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Marshall Space Flight Center

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Smithsonian

Morphology and Dynamics Observed with Hi-C and IRIS

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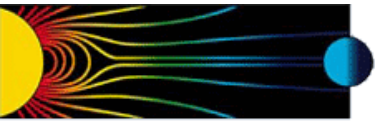
LOCKHEED MARTIN



SOLAR AND ASTROPHYSICS LAB

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University of Central Lancashire

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Abstract

The third flight of the High-resolution Coronal Imager (Hi-C 2.1) occurred on May 29, 2018, with significant co-observations with both space and ground based instruments, including the Interface Region Imaging Spectrograph (IRIS). The primary science goal of this flight was to identify the connections between the lower corona, transition region, and chromosphere at the native resolution of these connections. One way to relate the emission in these two instruments that image different temperature regimes is to compare the morphology, dynamics and time scales in each data set. In this poster, we present the initial results of this study.

Hi-C 2.1 Launch

- The initial launch of Hi-C (Hi-C 1) occurred in 2012 with a 19.3 nm passband.
- For the second launch of Hi-C in 2016 (Hi-C 2), the passband was changed to 17.2 nm and an MSFC-developed low noise camera was added. No scientific data was acquired during this flight.
- Hi-C 2.1 launched in the same configuration as Hi-C 2 on 2018 May 29 at 18:54 UT (Figures 1 & 2) and targeted Active Region 12712 on the disk (Figure 3).
- Coordinated observations with IRIS (Figure 4) was required to meet the science goal of tracing energy through the low corona.

Fig. 1: Hi-C 2.1 launch occurred on 2018 May 29 18:54 UT

Fig. 2: Hi-C 2.1 Leadership Team preparing for launch.

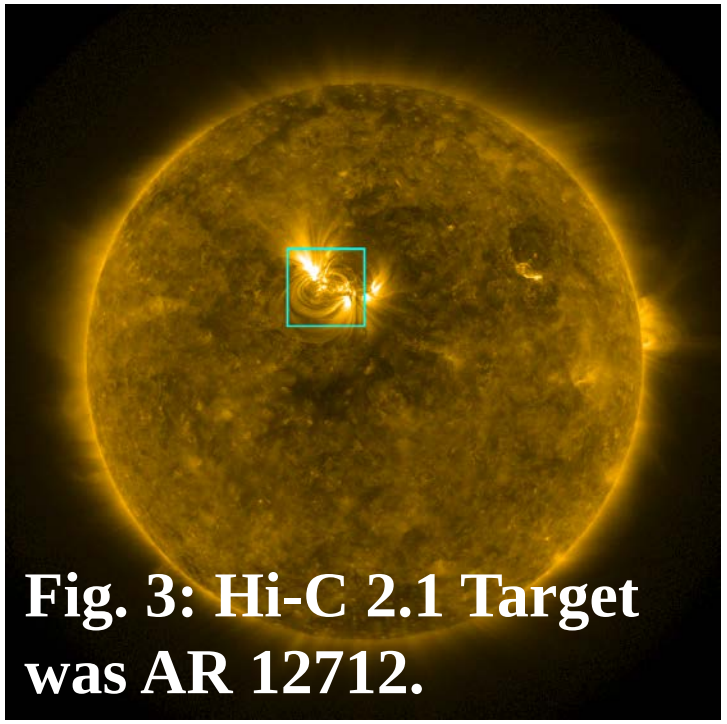


Fig. 3: Hi-C 2.1 Target was AR 12712.

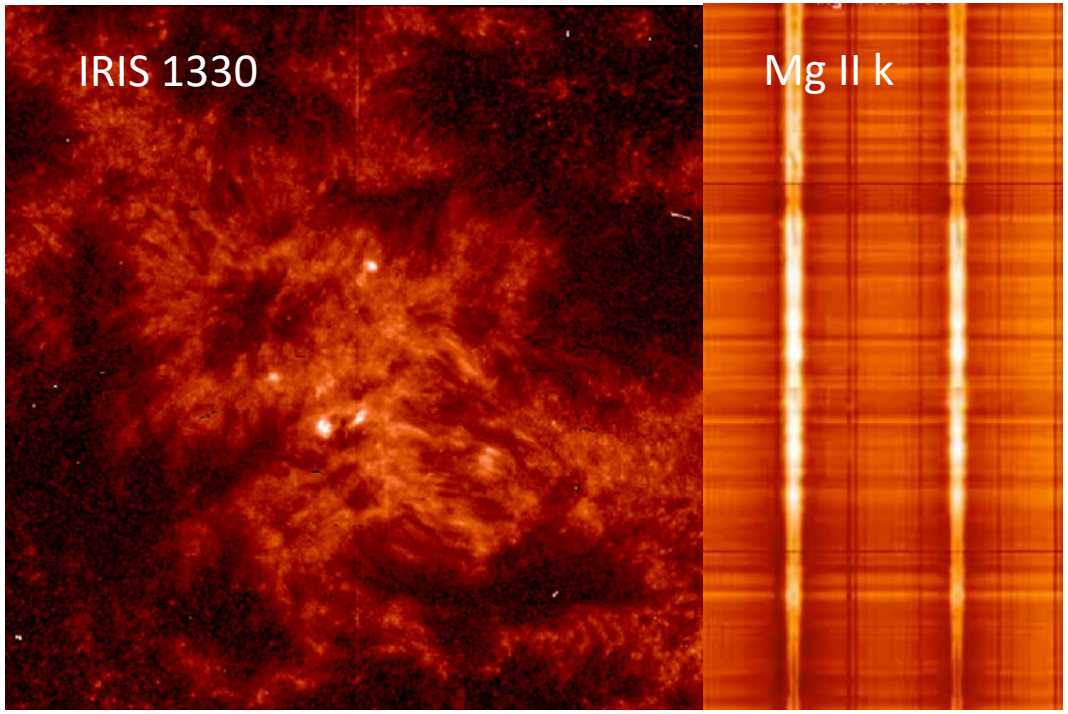


Fig. 4: Coordinated observations with IRIS.

