

Exploring the Time Evolution of Cool Metallic Absorption Features in UV Burst Spectra

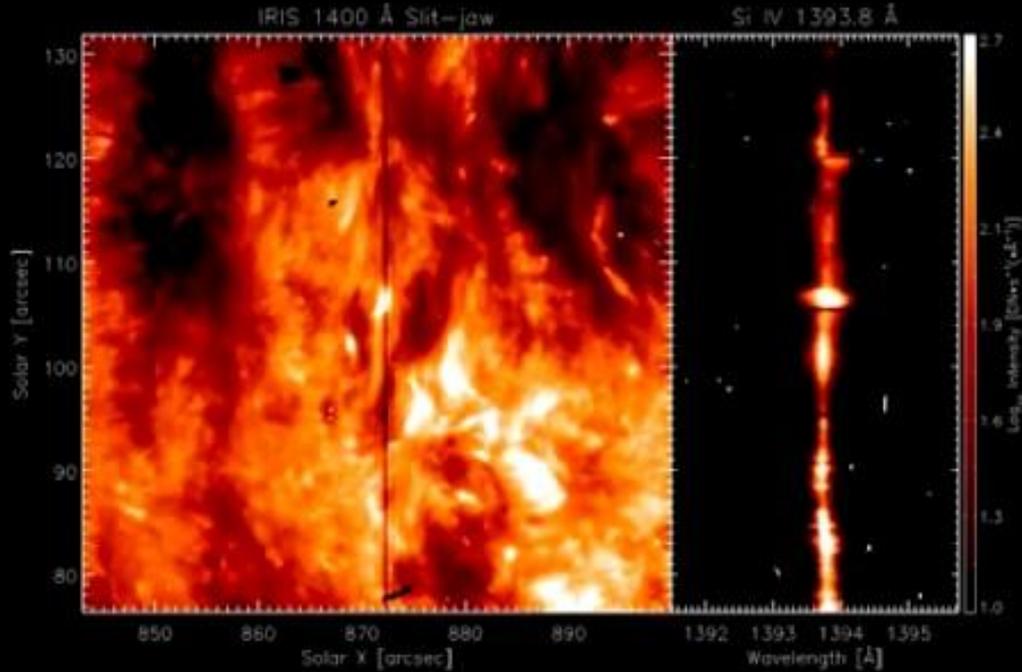
Harvard-Smithsonian Center for Astrophysics
Solar Research Experience for Undergraduates
Summer 2017



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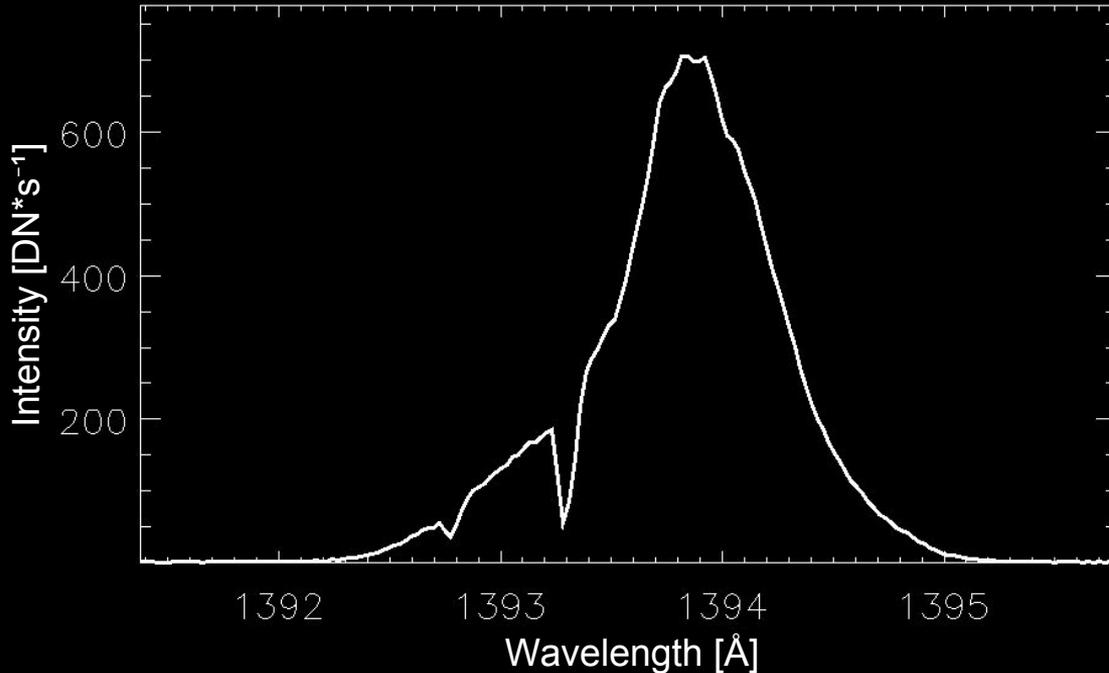
Background: What are UV bursts?

- Compact brightenings in active regions
- Appear in UV images



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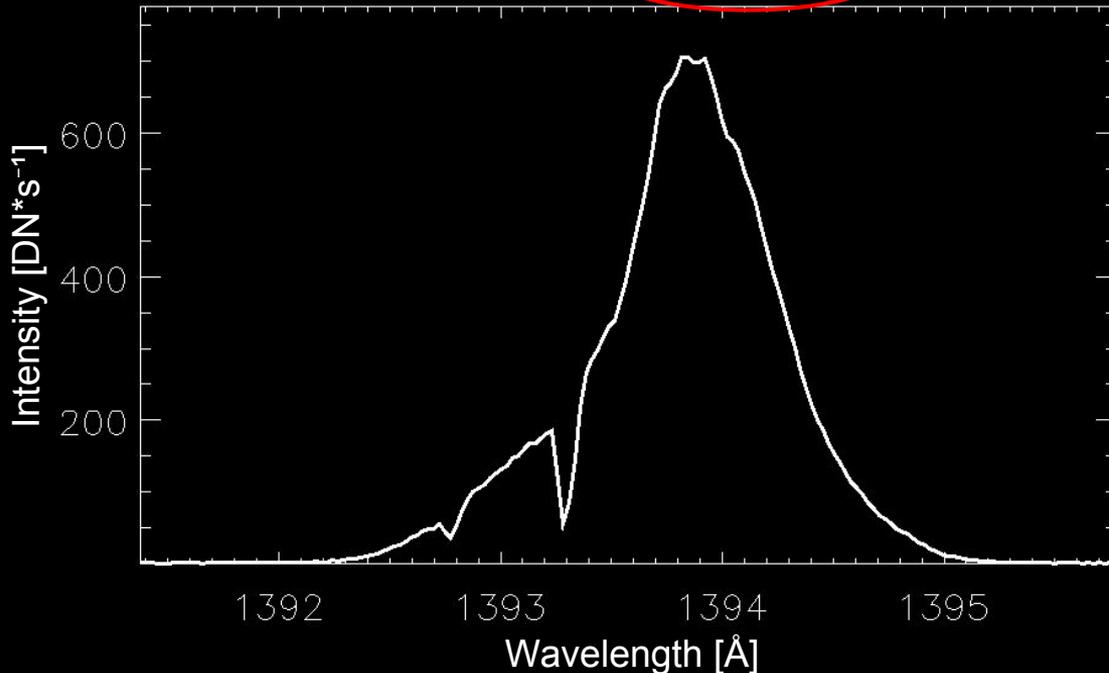
Line Profile



