

Hot X-ray onsets of solar flares

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2021



Universidade Presbiteriana
Mackenzie



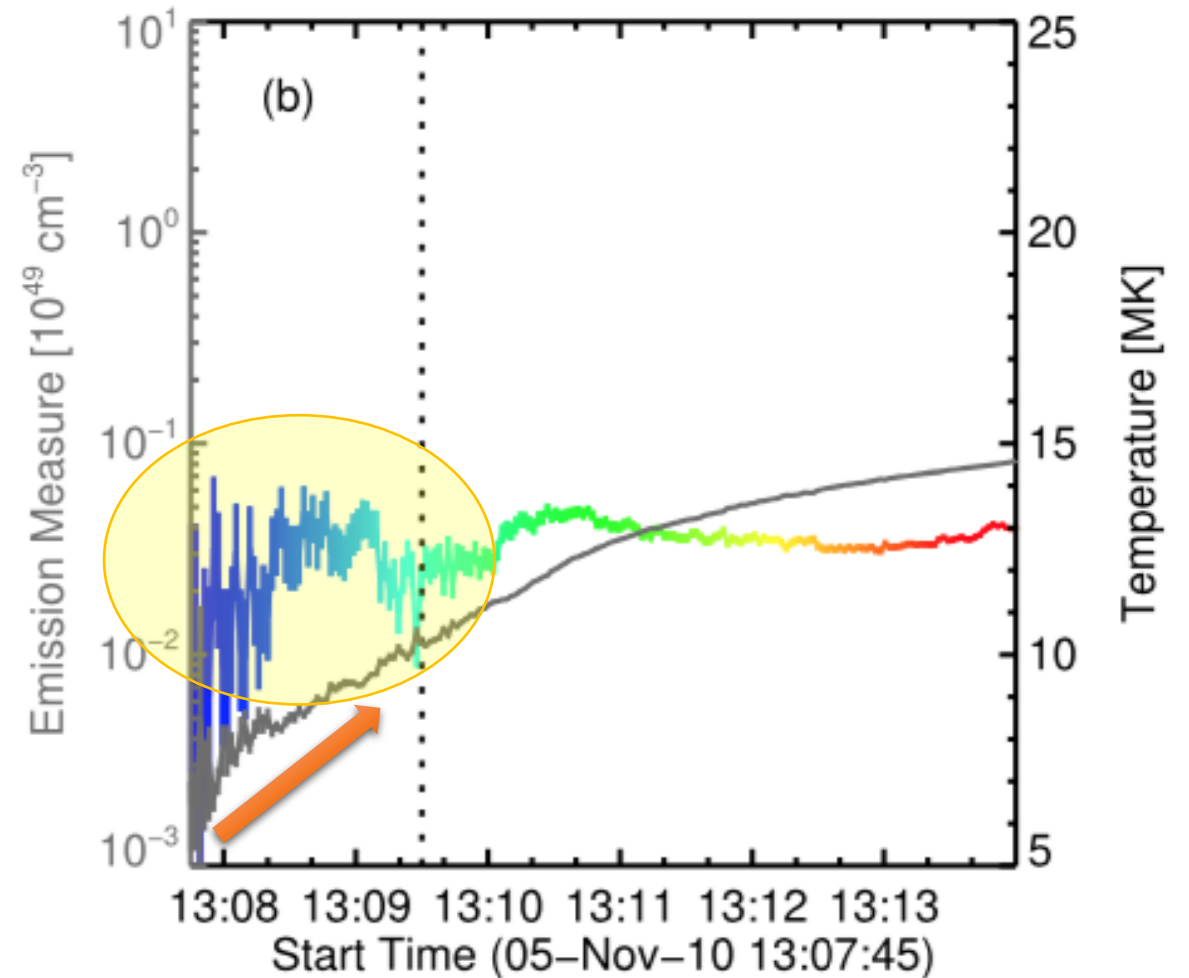
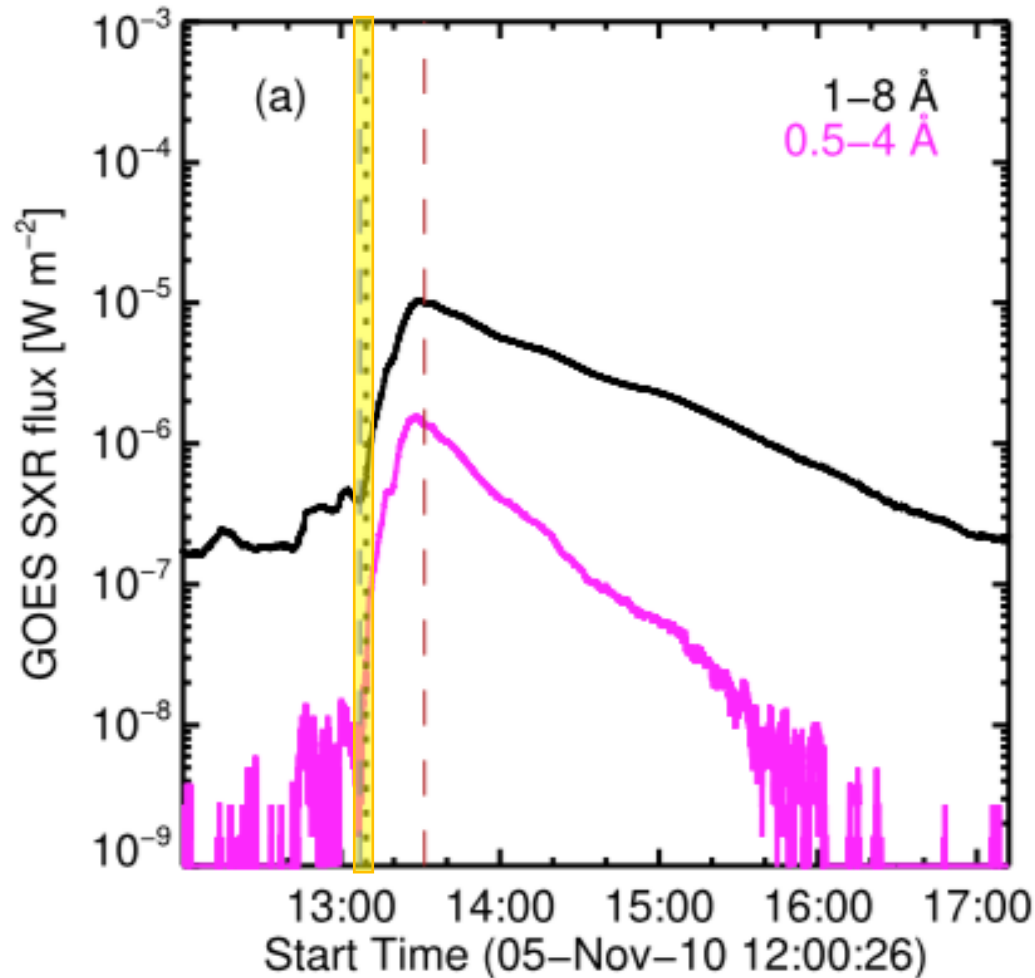
ESCOLA DE ENGENHARIA
MACKENZIE