Methodology

We have completed a preliminary comparison of the Hi-C 2.1 EUV images (imaging roughly 1 MK plasma) and the IRIS Slit Jaw images. We have identified:

1. Small, inter-moss loops that brighten for short times in one or both data sets (yellow),
2. Bright, steady regions of moss in the Hi-C data that are not particularly bright in the IRIS data (green), and
3. Bright steady regions in the IRIS moss images that brighten sporadically in the Hi-C data (blue).

See Figure 5.

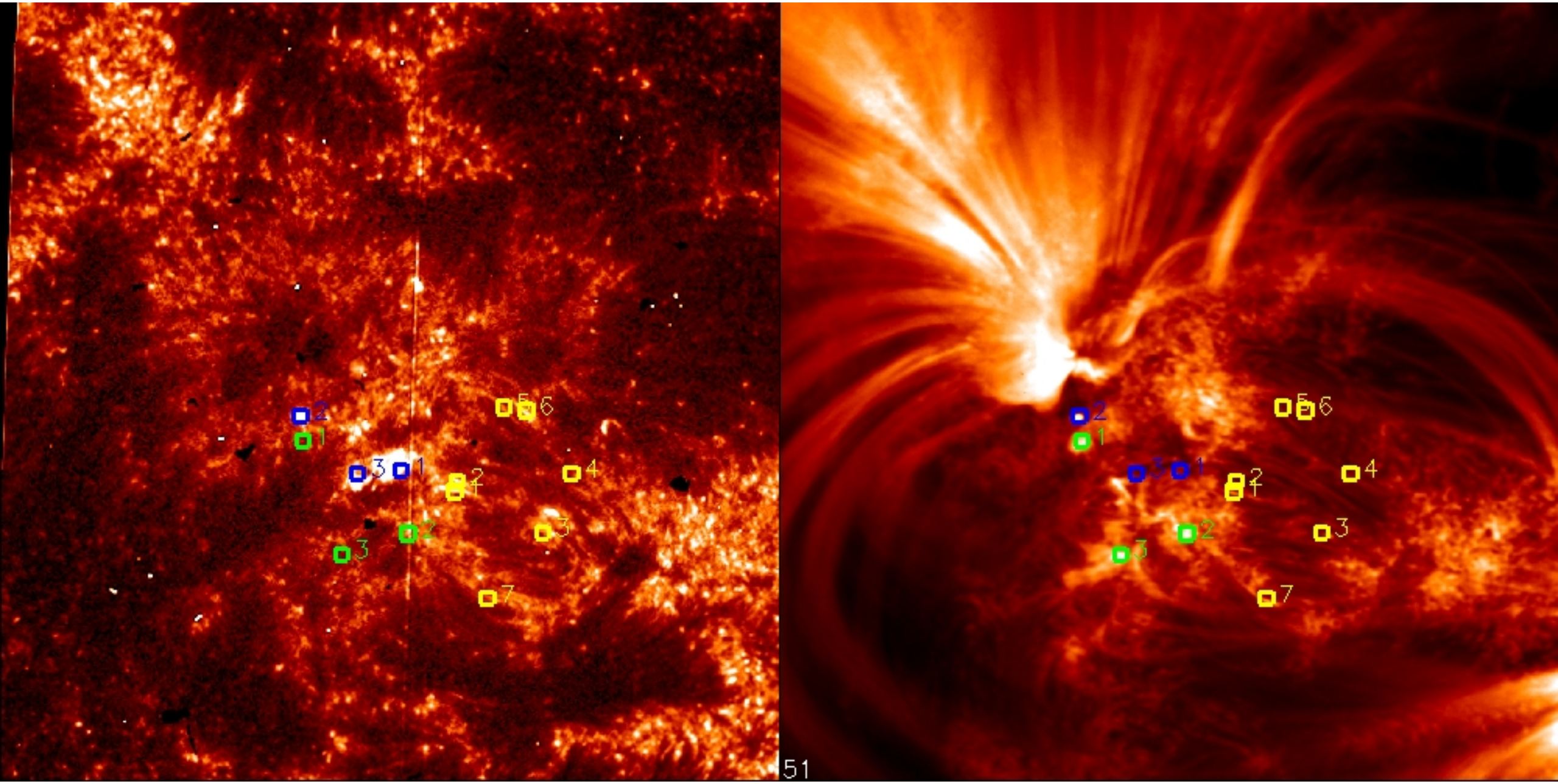
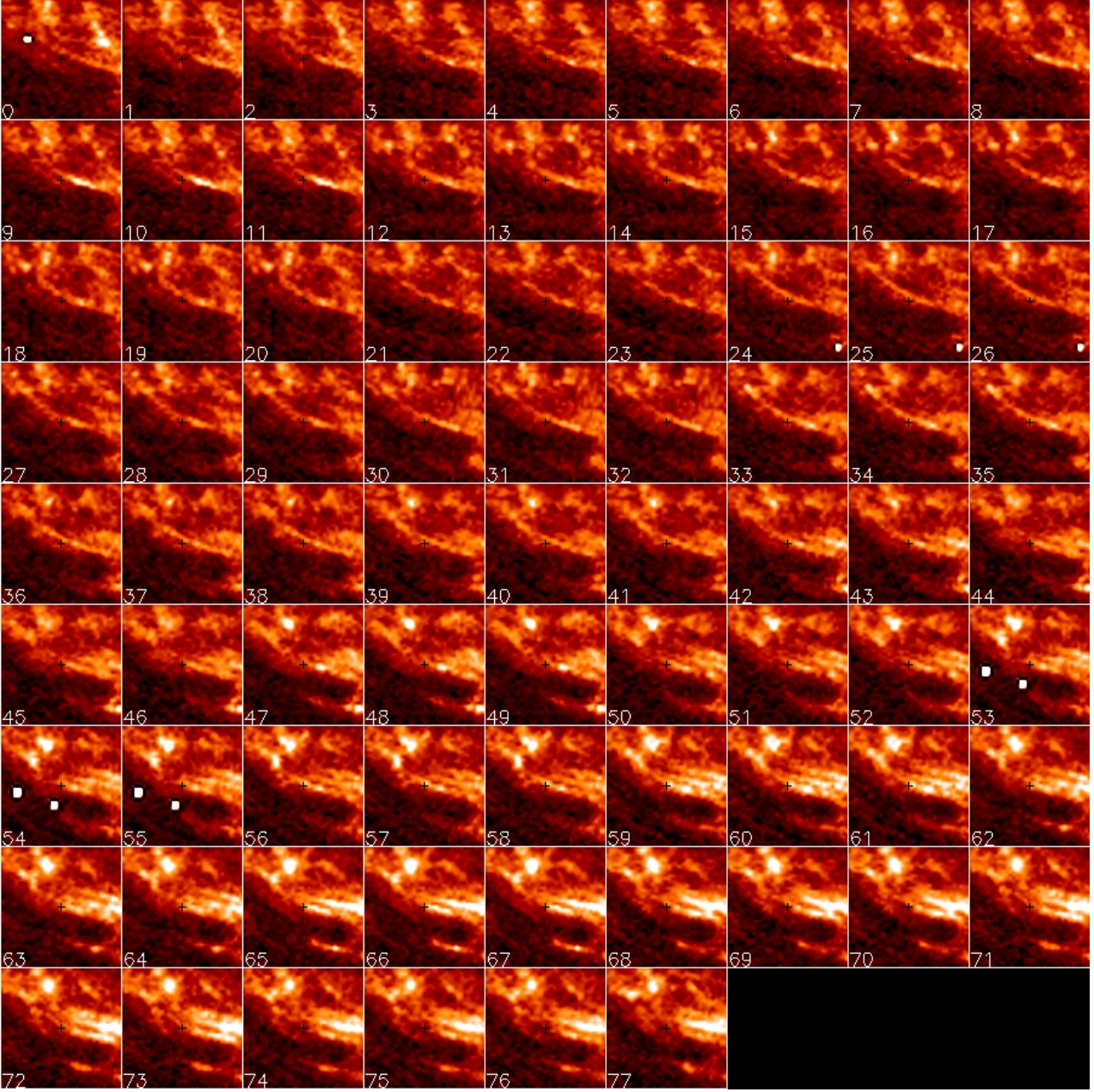


