

# Flocculent flows

*Intermittent flows in the chromospheric canopy  
observed with SST and IRIS*

Gregal Vissers

with

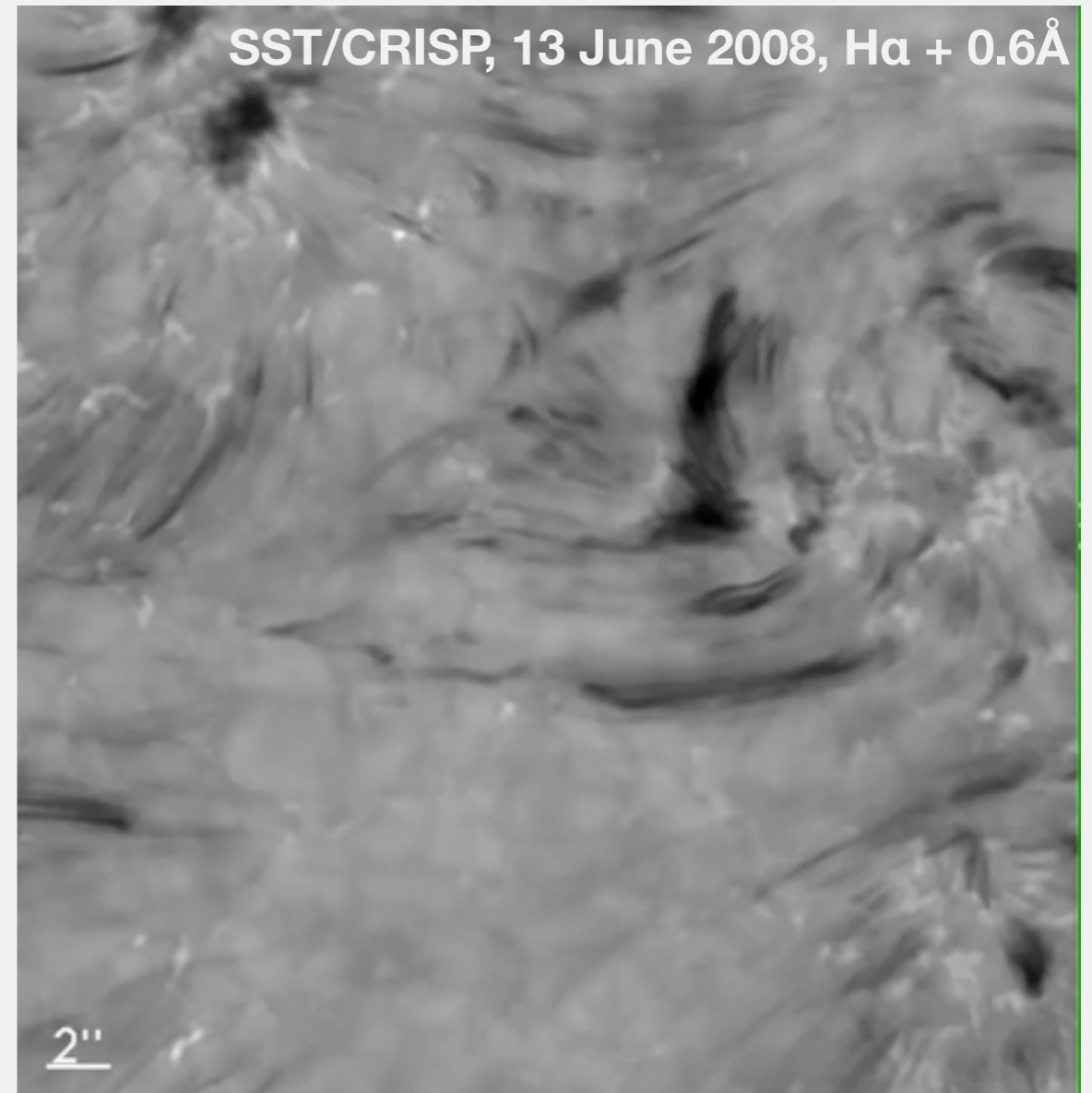
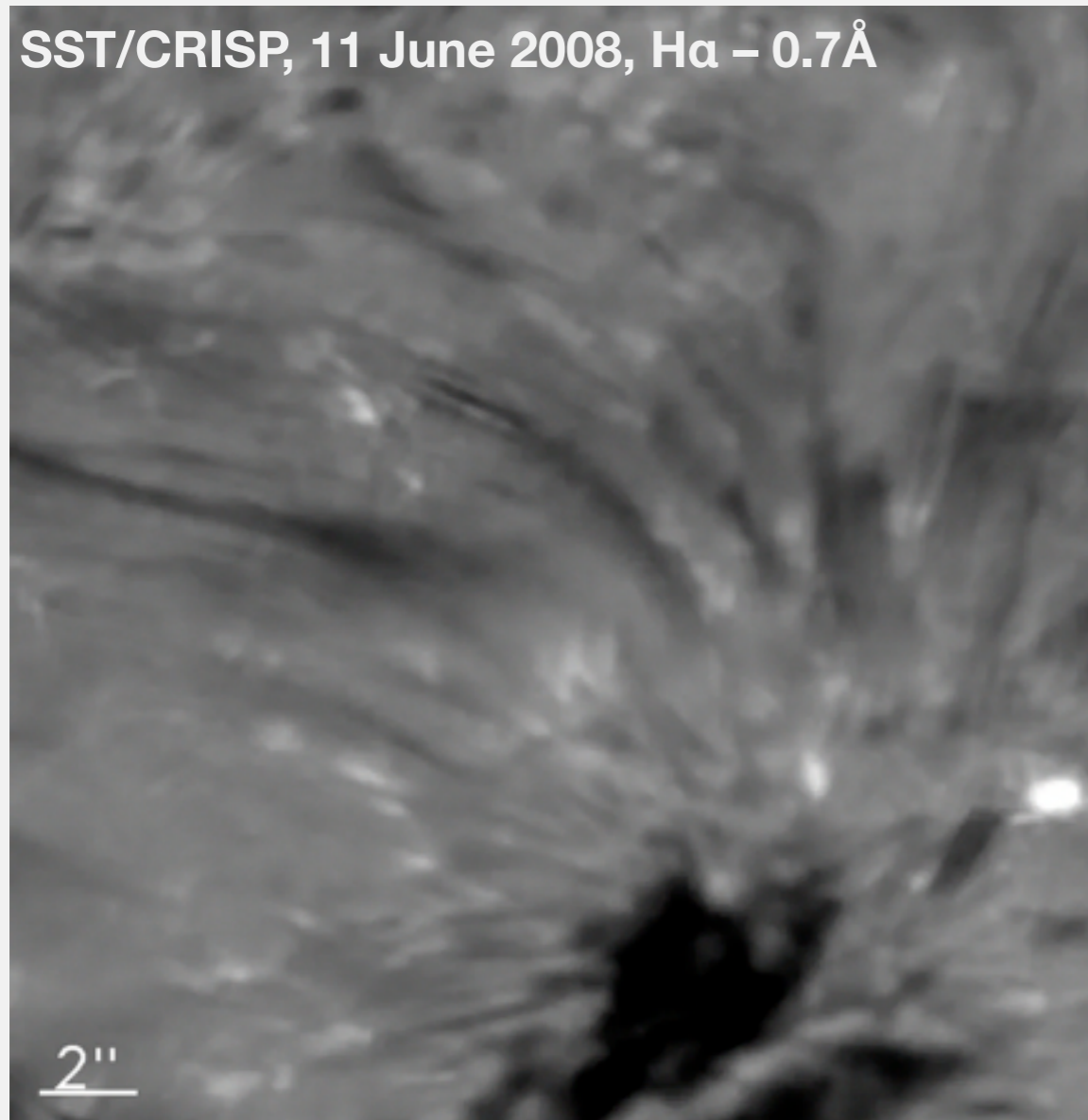
Luc Rouppe van der Voort and Mats Carlsson



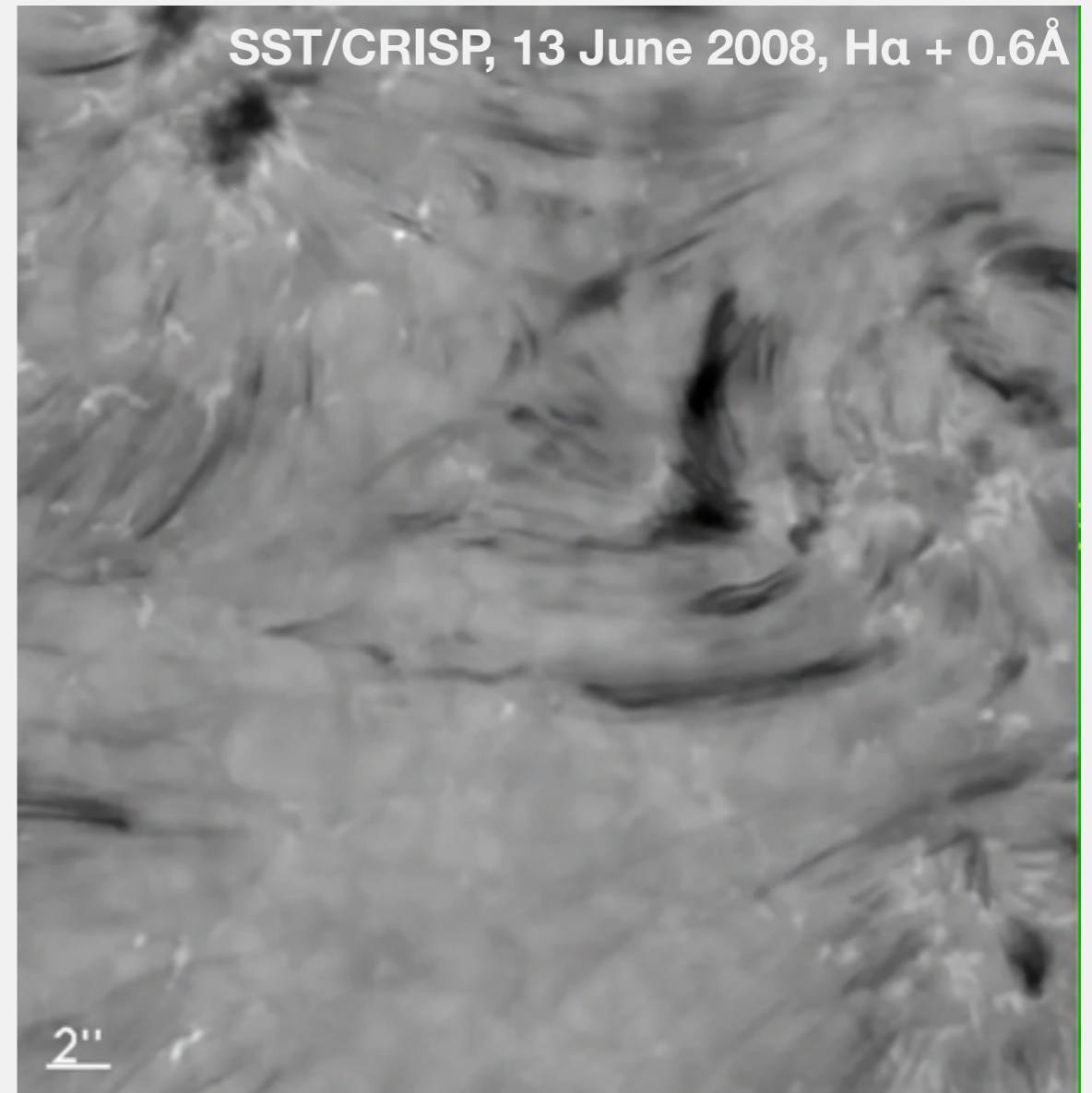
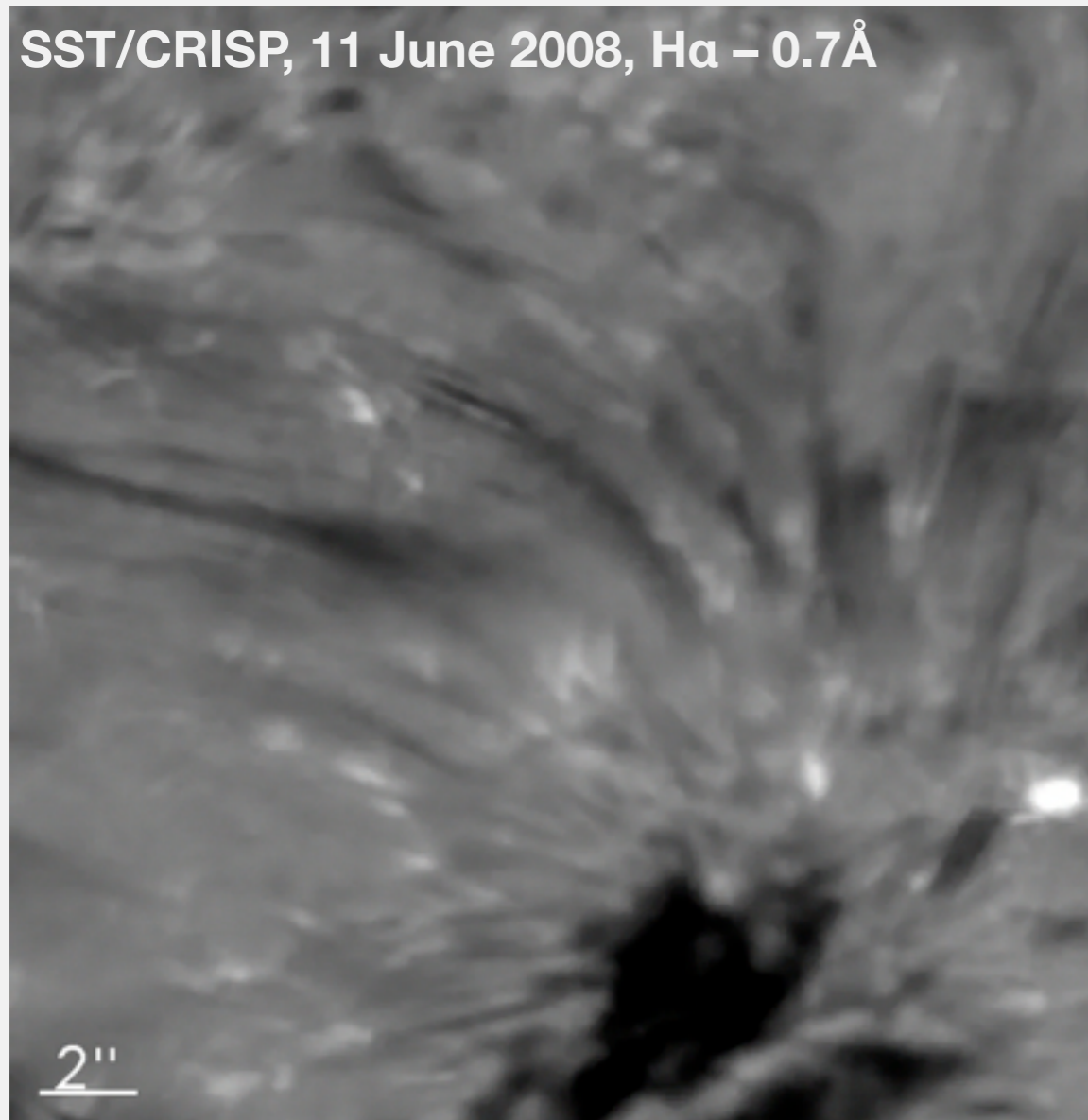
Institute of Theoretical Astrophysics  
University of Oslo



# CRISP observations show intermittent, clumpy streams in the chromospheric canopy



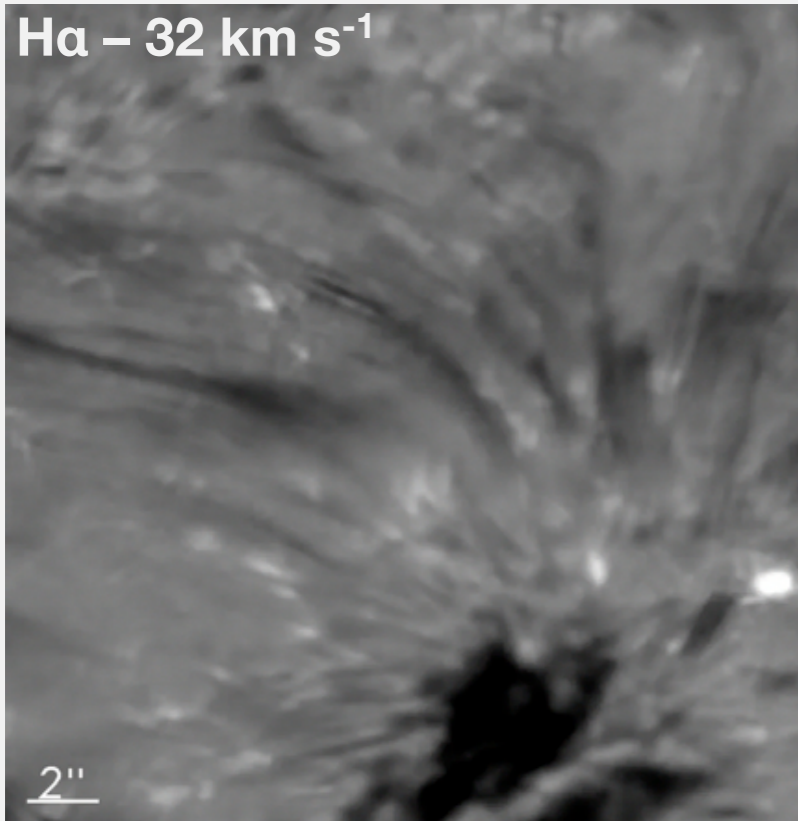
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# These clumps appear to follow the canopy

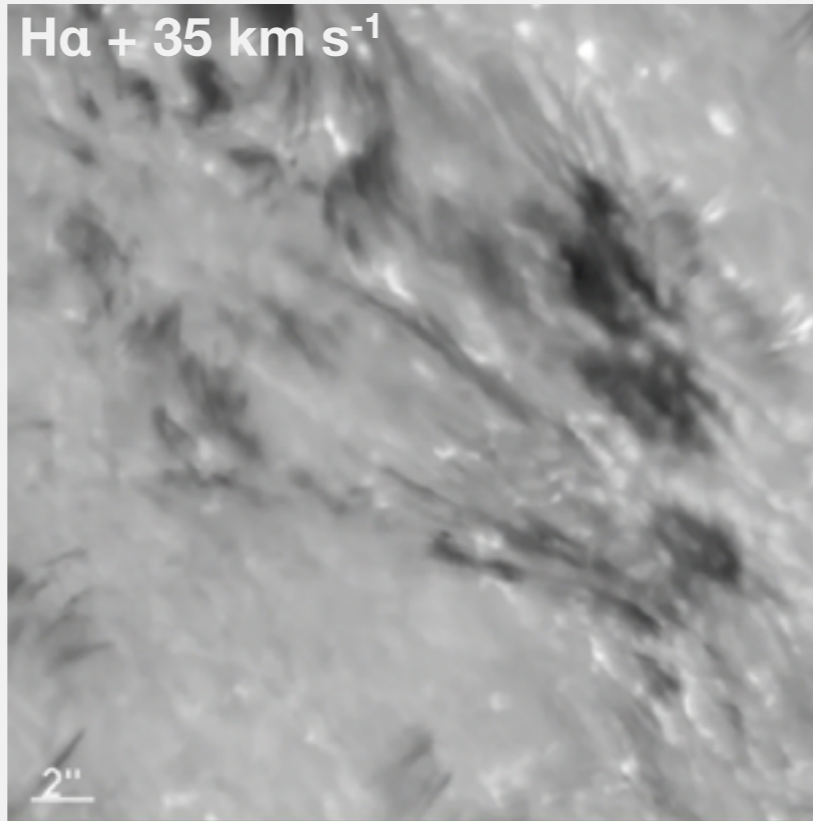
11 June 2008

H $\alpha$  - 32 km s<sup>-1</sup>



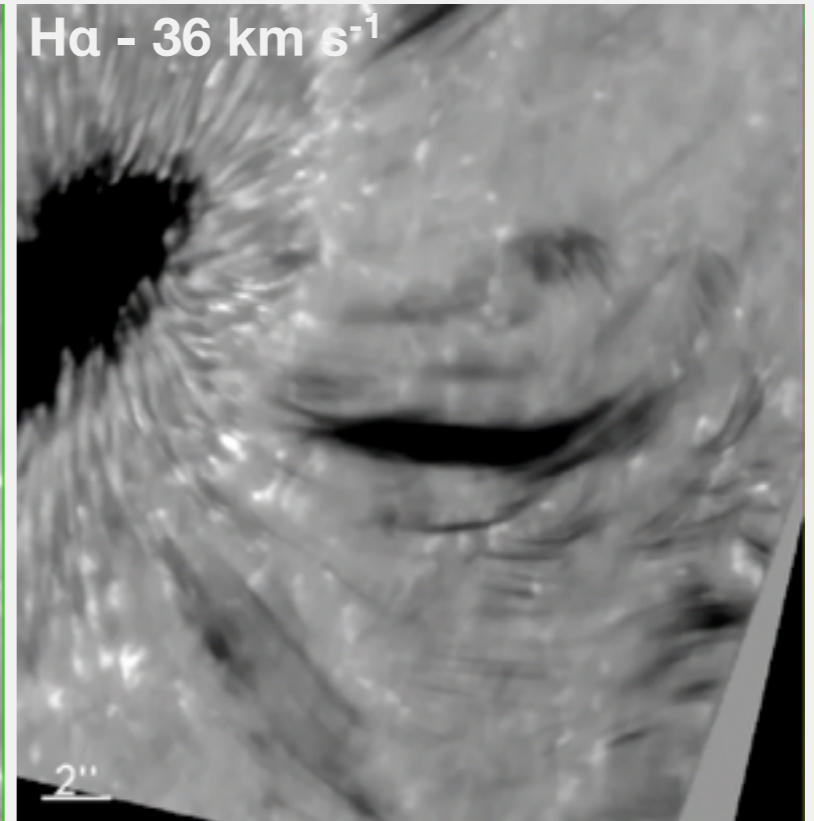
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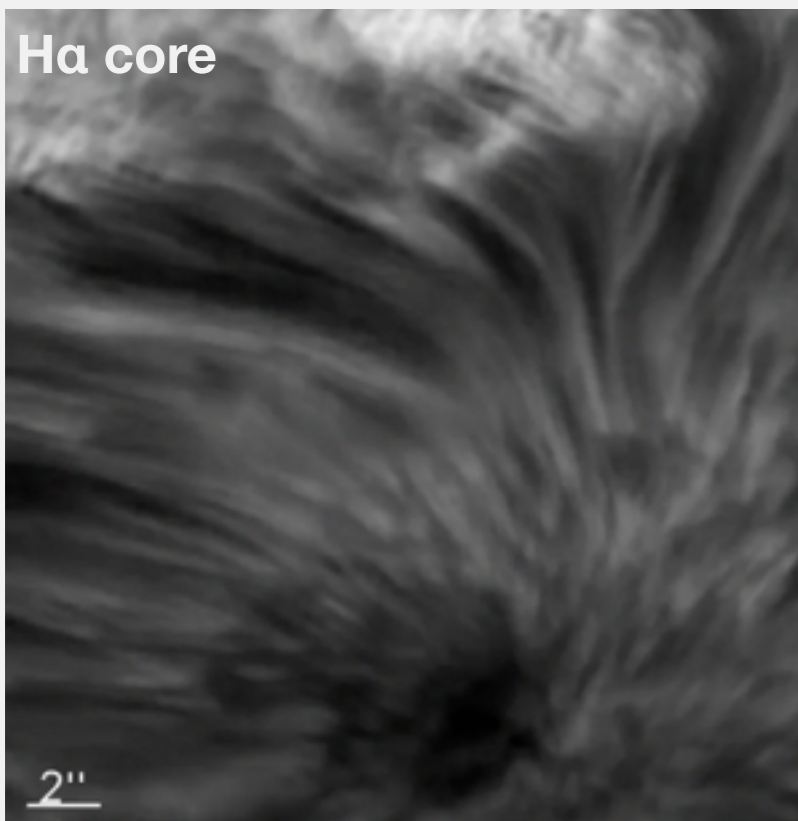


