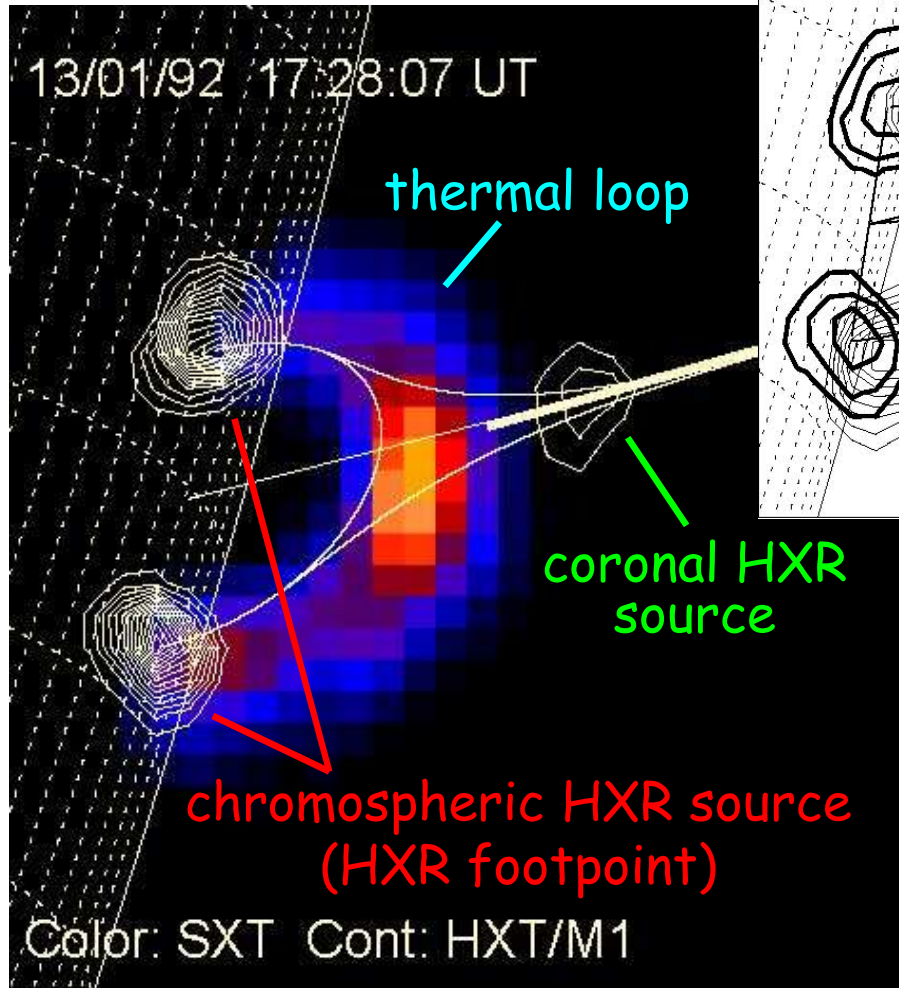
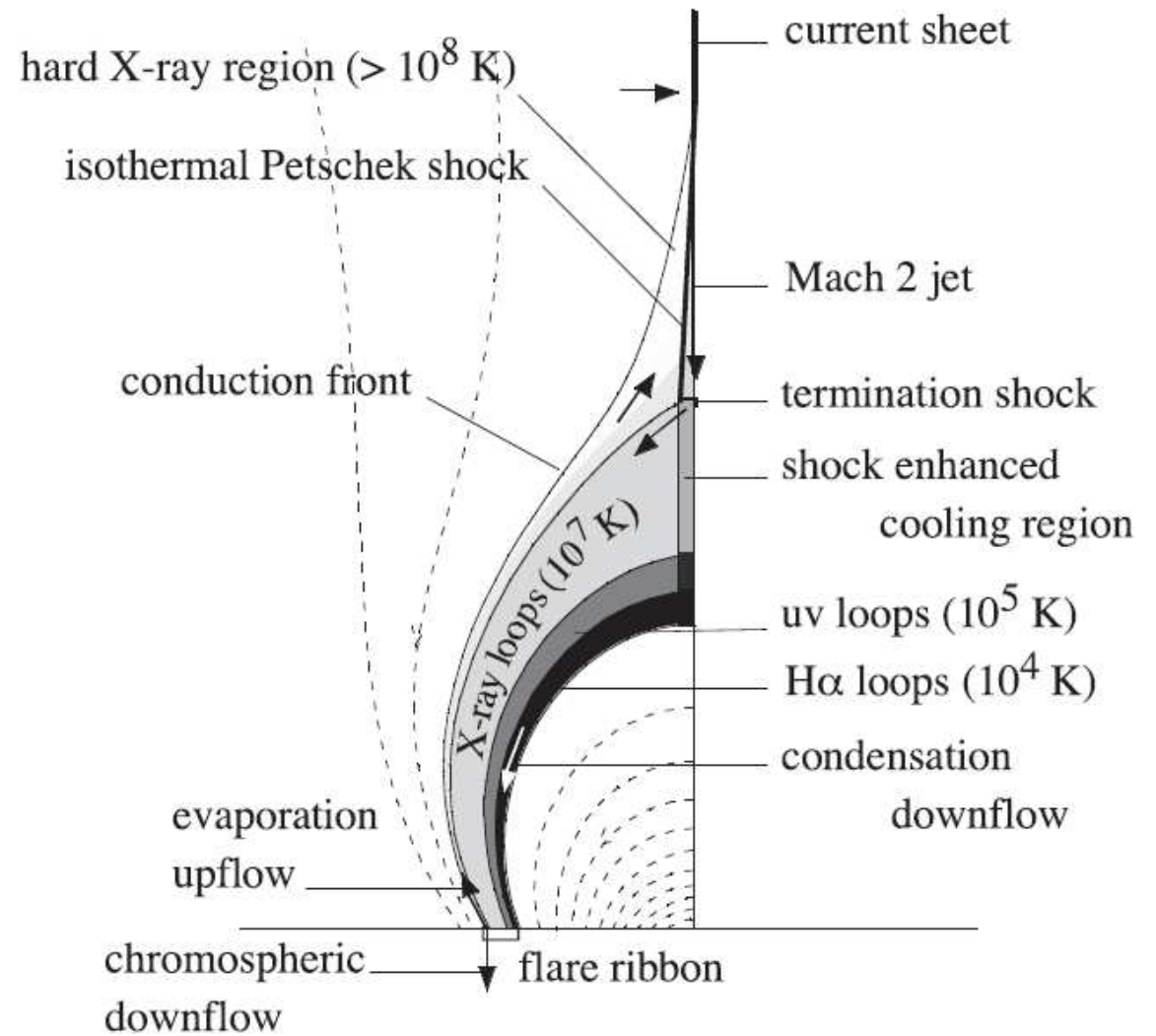
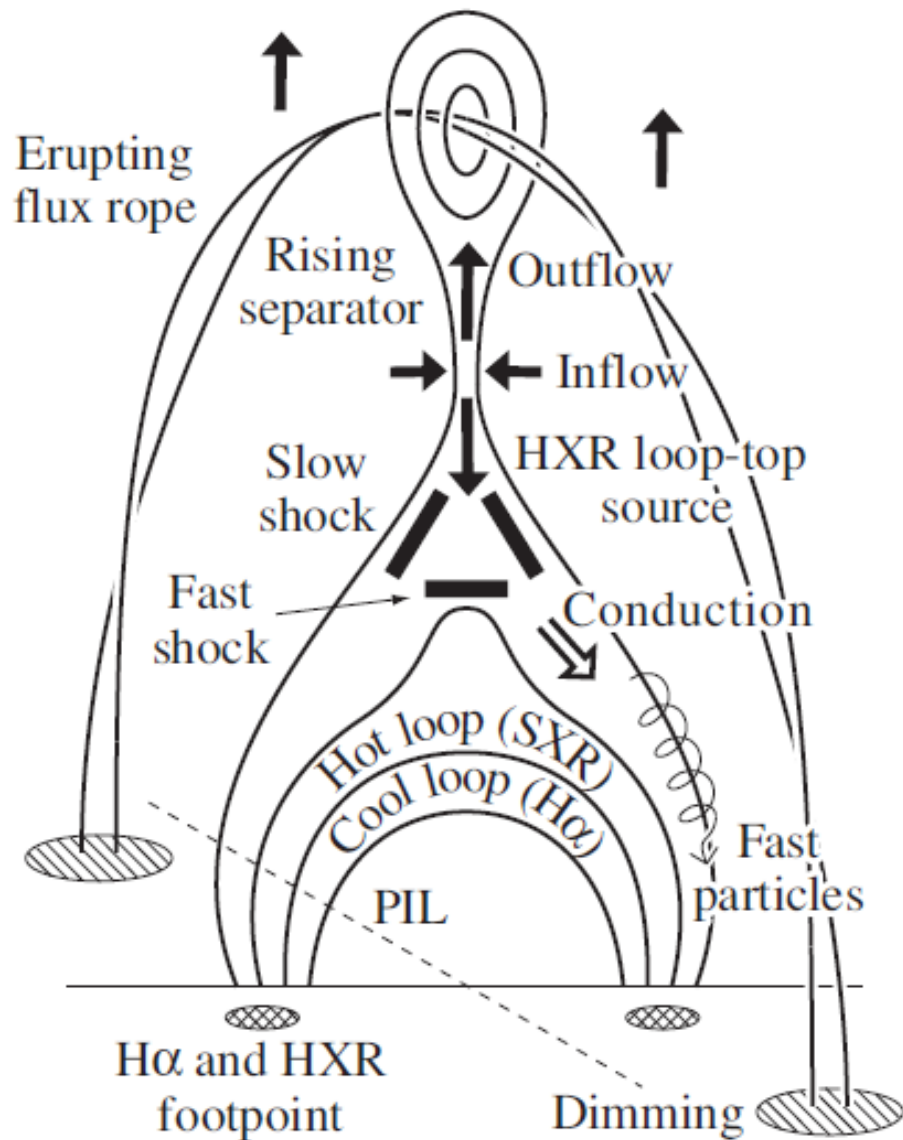


Fig. 12.12 in Markus J. Aschwanden (2005)



acceleration \rightarrow injection \rightarrow propagation \rightarrow trapping \rightarrow energy loss

Fig. 12.1(b) & Fig. 12.19 in Eric Priest (2014)