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

Sudden release of magnetic energy (10^{27}~10^{32} \text{ ergs in } \sim 10-1000 \text{ seconds}) built up in the solar atmosphere (worldwide energy consumption per year = 10^{27} \text{ 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}~10^{30} \text{ ergs}), nanoflare (10^{24}~10^{27} \text{ ergs}) → coronal heating?

thermal loop

coronal HXR source

chromospheric HXR source (HXR footpoint)

Color: SXT  Cont: HXT/M1

13/01/92  17:28:07 UT

h_{HXR} = 22100 km

h_{SXR} = 12500 km

Precipitating electrons

Acceleration and magnetic trapping in cusp region

Chromospheric Evaporation

Magnetic Reconnection

Thermal Loop

HXR Footpoints ← HXR Loop-Top Source ← Magnetic Reconnection

Chromospheric Evaporation ← Thermal Loop

Fig. 12.12 in Markus J. Aschwanden (2005)
Fig. 12.1(b) & Fig. 12.19 in Eric Priest (2014)
Fig. 12.14 & Fig. 12.15 in Markus J. Aschwanden (2005)
Double Coronal Sources

HXR coronal sources: close to acceleration site

Qingrong Chen in 2010 RHESSI Workshop

Sam Krucker in RHESSI 2008 Workshop
Qingrong Chen in 2010 RHESSI Workshop
NRH 09:49:24.5 (40%, 80%)

NRH 09:50:46.4 (40%, 80%)

- 164.0 MHz
- 236.6 MHz
- 327.0 MHz
- 432.0 MHz

Qingrong Chen in 2010 RHESSI Workshop
Composite Solar Flare Spectrum

γ-ray imaging not available prior to RHESSI. Are there γ-ray footpoints?

Positron and Nuclear Gamma-Ray lines

soft X-rays  hard X-rays  Photon Energy

π^0 Decay
Fig. 14.1 & Fig. 14.7 in Markus J. Aschwanden (2005)
RHESSI found that the footpoints of the 2.223 MeV line—indicating ion precipitation—and the footpoints of the non-thermal continuum emission—produced by precipitating electrons—do not always coincide. This implies spatial differences in acceleration and/or propagation between the flare-accelerated ions and electrons.