- Compact brightenings in active regions
- Appear in UV images
- Defined by three spectroscopic signatures:

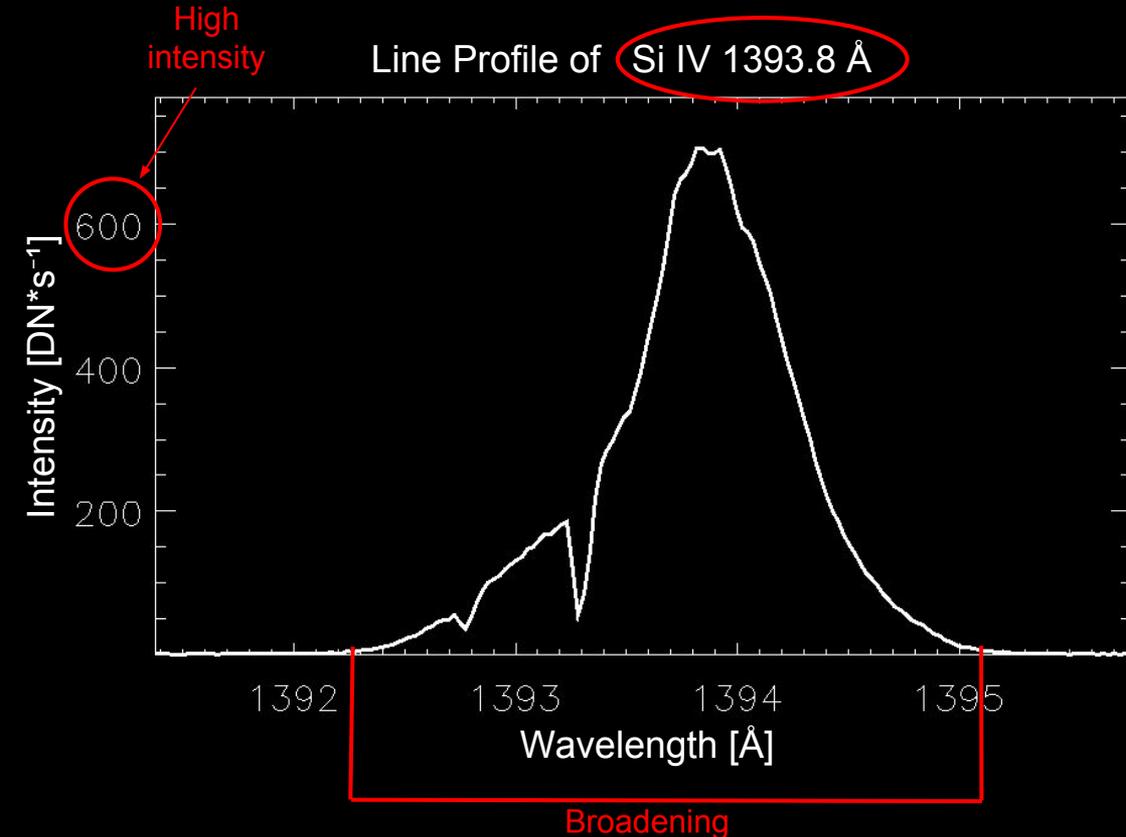
Background: What are UV bursts?

Line Profile of Si IV 1393.8 Å



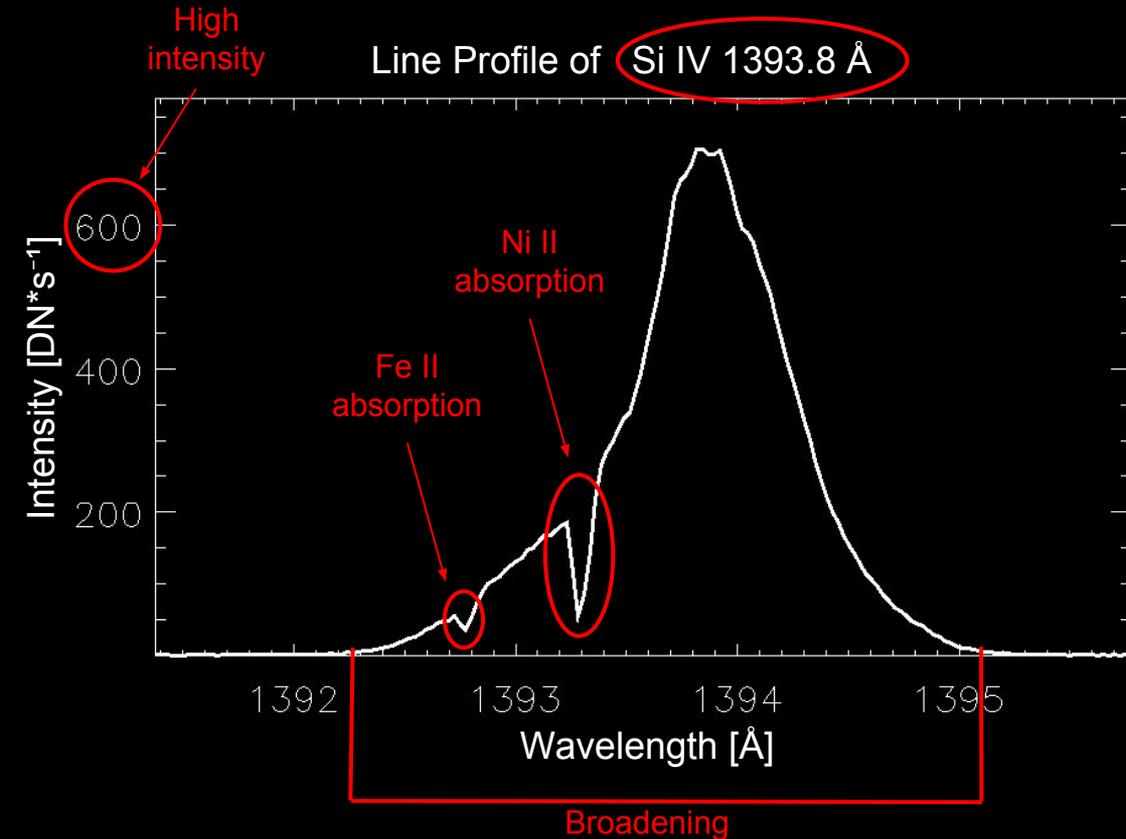
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 - Presence of **optically thin Si IV** emission lines
 - **Broadening and intensification** of NUV/FUV emission lines

