

# More Interesting Than You Thought: IRIS Observations of Explosive Events



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# Abstract

Transition region explosive events (EEs) are characterized by line broadenings (to the blue or red or both) with nonthermal velocity  $\sim 100\text{km/s}$ . They are widely attributed to reconnection, though their nature is still obscure and some observers have reported rotary motion. The transition region is an excellent laboratory to study reconnection in a solar context, with high emission measure in the reconnection region, a high event rate, and optically thin spectral lines. The Interface Region Imaging Spectrograph (IRIS) has observed many explosive events in Si IV and C II. We describe the substructure of supersonic flows in EEs observed by IRIS, and their morphology as revealed by IRIS slit jaw images.

PDF with embedded movies:

<http://solar.physics.montana.edu/kankel/EE/>

# Introduction

Explosive events are defined observationally as follows:

1. Transition region line broadening in excess of sound speed (e.g.,  $> 40$  km/s for Si IV).
2. Supposed to be small (typ  $< 5000$  km).
3. Prominent in Si IV (63,000 K) and C IV (100,000 K).
4. Observed in transition region lines from C II (20,000 K) to O V (250,000 K).

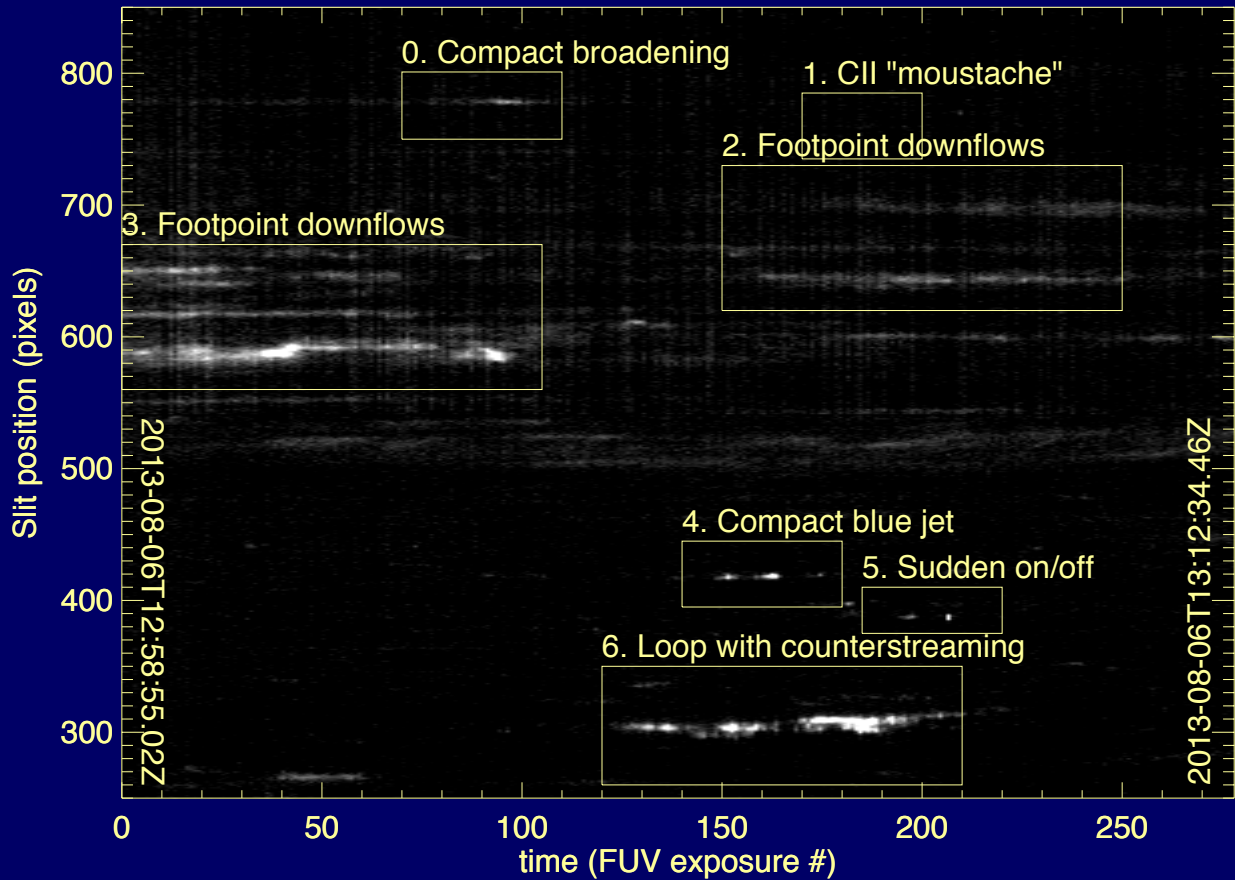
**Objective:** Use IRIS slit jaw imager (SJI) in conjunction with FUV spectra to investigate reconnection in the transition region.