6 September 2014

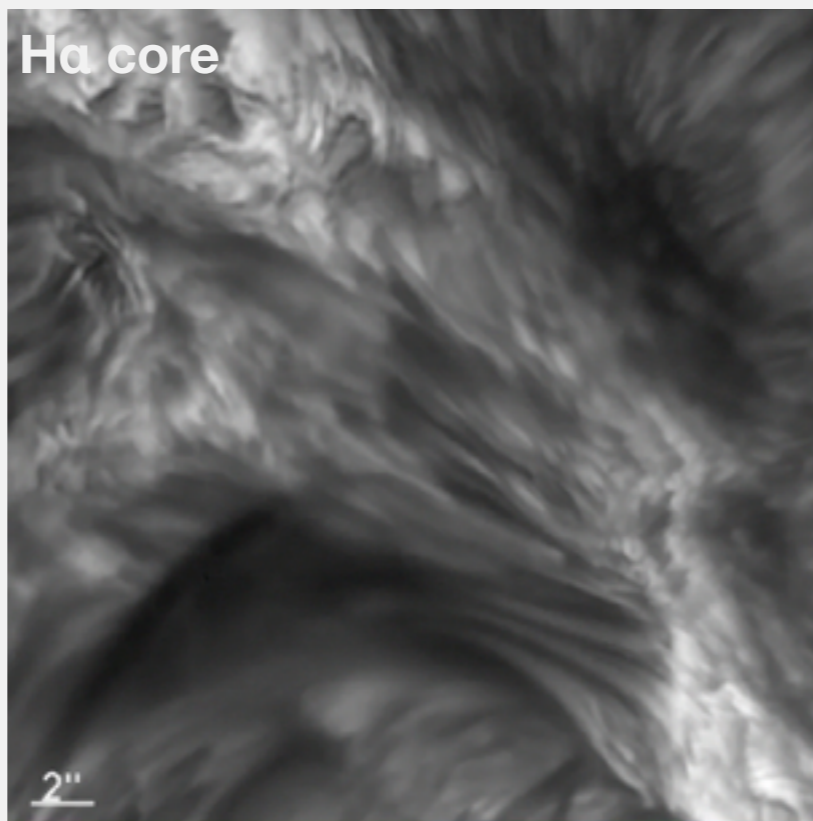
H $\alpha$  - 36 km s<sup>-1</sup>



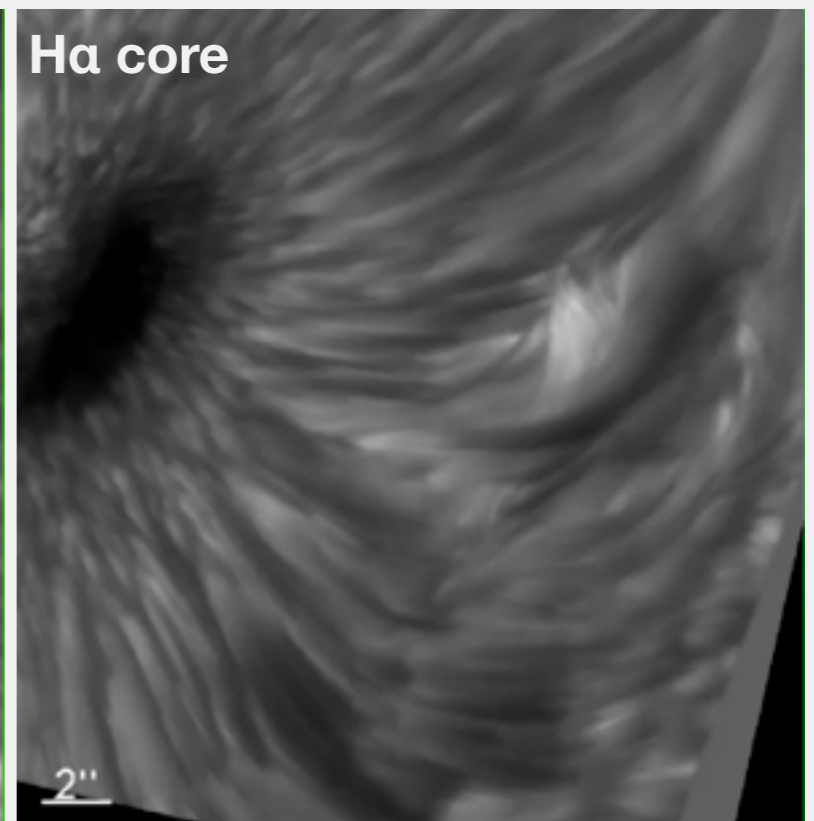
H $\alpha$  core



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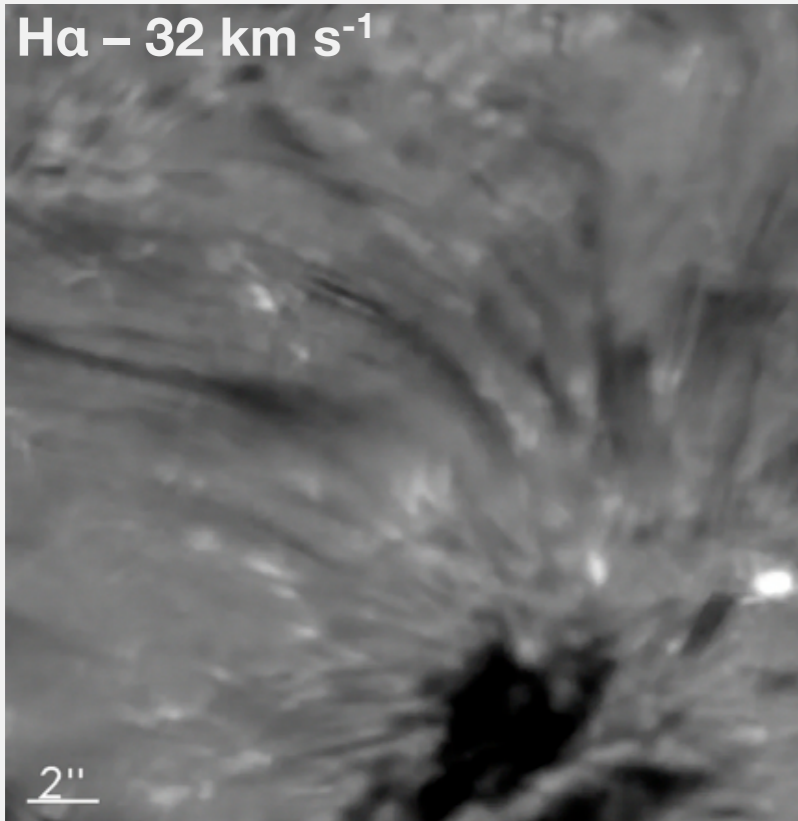
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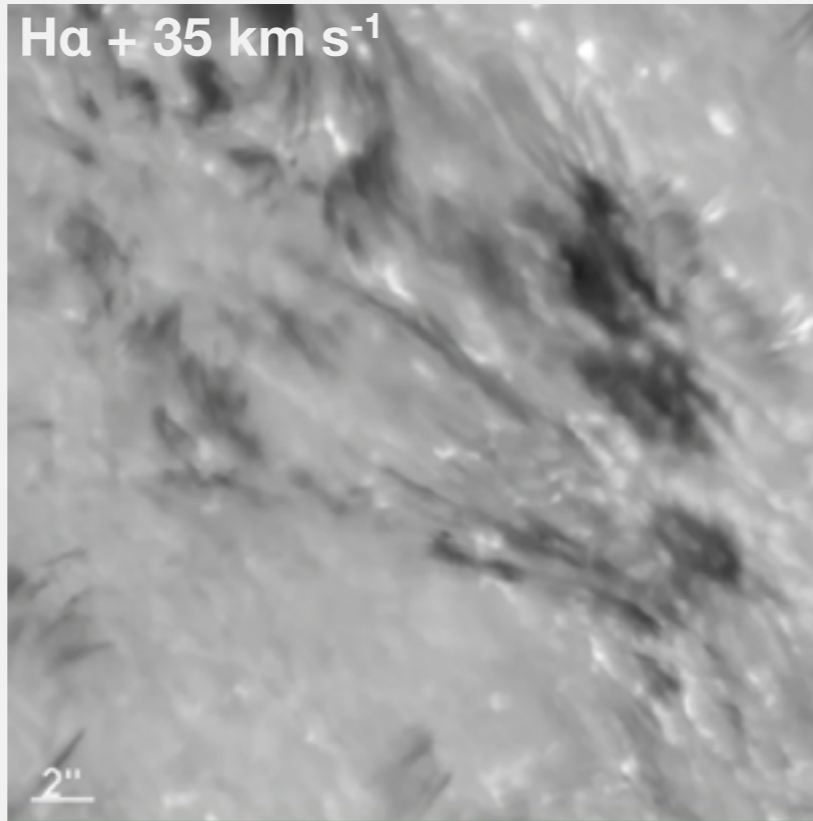
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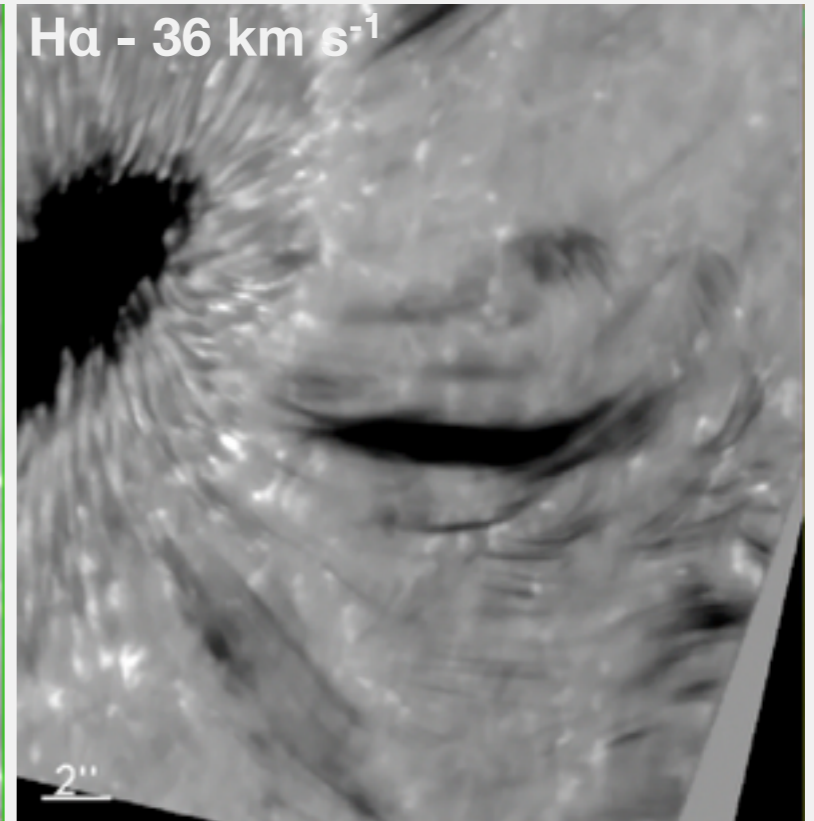
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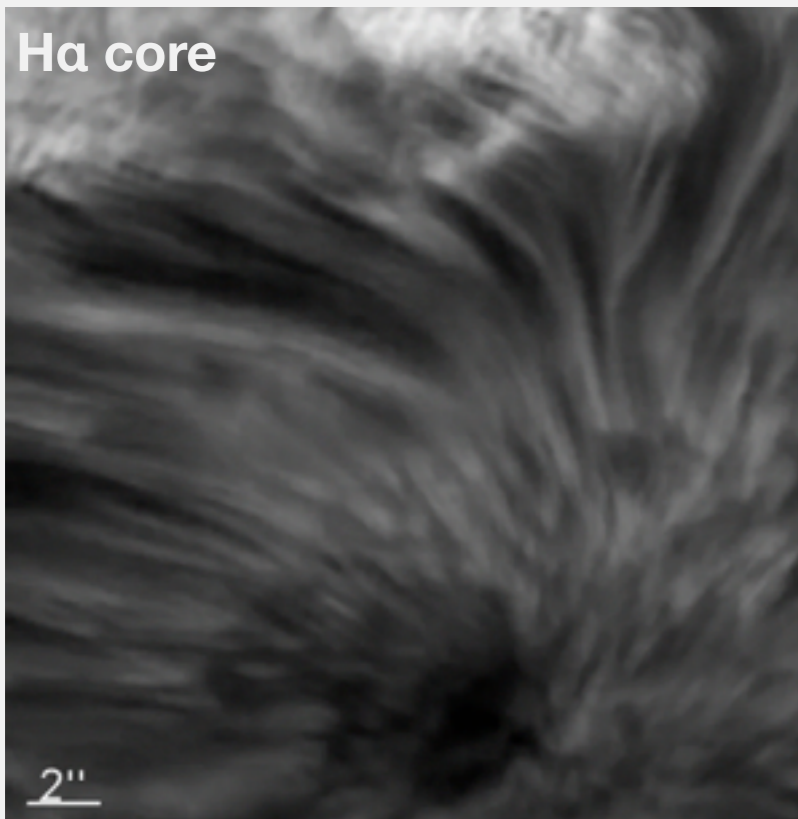


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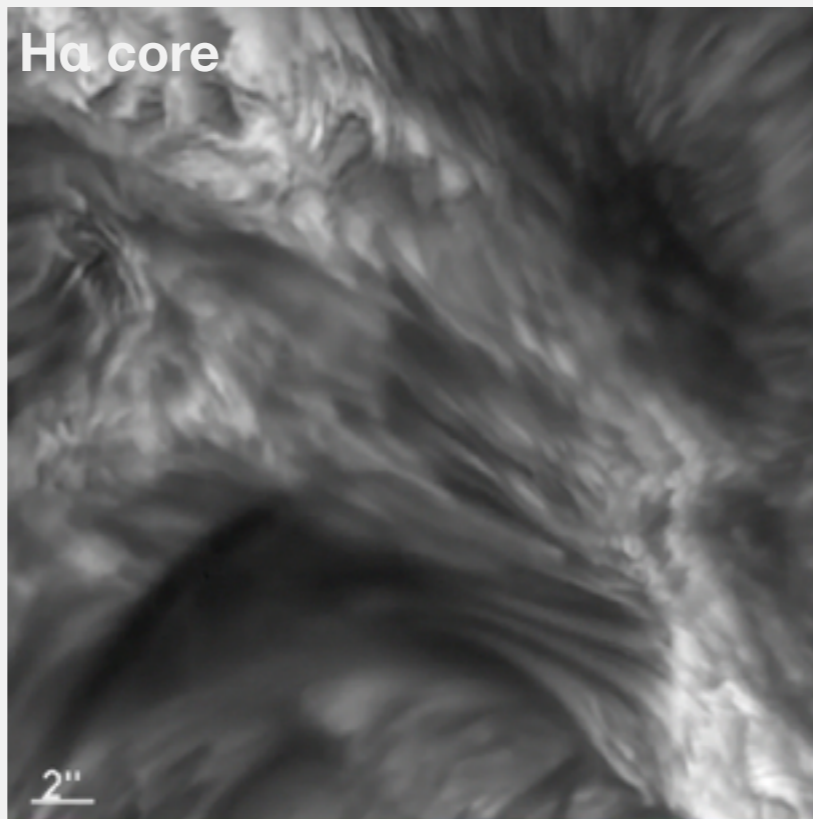
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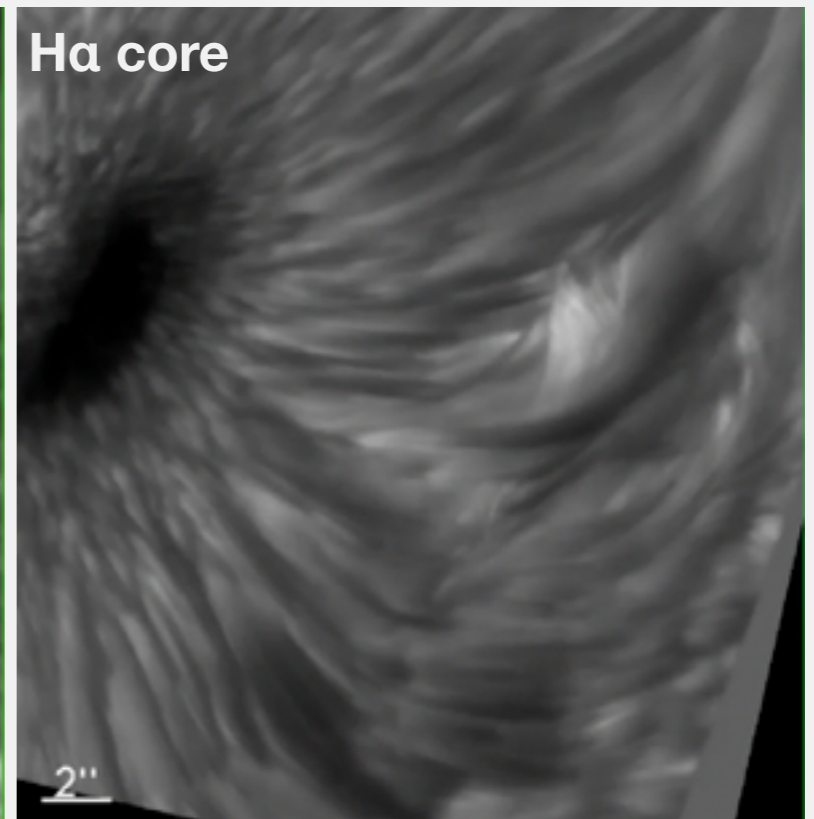
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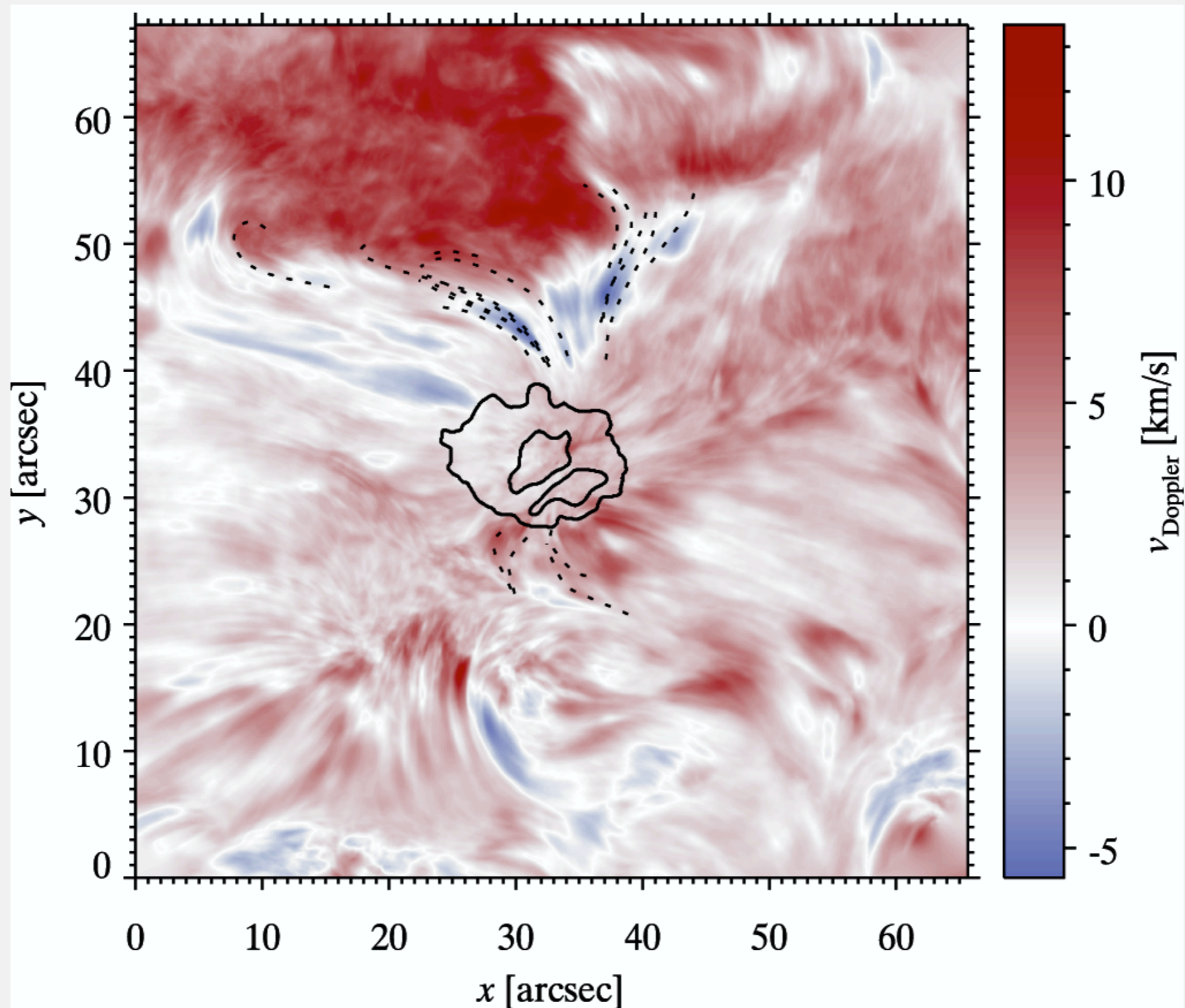
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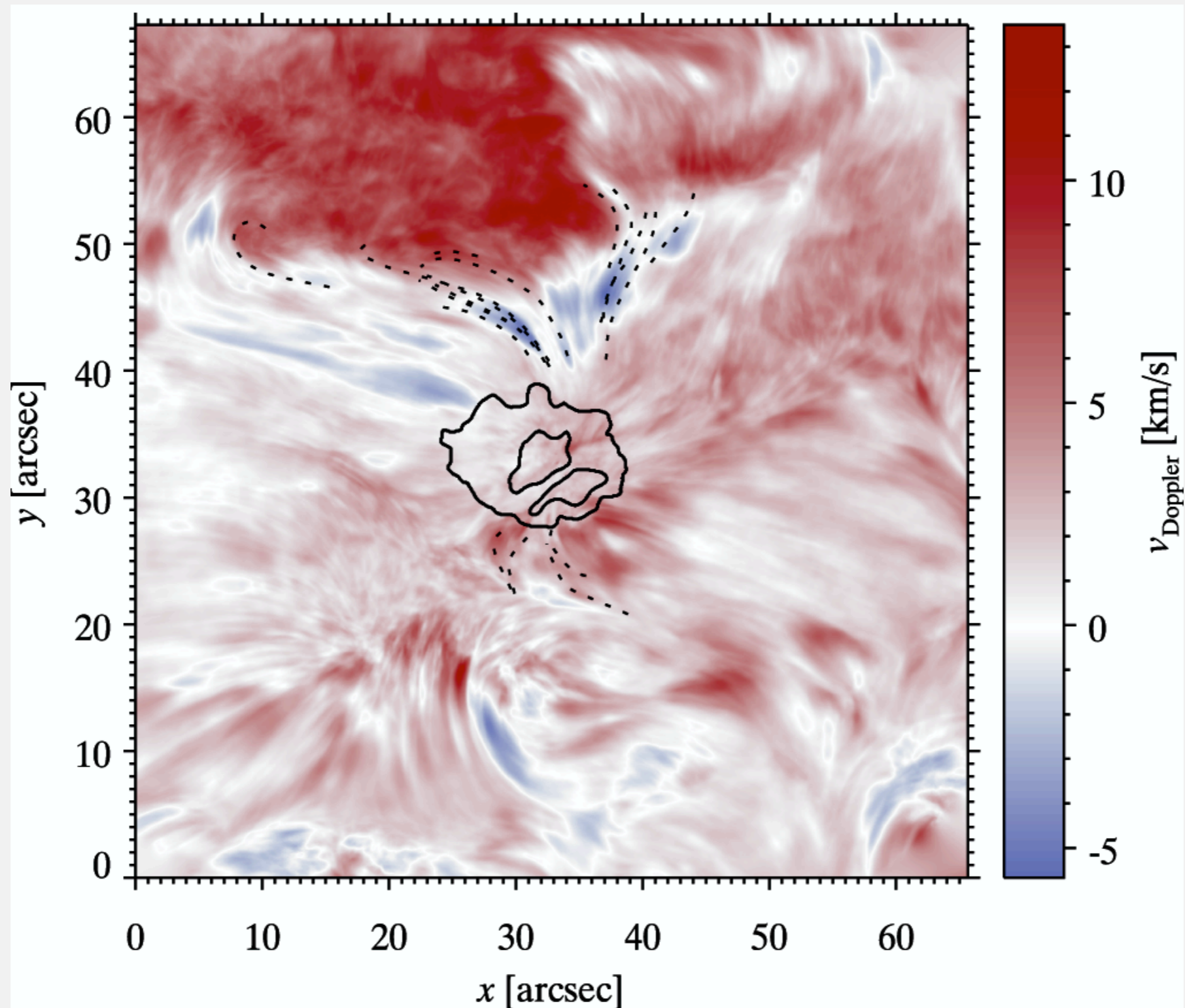
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# The paths traced by the blobs correspond well with concentrations of inverse Evershed flows

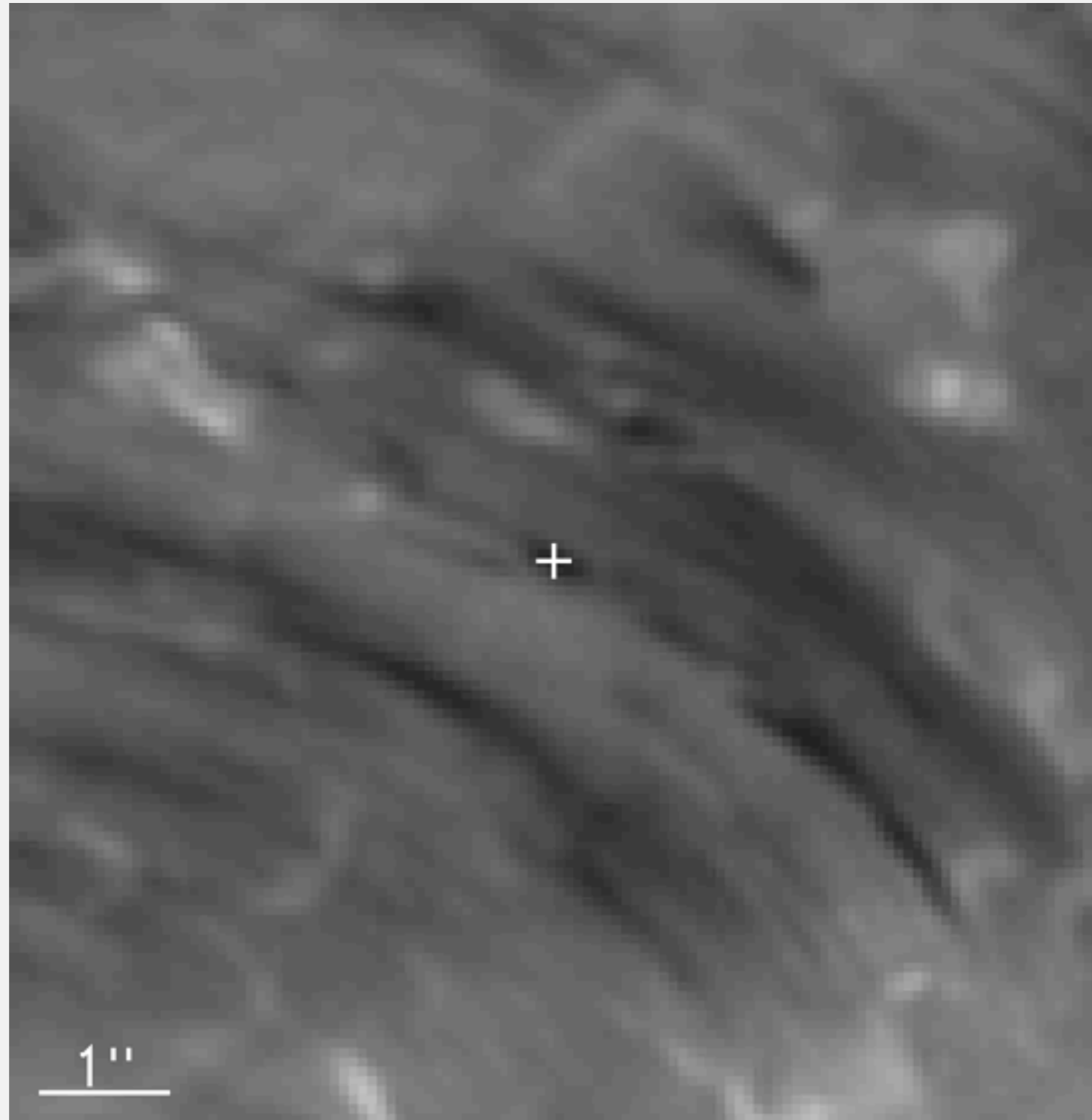


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Vissers & Rouppe van der Voort (2012)

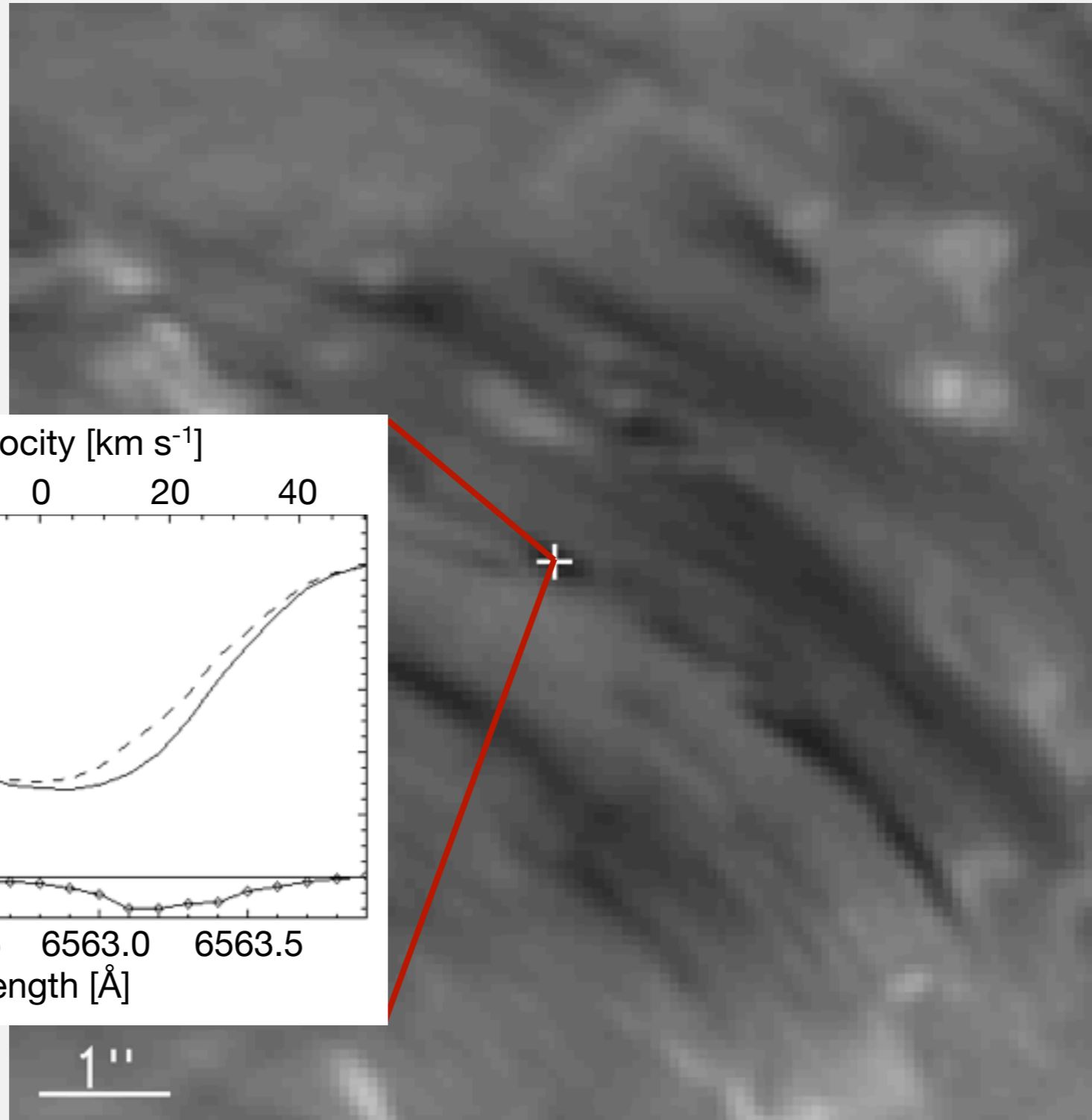
# The H $\alpha$ profile gets noticeably broadened by a second component due to the clumps



SST/CRISP, 11 June 2008, H $\alpha$  - 0.7Å

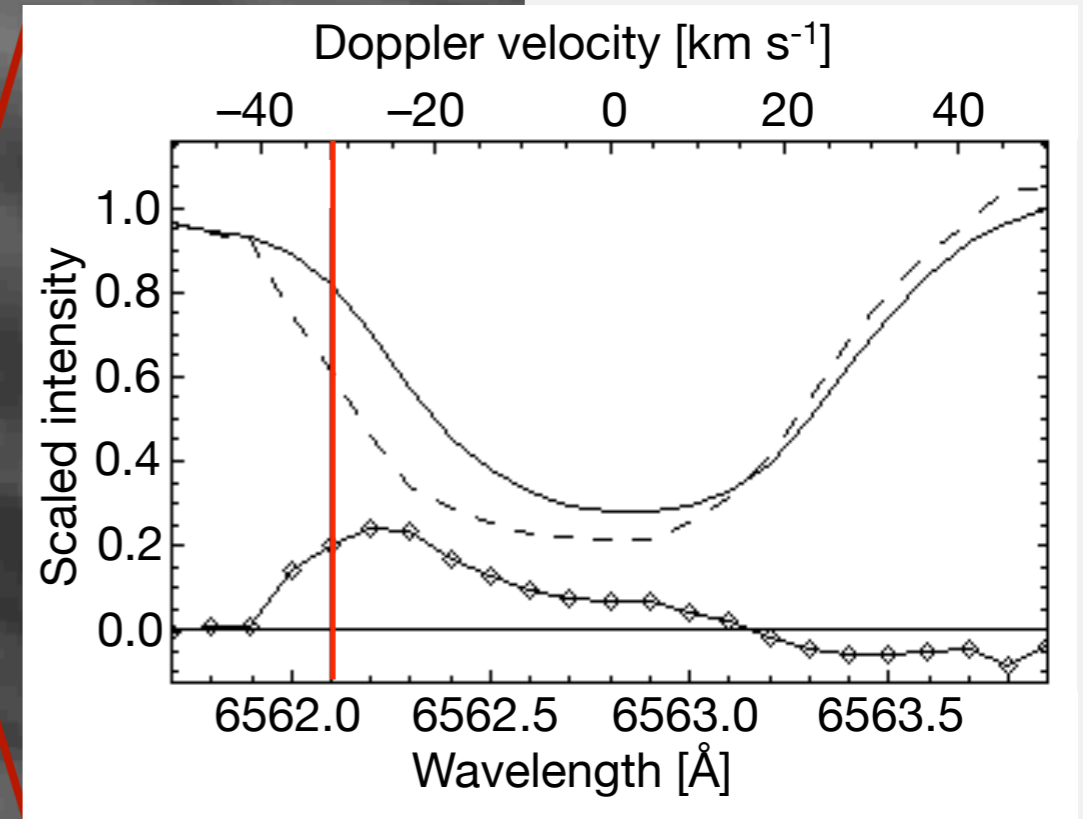
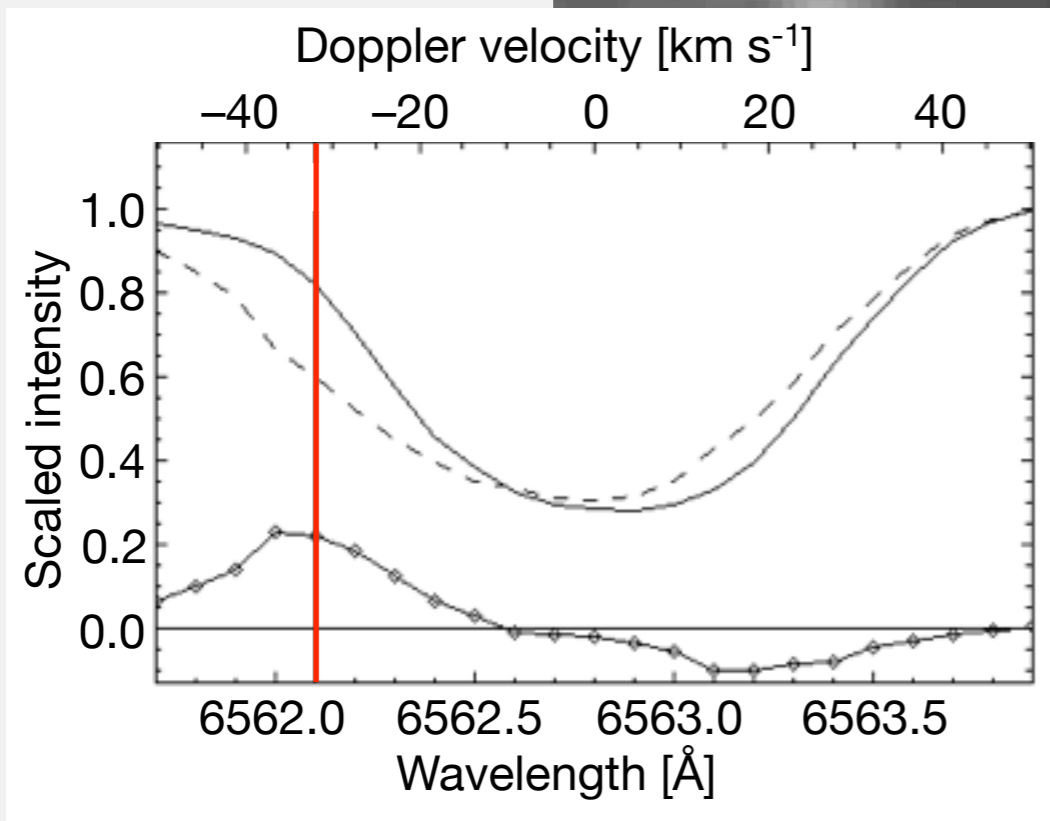
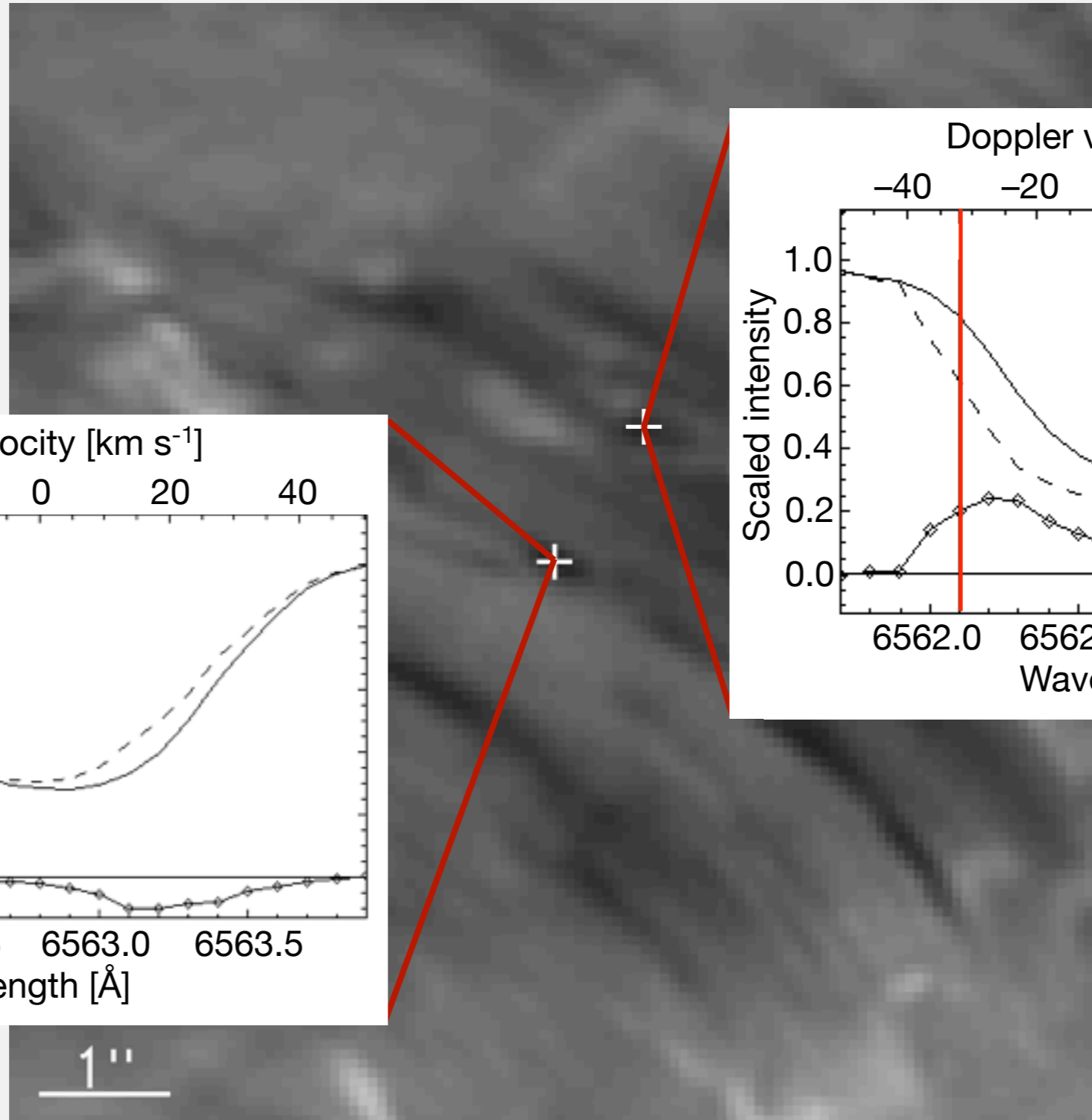