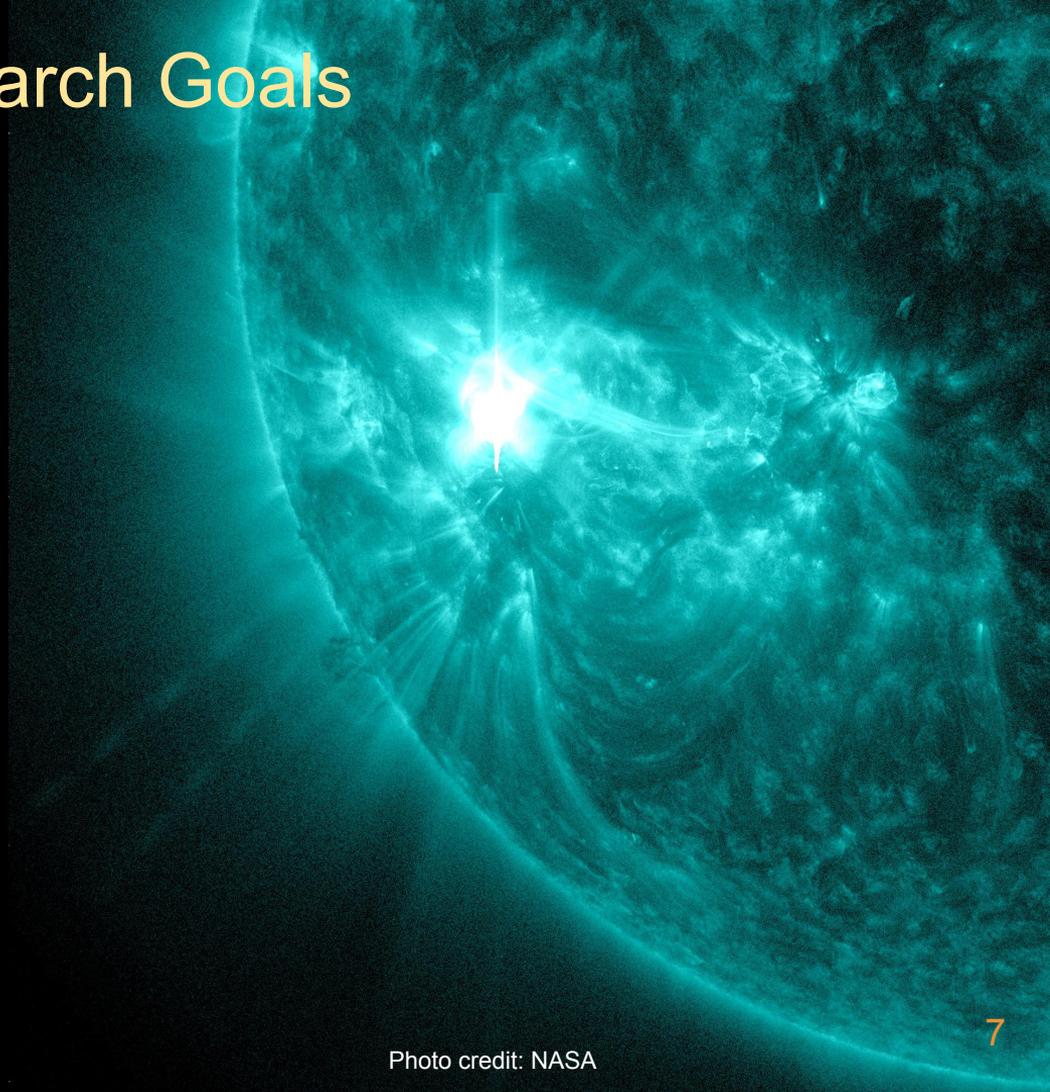
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- Defined by three spectroscopic signatures:
 - Presence of **optically thin Si IV emission lines**
 - **Broadening and intensification** of NUV/FUV emission lines
 - Presence of **cool metallic absorption features**

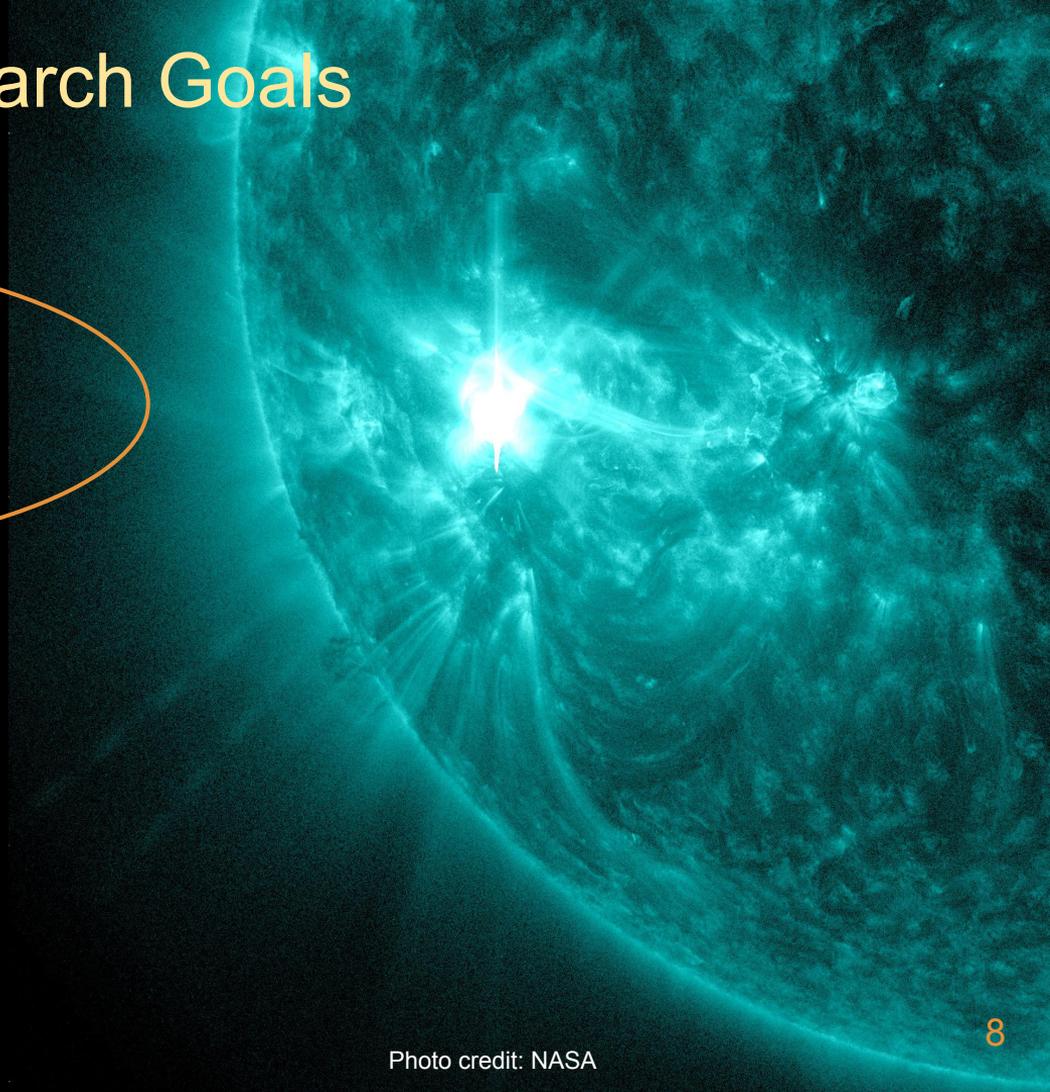
Research Goals

- **Ant's eye view**
 - Characterize UV bursts
 - Investigate time evolution of cool metallic absorption features in UV burst spectra
 - Look for signs of heating
- **Bird's eye view**
 - Better understanding of chromosphere
 - Possible contribution to chromospheric & coronal heating



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Data Source: IRIS

- Interface Region Imaging Spectrograph (IRIS): Space telescope that captures **spectral data** and **context imaging** (**slit-jaw images** or **SJI**) in NUV and FUV
- Unprecedented spatial and temporal resolution in UV
- Telescope built at Smithsonian Astronomical Observatory