2021 Mackenzie
10 anos de pesquisa

What is the Hot Onset?

Before the HXR: initial temperature values measured from a flare: **10-15 MK**

EM starts low (log EM 46) **increasing 10-fold** during this onset



GOES Temperatures: first detection at 10-15 MK

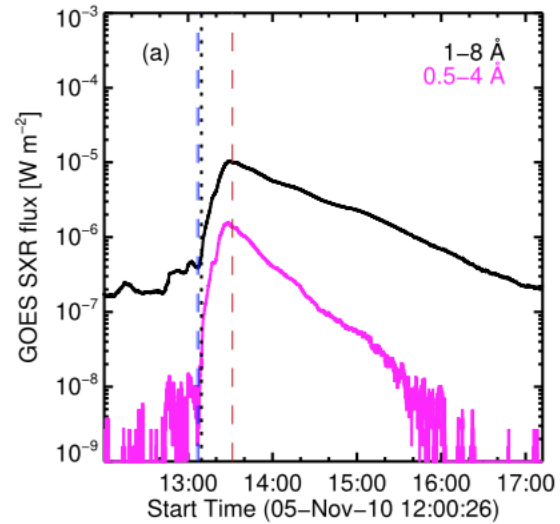
Sample: 4 events

Strong & Slow
SOL2010-11-05T13:29
M1.0

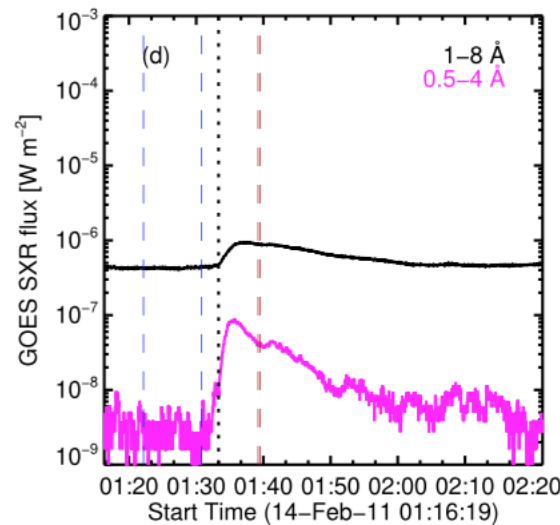
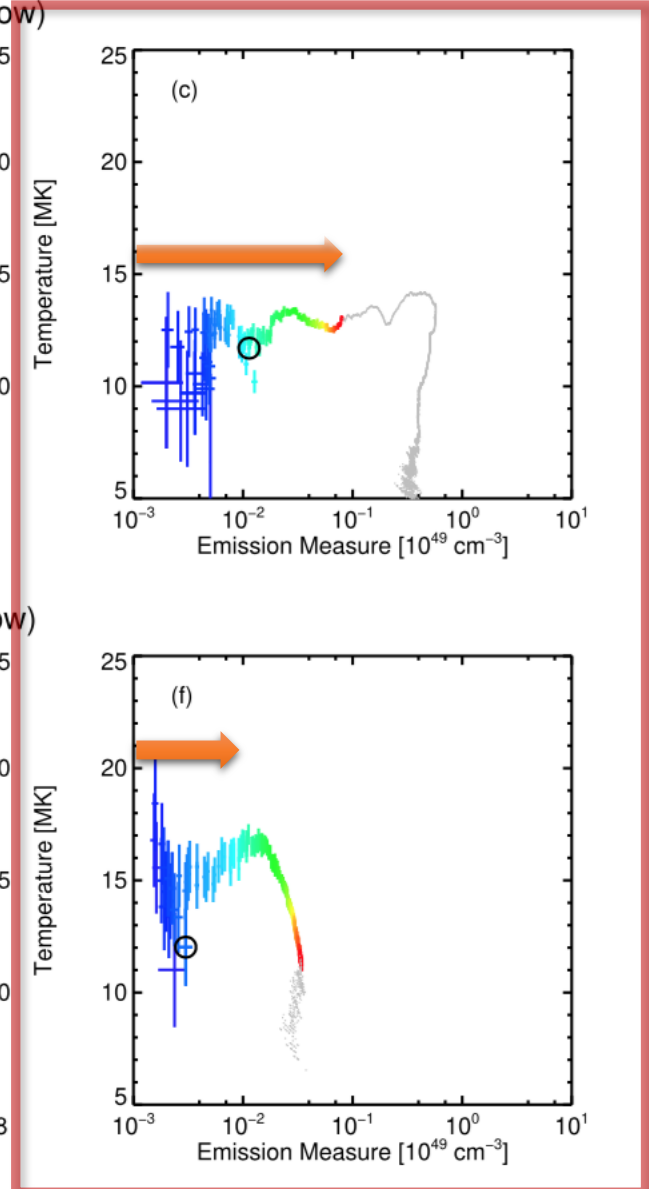
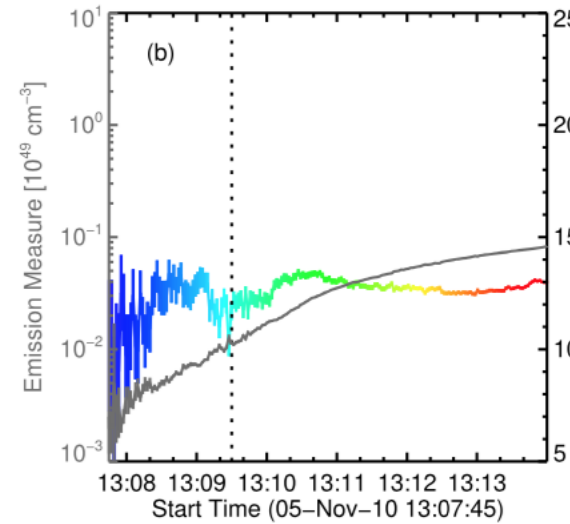
Weak & Slow
SOL2011-02-14T01:37
B9.4