Fig. 5: Aligned IRIS 1400 SJ data (left) and Hi-C 2.1 data. The boxes indicate regions of investigation.

Intermoss loops

- We identified seven intermoss loops.
- These loops brighten and/or fade over the ~5 minutes of Hi-C data.
- Most loops have signatures in both data sets. Figures 6 and 8 shows an example of a loop that brightens in both Hi-C and IRIS.
- One short lived loop brightened in Hi-C without a corresponding structure in IRIS. This is shown in Figures 7 and 9.
- Intermoss loops that appear in both data sets are likely cool loops that may be out of ionization equilibrium.
- Intermoss loops that appear only in the Hi-C data set are likely warm (~1 MK) loops. The IRIS SJ data may show the classic transition region of these loops after additional analysis.
- These observations are likely indicative of small scale, short lived reconnection occurring in the active region core.



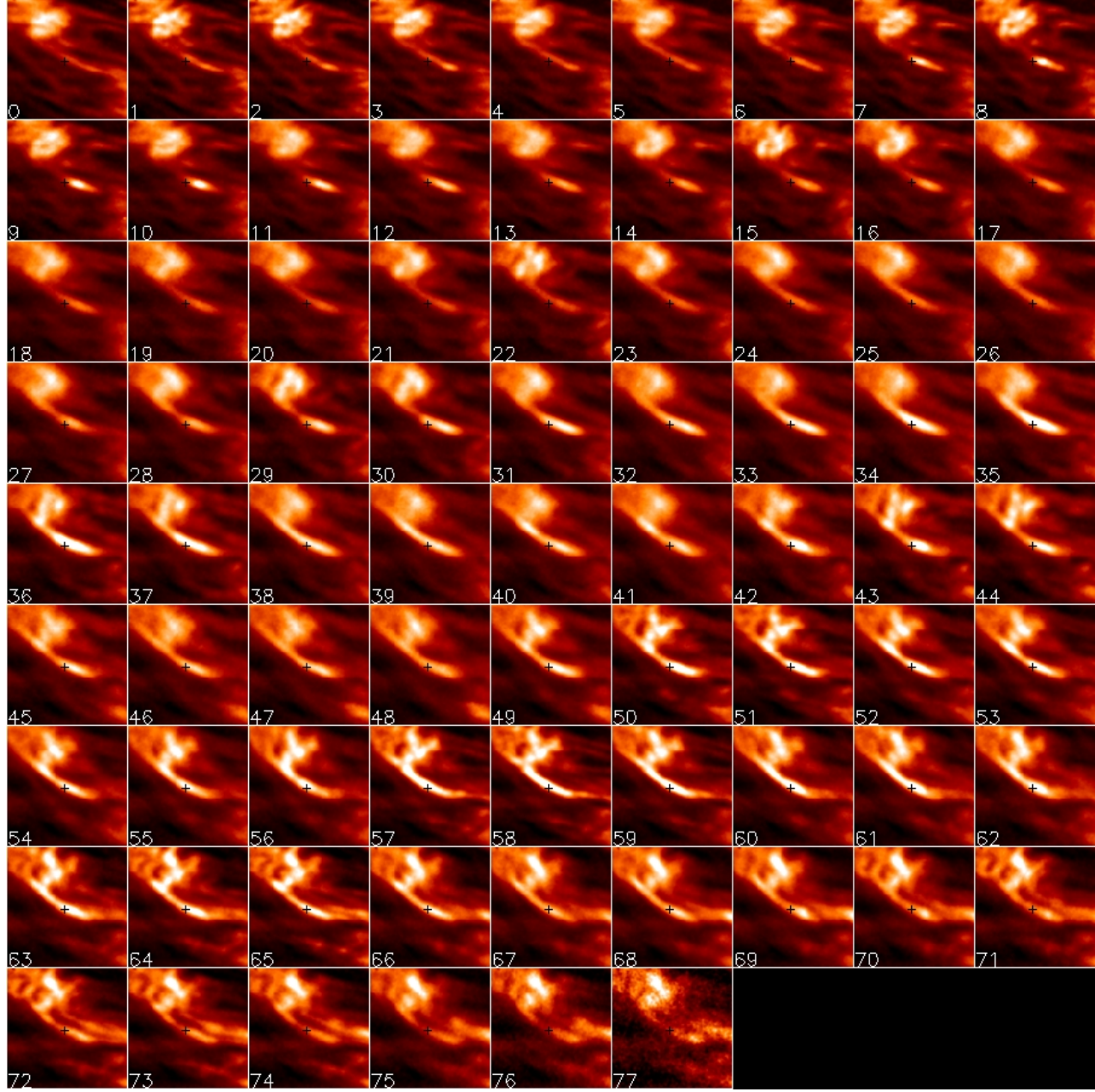
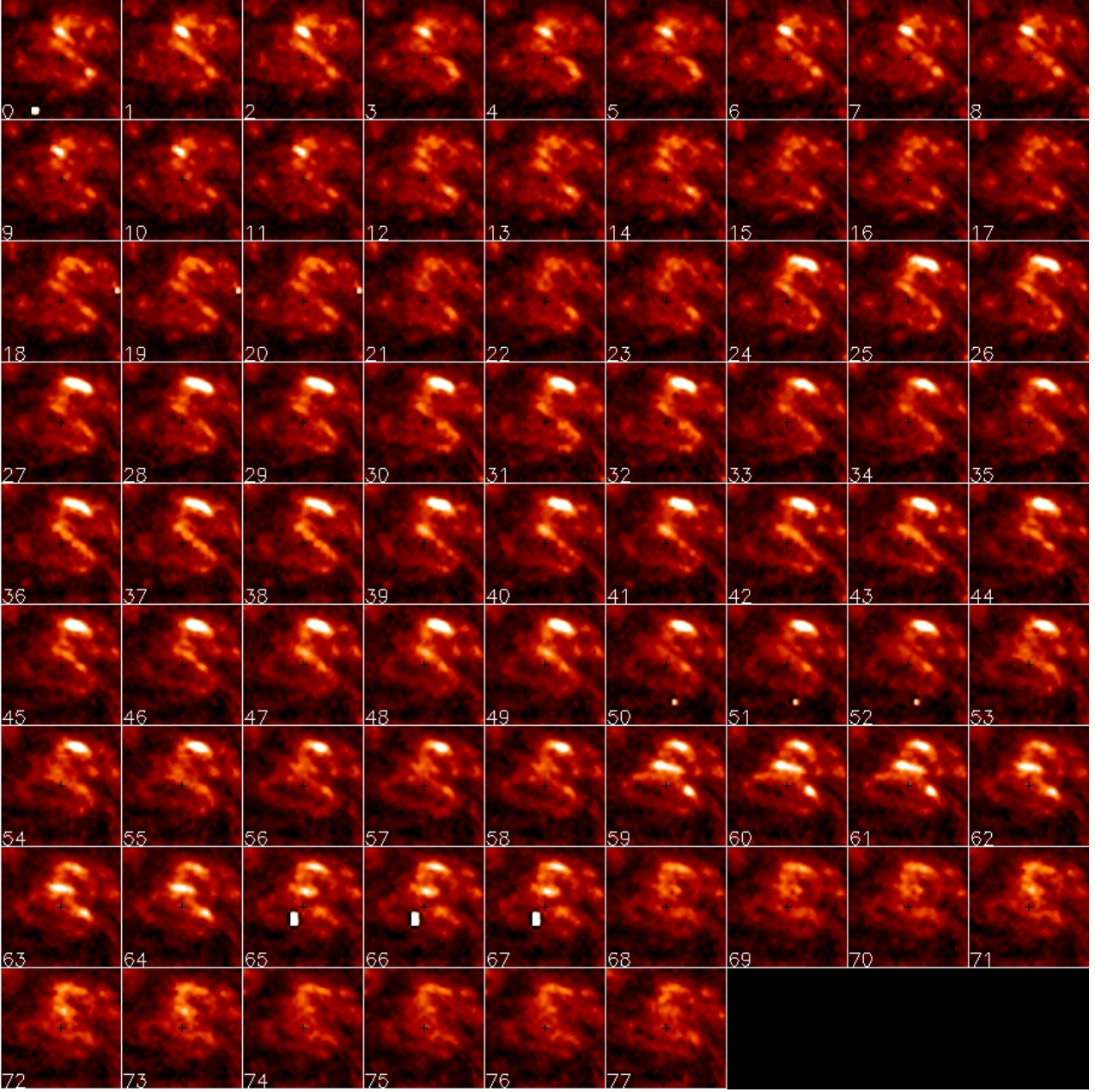