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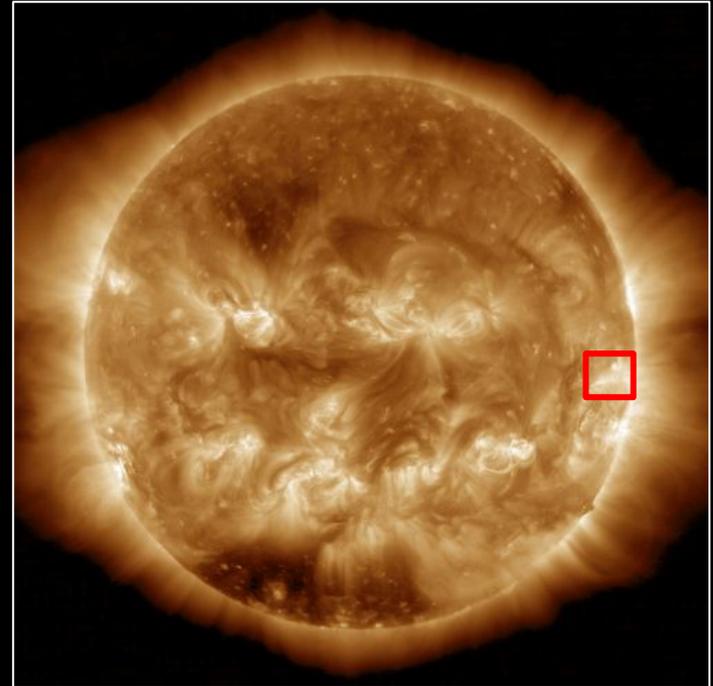
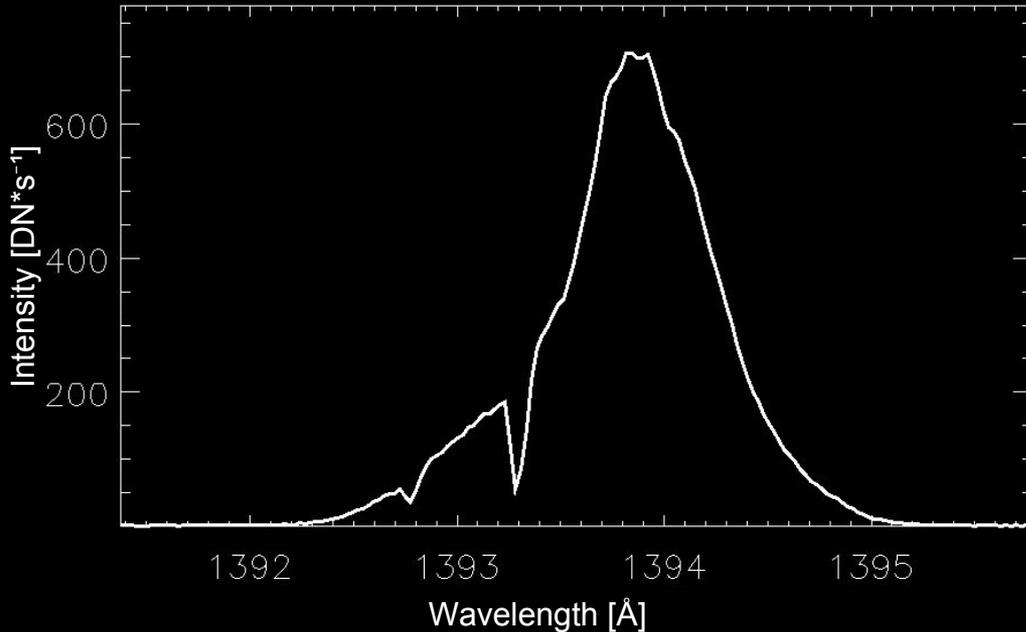
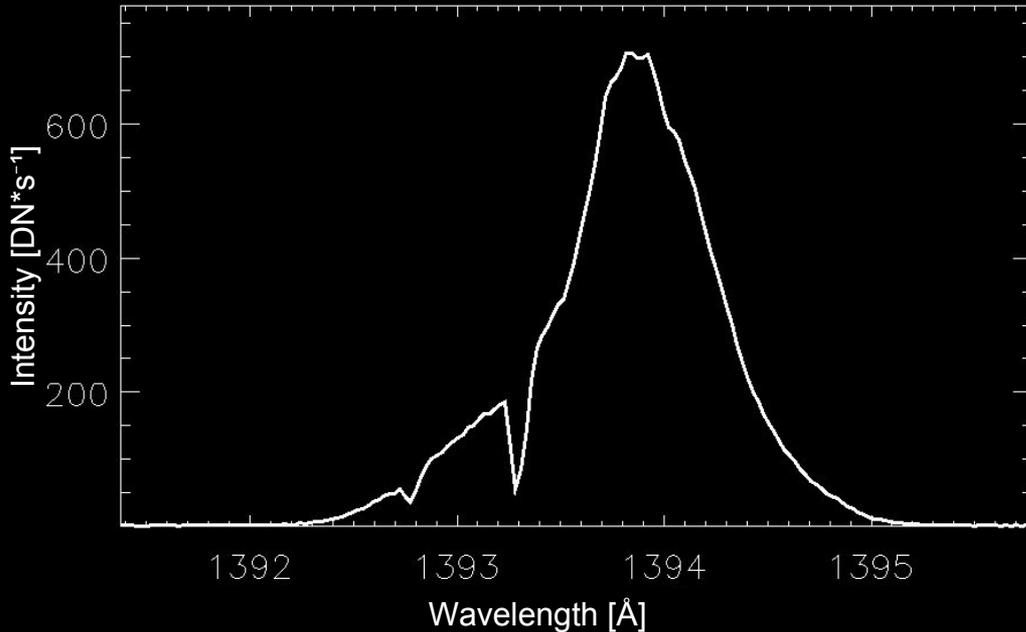


Photo credit: SDO/AIA

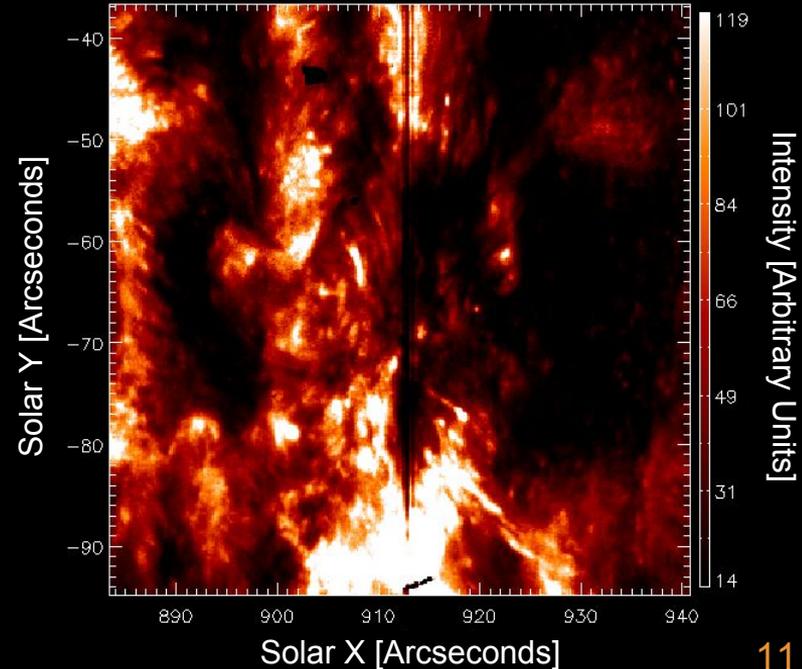
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Line Profile of Si IV 1393.8 Å