# The H $\alpha$ profile gets noticeably broadened by a second component due to the clumps



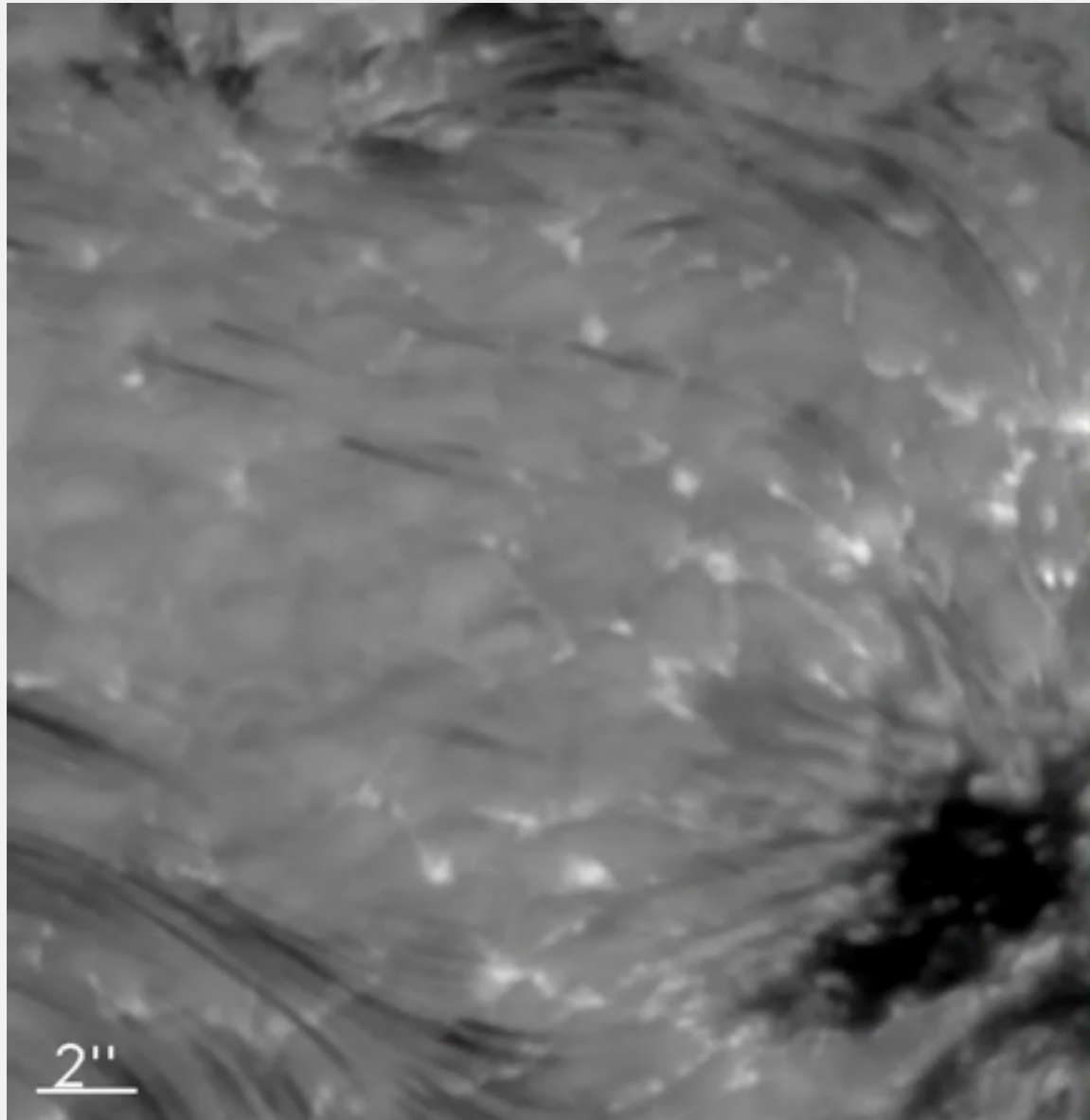
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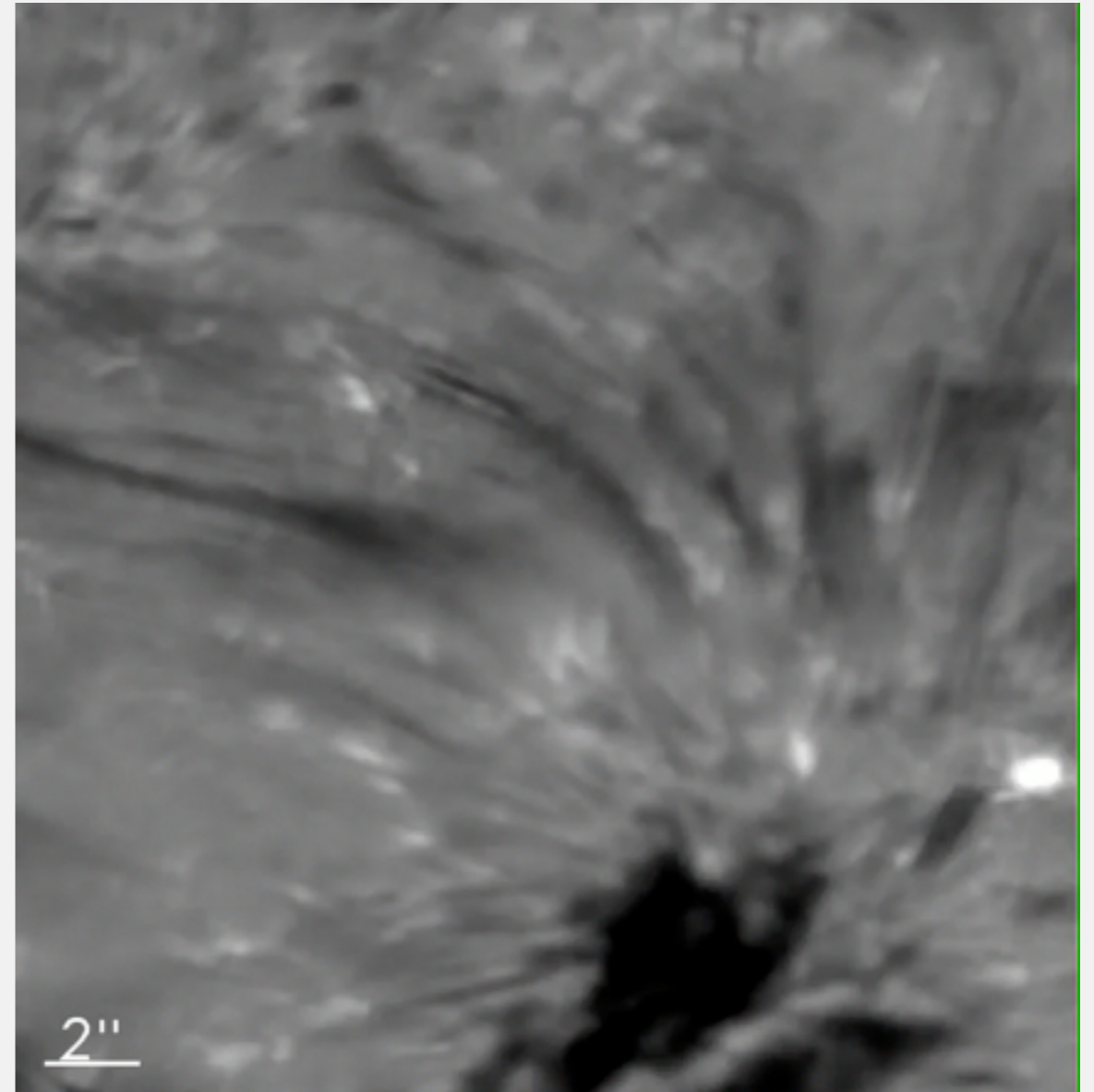


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**Morphologically they resemble coronal rain, suggesting a related formation mechanism**

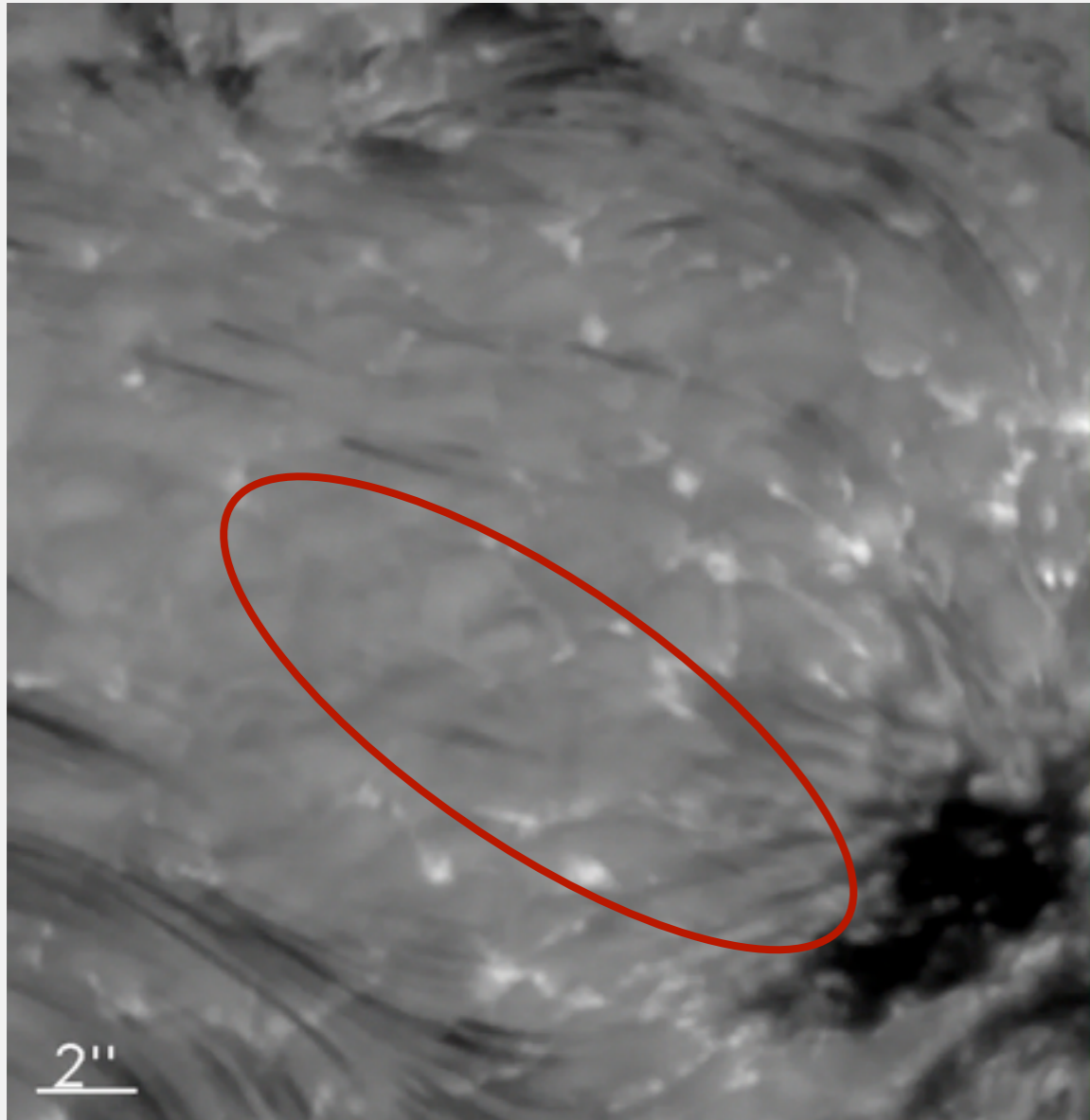


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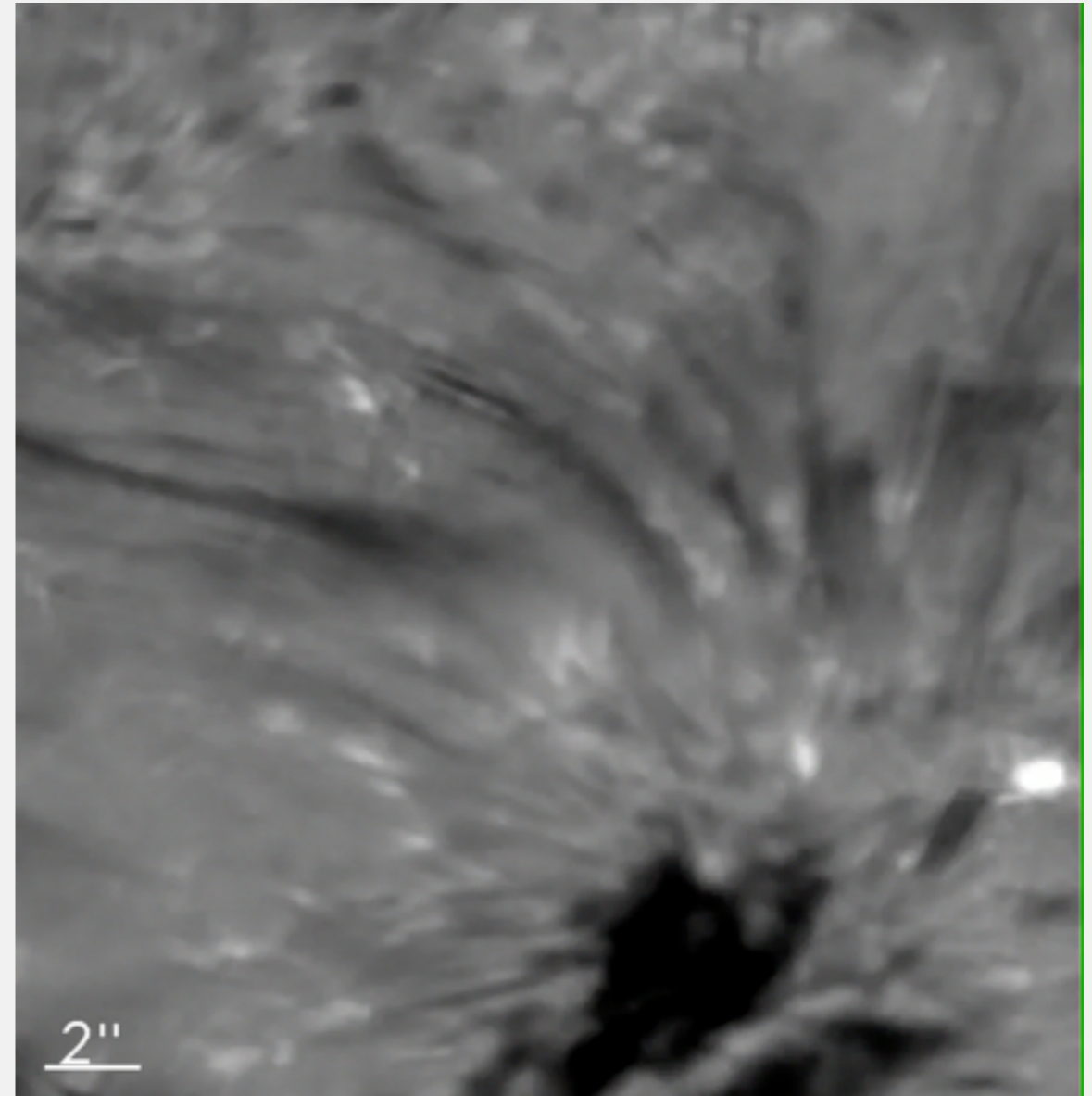


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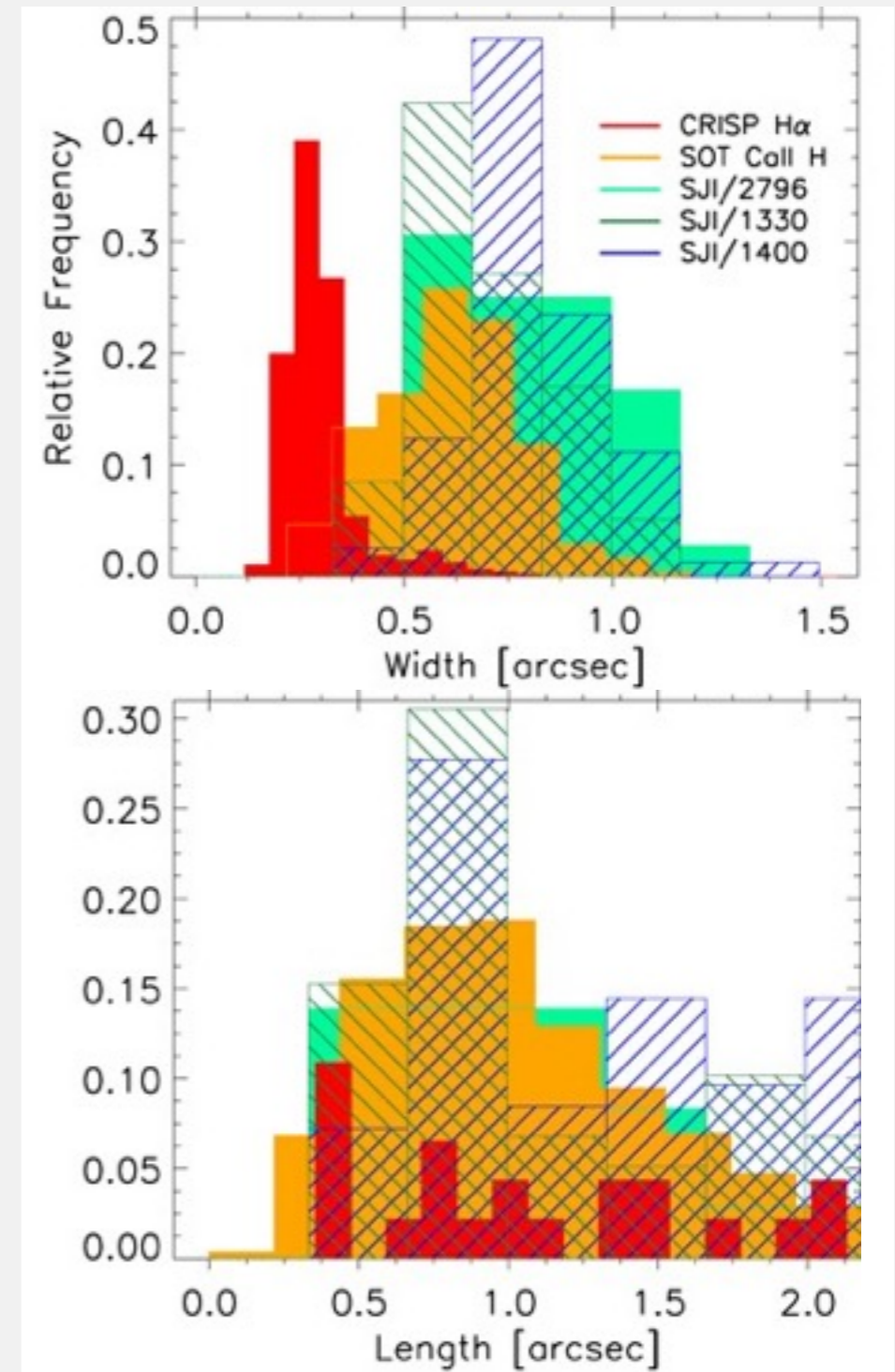
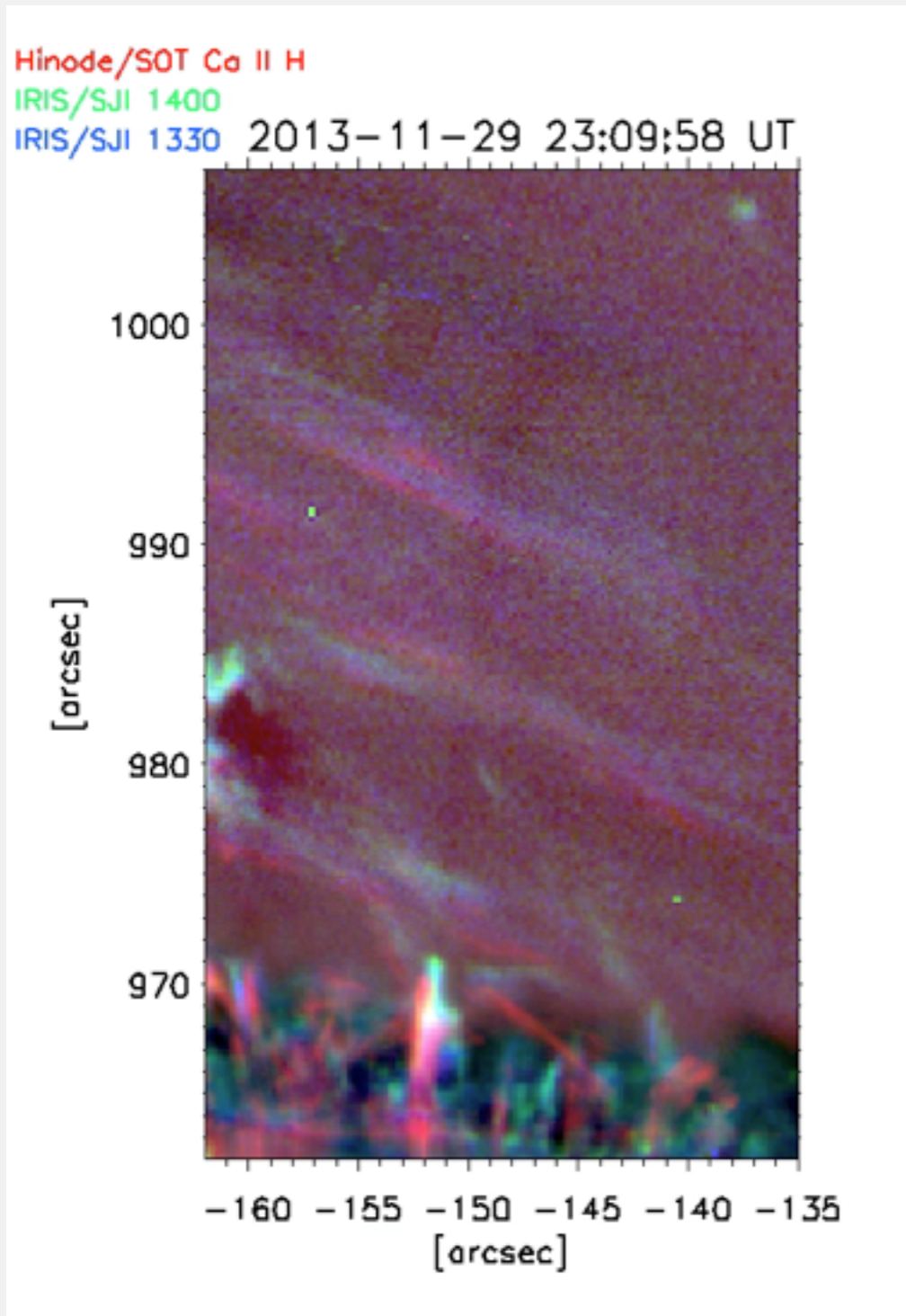