# IRIS Data

- 2013-Aug-6 12:58:55-13:12:34 UT
- 2s Exposures, 3s cadence
- FUV (& NUV) spectra
- SJI 1330, 1400, 2796 alternating.
- Data reduction: Level 1 → IRIS\_PREP (flats, darks, geometrical correction).

This presentation emphasizes Si IV and C II FUV spectra, and SJI 1400.

# Event Detection: Si IV > 100 DN @ |v| > 60 km/s



# Compact Event

SJI 1400 Å  
(31000 km wide cutout)

Si IV  
(±137 km/s)

C II  
(±117 km/s)

0. Compact broadening



2013-08-06T13:03:05.96Z

C II blue wing precursor 13:02:33-13:03:15.

0. Compact broadening



2013-08-06T13:03:36.34Z

EE in Si IV 13:03:15-13:04:05.

# Self-Absorbed C II Event

1. C II "moustache"



2013-08-06T13:08:03.09Z

Compact, mainly C II.

Self-absorbed, no brightening in line core (very low).

Profile is nearly symmetric. Reconnection low in the atmosphere may encounter neutrals.

# More Compact Events

## 4. Compact blue jet



2013-08-06T13:06:54.87Z

Predominant blue shift. C II is not self-absorbed.

## 5. Sudden on/off



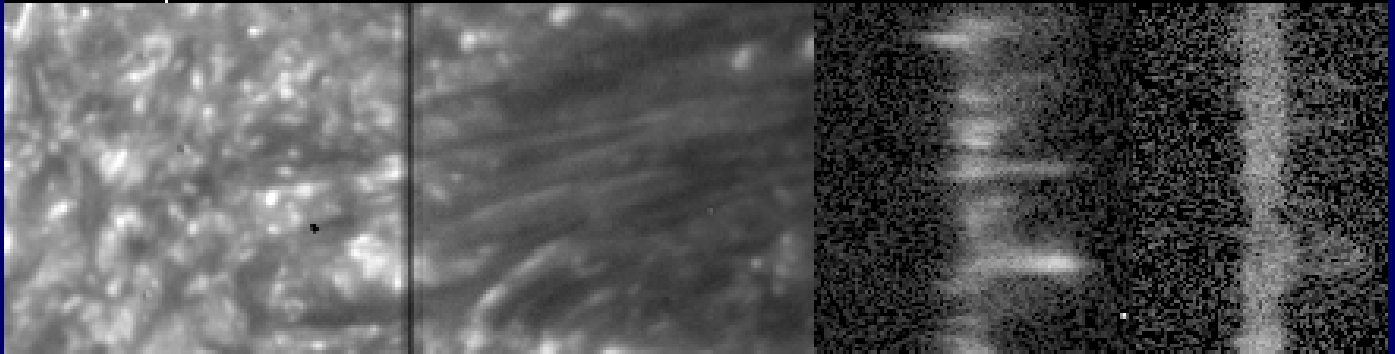
2013-08-06T13:09:05.17Z

Two pulses. The second is very fast, lifetime  $< 4$  s.