SJI 1330 Å 2014-10-08 16:28:44

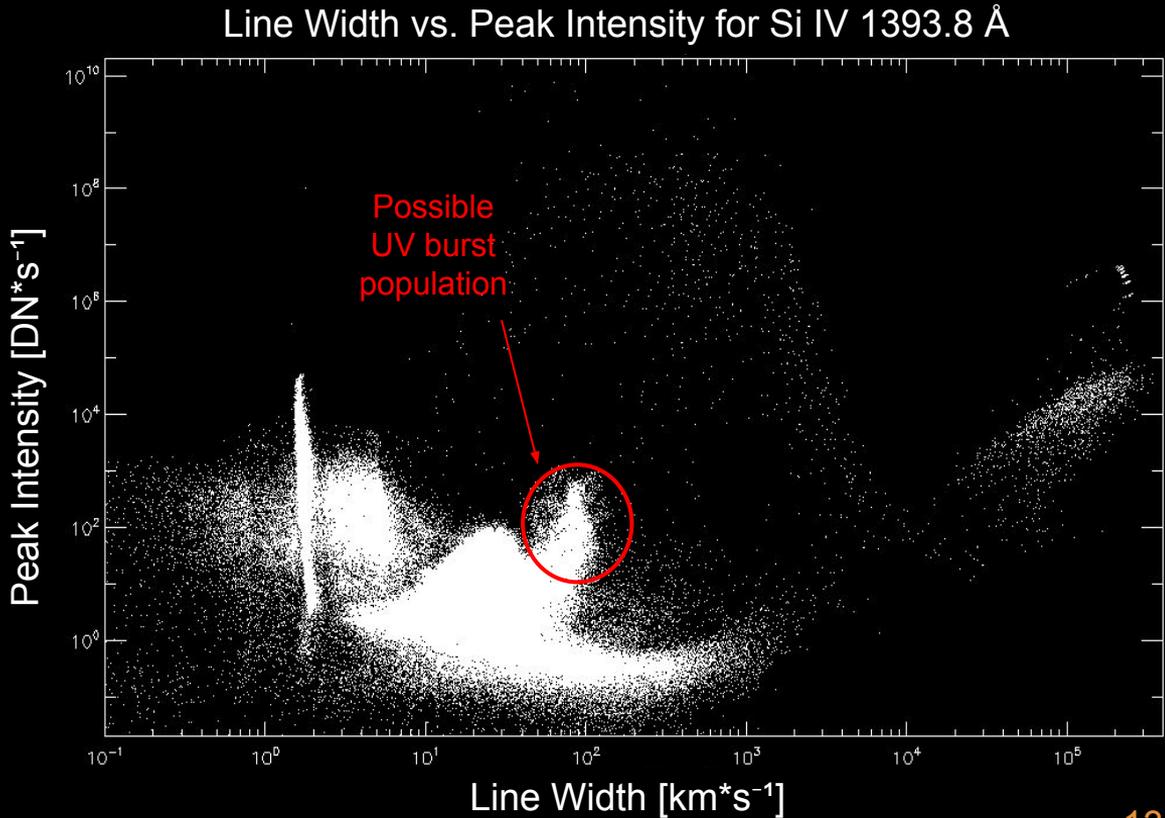


Data & Observations

- Began with 8 observations ranging from April-October 2014
 - Narrowed down to 3 observations with 4 UV bursts total
- Looked exclusively at Si IV 1393.8 Å spectral profiles for analysis
 - Stronger signal than 1402.8 Å
 - Optically thin
 - Cool metallic absorption features: Ni II & Fe II
- Sit-and-stare images
- High cadence: 5-9 seconds

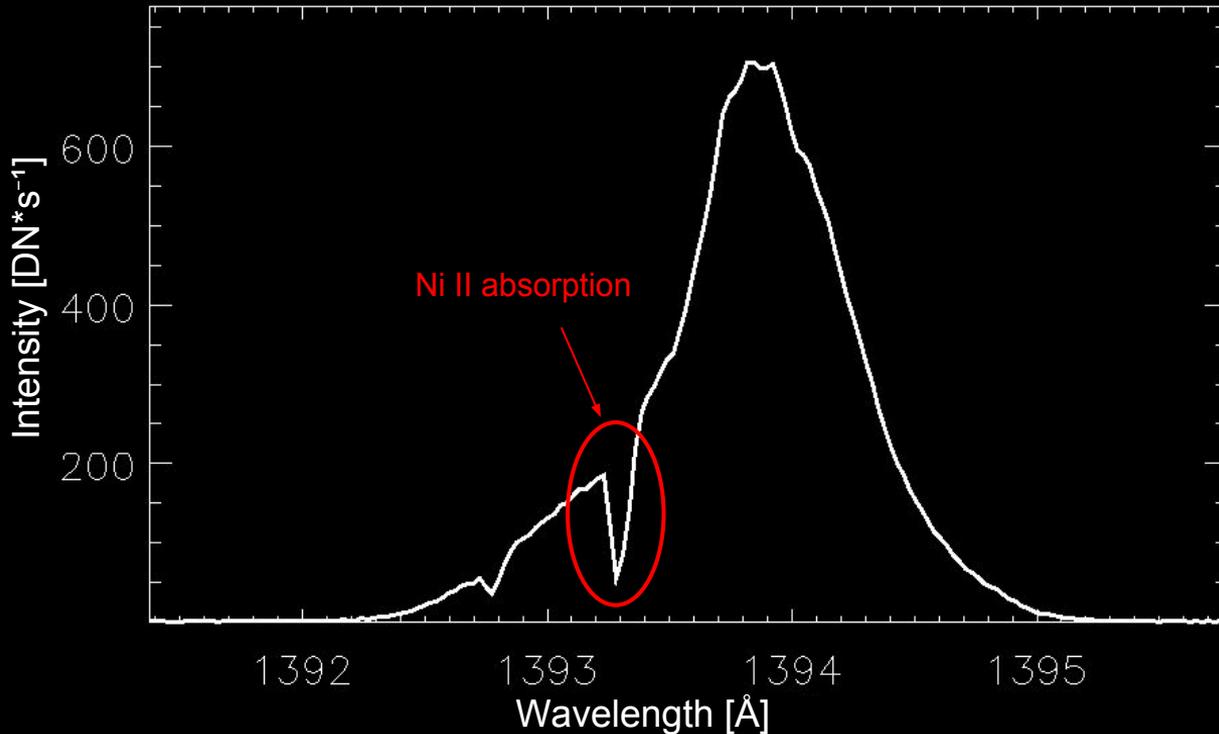
Detecting UV Bursts - Phase I: Group Isolation

- Applied four-parameter Gaussian fits to spectral profiles
- Constructed Line Width vs. Peak Intensity plots
 - Made cuts in parameter space