Weak & Fast
SOL2012-05-14T13:38
C1.1

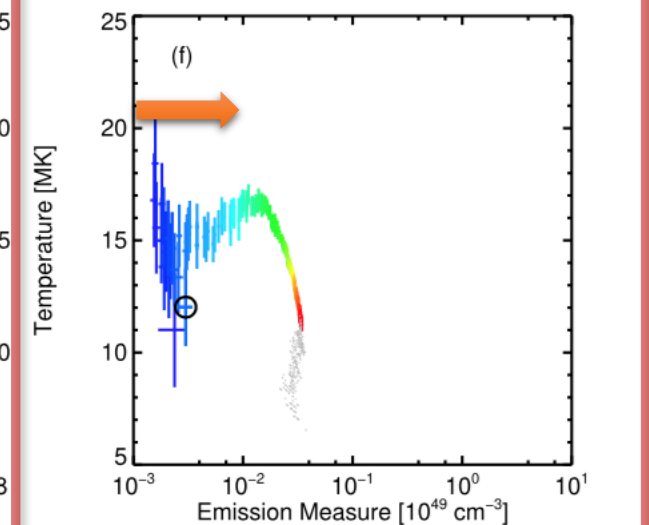
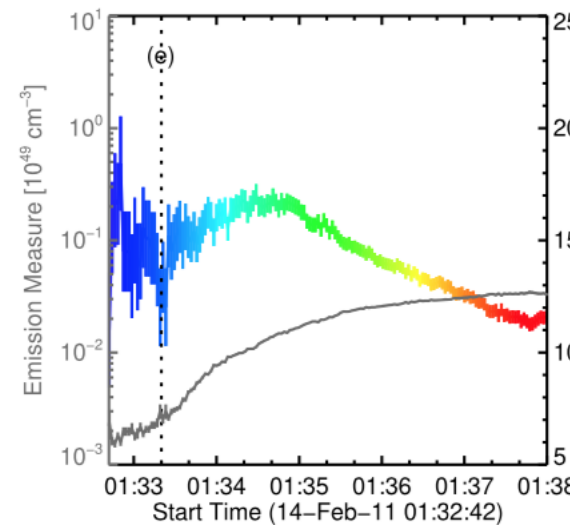
Strong & Fast
SOL2014-01-07T10:13
M7.3



SOL2010-11-05T13:29 M1.0 (strong & slow)



SOL2011-02-14T01:37 B9.4 (weak & slow)