Fig. 6: IRIS 1400 SJ data (left) and Hi-C 2.1 data for Loop 7. The cursor indicates a loop that brightens in both data sets. The light curve of this loop is shown in Figure 8.



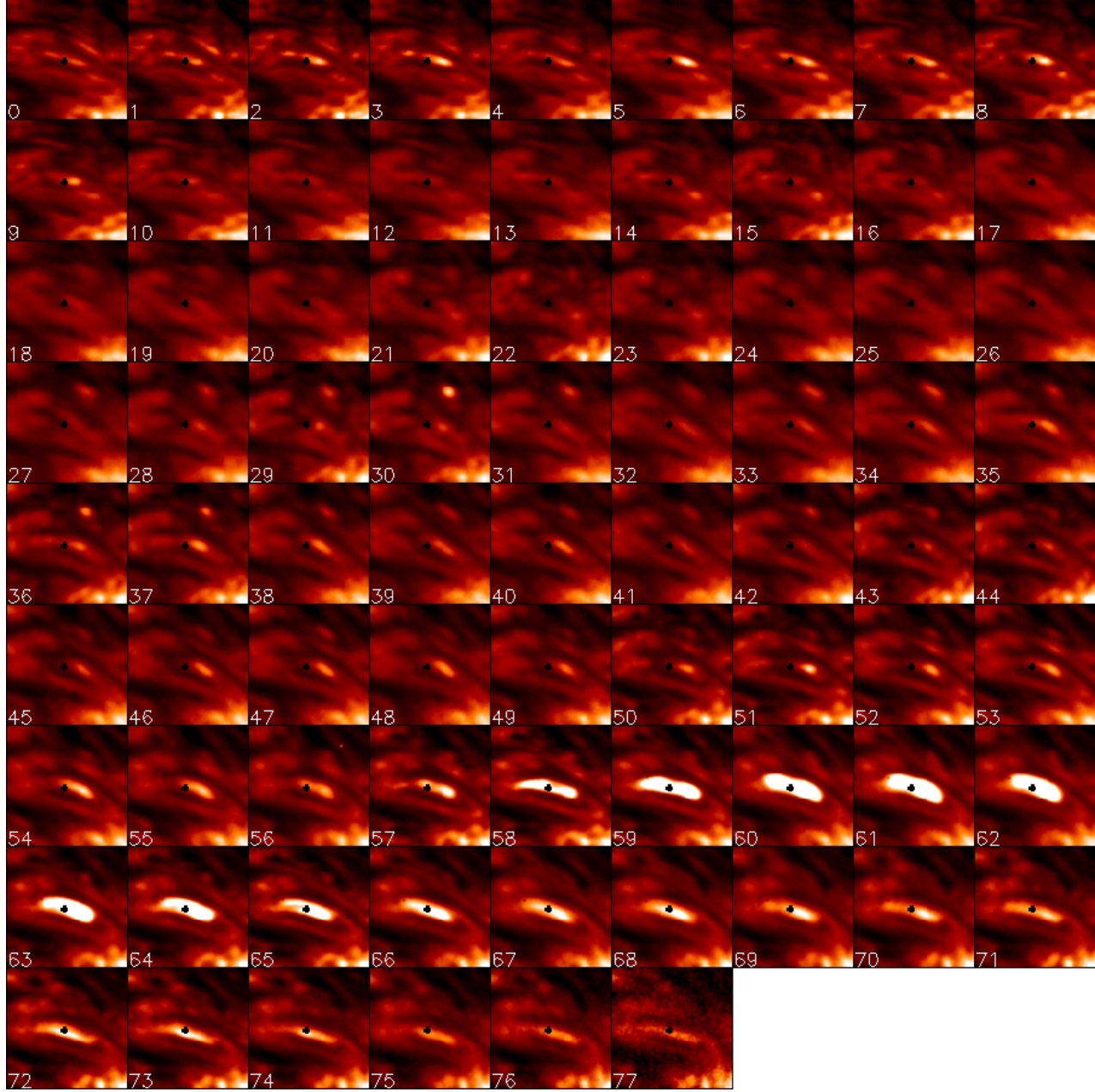


Fig. 7: IRIS 1400 SJ data (left) and Hi-C 2.1 data for Loop 3. The cursor indicates a loop that brightens in the Hi-C data sets in frames 56-76. There is not a corresponding structure in IRIS. The light curve of this loop is shown in Figure 9.