Detecting UV Bursts - Phase II: Individual Detection

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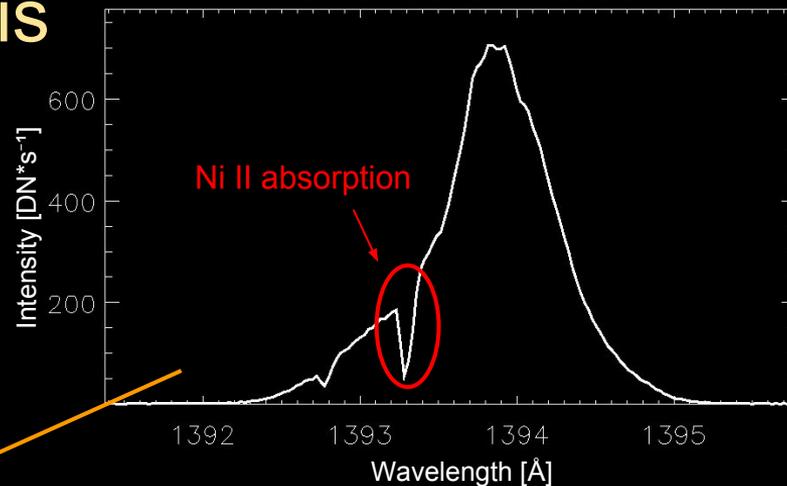


- Looped through remaining spectral profiles corresponding to UV bursts
- Manually looked for **Ni II absorption** by eye
- Extracted 4 UV bursts total

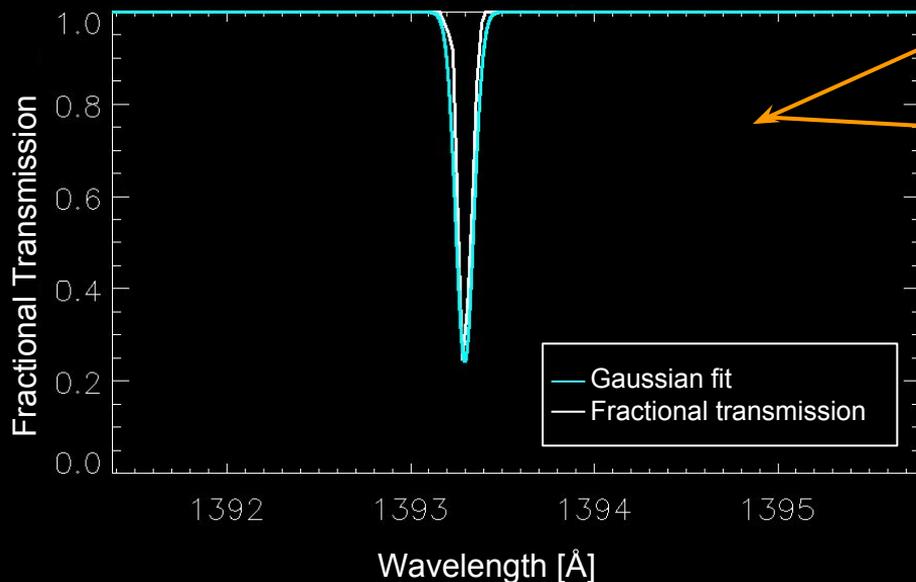
Analysis

- **Normalized Si IV 1393.8 Å profiles**
 - Measured maximum fractional extinction

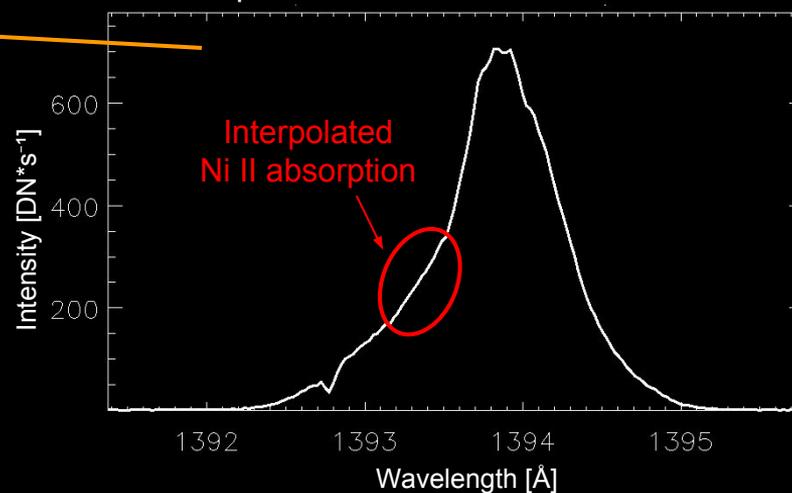
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Fractional Transmission for Ni II 1393.3 Å