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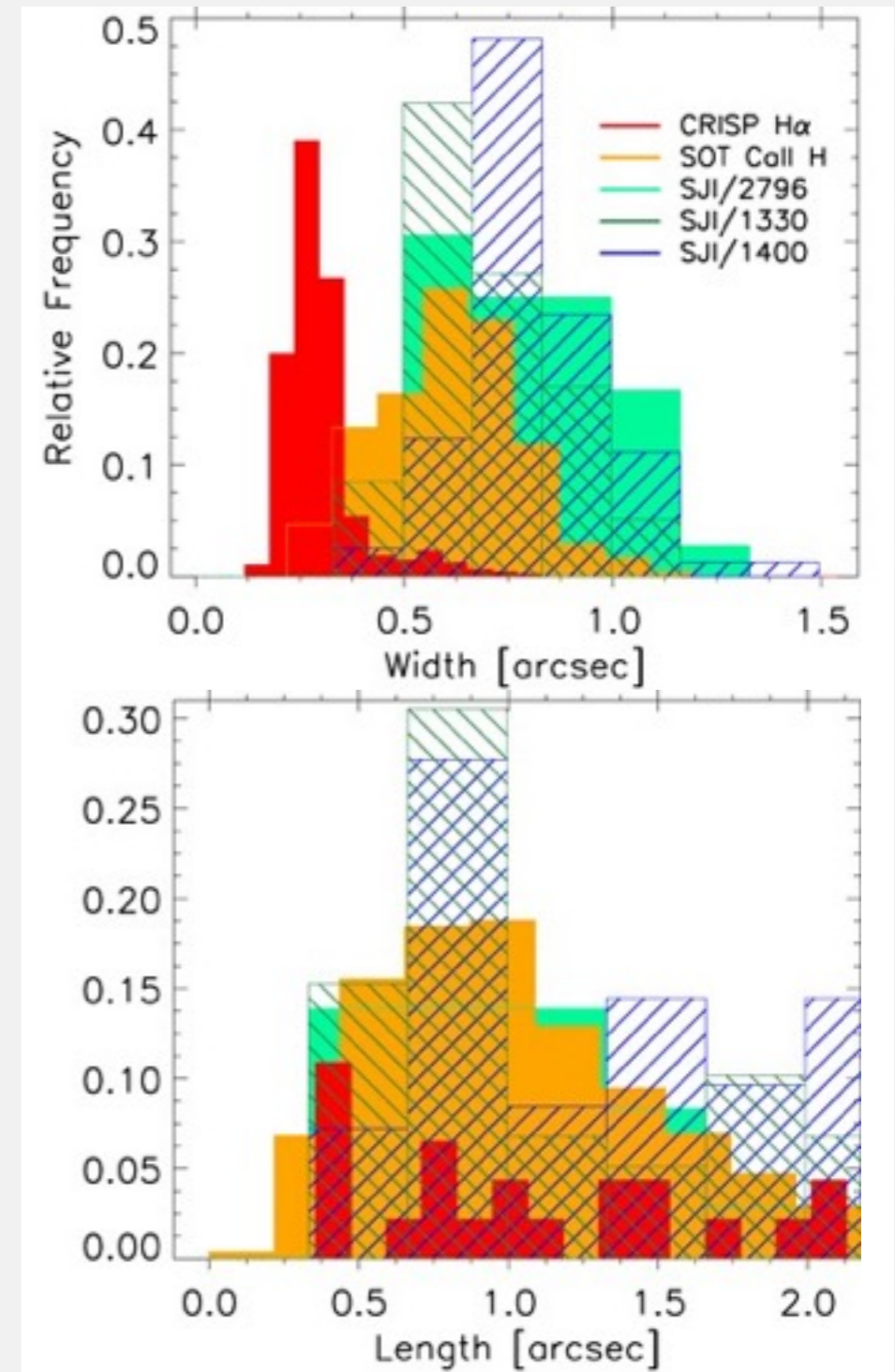
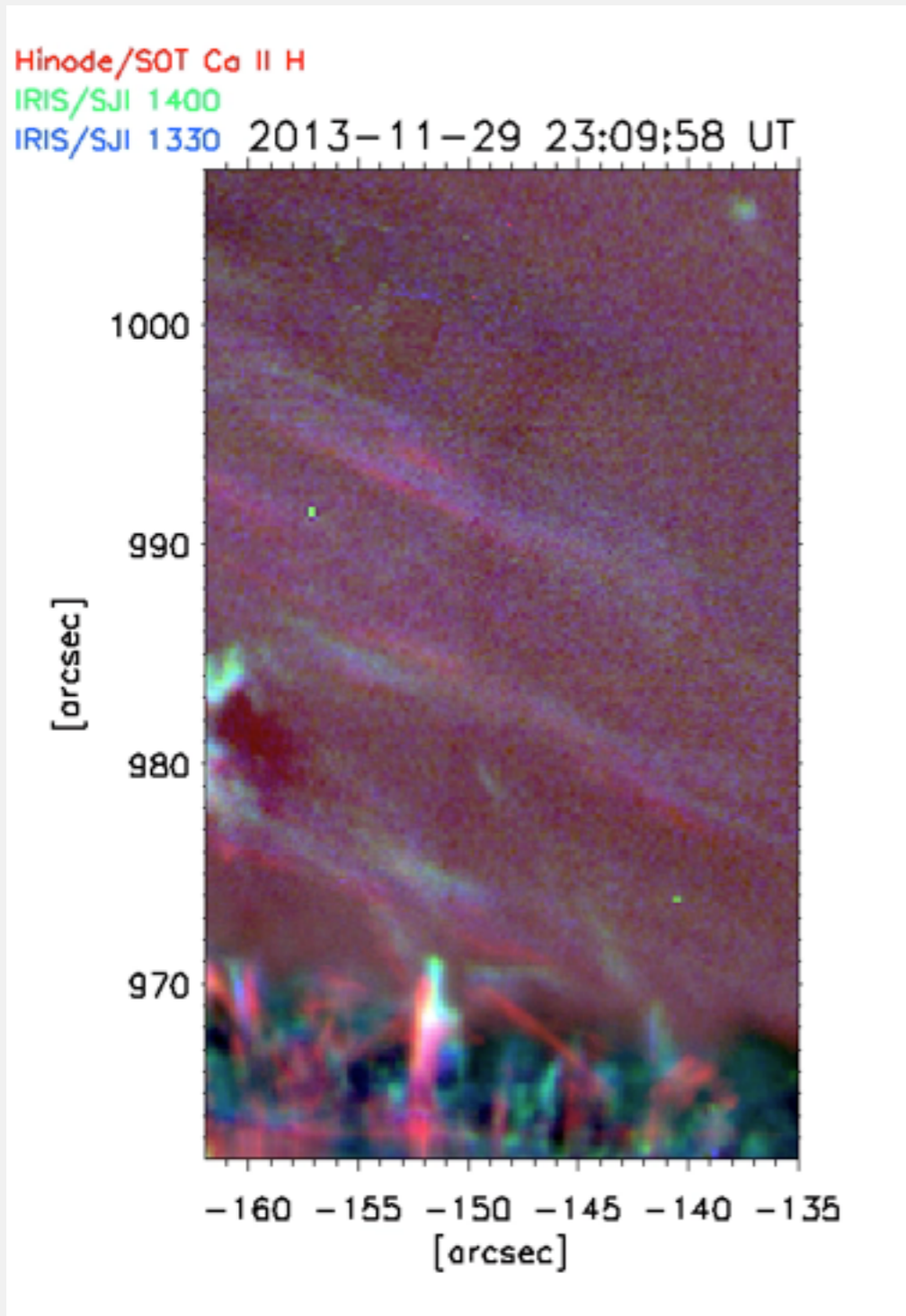
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# Coronal rain is clearly observed in the IRIS slit-jaw images



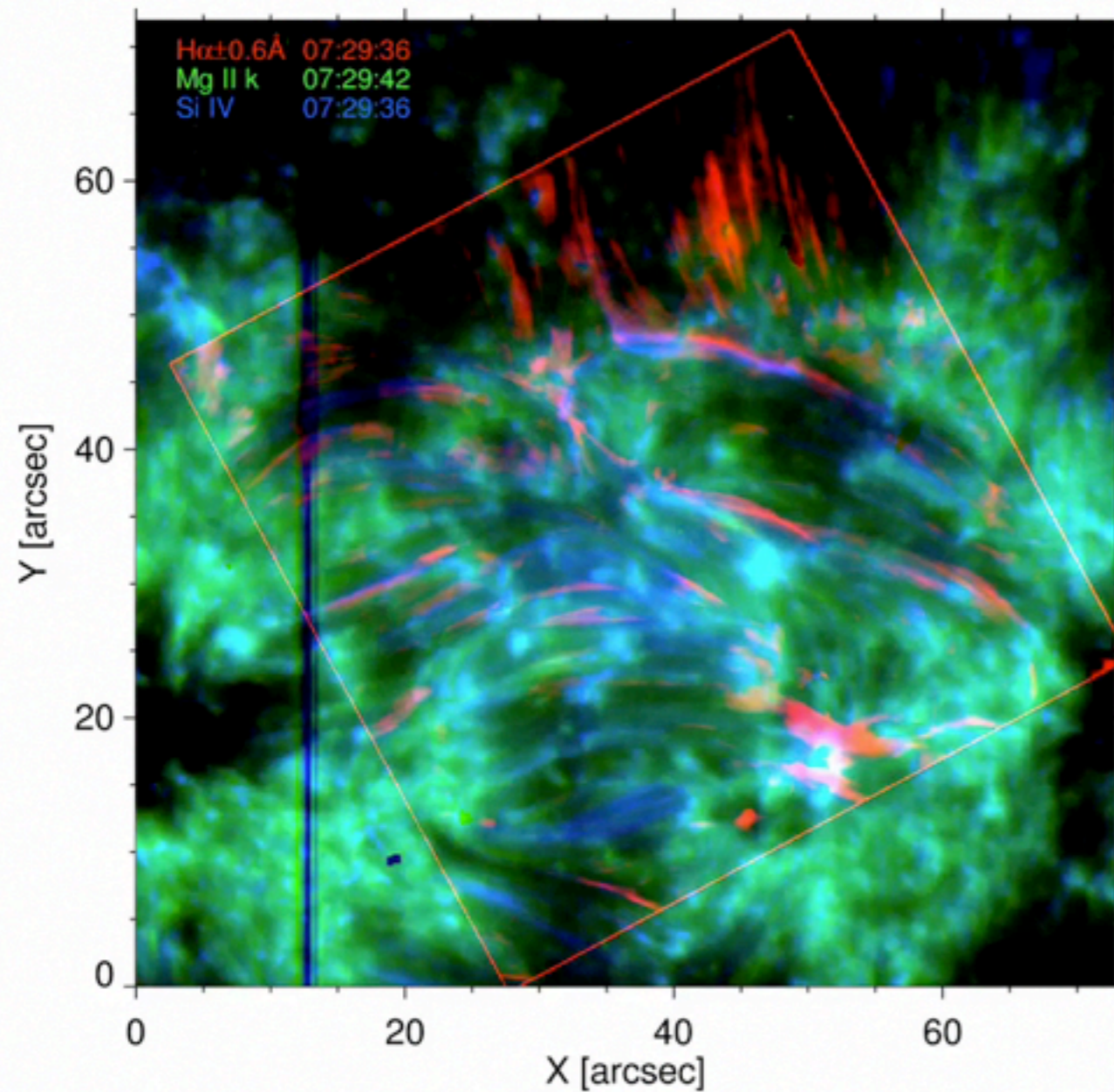
Antolin et al. (2015)

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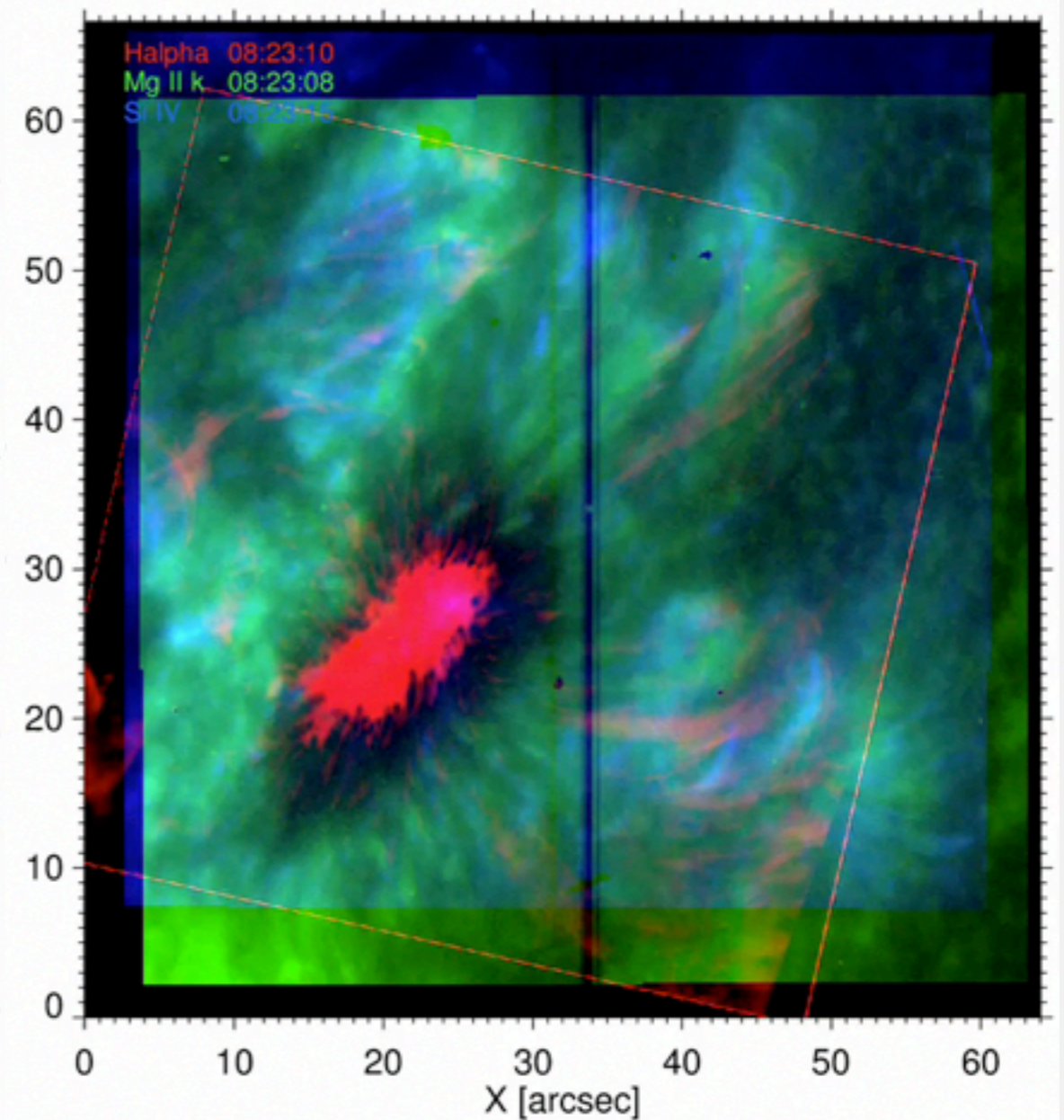


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# Clumpy streams H $\alpha$ are in part also visible in Si IV and Mg II k

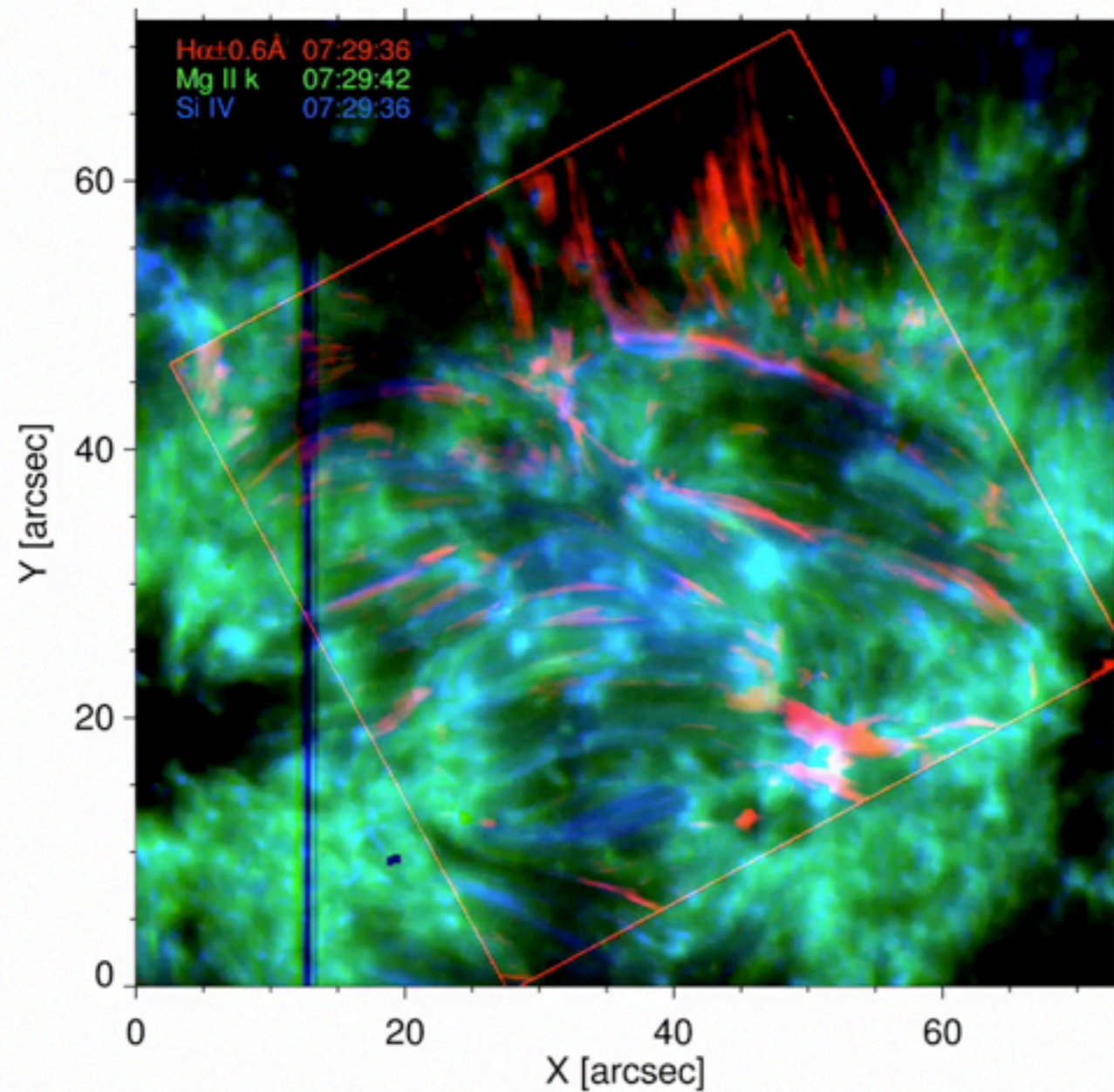


14 June 2014

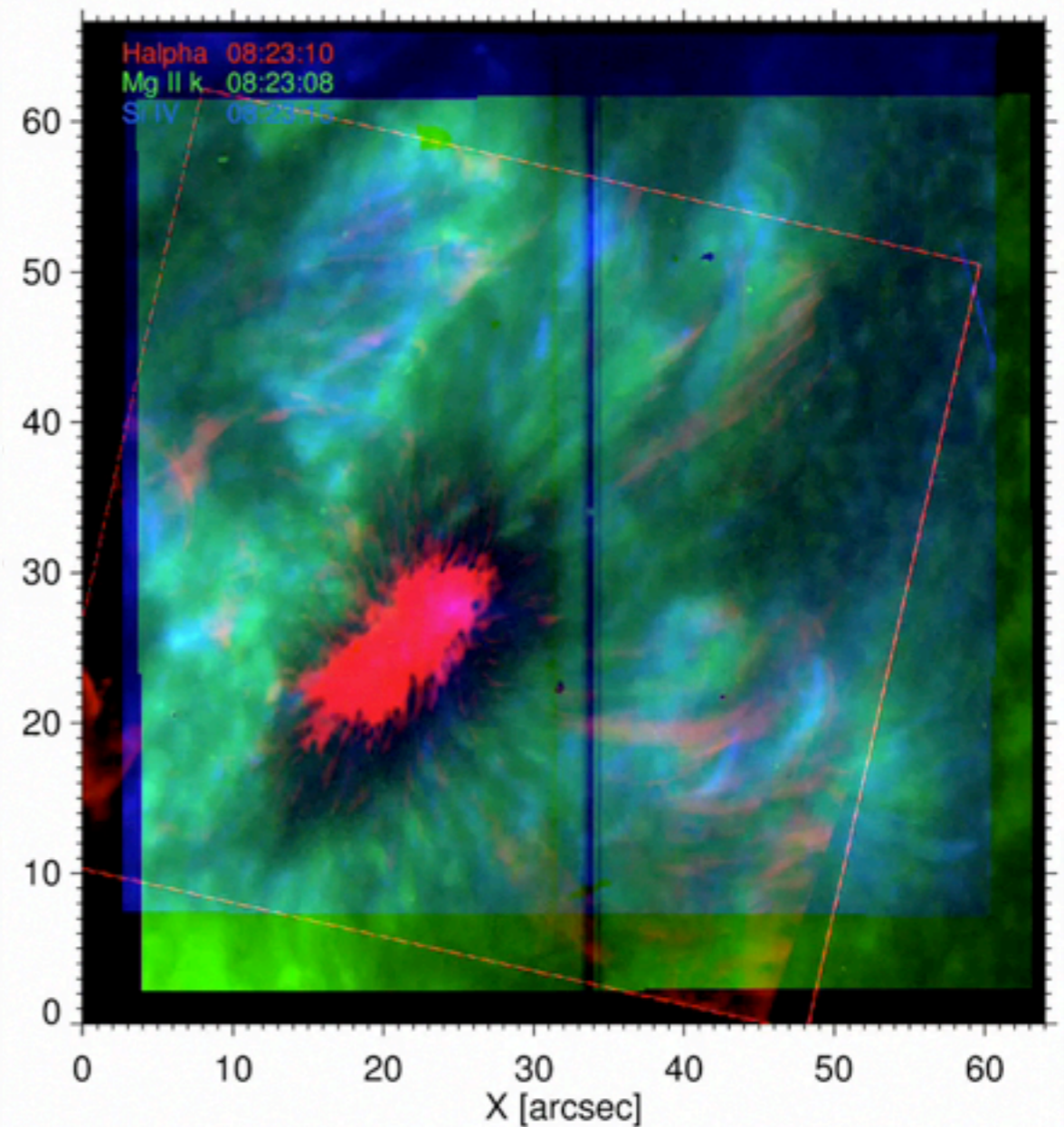


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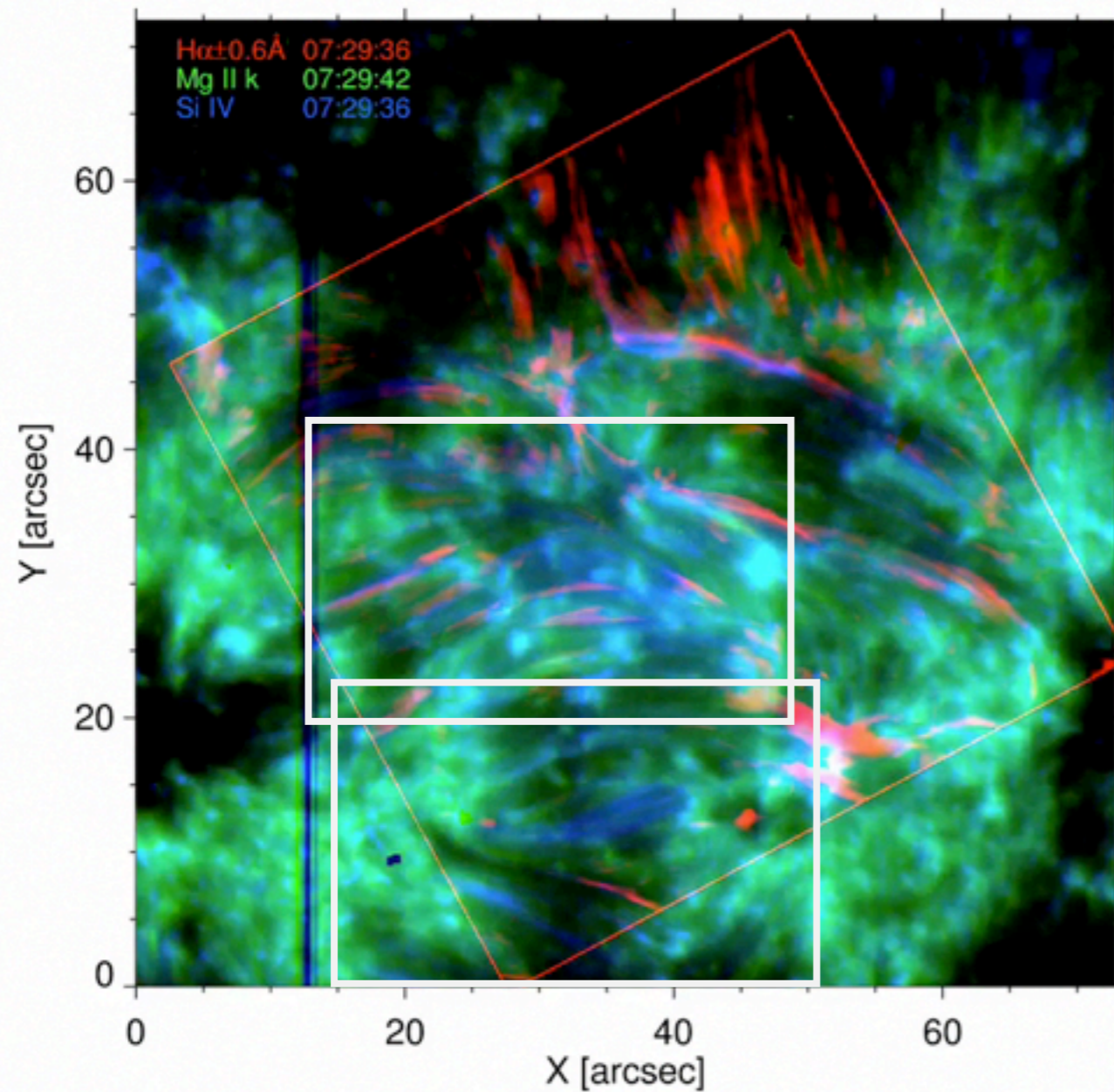
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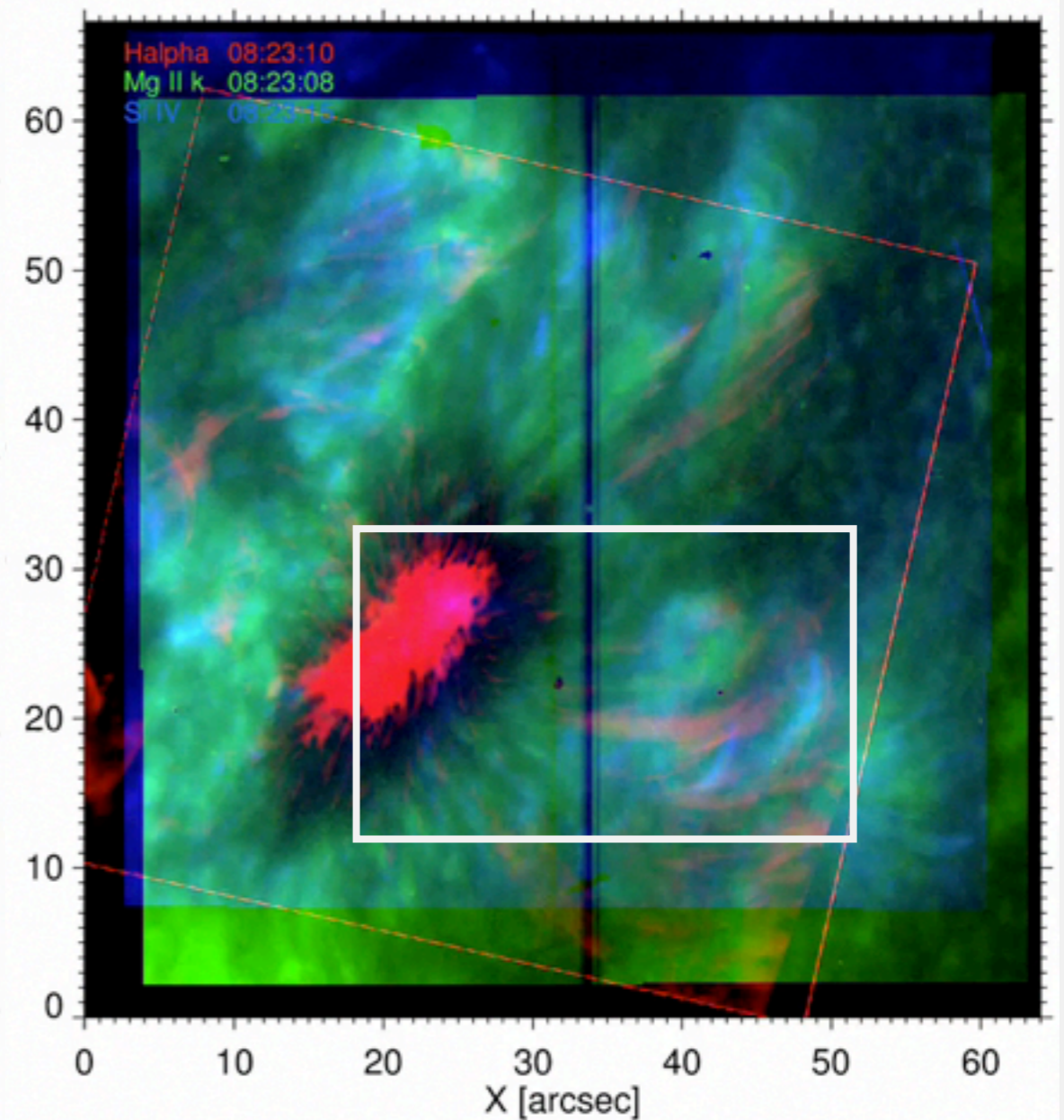
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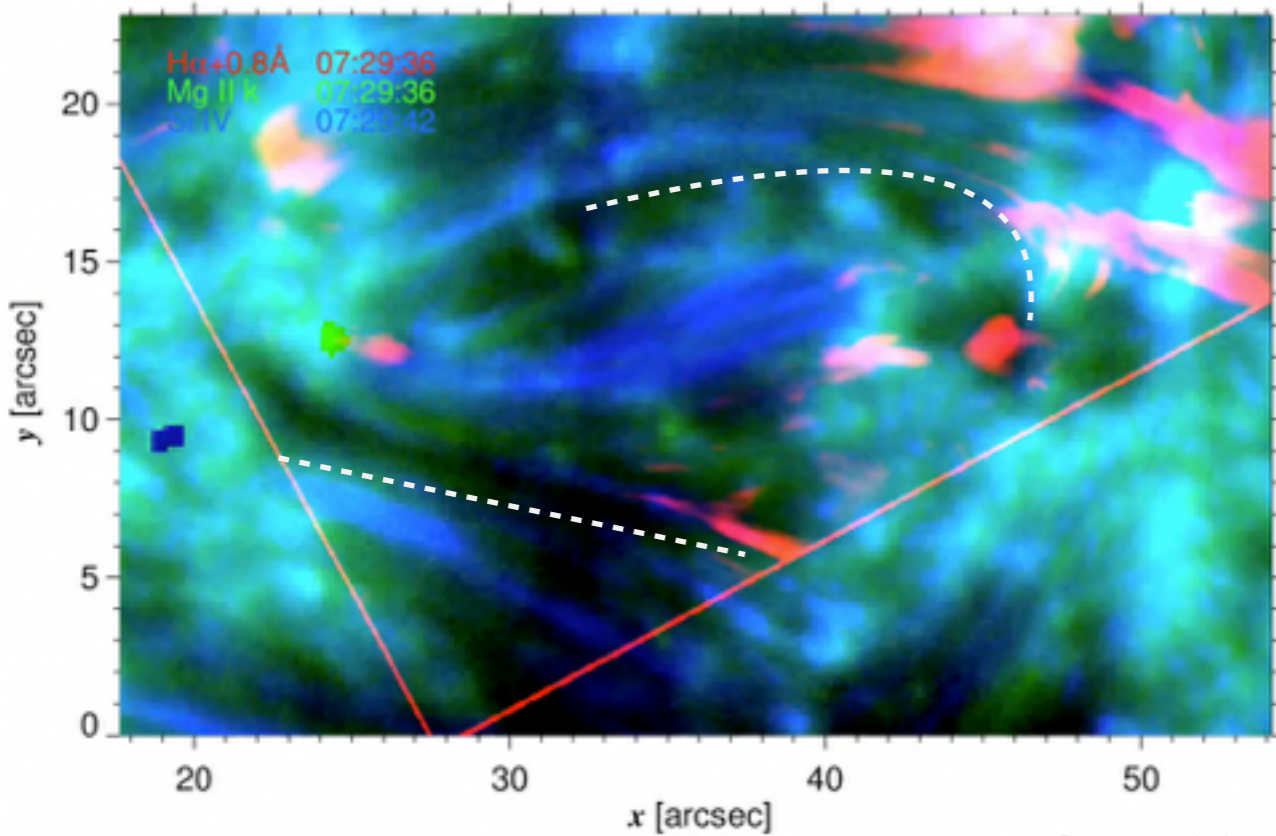
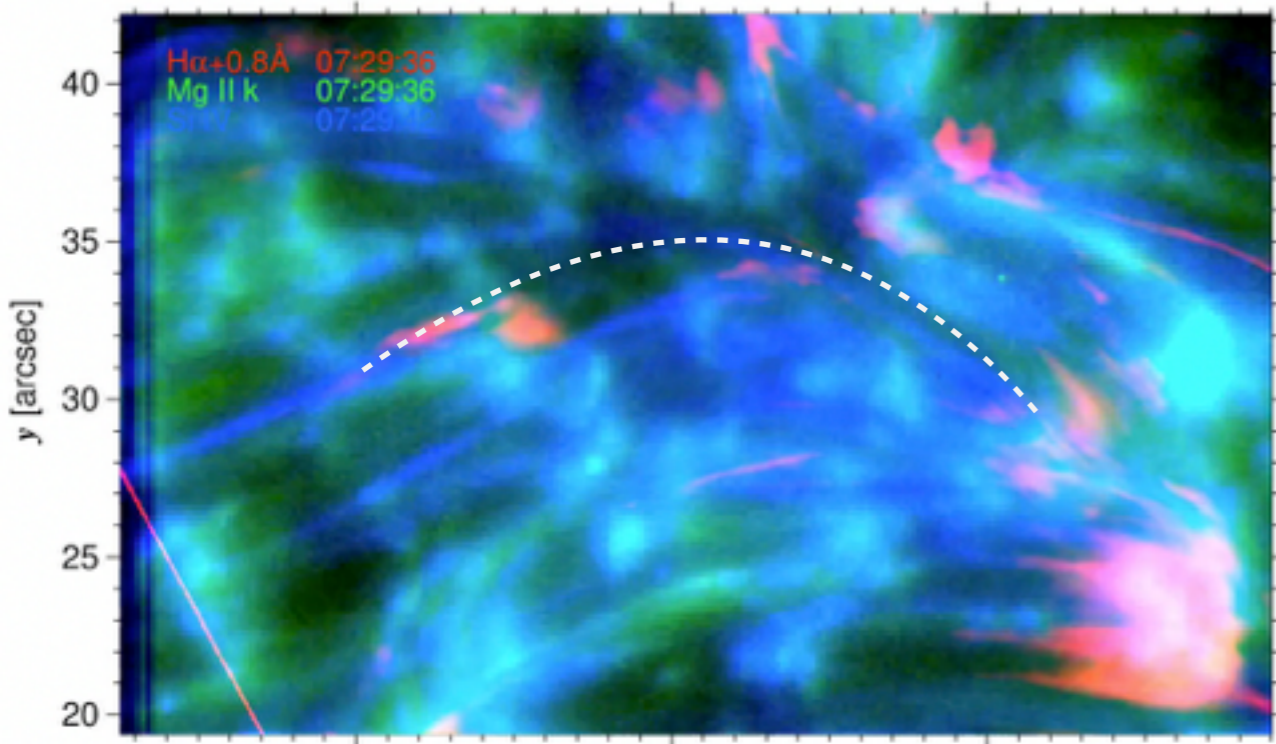