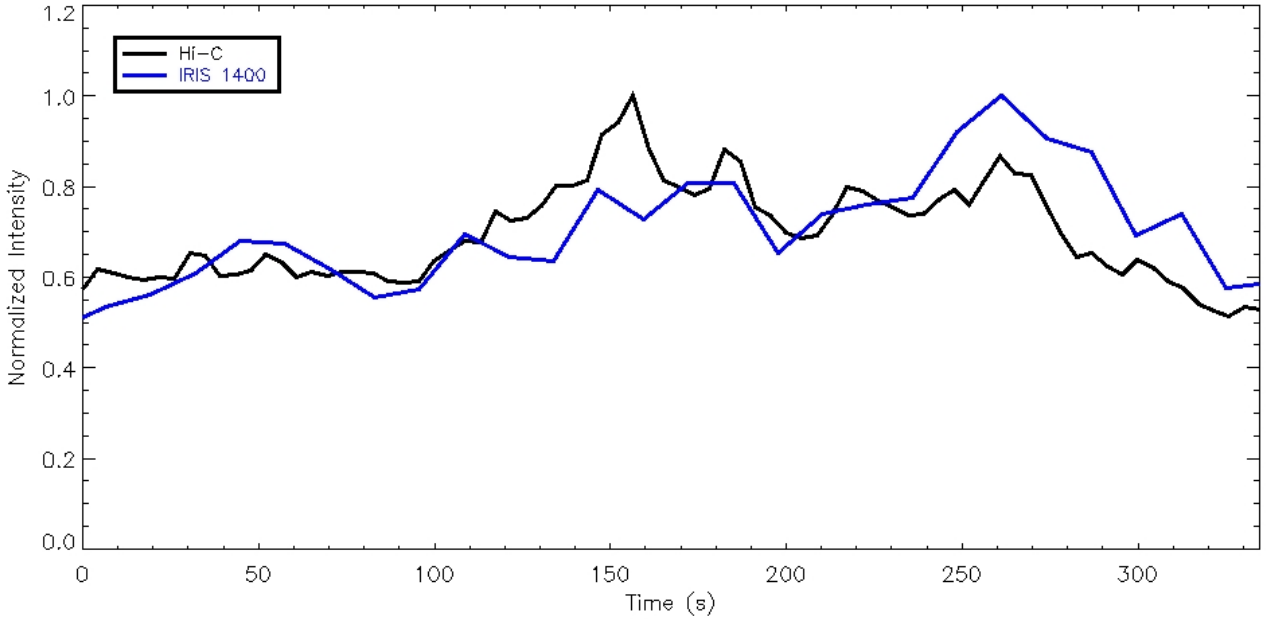


Fig. 8: Hi-C 2.1 (black) IRIS 1400 SJ (blue) light curve for Loop 7. Time is given from Hi-C 2.1 launch time. The loop is apparent in both instruments the entire launch time, but brightens twice.

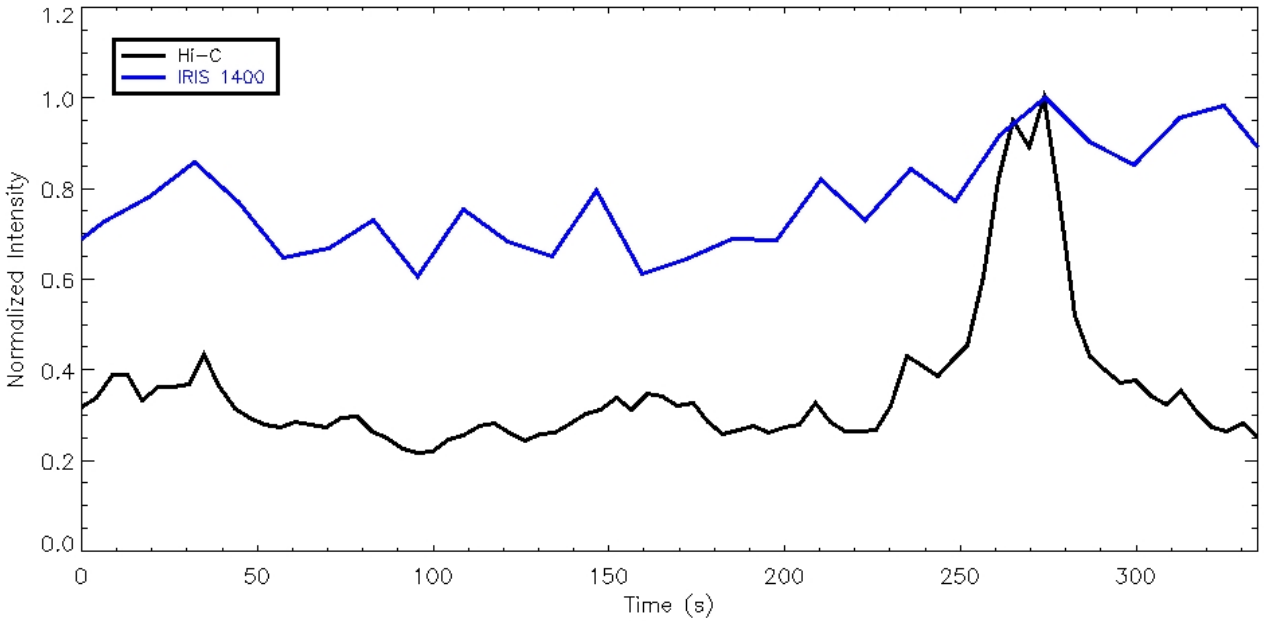


Fig. 9: Hi-C 2.1 (black) IRIS 1400 SJ (blue) light curve for Loop 3. Time is given from Hi-C 2.1 launch time. The loop is short lived and brightens around 270 s in Hi-C.