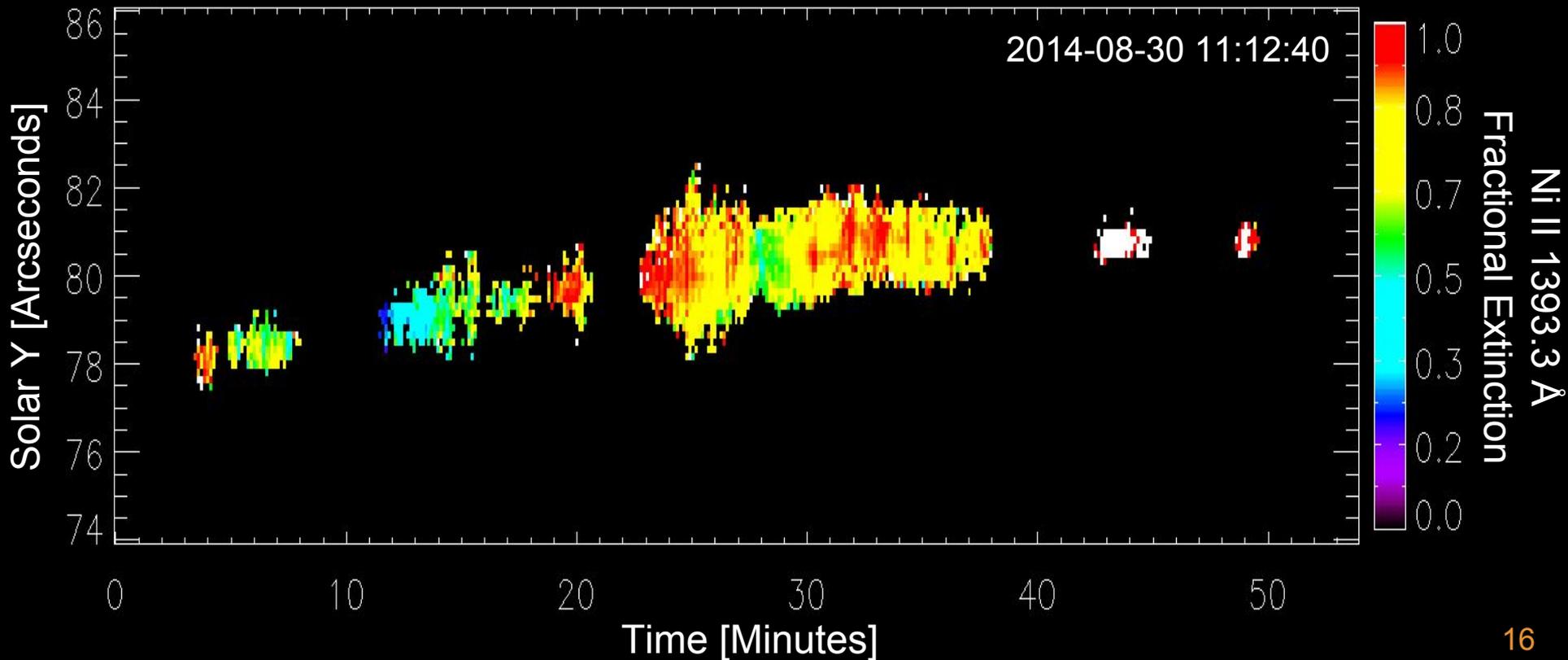


Interpolated Line Profile of Si IV 1393.8 Å

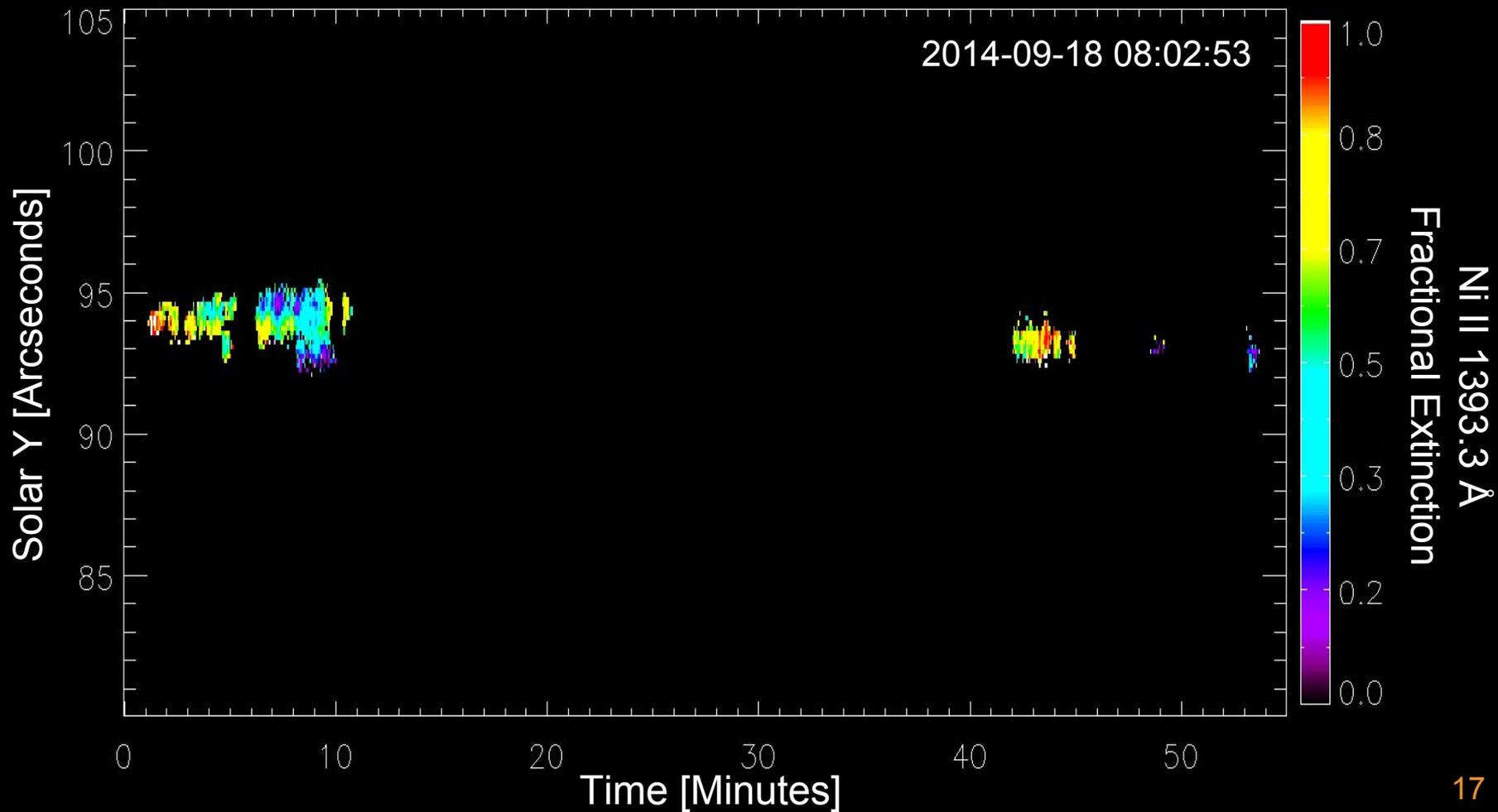


Results

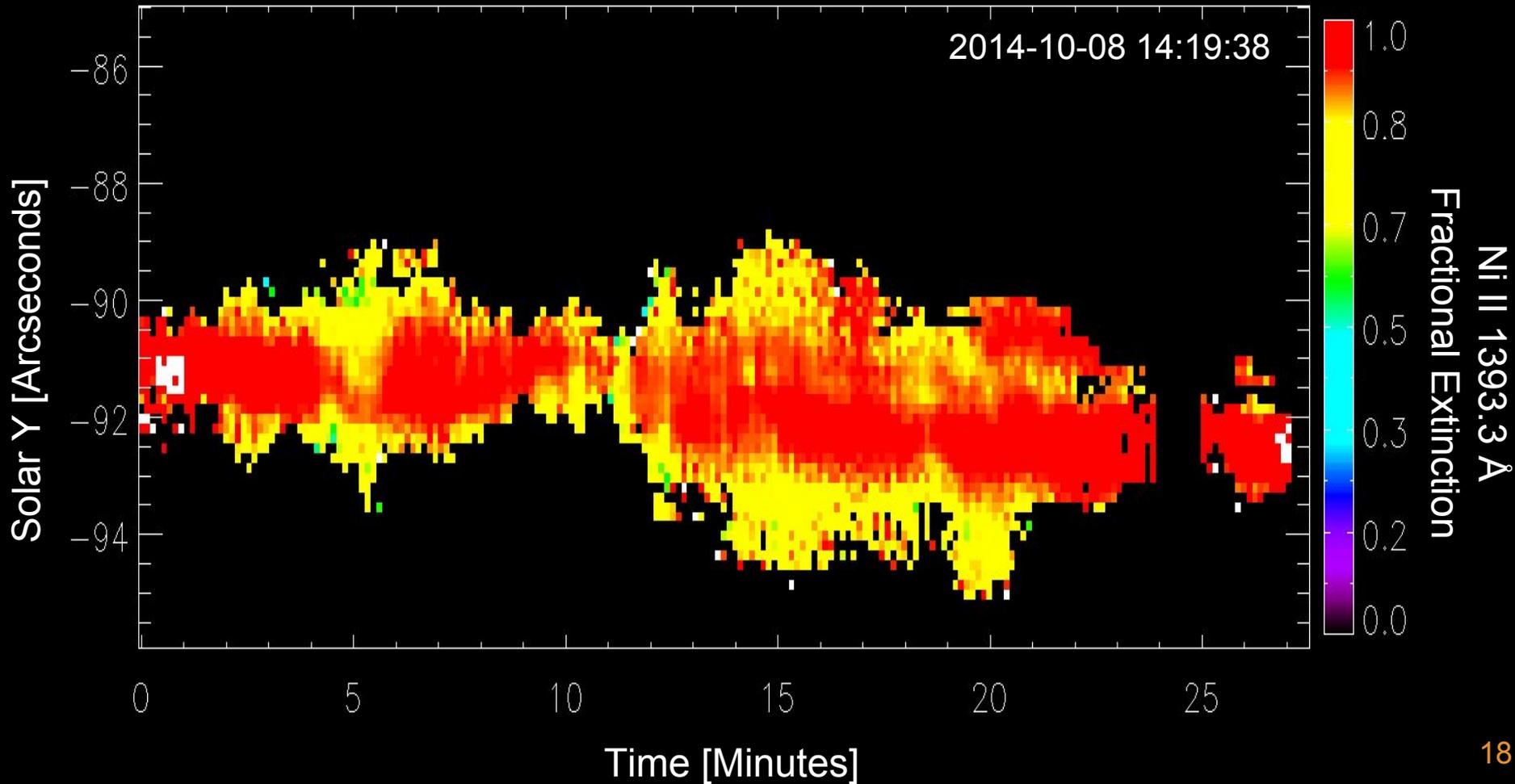
Space-time Plot of Peak Ni II 1393.3 Å Fractional Extinction