GOES Temperatures: first detection at 10-15 MK

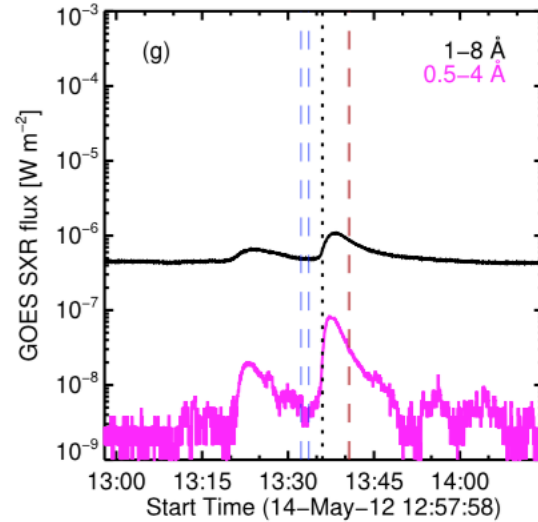
Sample: 4 events

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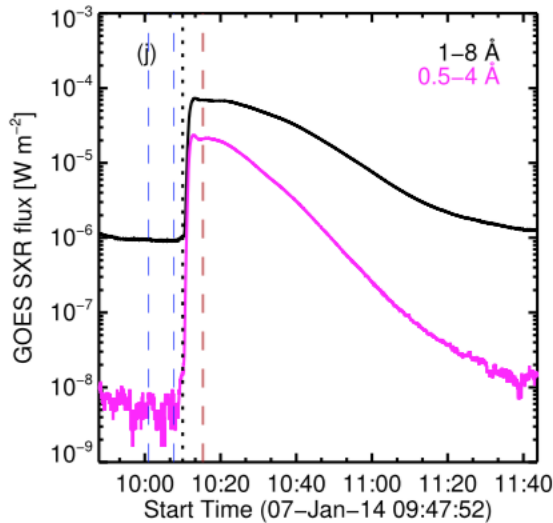
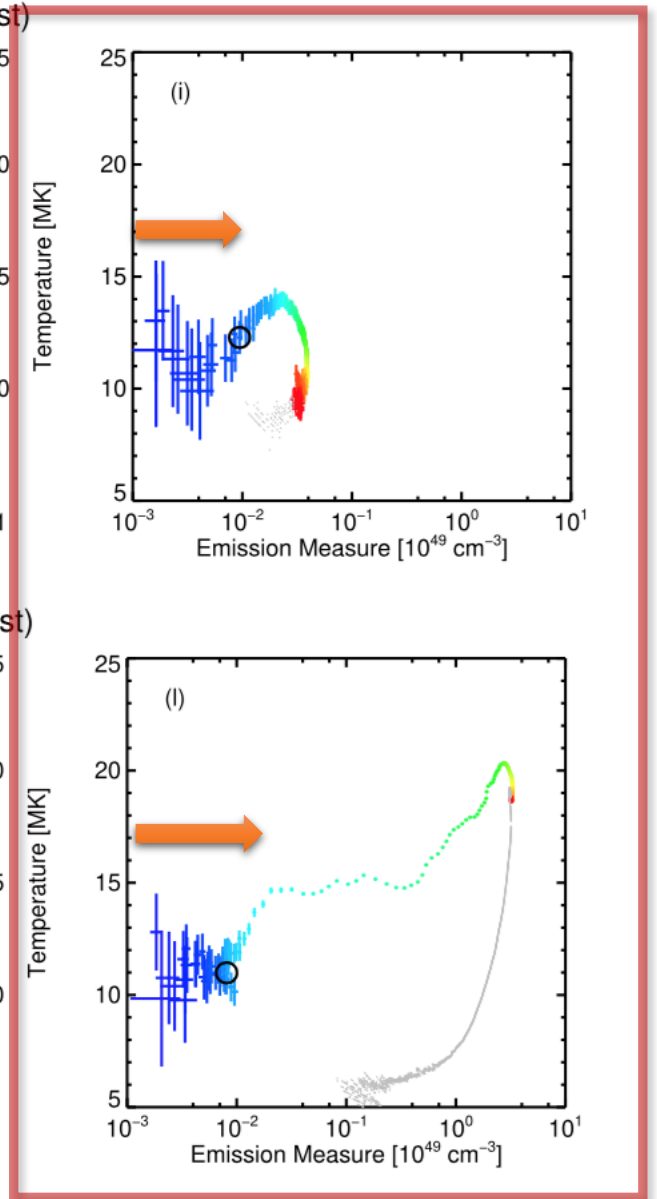
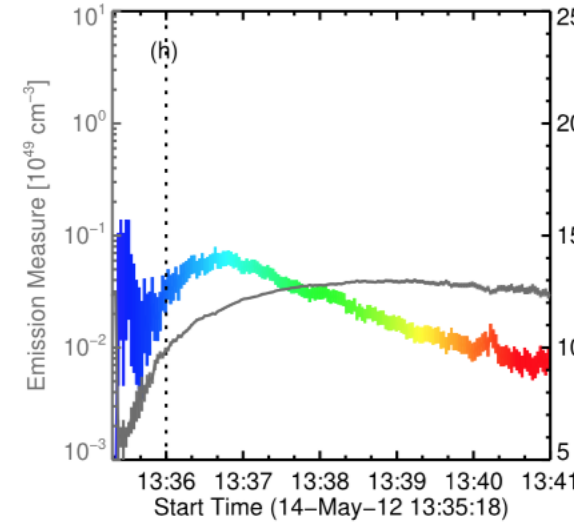
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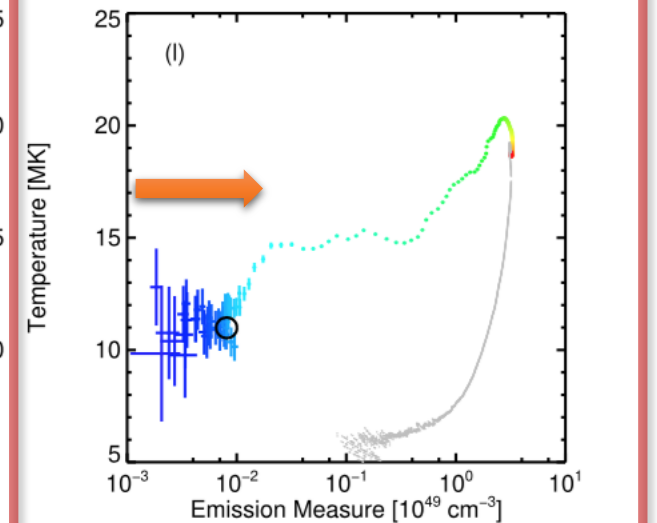
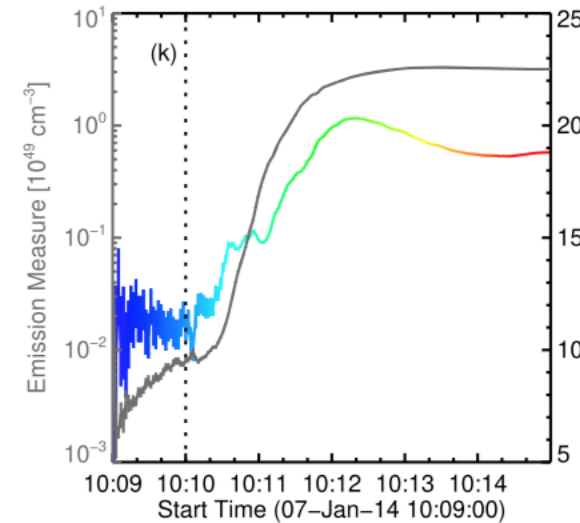
Strong & Fast
SOL2014-01-07T10:13
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SOL2012-05-14T13:38 C1.1 (weak & fast)