Bright Steady Moss Regions in Hi-C

- We identified three regions that are bright in the Hi-C moss that have no corresponding bright feature in the IRIS 1400 SJ moss.
- An example of these regions is shown in Figure 10.
- The lack of a clear observational relationship between the upper transition region imaged in Hi-C and the mid-transition region imaged in the IRIS 1400 SJ images is curious and needs further investigation.

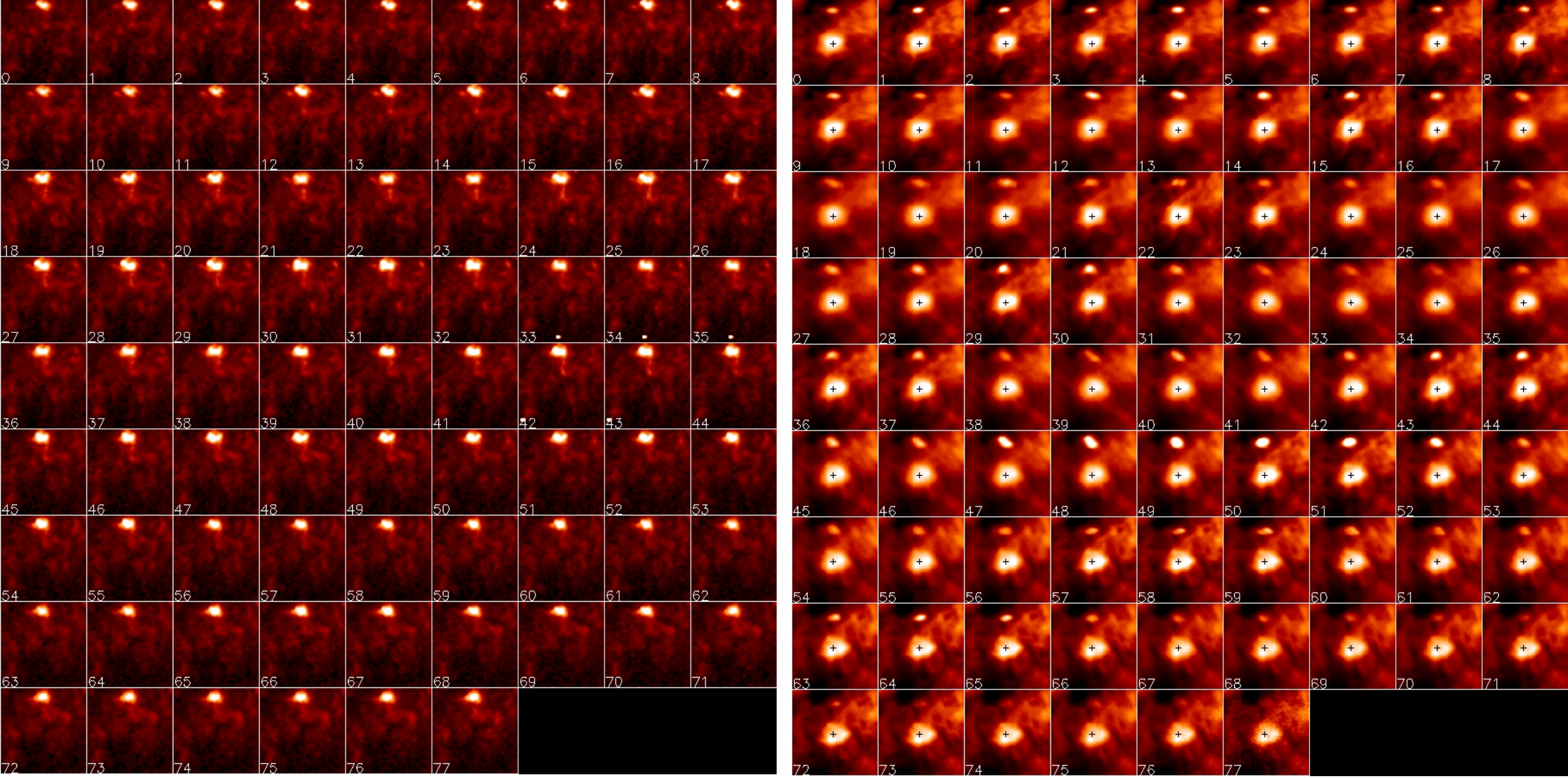


Fig. 10: IRIS 1400 SJ data (left) and Hi-C 2.1 data for the bright steady Hi-C moss region labeled #1 in green in Figure 5.

Bright Steady Moss Regions in IRIS

- We identified three regions that are bright in the IRIS moss that brighten sporadically in the Hi-C moss.
- An example of these regions is shown in Figure 11, the light curve is in Figure 12.
- These events may indicate transition region plasma being heated to coronal temperatures and feeding hot loops.