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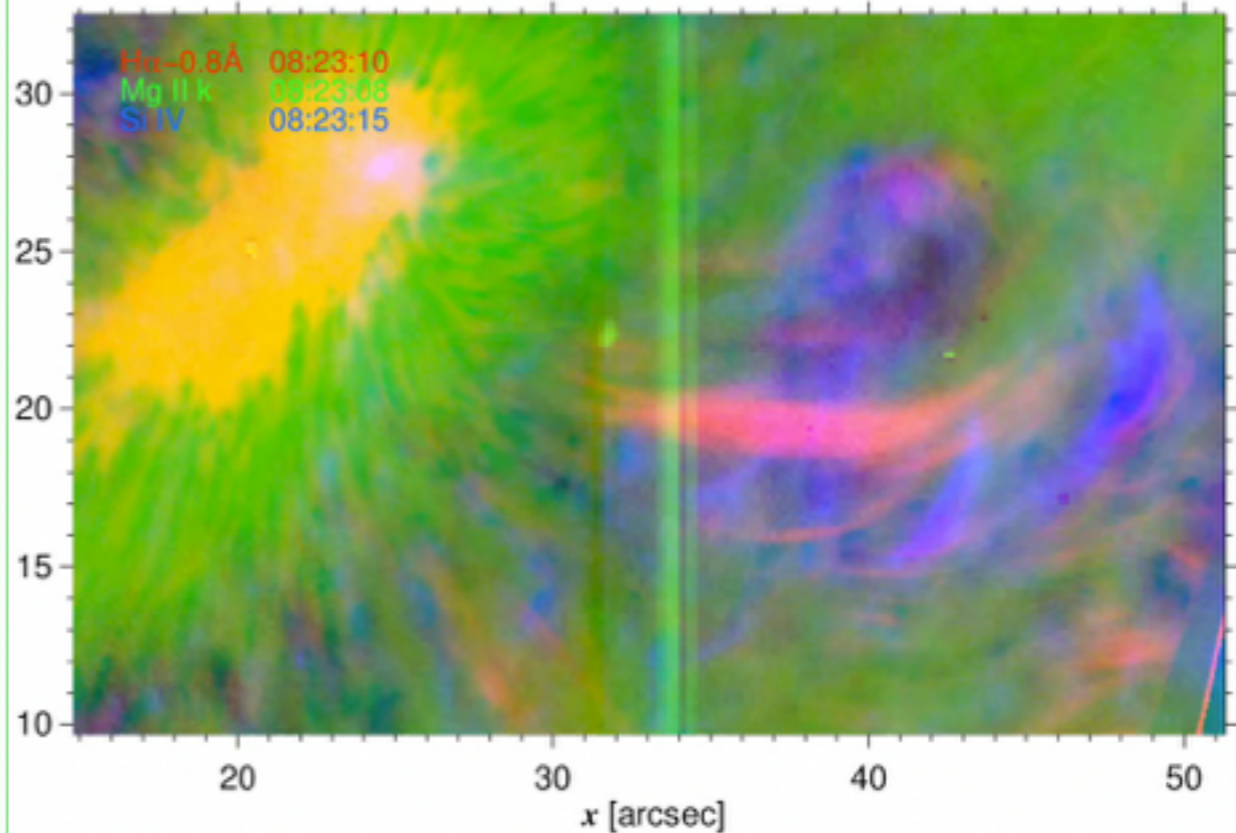


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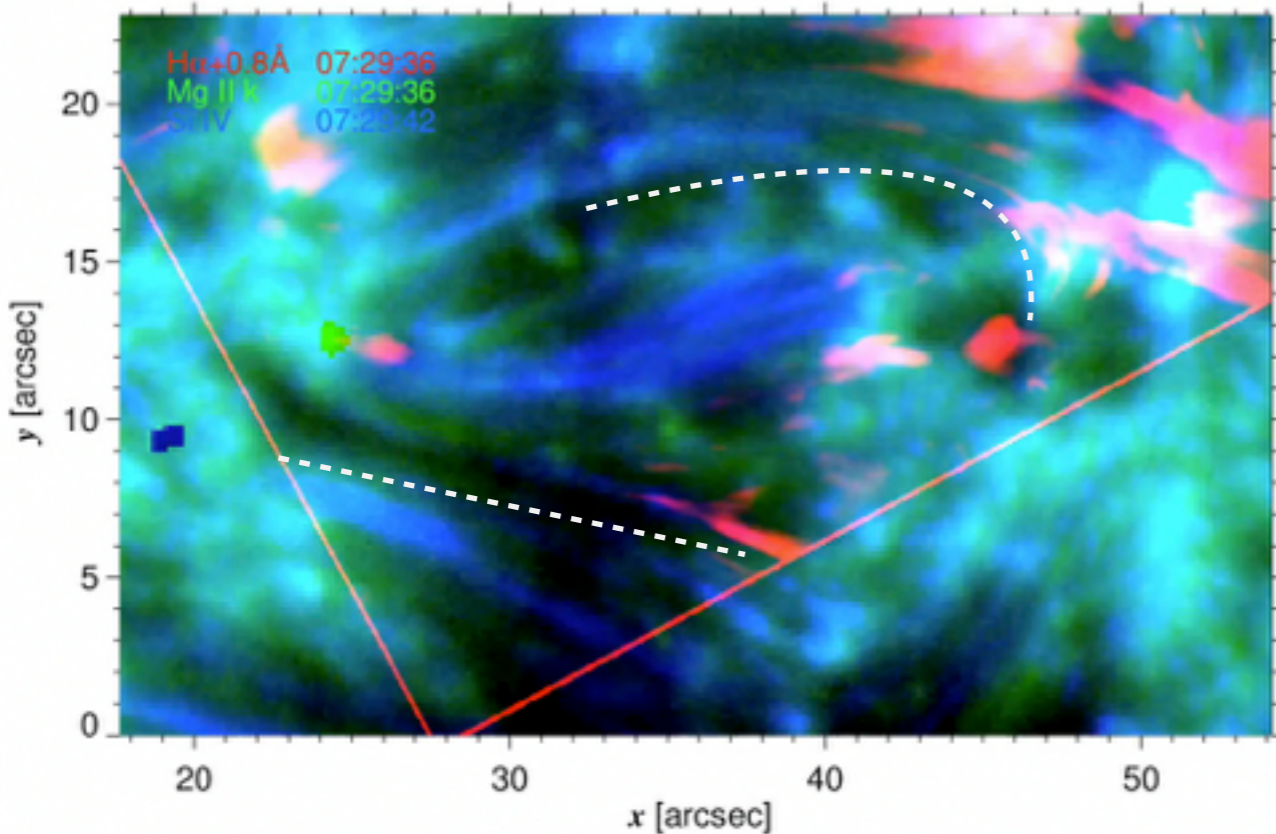
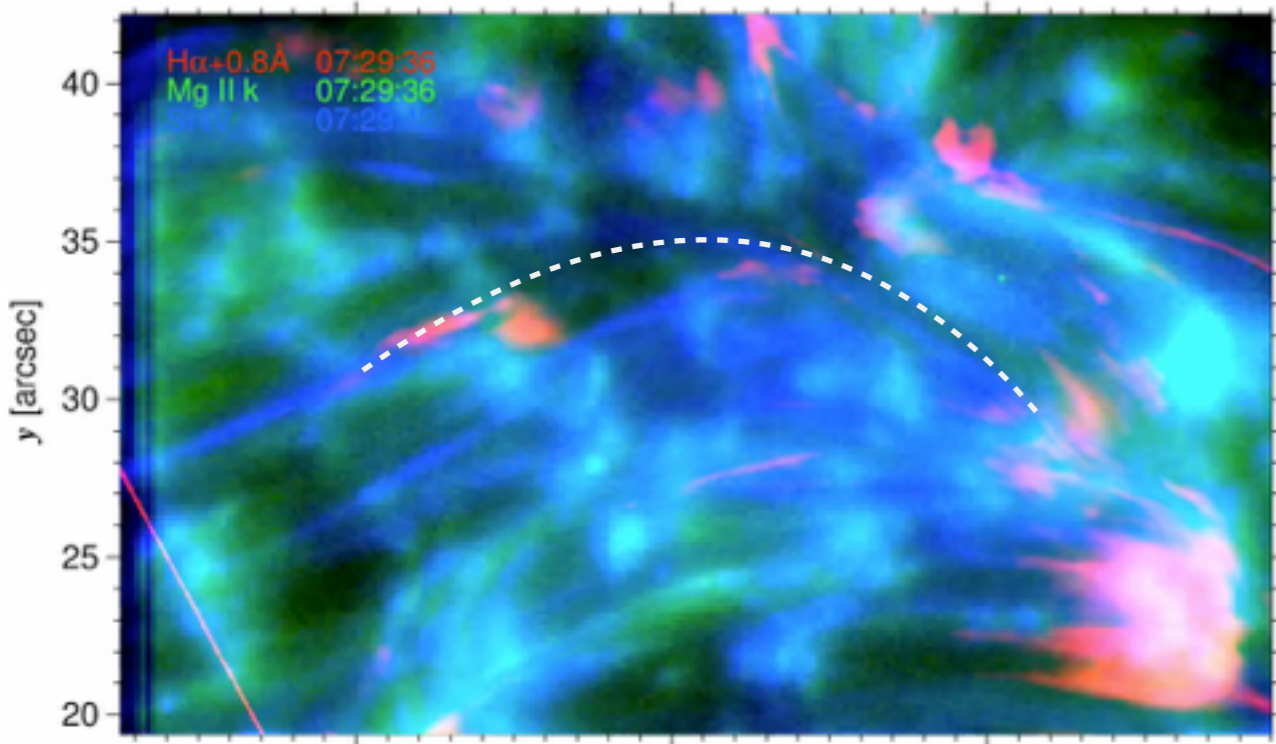


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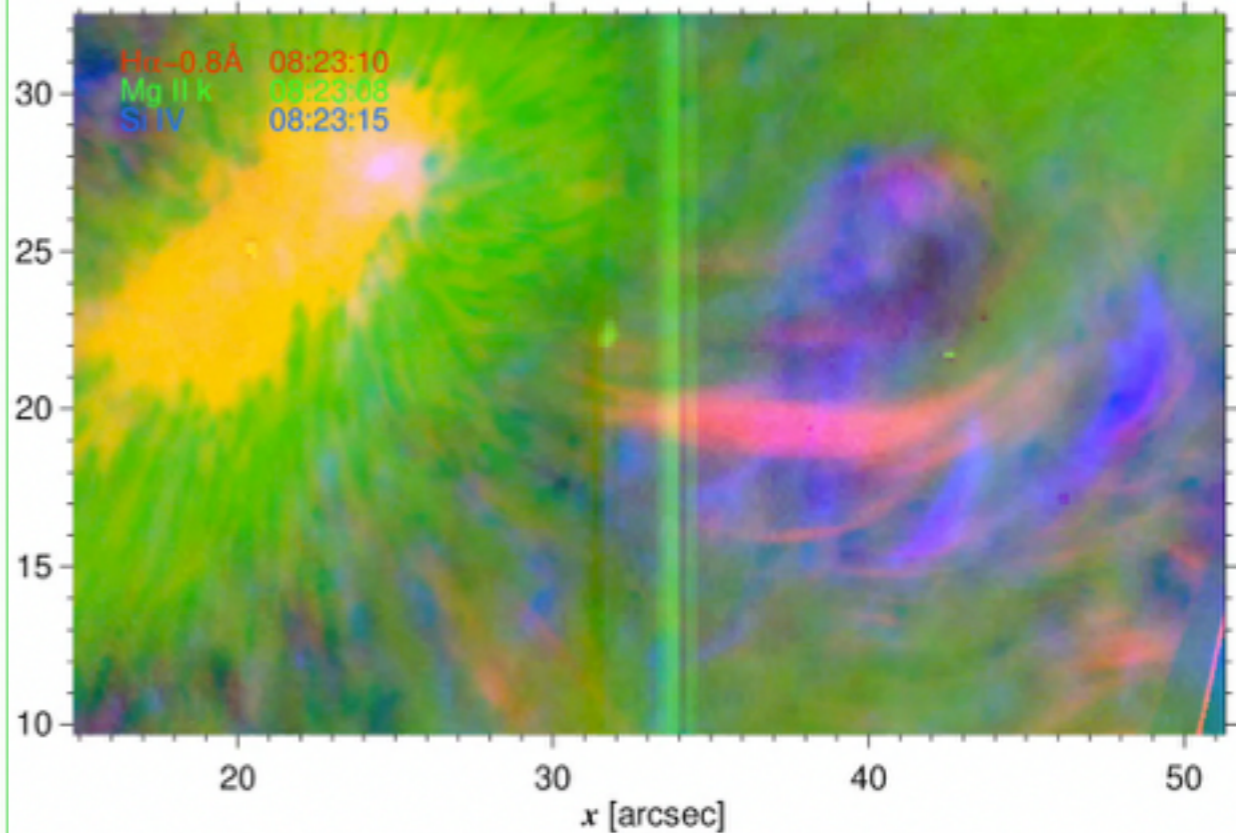


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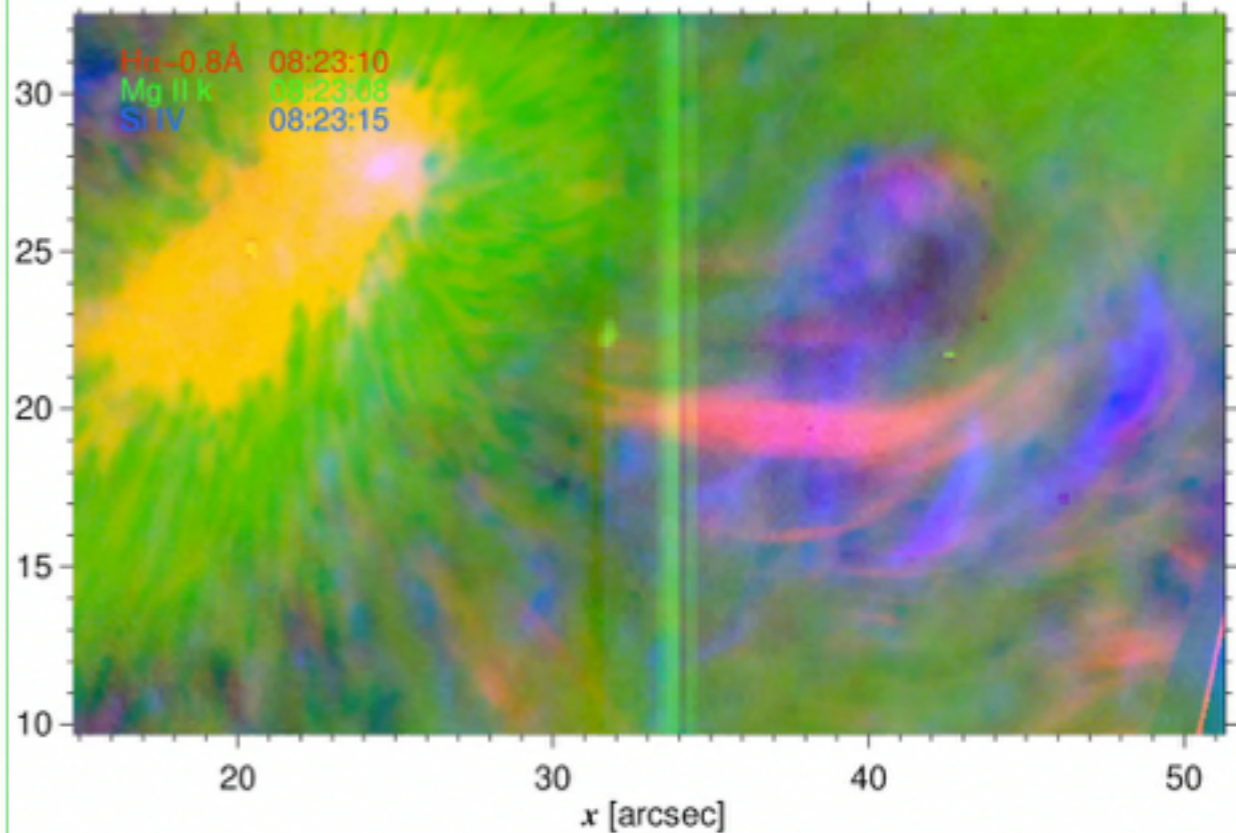
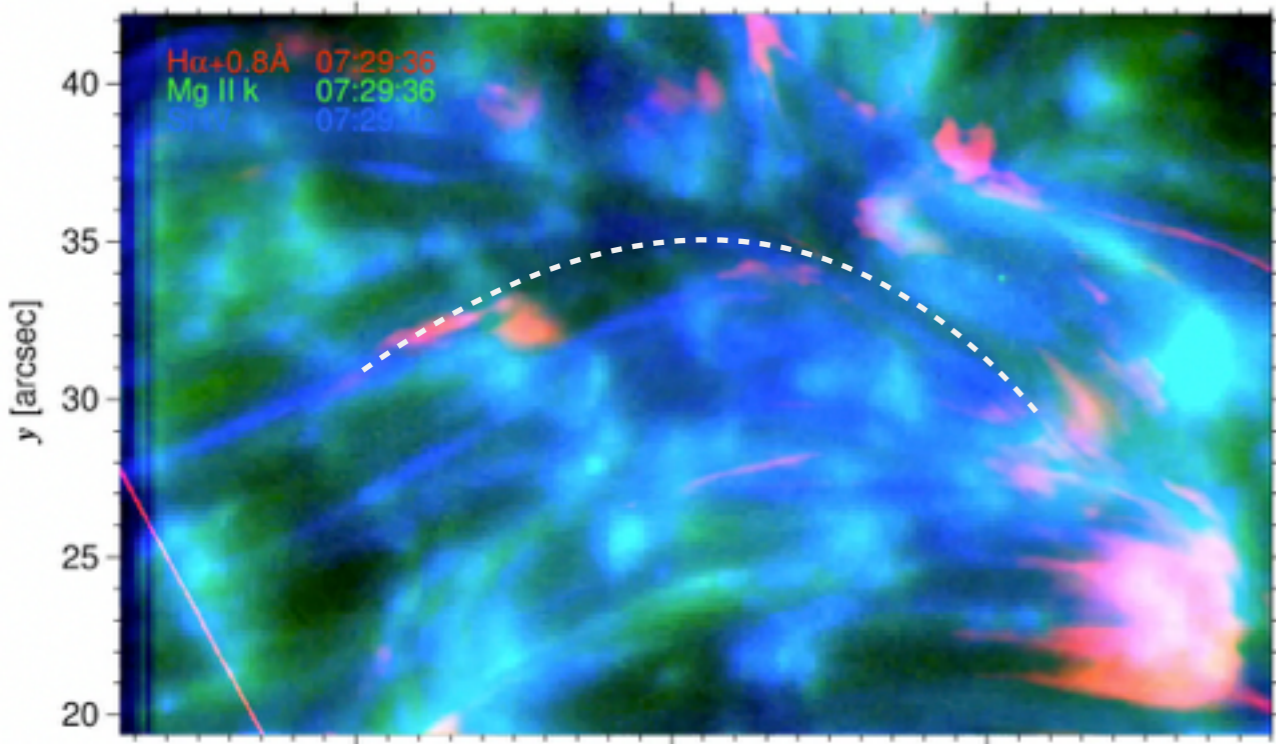


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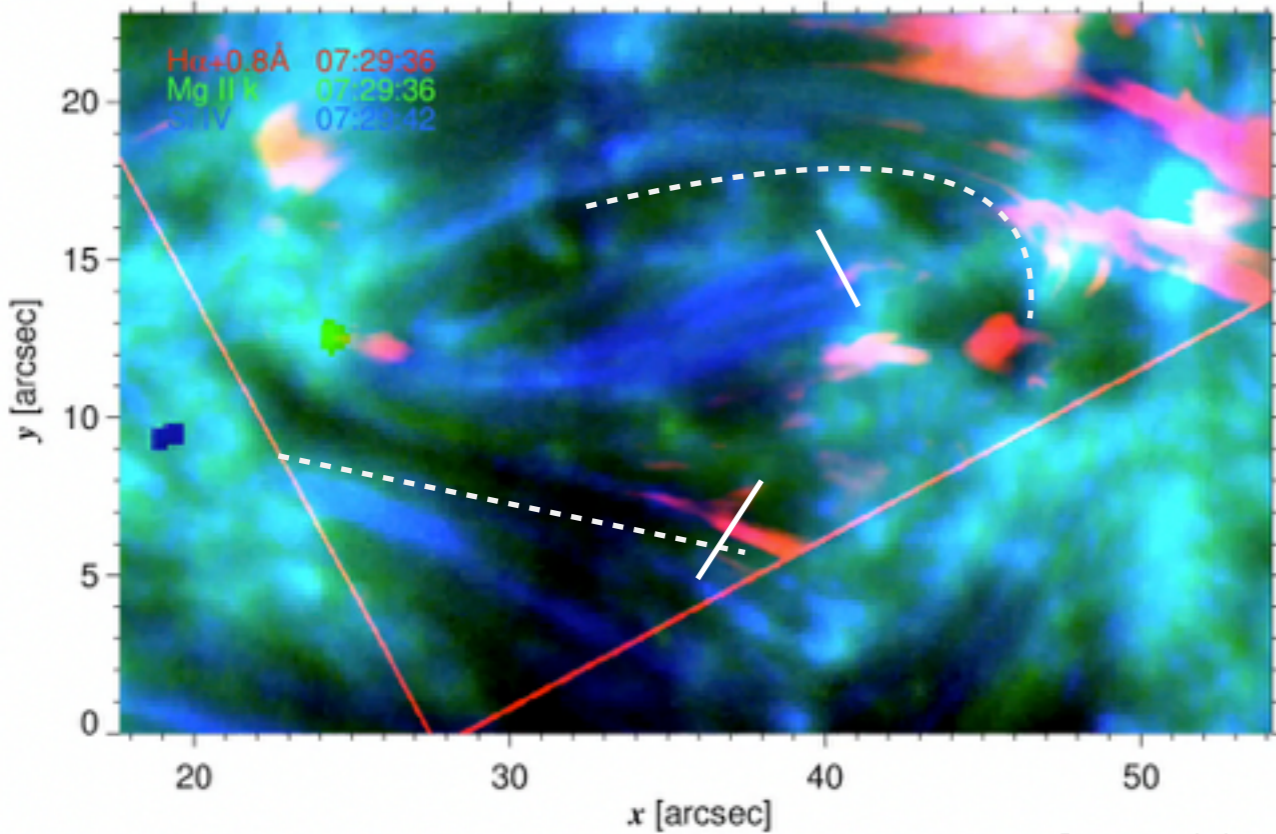


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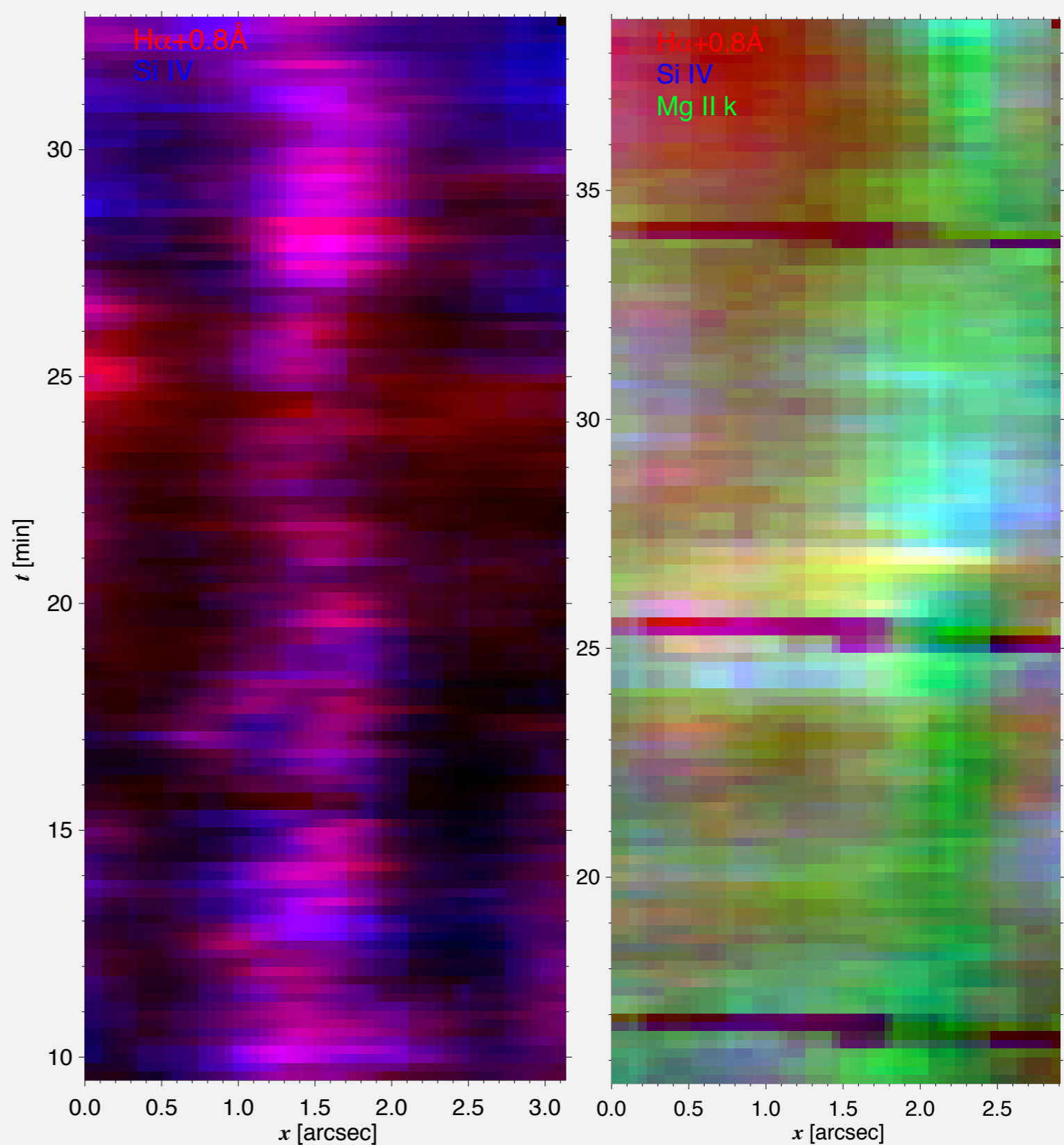
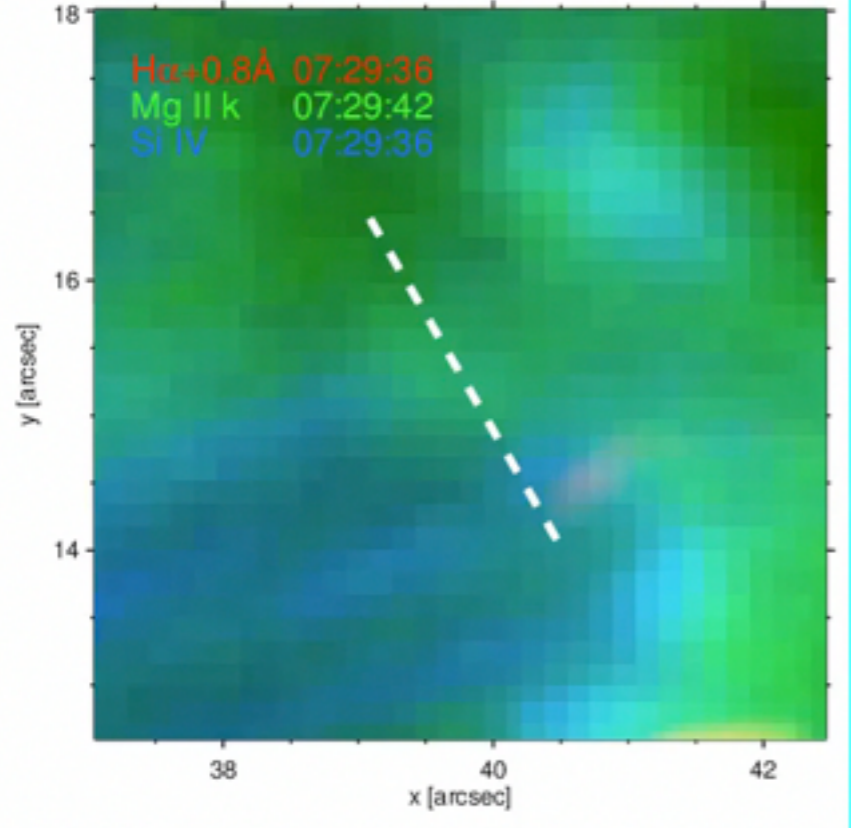
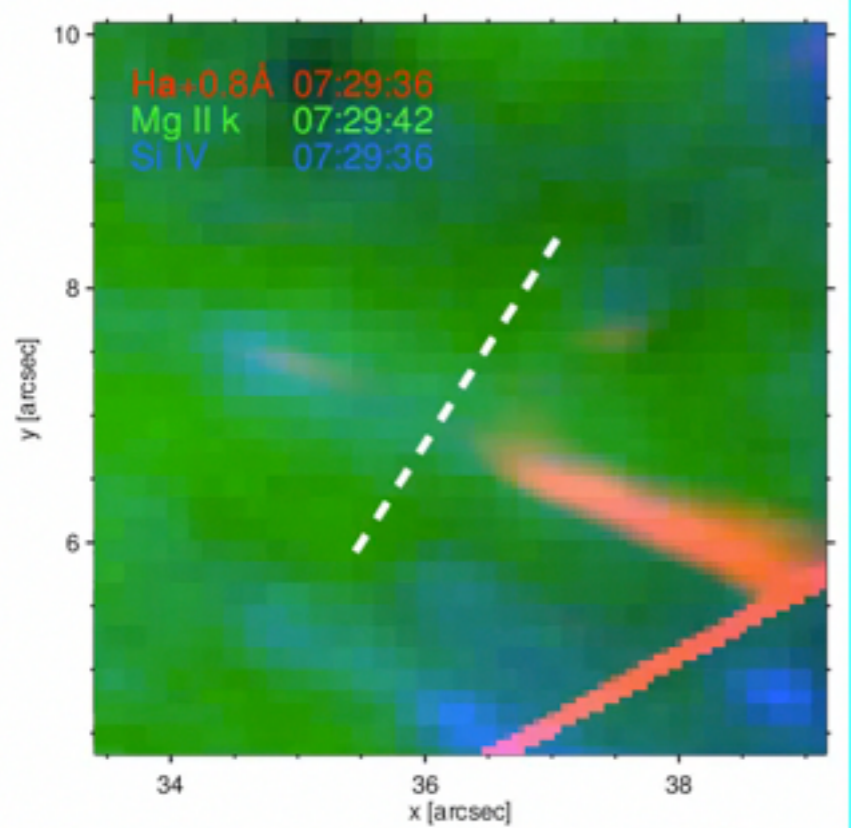