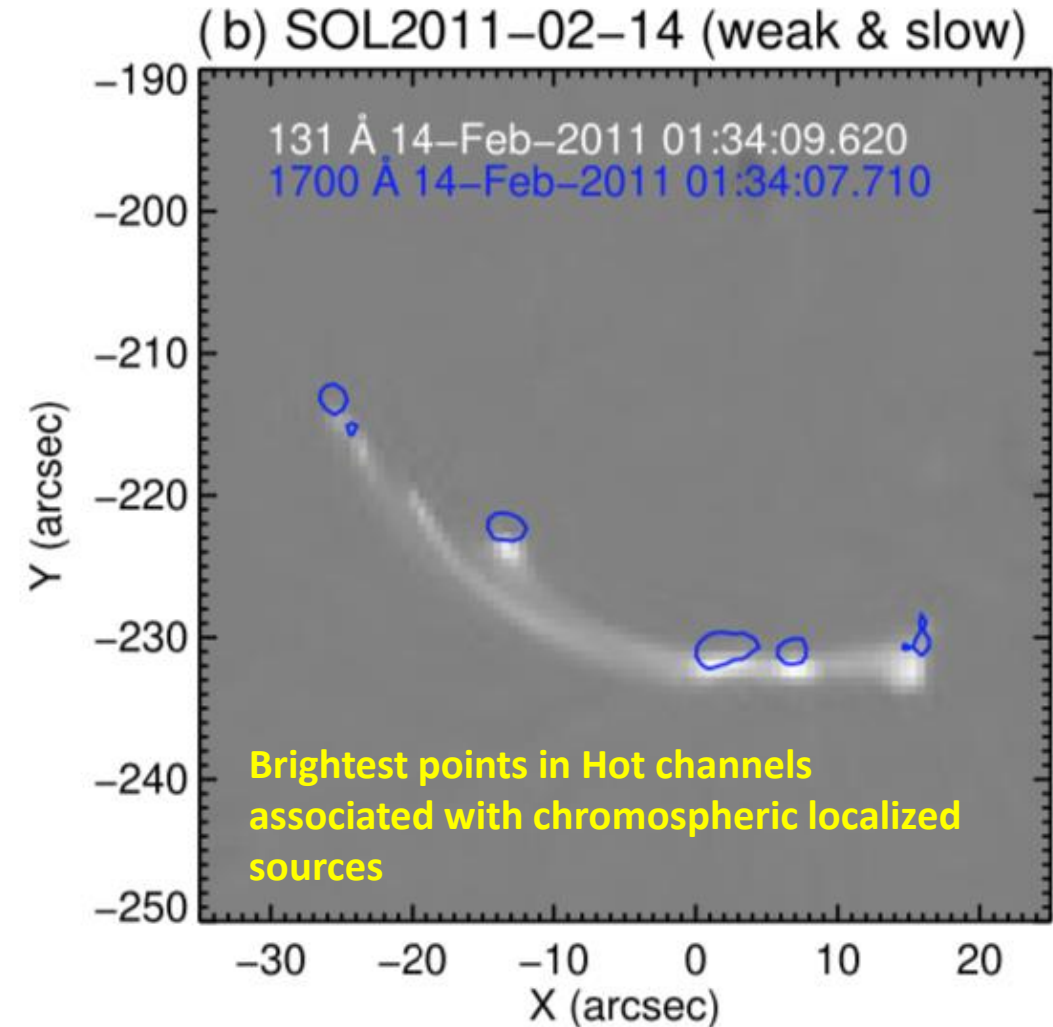
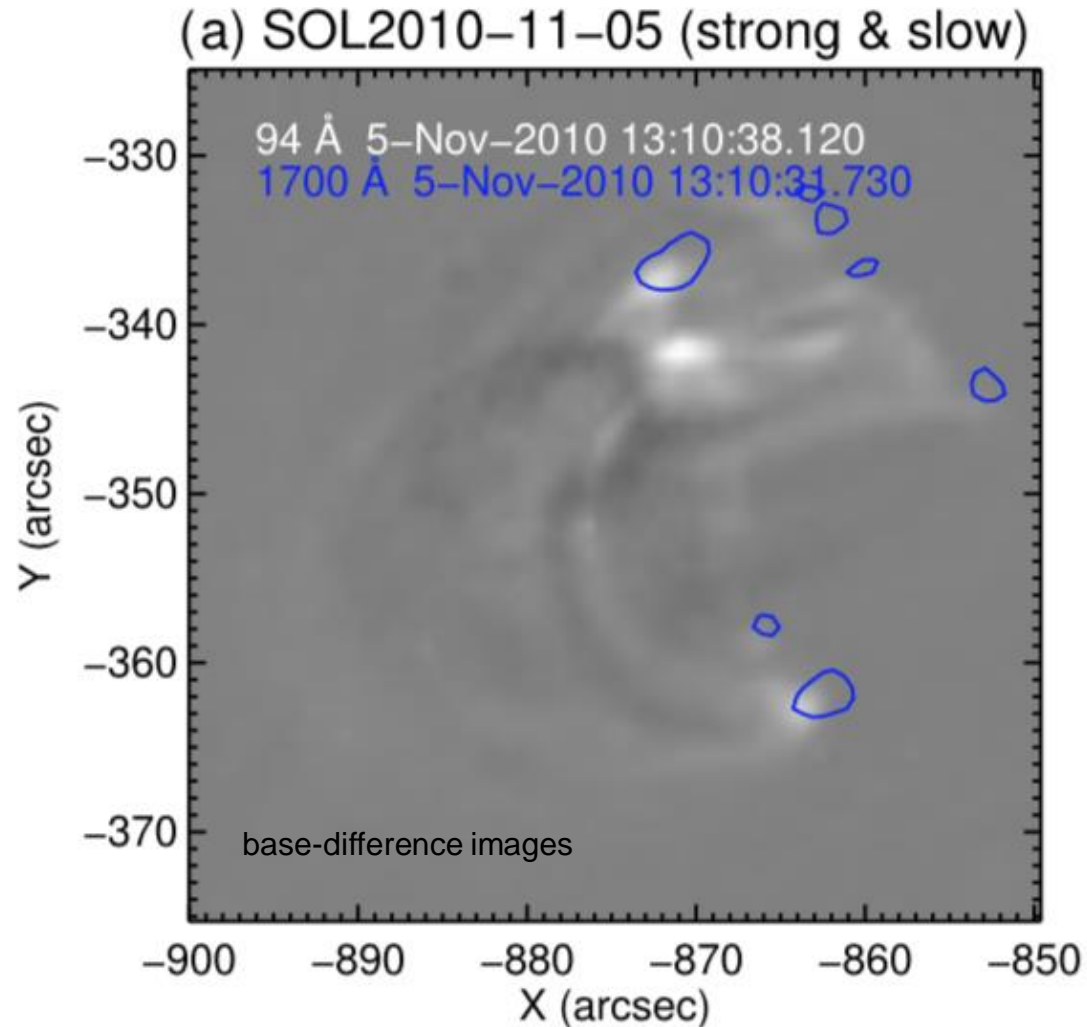
SOL2014-01-07T10:13 M7.3 (strong & fast)