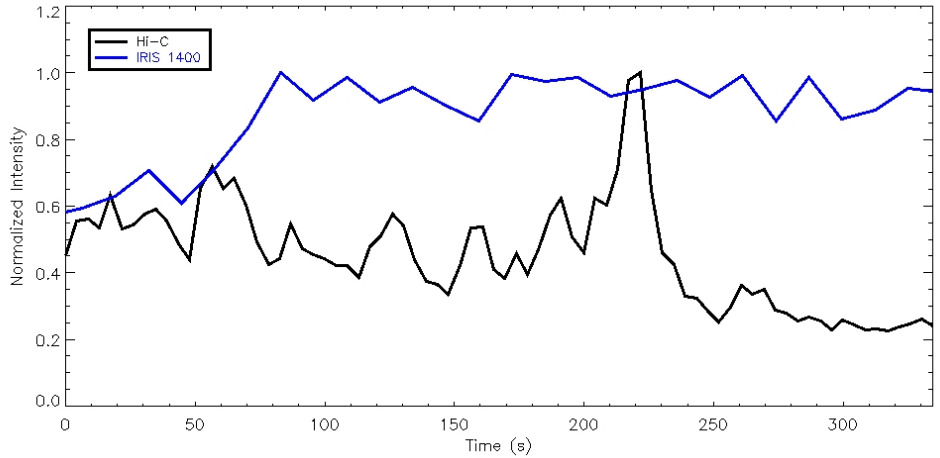


Fig. 12: Hi-C 2.1 (black) IRIS 1400 SJ (blue) light curve for the IRIS moss region 2 (blue boxes in Figure 5) . Time is given from Hi-C 2.1 launch time. The moss is bright and steady in IRIS over most of the flight, but brightens sporadically in Hi-C 2.1 data.

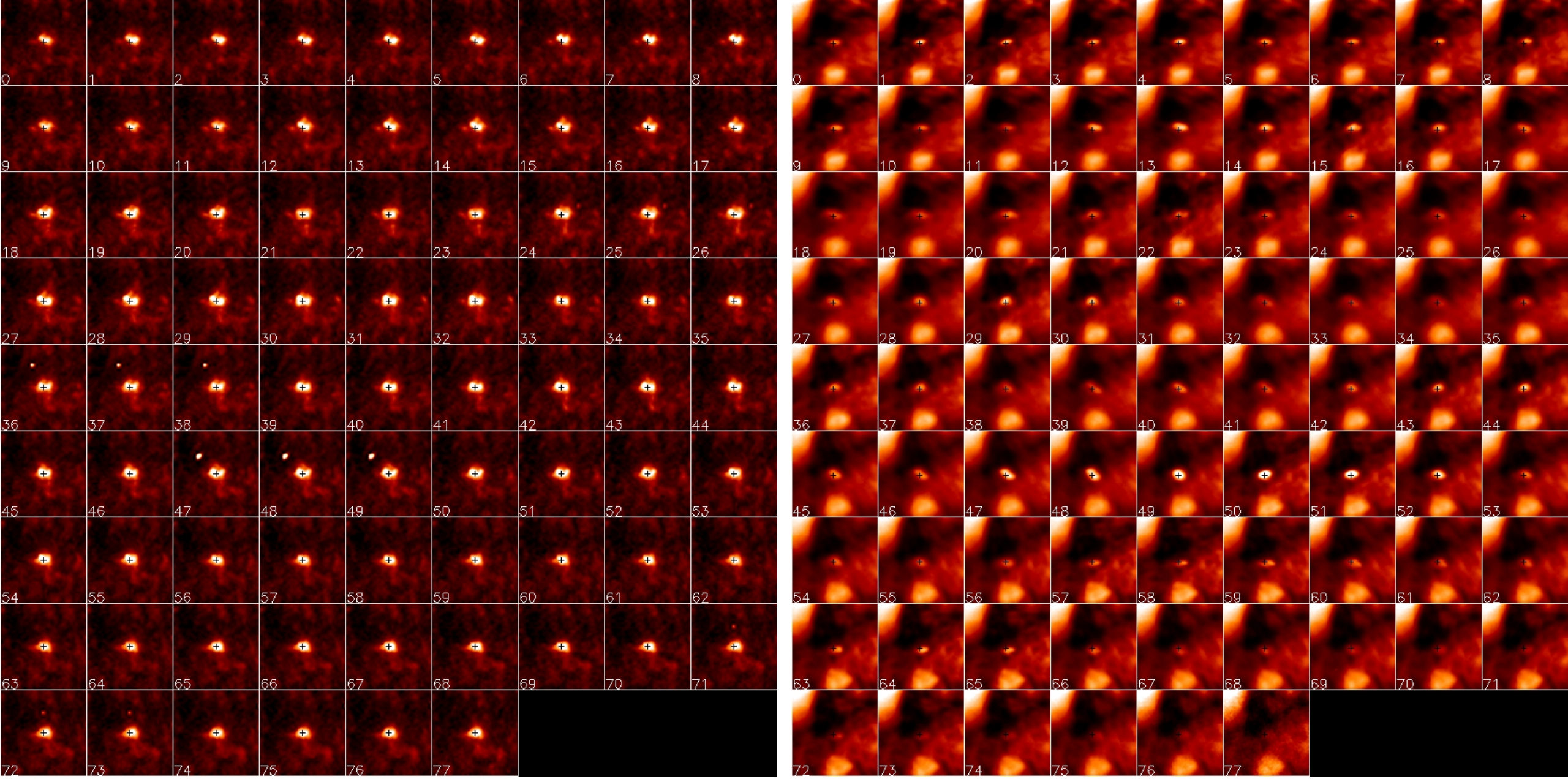


Fig. 10: IRIS 1400 SJ data (left) and Hi-C 2.1 data for the bright steady IRIS moss region labeled #2 in blue in Figure 5.

Conclusions

- The primary goal of the Hi-C 2.1 launch was to trace mass and energy through the transition region and corona.
- This goal will be accomplished by careful comparison of the IRIS and Hi-C data sets.
- We have presented a preliminary analysis in this poster of the types of structures we are investigating. Conclusions about the different structures are given in red on the previous slides.

The Hi-C team

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