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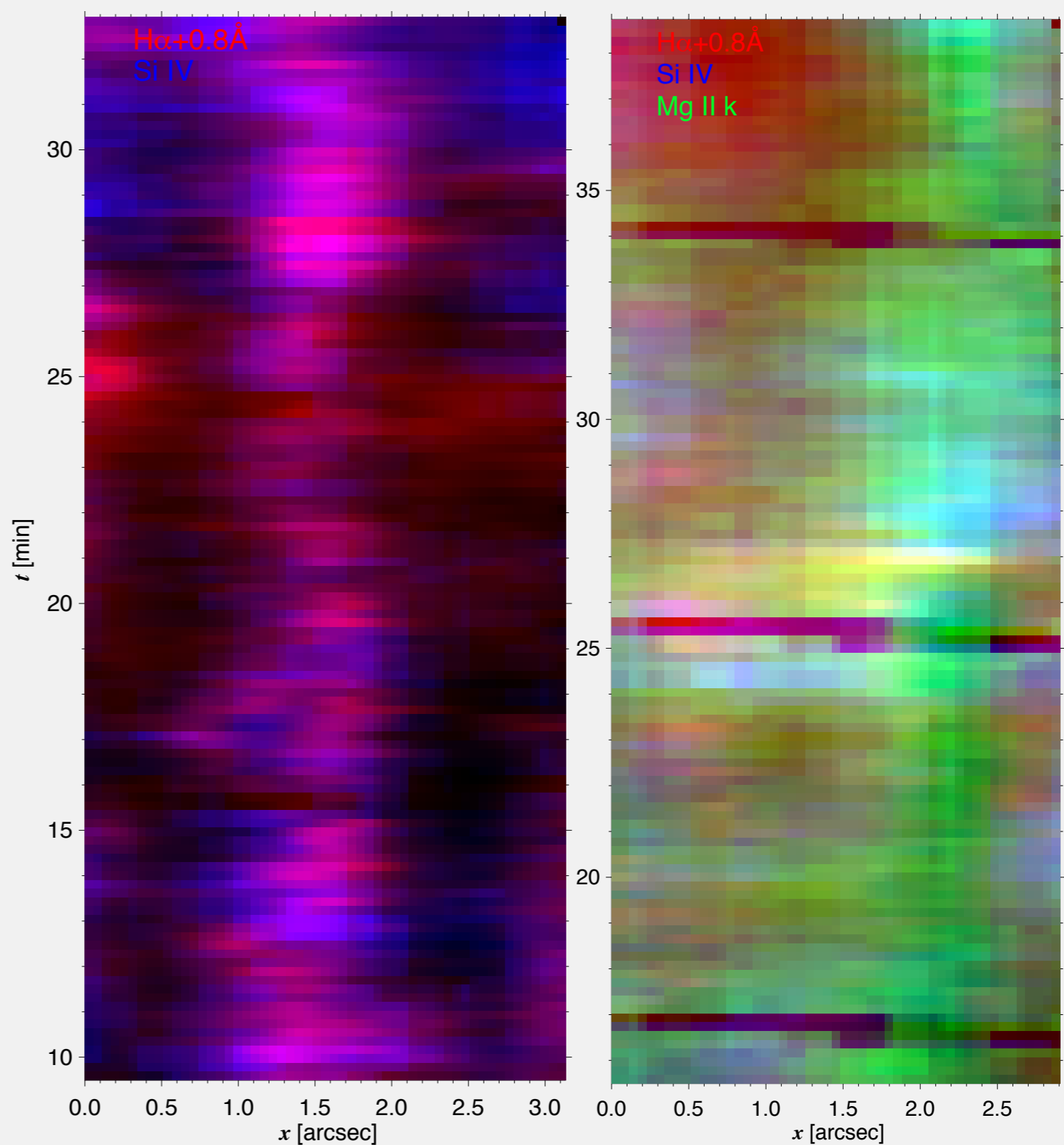
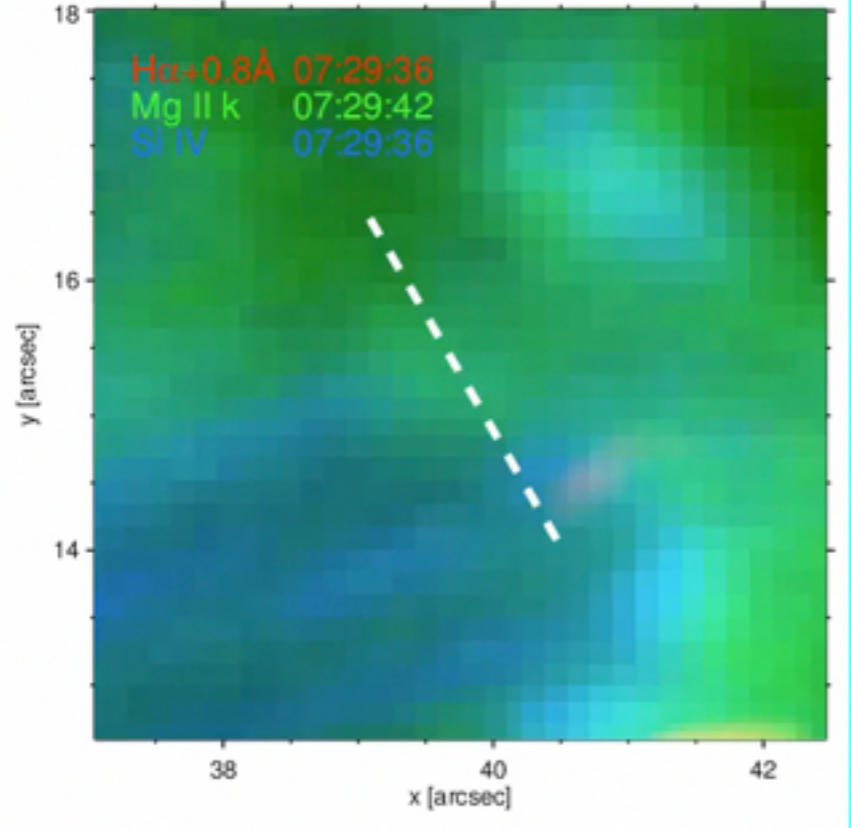
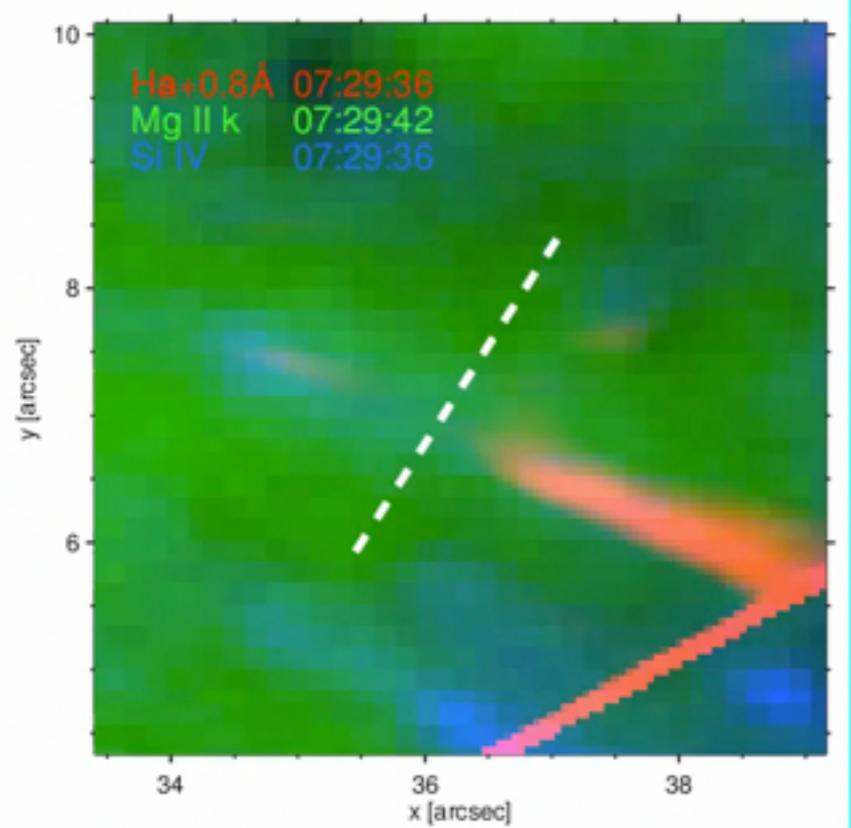
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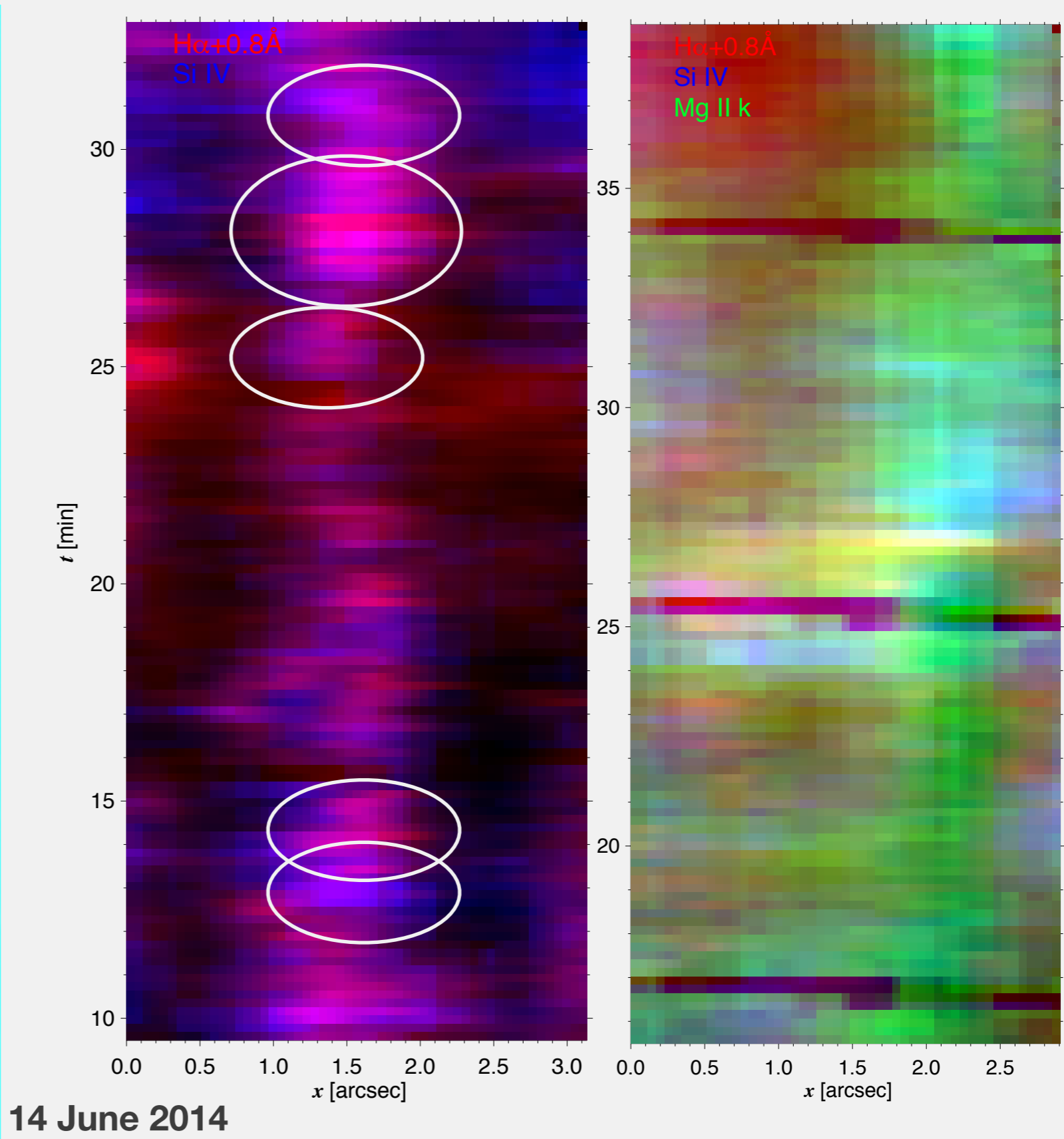
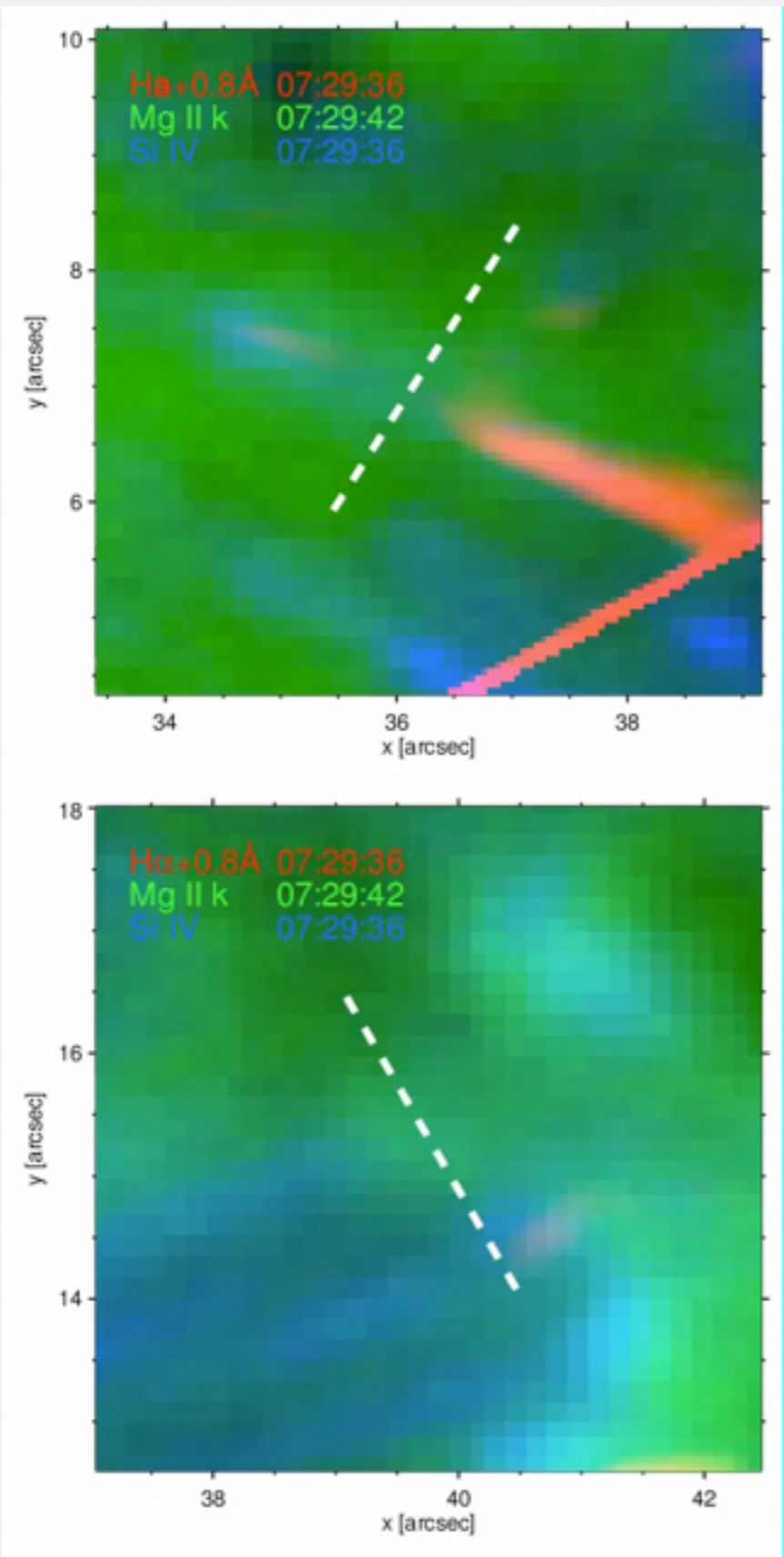
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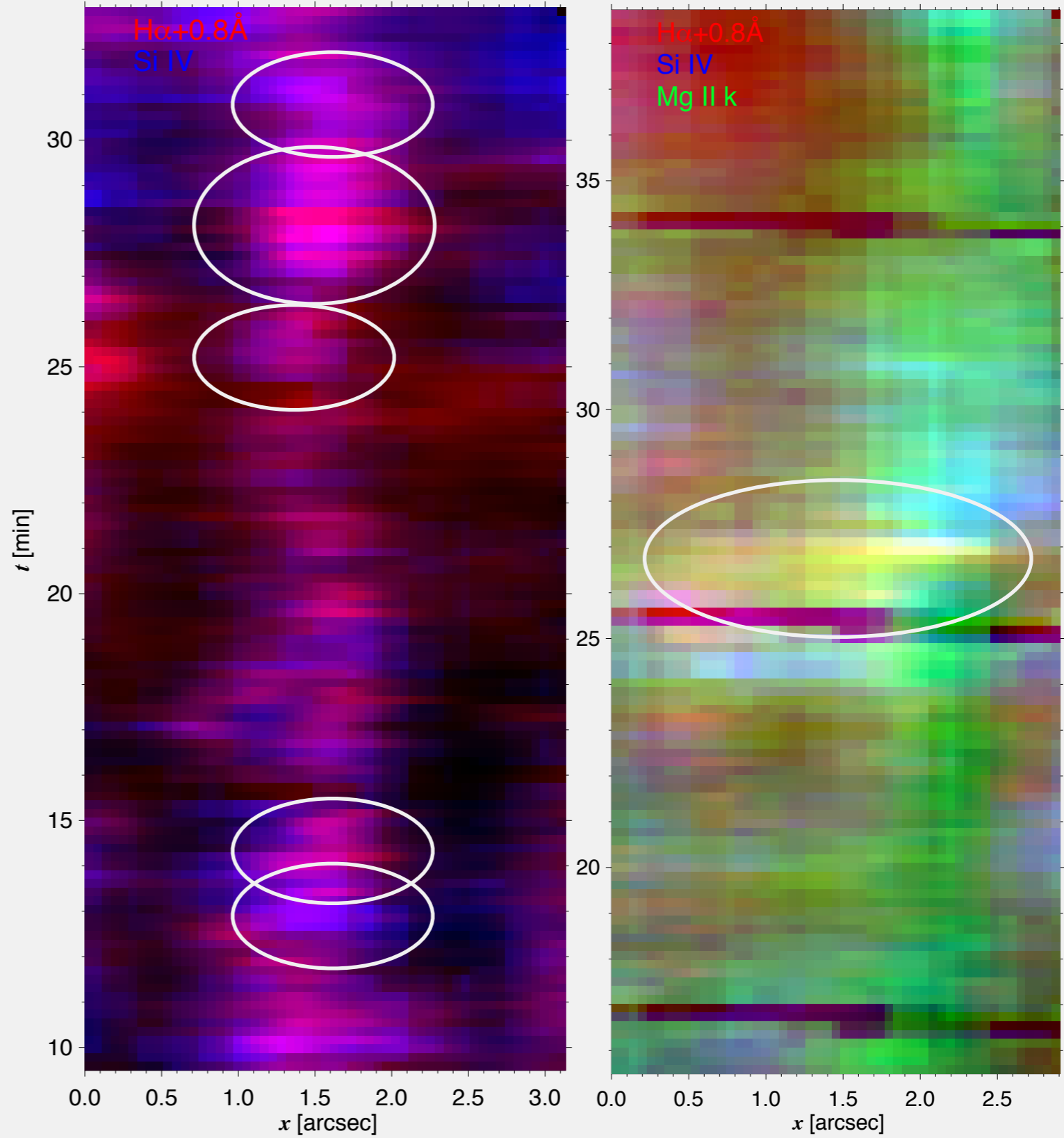
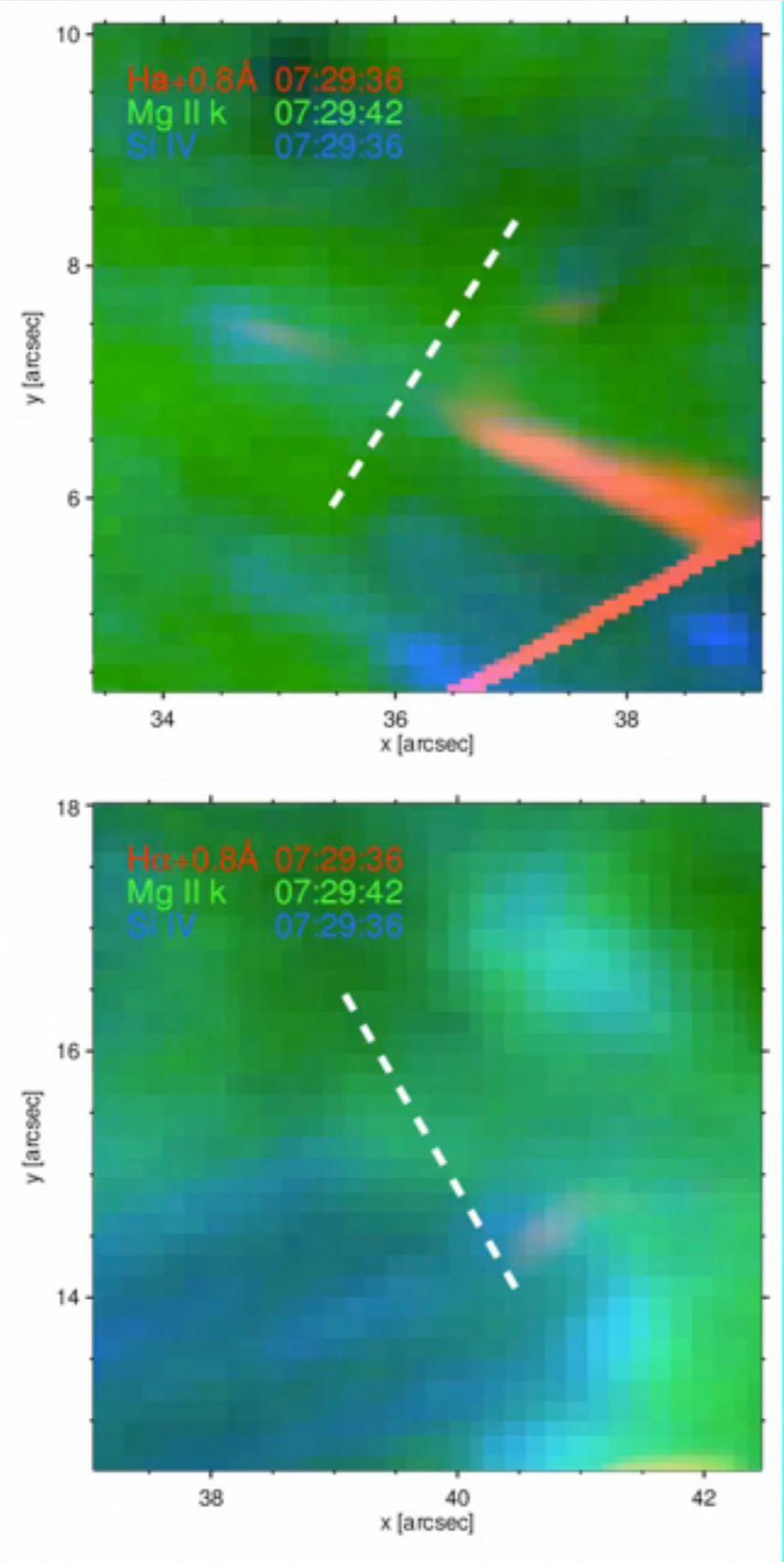
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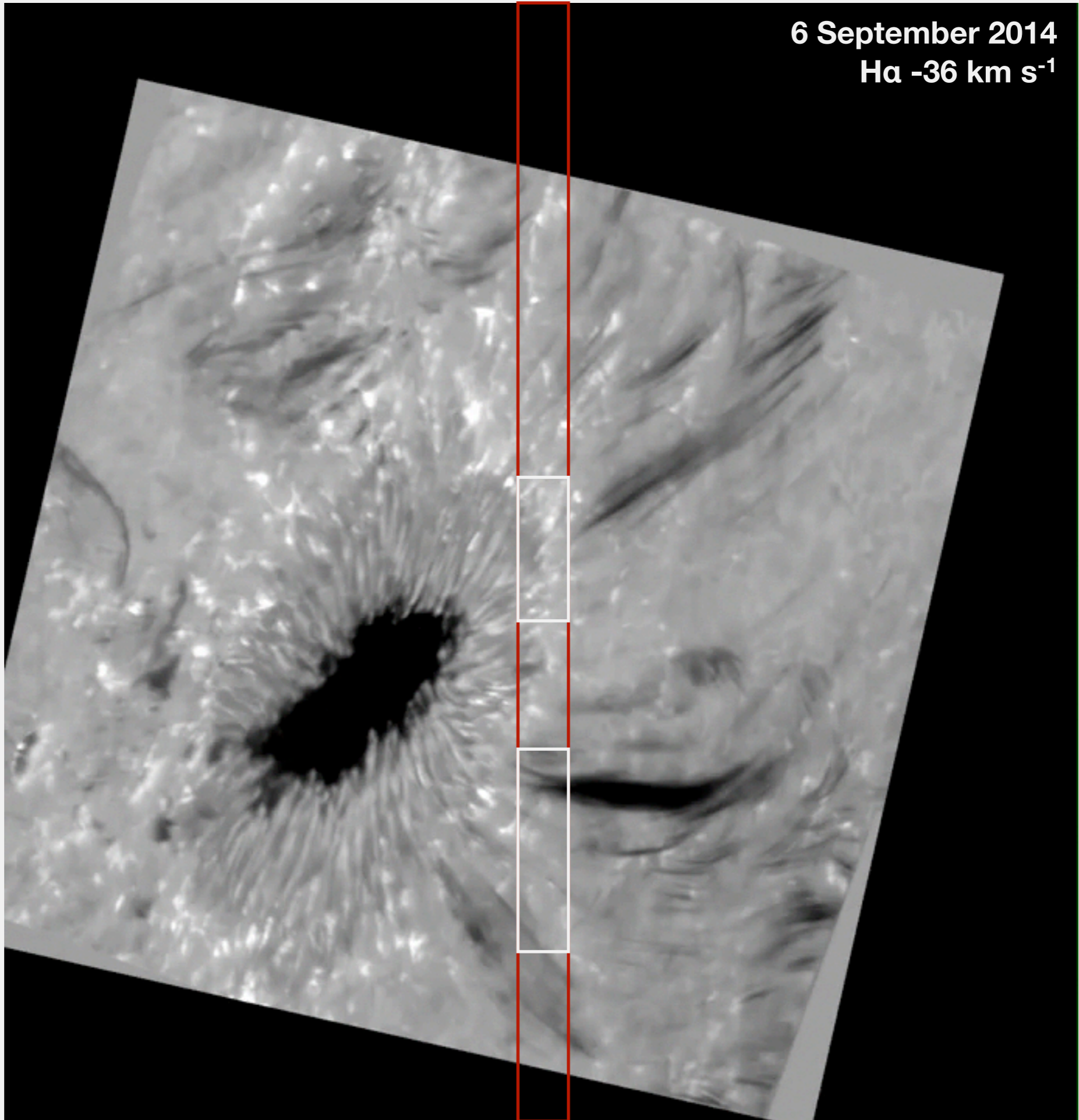