Sources of the Hot Onset: AIA imaging

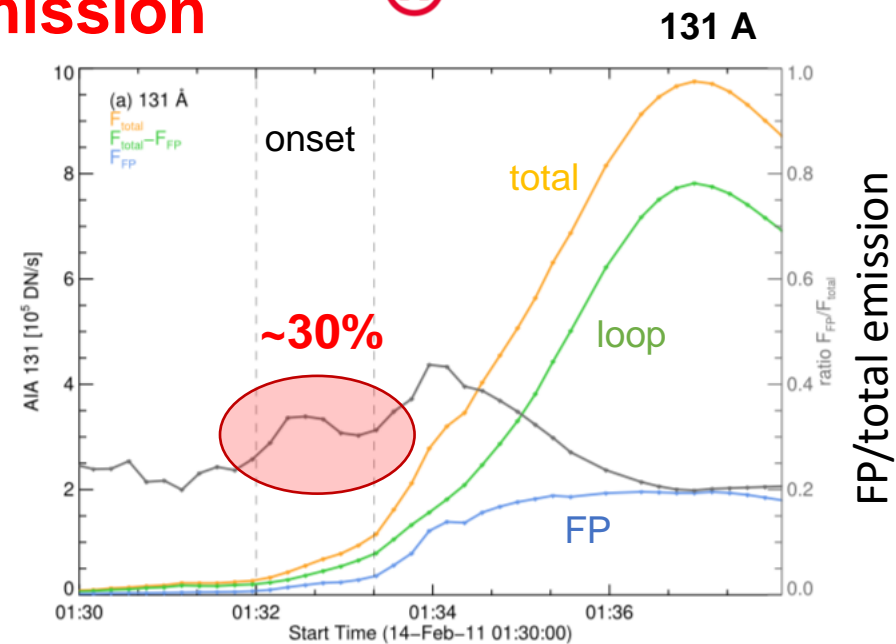
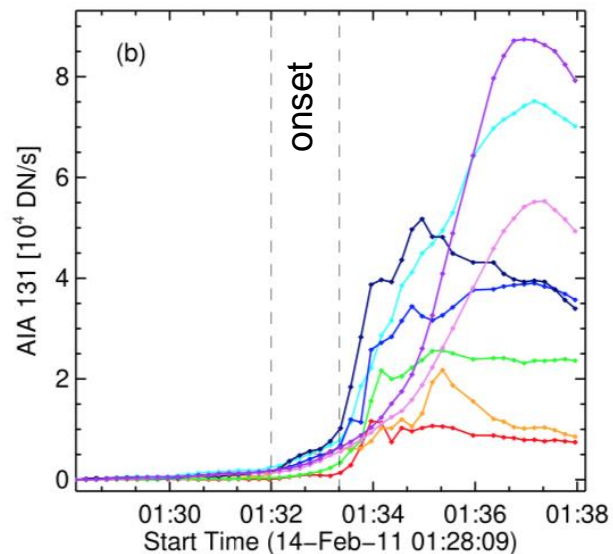
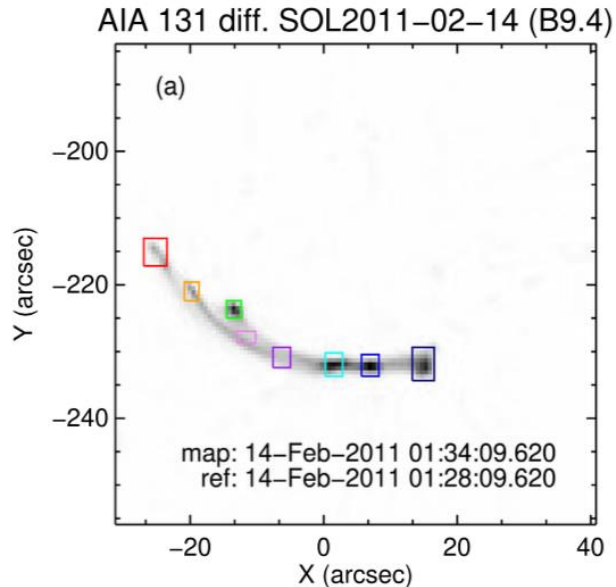
Hot emission: 94 \AA (Fe XVIII/XX, 8-10 MK) and 131 \AA (Fe XXI/XXIII, $\sim 12 \text{ MK}$) (e.g. O'Dwyer et al. 2010)

