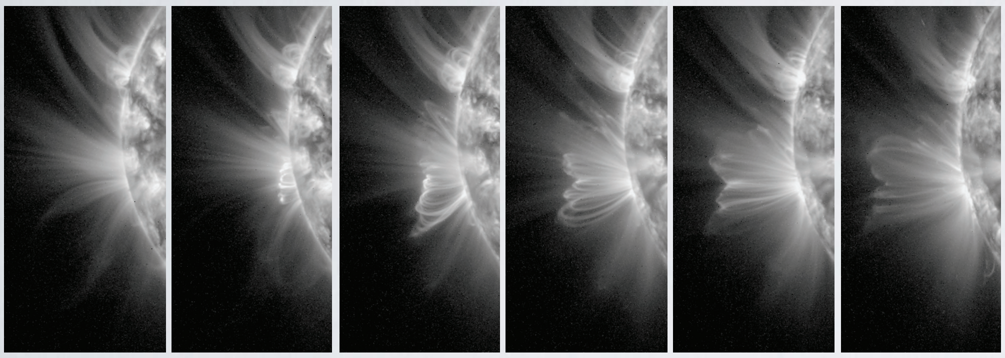
SWAP Observations of Post-flare Loops

and the Effects of Background Coronal Conditions

Matthew J West & Daniel B Seaton - Royal Observatory Belgium

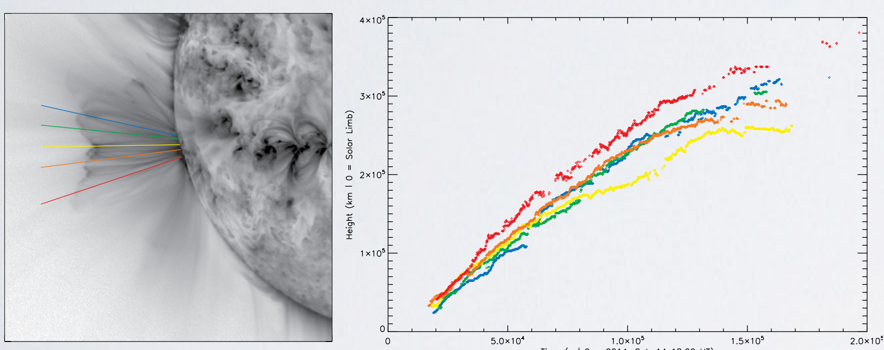
AR 12192, the most prolific of Solar Cycle 24, rotated into view on 18 Oct 2014 but announced its presence at 18:30 UT on 14 Oct with an unusual eruption from beyond the east limb, producing a CME (v=1300 kms^{-1}) and an M2.2 solar flare.



Growth of post eruption loops observed by SWAP

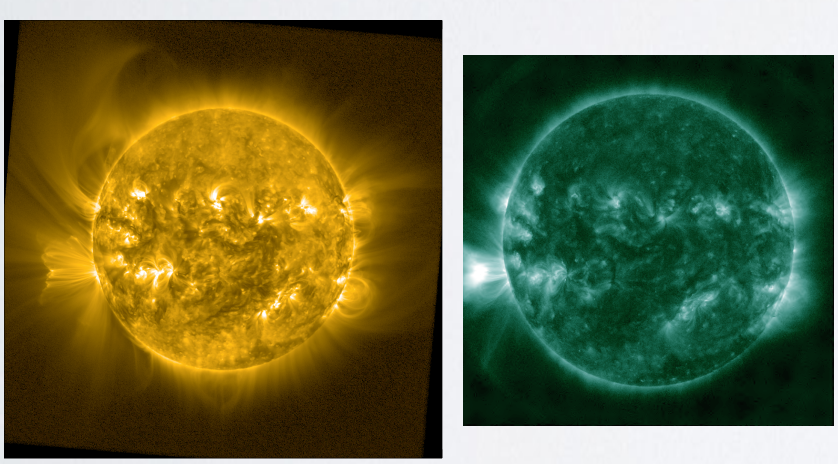
In the 48 hr following the eruption, the associated post-eruptive loops grew to a height of 4×10^5 km (>0.5 R) at 2 - 6 km s^{-1}.

The GOES x-ray irradiance was double-peaked, probably because the footpoints were occulted. The signature was seen for over a day.