**Si IV**  
**-13 km s<sup>-1</sup>**

**Mg II k**  
**-11 km s<sup>-1</sup>**



**6 September 2014**  
**H $\alpha$  -36 km s<sup>-1</sup>**

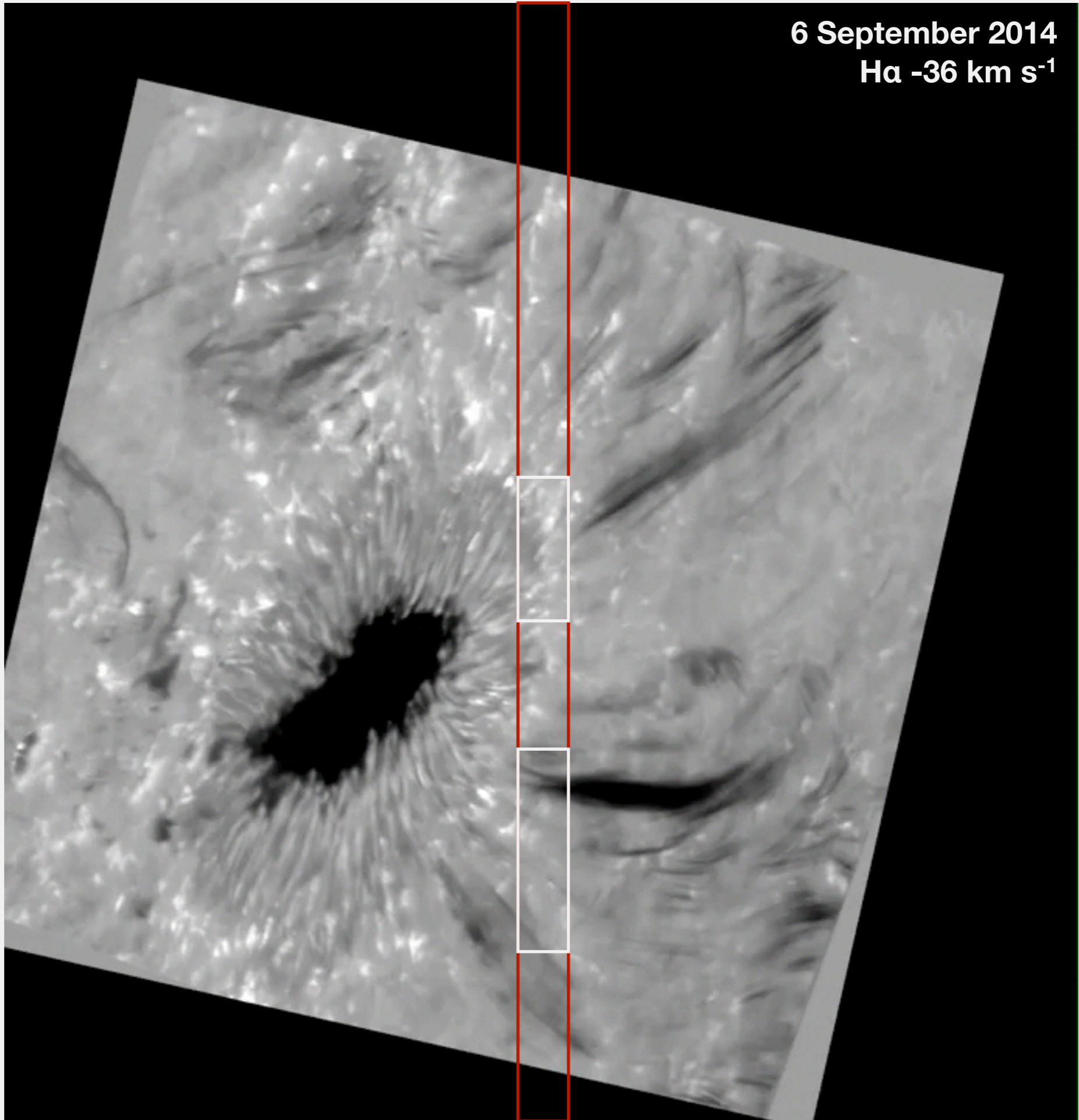


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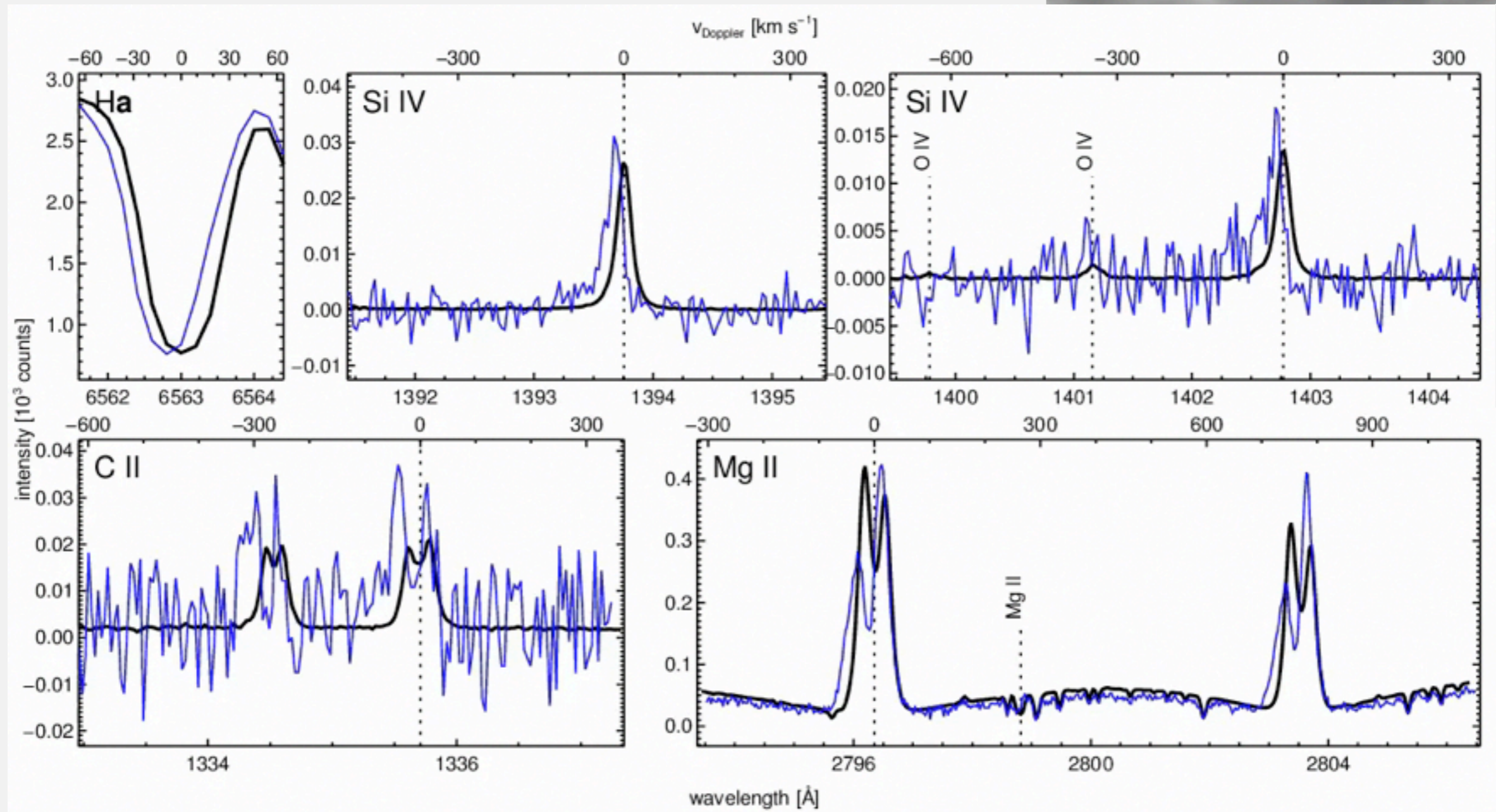
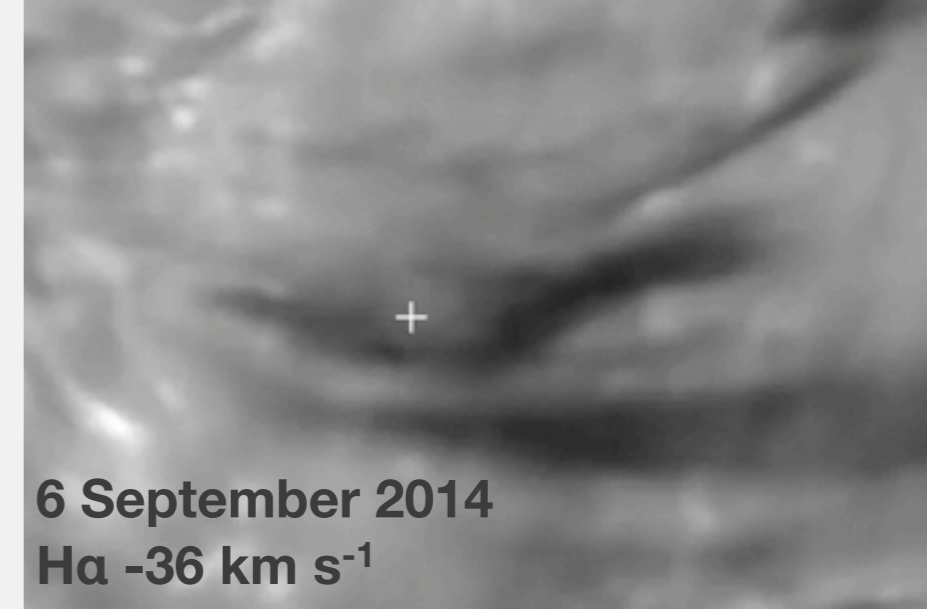
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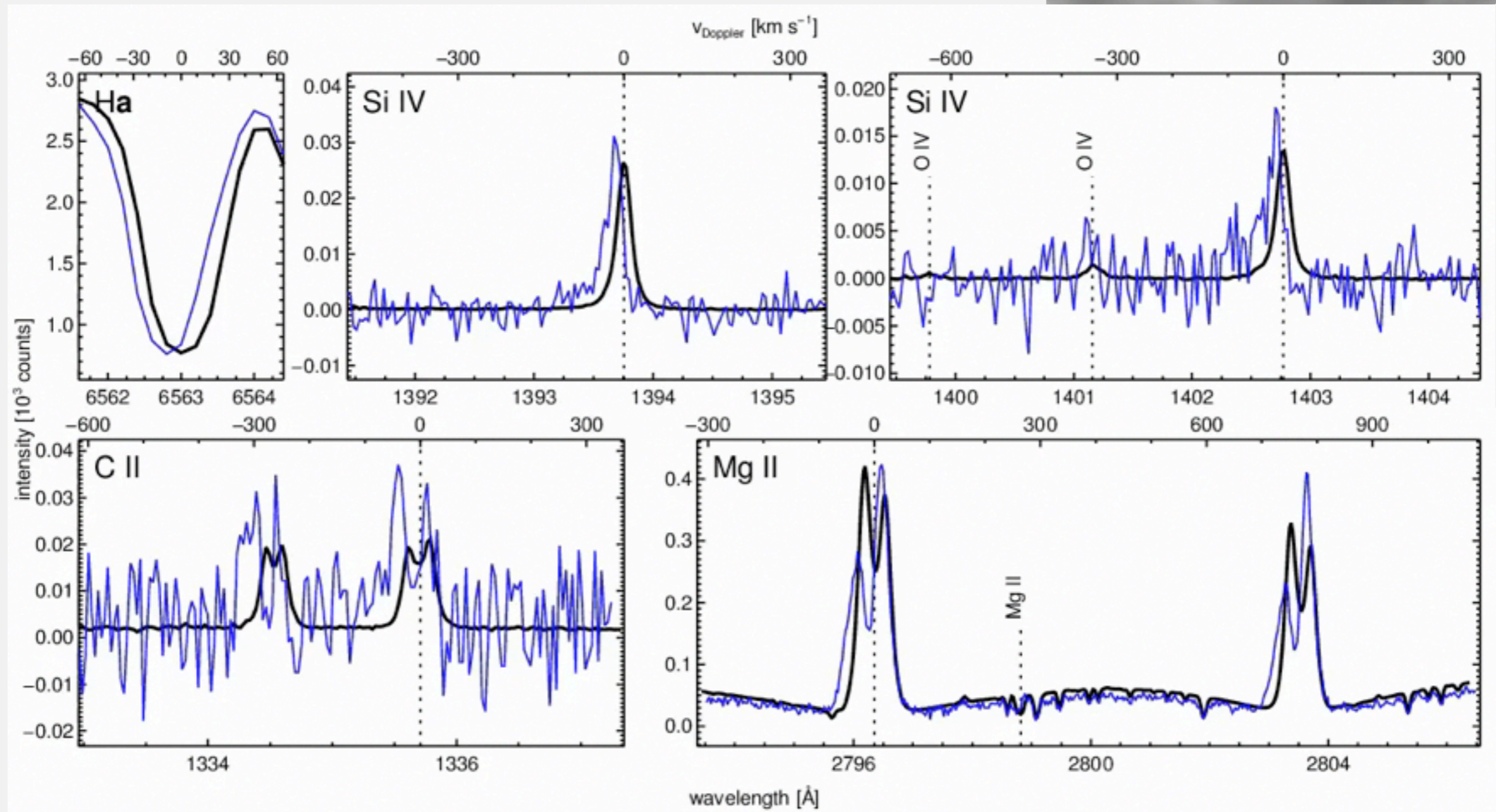
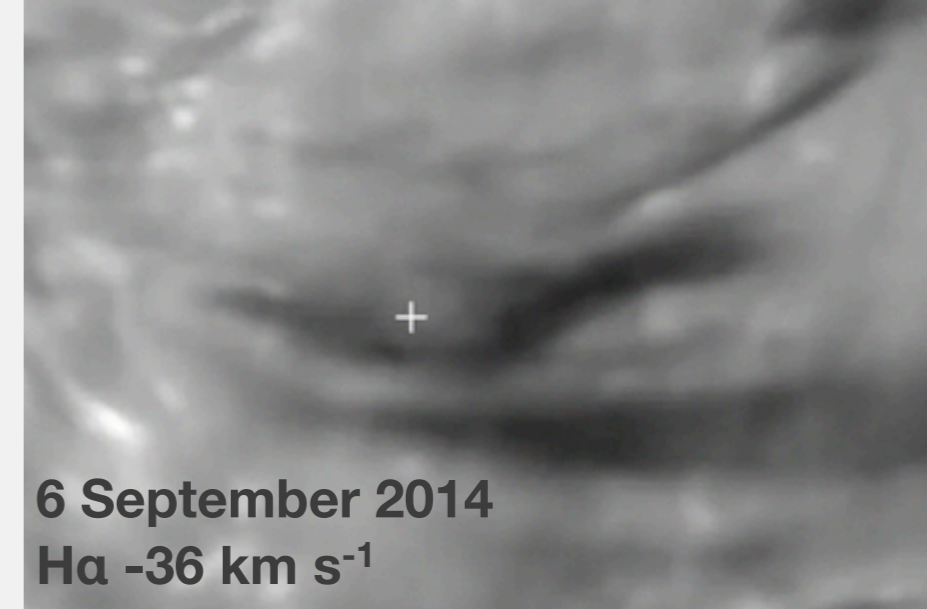
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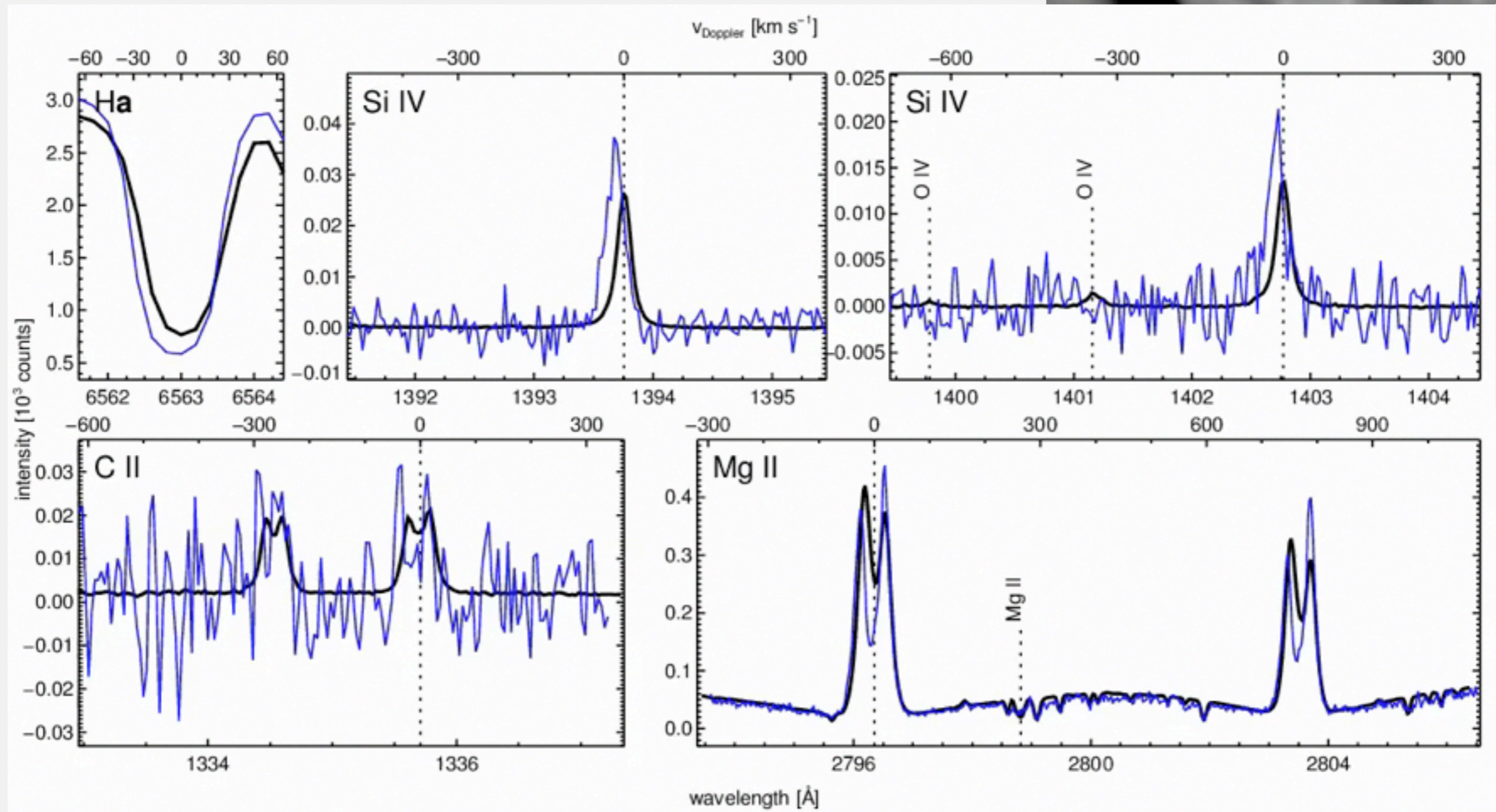
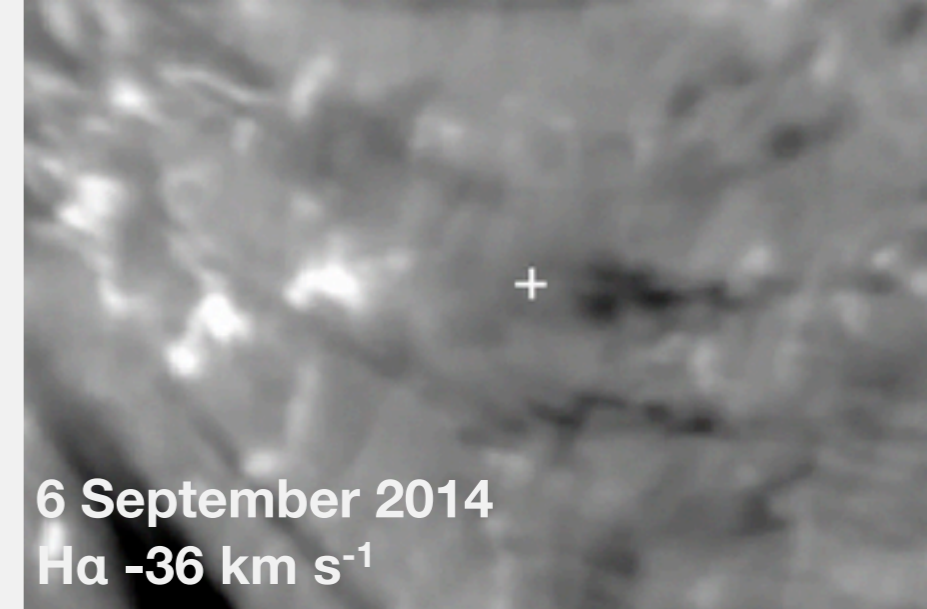
# The passage of clumps has a noticeable effect on the Mg II asymmetry and Si IV intensity