Chromospheric emission: 1700 \AA (C I, He II, Al II +lines, $\sim 10^{4.5} \text{ K}$) (Simões et al. 2019)

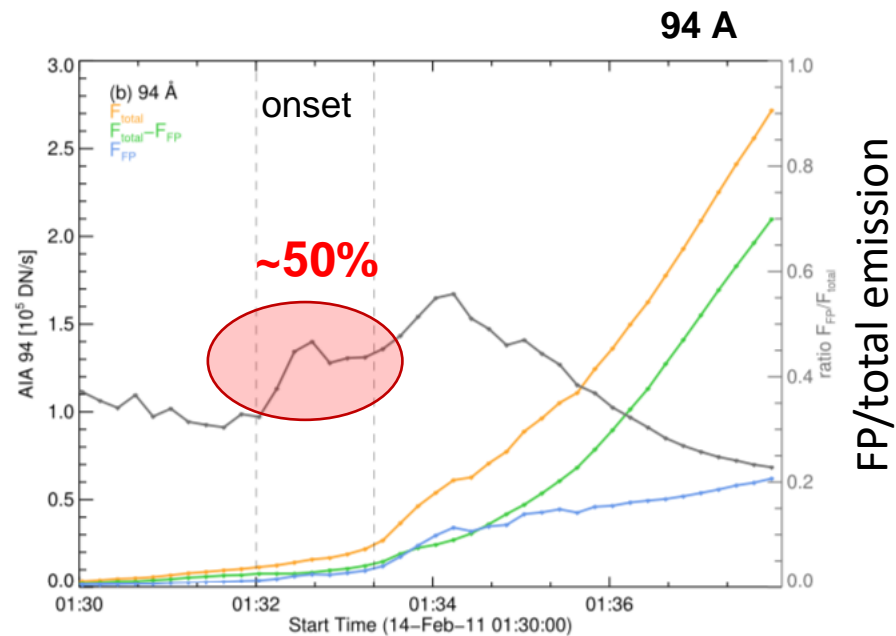
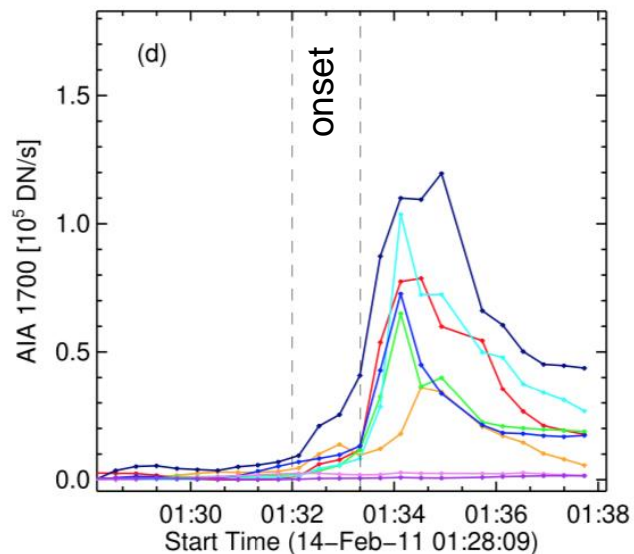
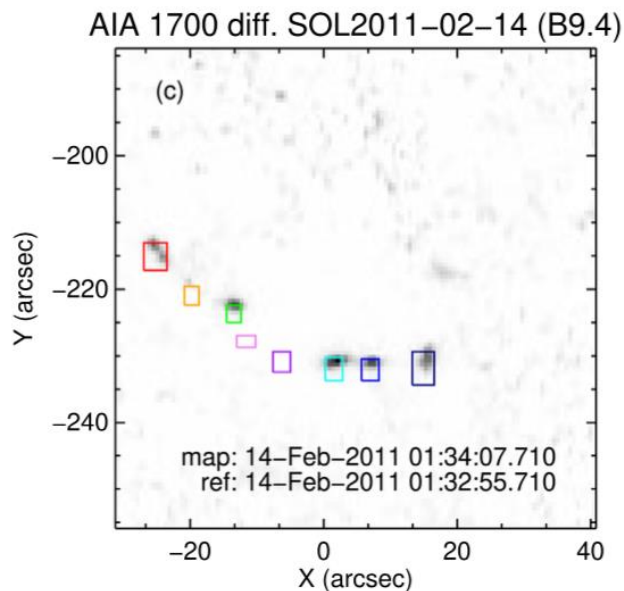