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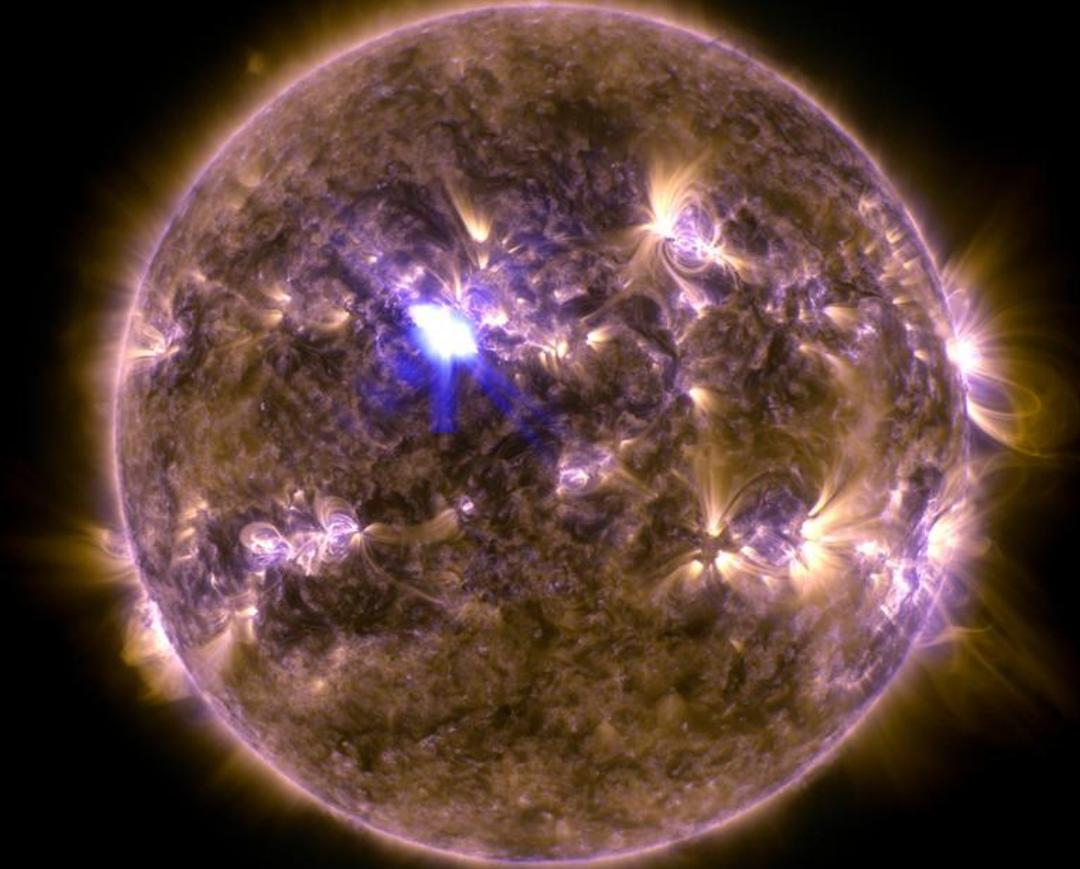


Space-time Plot of Peak Ni II 1393.3 Å Fractional Extinction

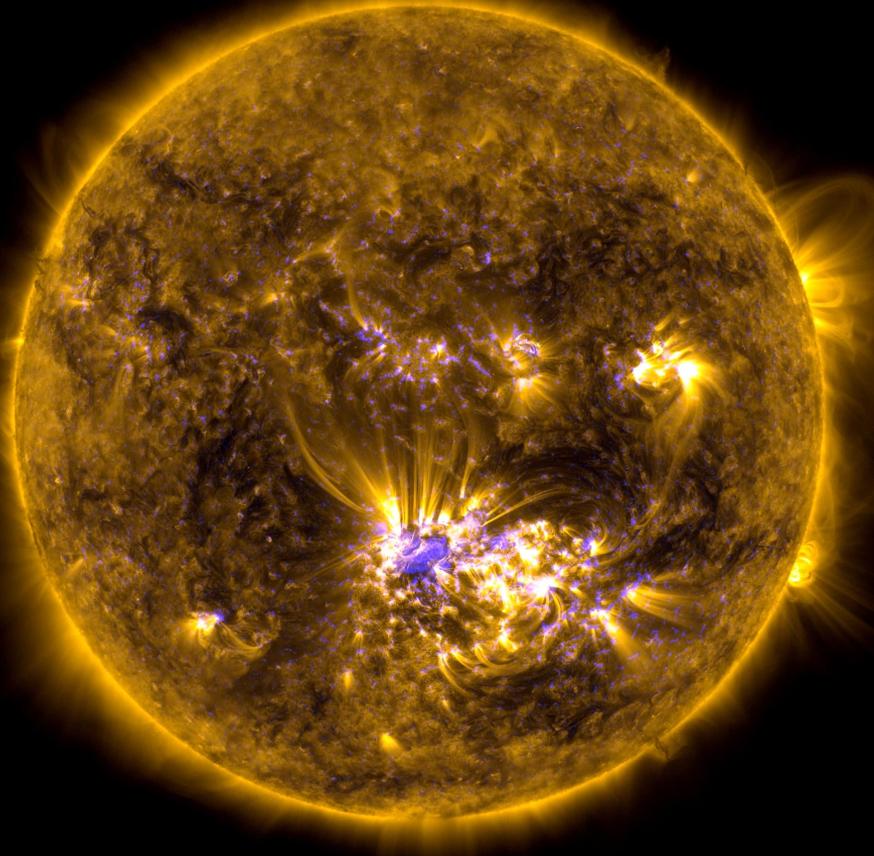


Limitations

- Lack of time
 - Small UV burst sample
- UV bursts with low exposure time
 - Prevented analysis of smaller UV bursts



Future Work



- Continue same research with more UV burst samples
 - Longer exposure time
- Investigate shape of spectral profiles and its correlation to absorption
- Look at other emission lines
 - Mg II can reveal if a burst occurs far deep down

Acknowledgments



A HUGE thank you to my mentor duo, Dr. Chad Madsen and Dr. Ed Deluca.

I would also like to thank Kathy Reeves, Ken Wiley, and the NSF-REU solar physics program at SAO, grant number AGS-1560313.

A deep space photograph showing a vast field of stars of various colors (white, blue, orange) against a dark background. On the right side, a bright, glowing band of a galaxy, likely the Milky Way, is visible, showing intricate patterns of light and dark matter.

Thank you all for being a **stellar** audience!
Comments or questions?