# Loop Footpoint Downflows

## 3. Footpoint downflows

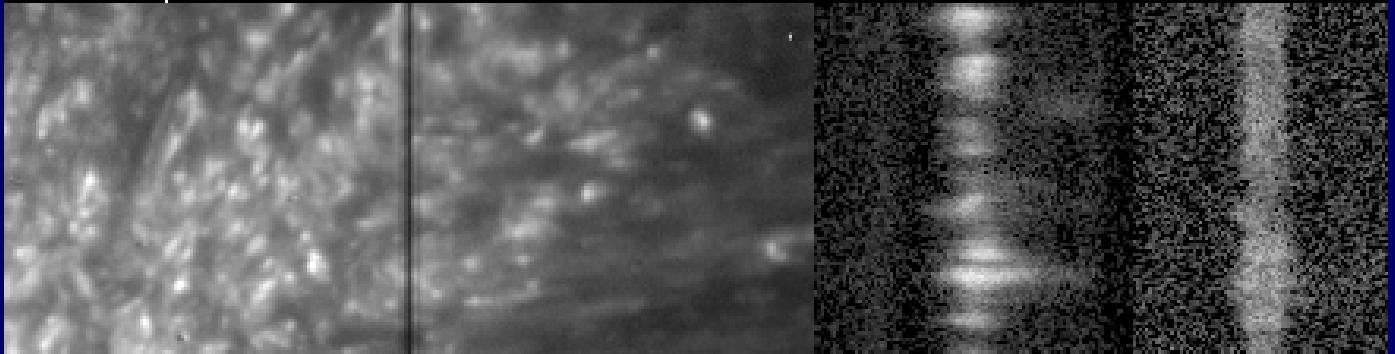


2013-08-06T13:00:50.77Z

The red shifted bits are apparently in the foreground.  
Also some compact events in the vicinity.

# More Loop Footpoint Downflows

2. Footpoint downflows

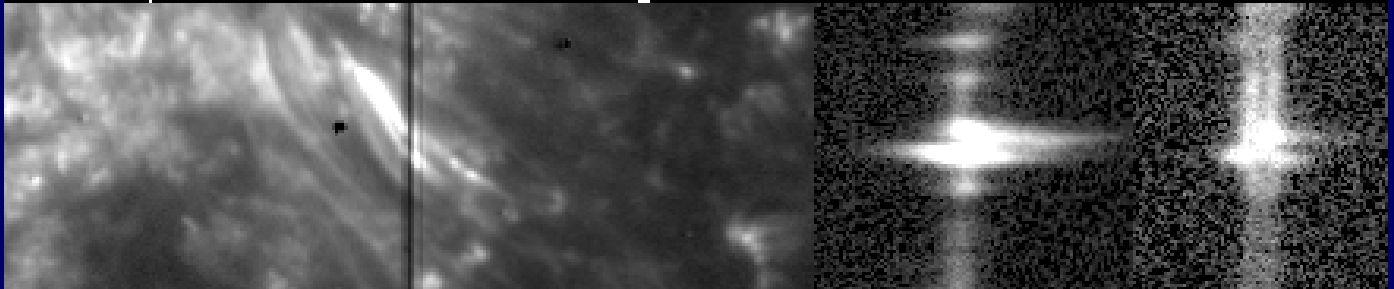


2013-08-06T13:09:37.43Z

These satisfy the observational definition of explosive events, including small apparent size on the slit. SJI images show that they are part of extended structures.

# Counterstreaming Loop Flows

6. Loop with counterstreaming



2013-08-06T13:08:03.09Z

More loops crossing the slit, this time with bursty flows, alternating red and blue shifts.

Could this be reconnection along a separator field line?

# Conclusions

- “Explosive Events” correspond to multiple different phenomena.
- Compact features:
  - Events appear to be localized in height, but occur over a range of heights (C II with or without self absorption, and Si IV).
  - Repetitive pulses observed in compact (few pixel) events, short as  $< 4$  s
- Extended loops/fibrils:
  - Emission in Si IV, C II
  - Intermittent, recurring downflows at footpoints
  - Rapidly reversing flows in reconnecting loops