Sources of the Hot Onset: Loop vs. footpoint emission

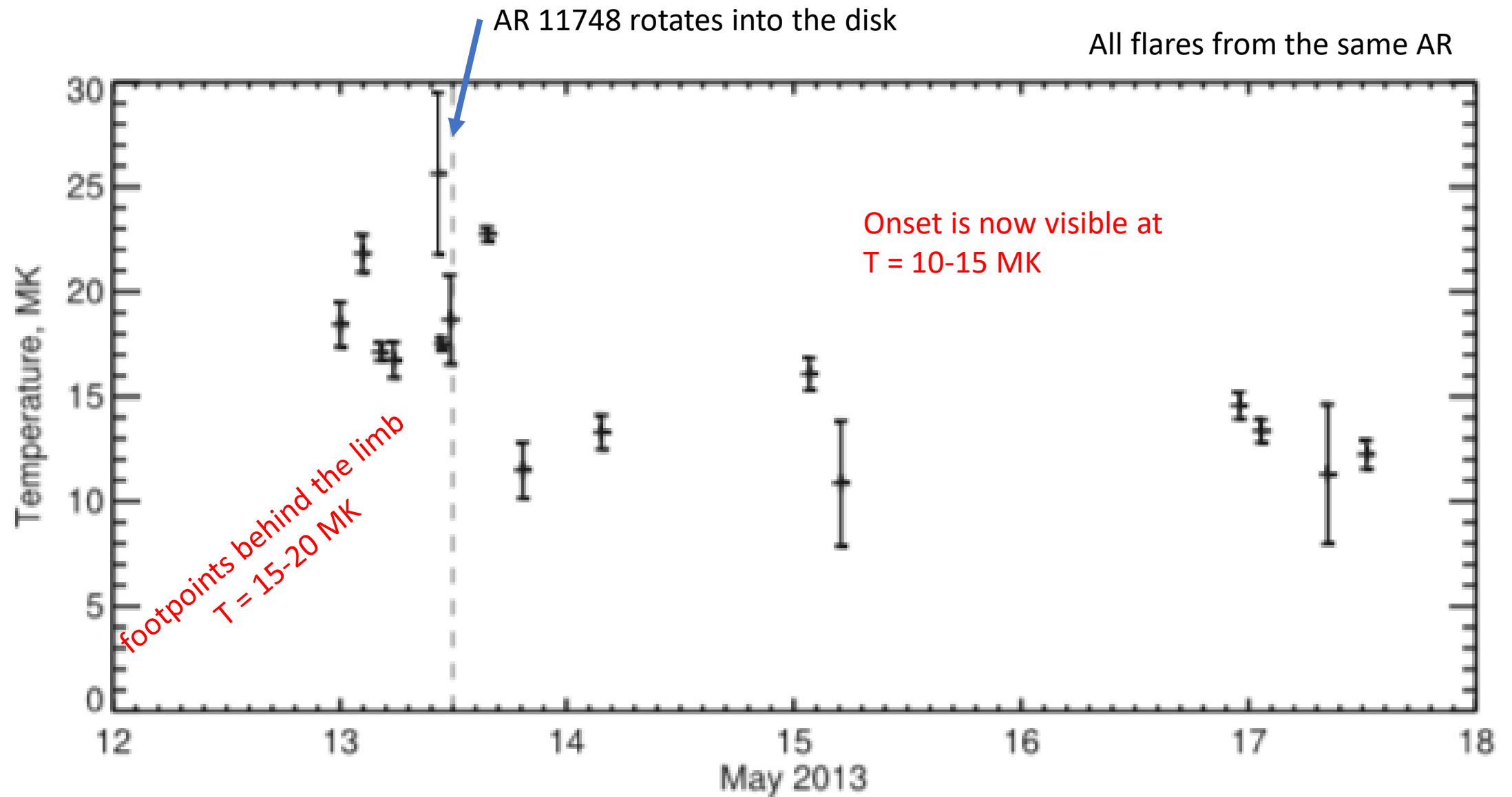
131 Å



1700 Å



Verification: limb-occulted flares



Summary

GOES temperatures start at 10-15 MK

B to M classes

Onset temperatures confirmed with RHESSI data

Very small amounts of plasma: $\log EM \sim 46$ to 47 cm^{-3}

SDO/AIA imaging: localized near footpoint regions & low-lying faint loops

Flare models? Regulated 10-15 MK while EM increases 10-fold

Ubiquitous? Are there hints to flare magnitude here?

Future work

Alasdair Wilson (Glasgow): DEMograms (temperature analysis via AIA-DEM)

Douglas Silva (CRAAM/Mackenzie): statistical analysis of GOES temperatures

More details:

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