Growth rate of post eruption loops observed by SWAP

The hot passbands of SDO/AIA showed signatures of hot, diffuse plasma above the post-flare loop system. Inflowing material and shrinking loops indicate on-going magnetic reconnection.



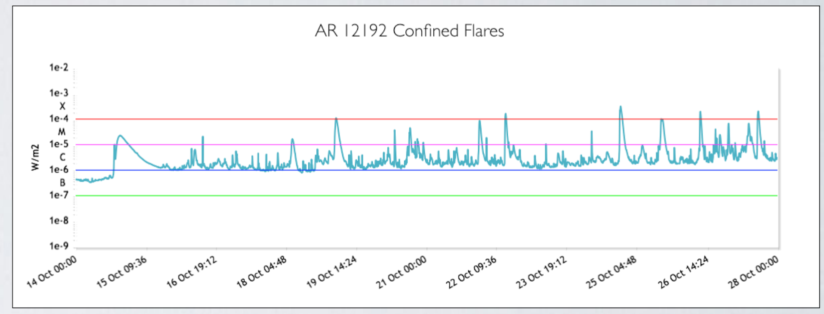
SWAP 174 Å (Fe IX/X at log T ≈ 6; left) and AIA 94 Å (T = $10^{6.8}$ K; Right) images of the loops on 15-Oct.

These loops appear to be the EUV counterparts of X-ray "post-flare giant arches" (see de Jager & Švestka, 1985).

Forbes and Lin (2000) showed, using their analytic eruption model, that reconnection could be sustained to great heights if the density falls fast enough to balance any decrease in the magnetic field.

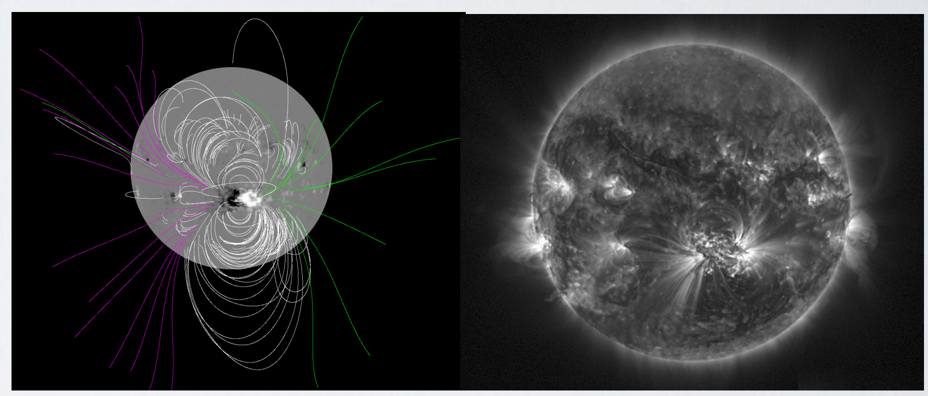
Much later in its evolution AR 12192 was associated with a large region of open field. Does that tell us anything? Could this be evidence of large-scale density outflows?

In addition to this event, AR 12192 produced at least nine M5 or above flares, but none of these were associated with a CME.



GOES X-ray signatures

This region was associated with a massive set of dipolar loops that were practically as large as the sun itself.



PFSS reconstruction of the field (left); SWAP image of the Sun on24 Oct 2014.

Any erupting structure would have a hard time breaking through this highly potential field system and erupting. Most eruptions from this region came from weak flares near the edges of the region.

Sun et al. 2015 looked at the free energy. They compared the eruptions from this region to other similar active regions. They found that, although the fields are strong and there were plenty of drive flares, the critical height for eruptions is very large and the ratio of free energy to potential energy is low. - *Eruptions were energetically impossible.*

Conclusions

1. The Post-Flare Giant Arches associated with the October 14 eruption were generated by magnetic reconnection.
2. Despite its size, AR 12192 could not produce CMEs because of the massive, highly potential dipolar fields overlying it.
3. Why the October 14 event did produce a CME — and its role in the evolution of AR 12192 — is an interesting but unanswered question.

It would be very interesting to know what was special about our event, or whether our event played a role in setting up the conditions that dictated the dynamics of the rest of the non-eruptive flares later on.

See: West & Seaton ApJ 2015