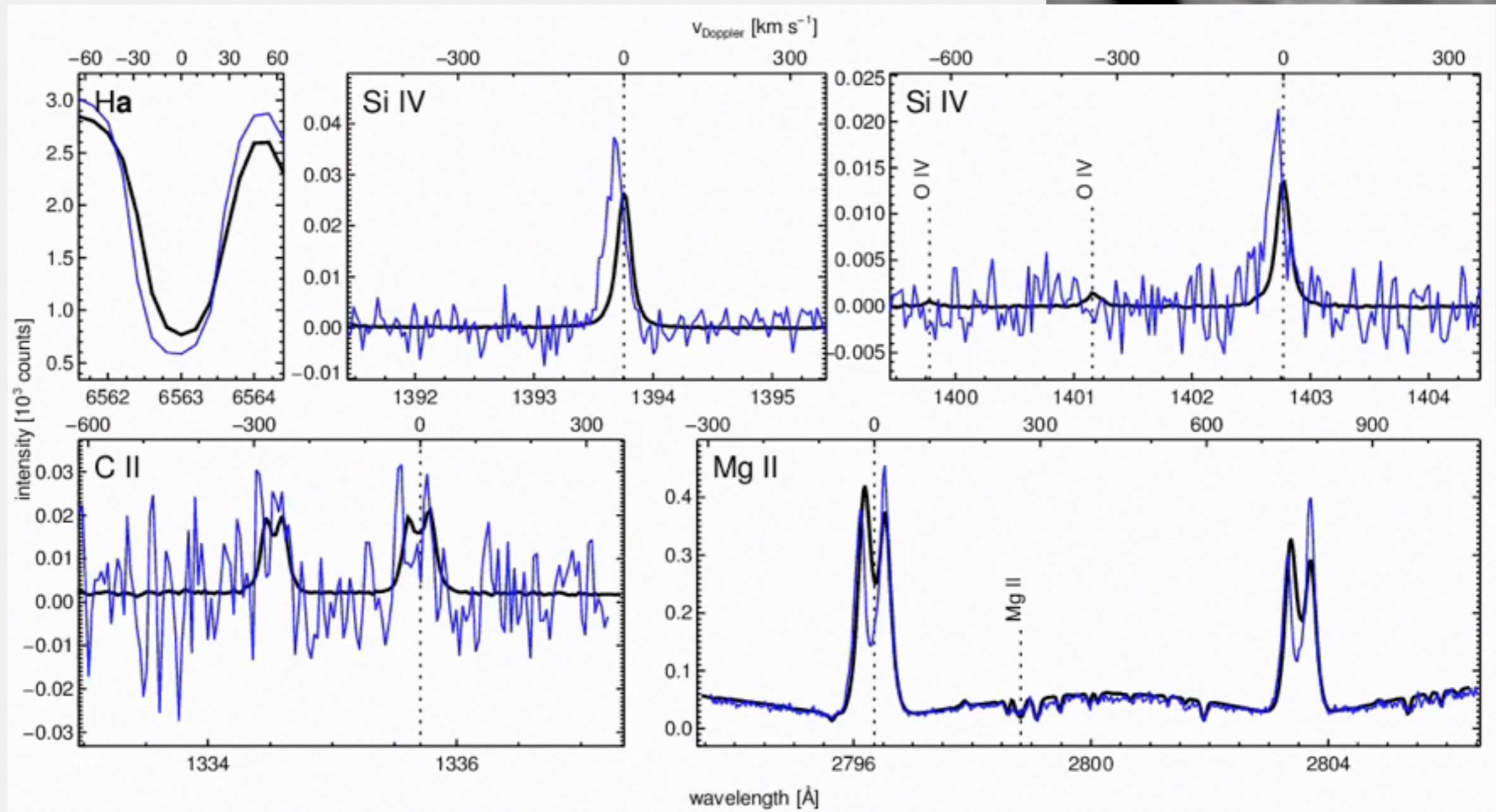
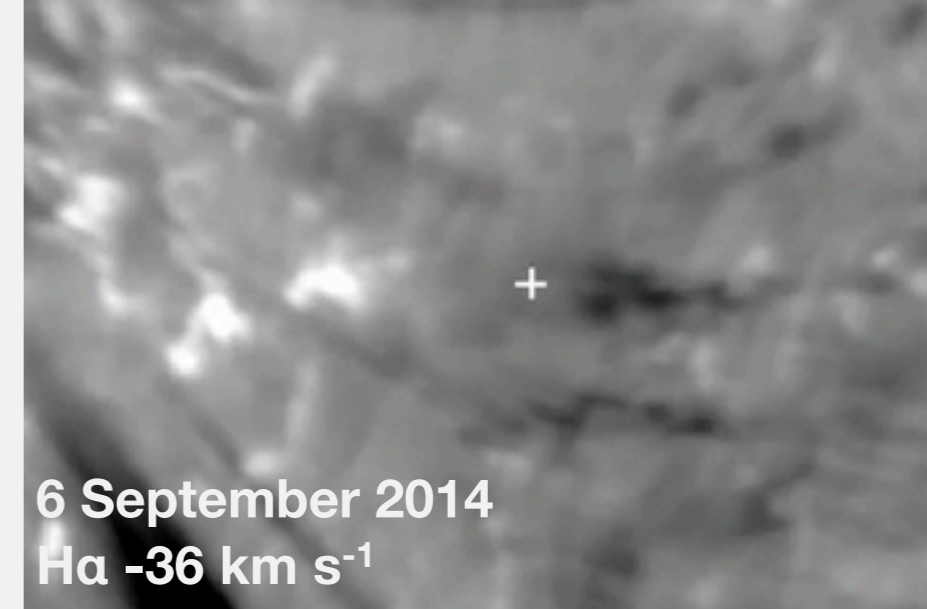
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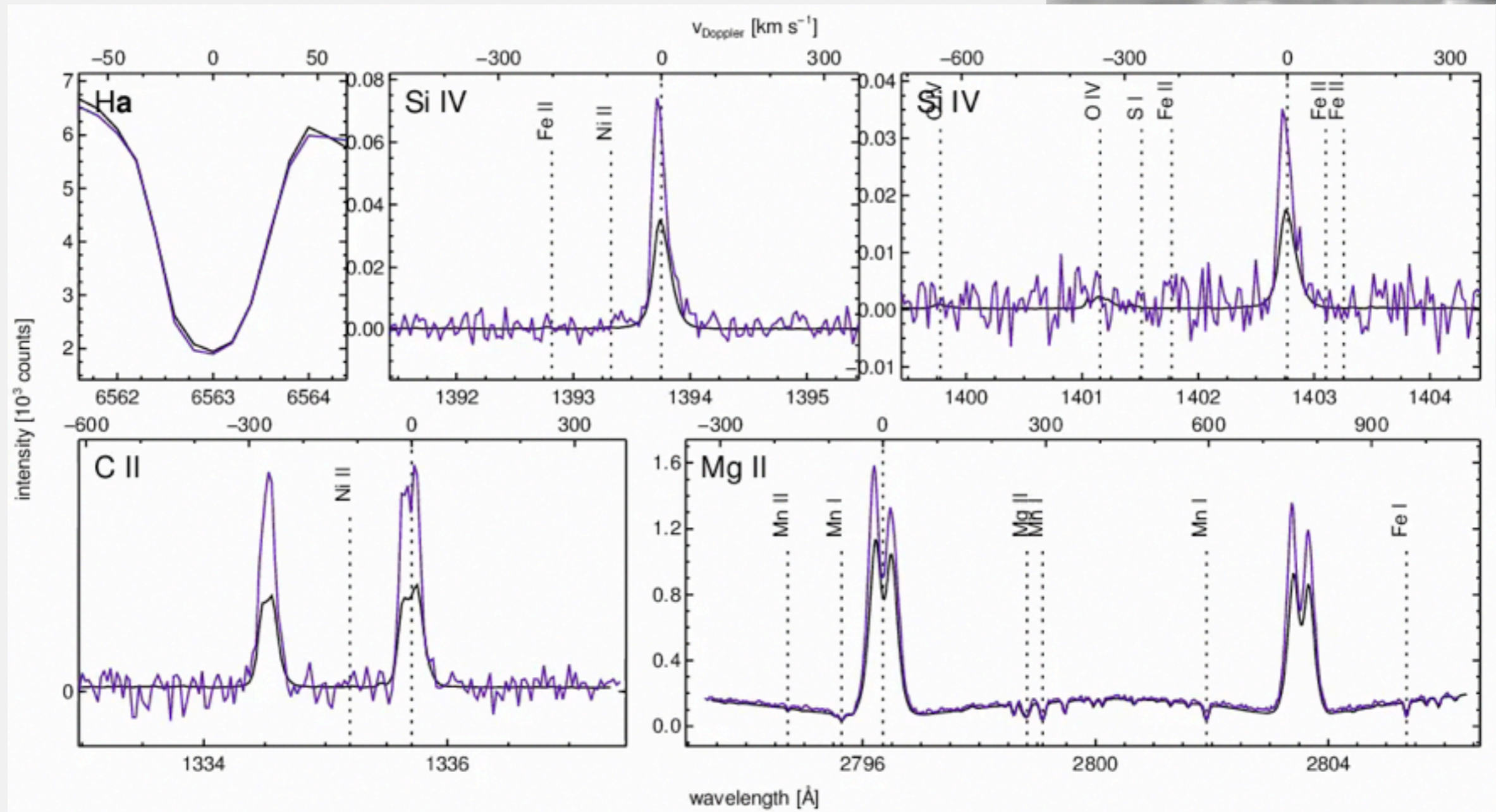
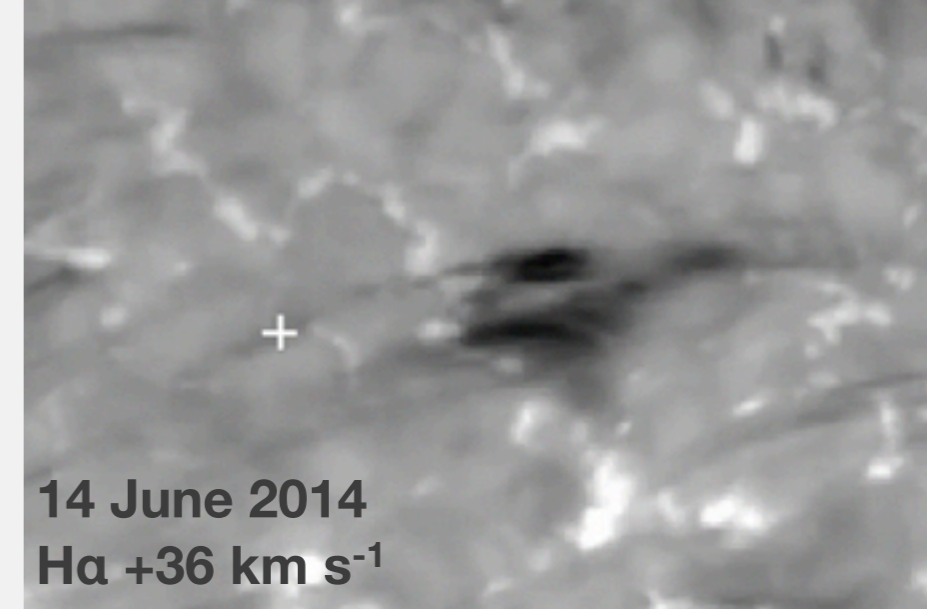
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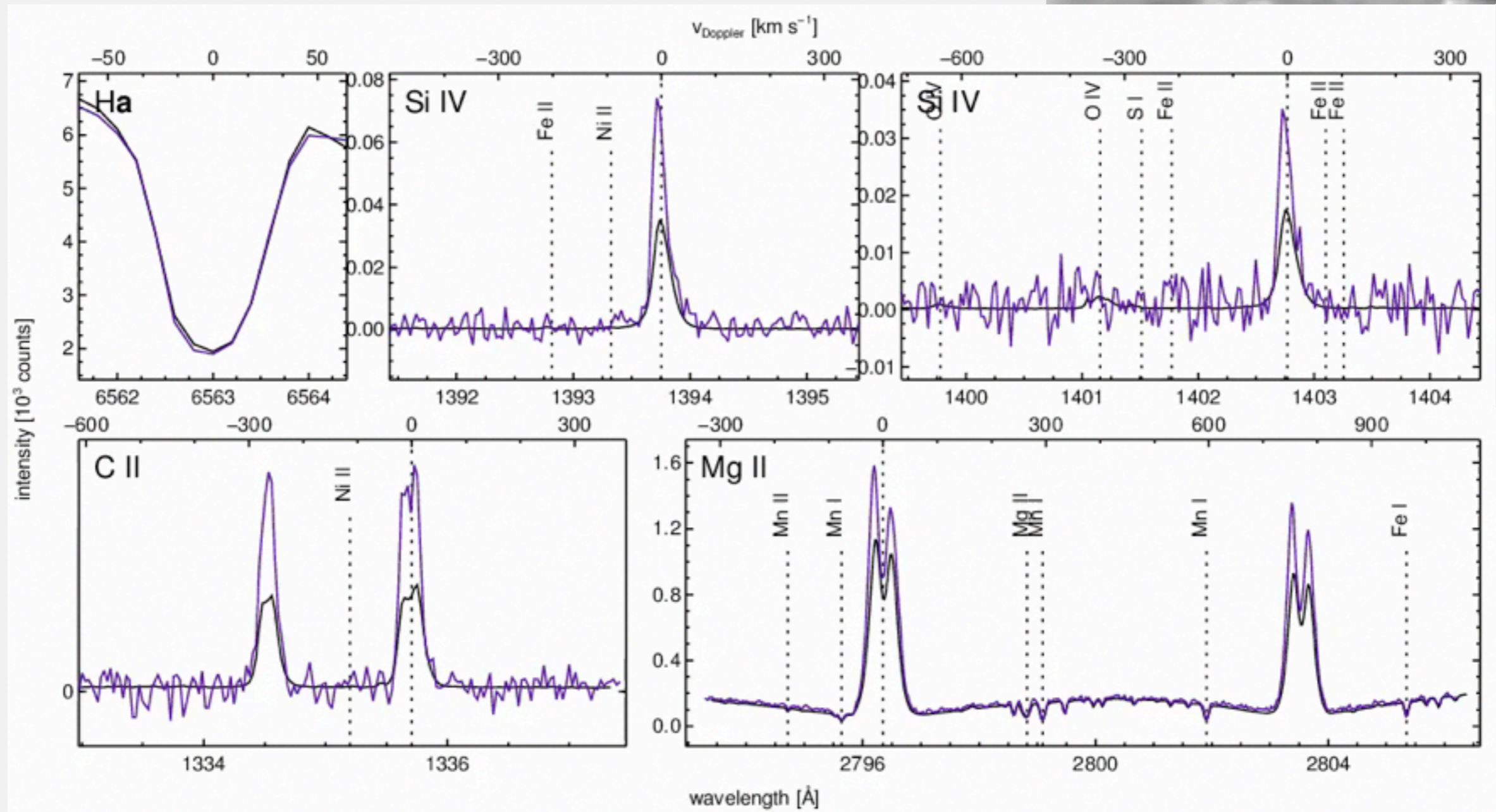
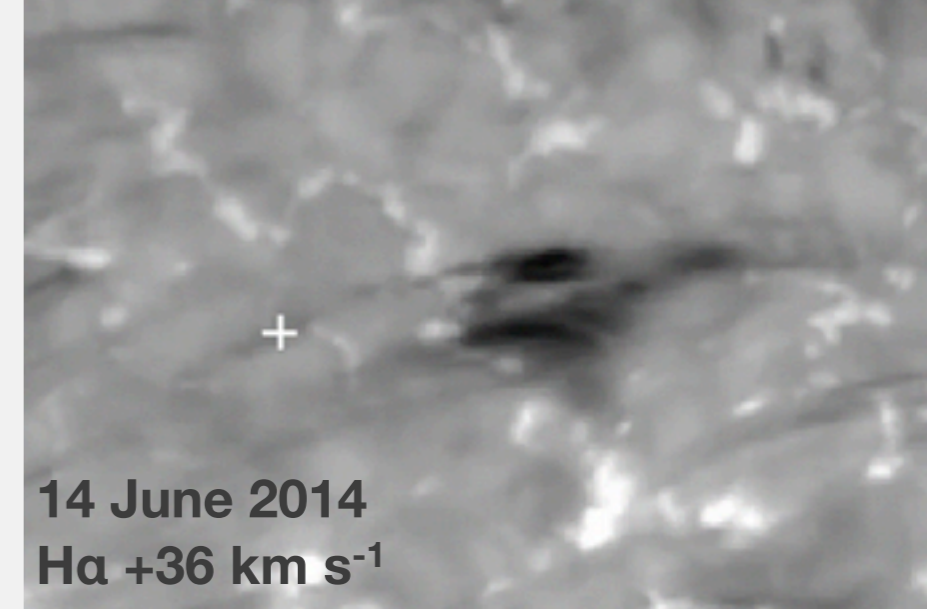
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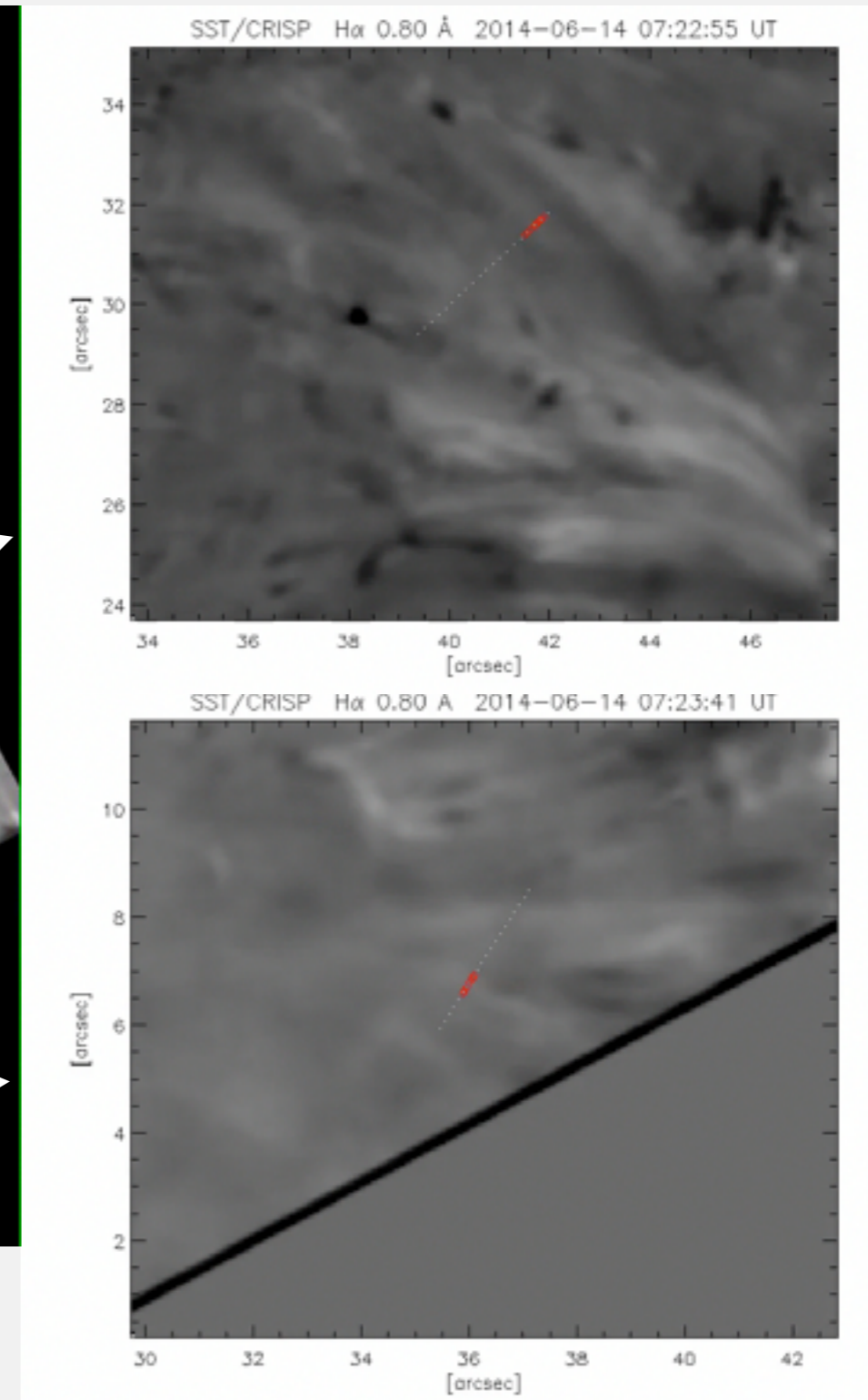
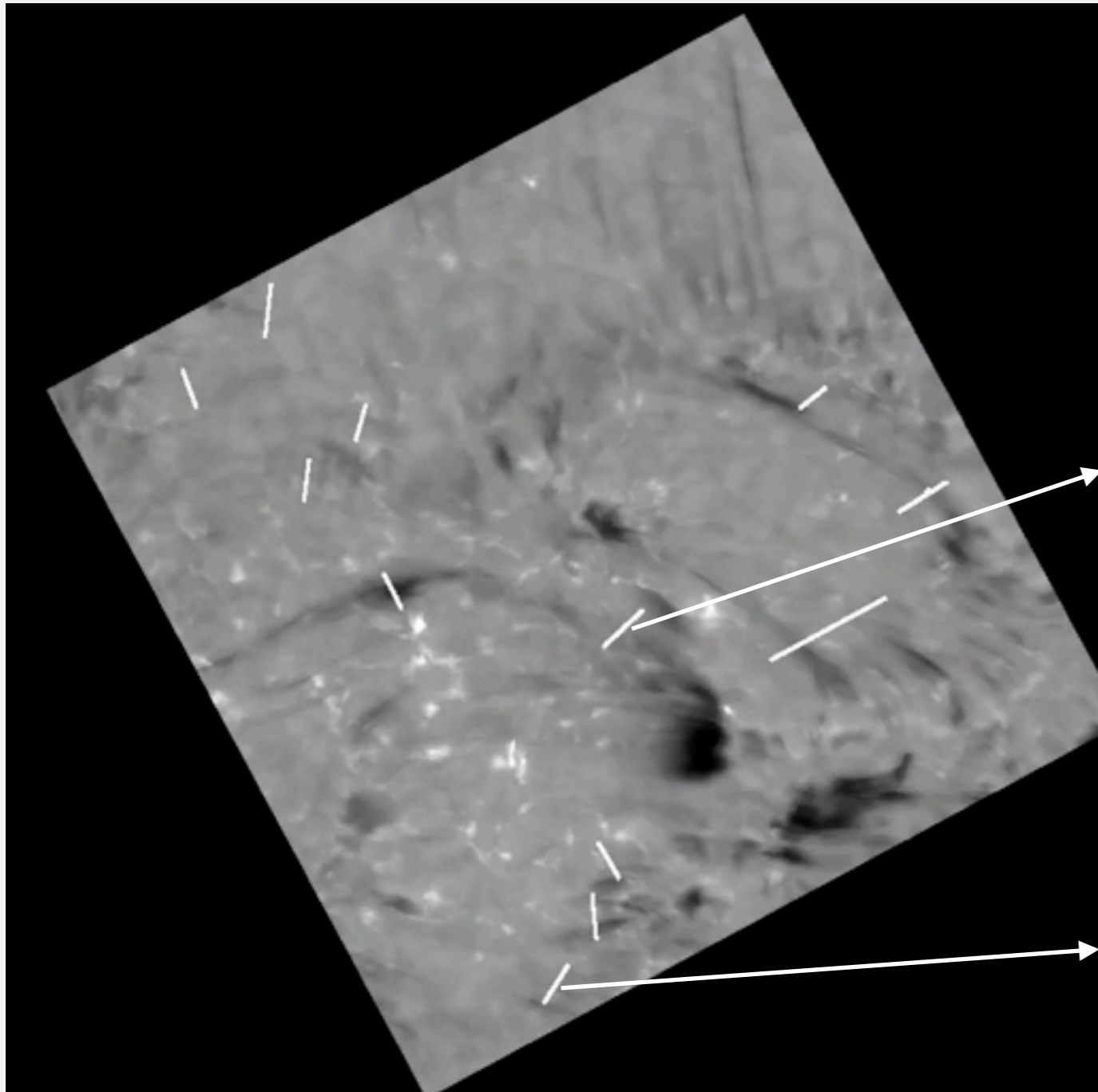


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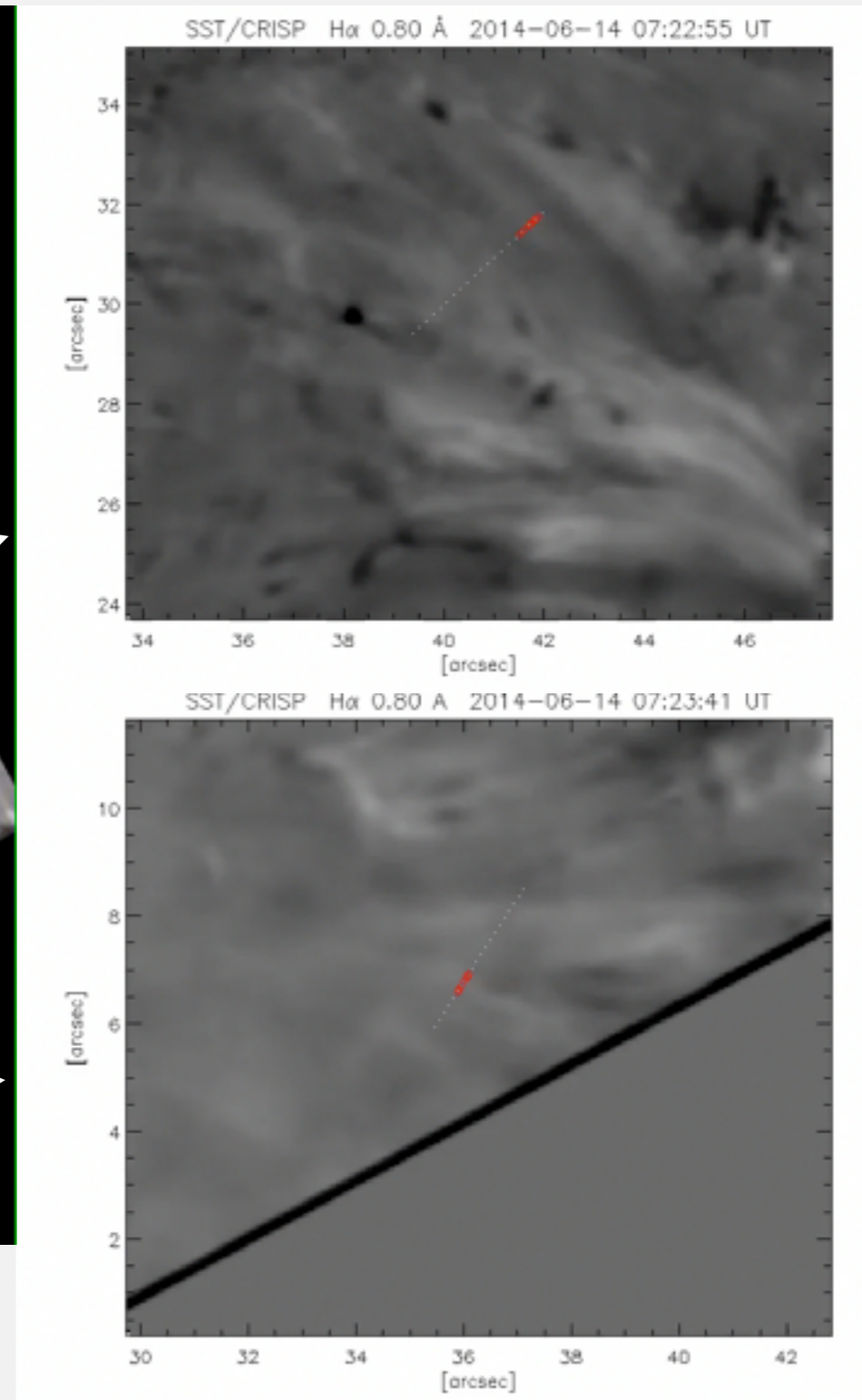
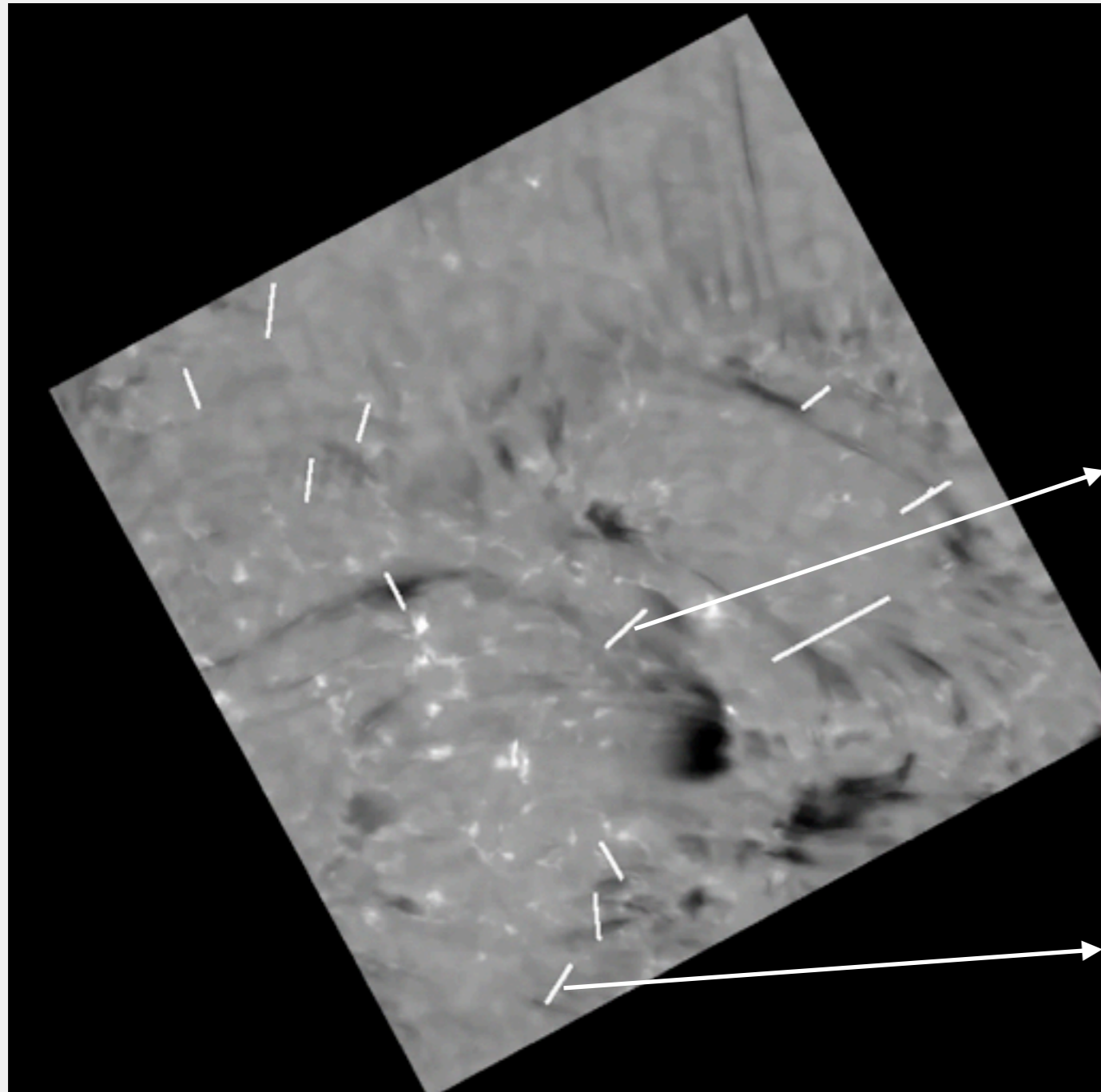




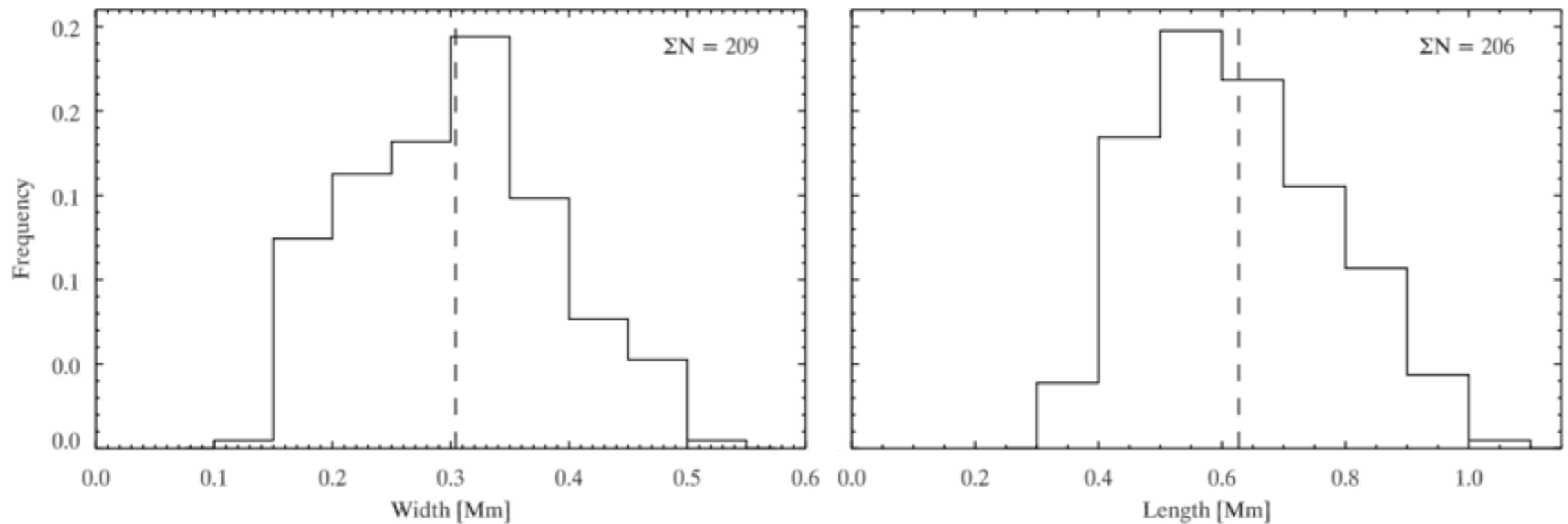
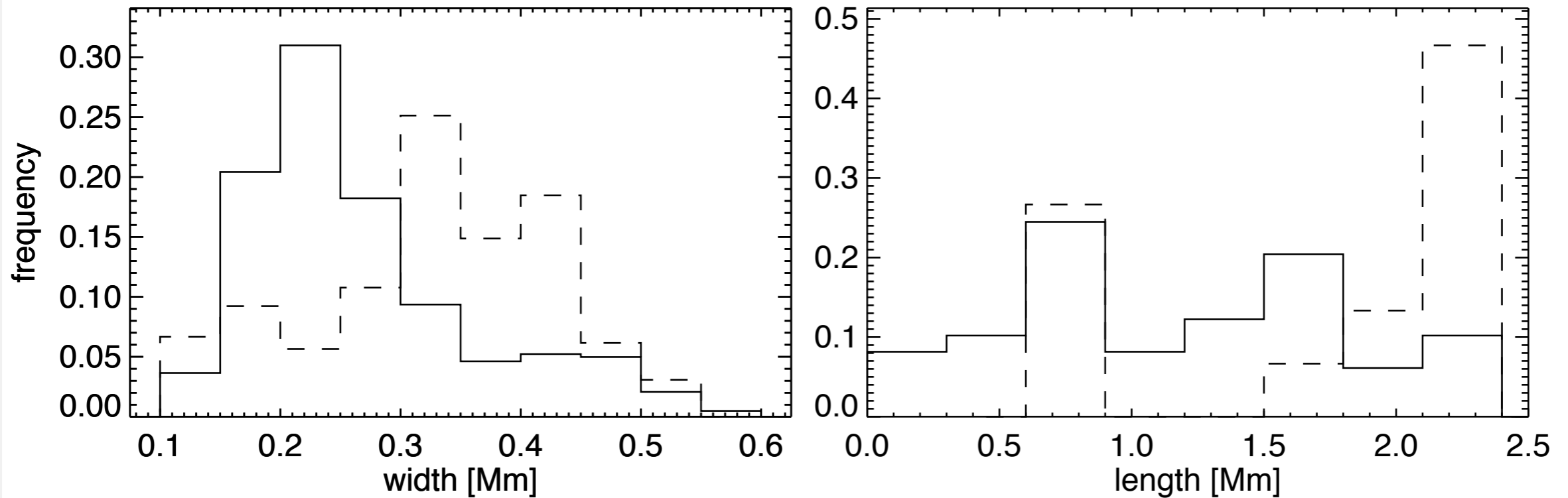
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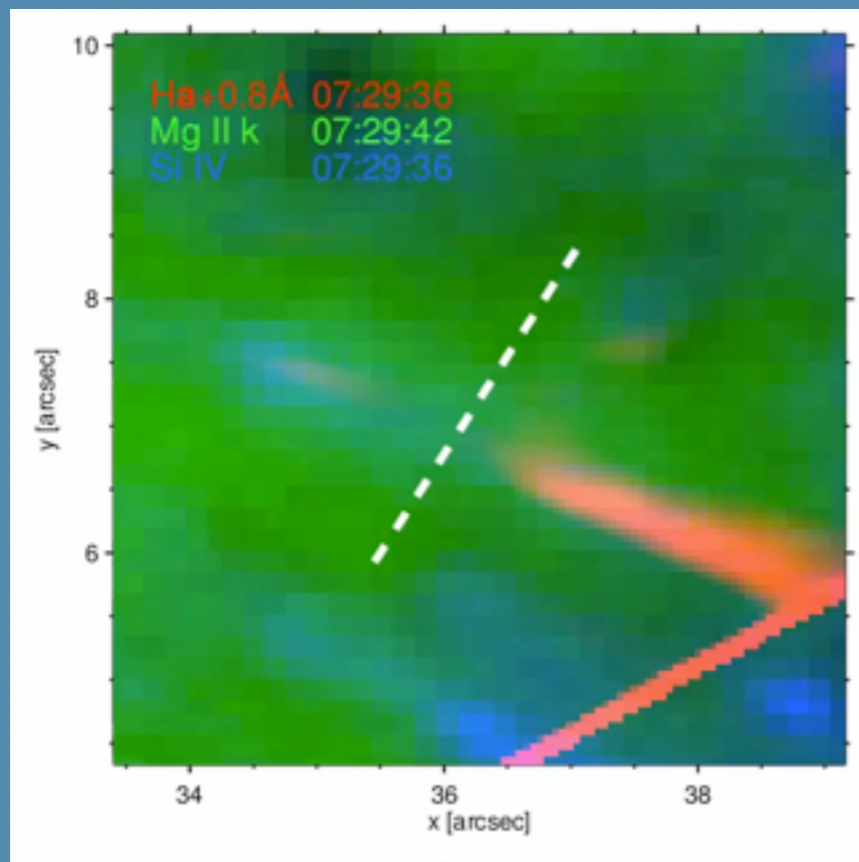


# Clumps appear to be larger in Si IV than in H $\alpha$ , where sizes are similar to those found before



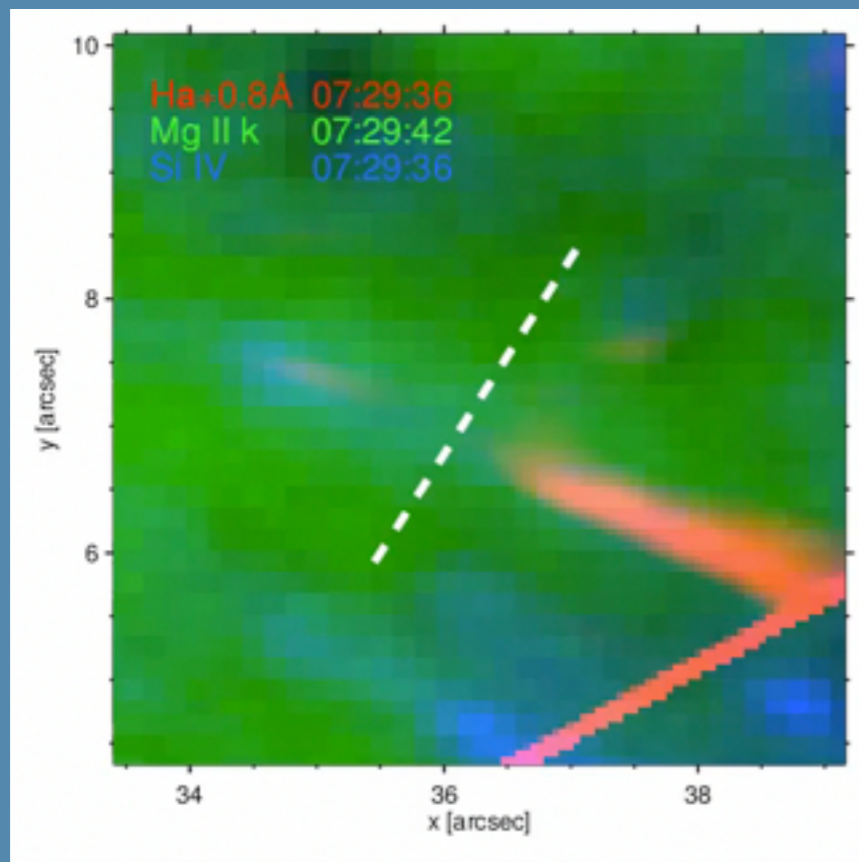
# Co-spatial to the clumpy flows in H $\alpha$ we find similarly intermittent streams with IRIS

## Multi-thermal flows?



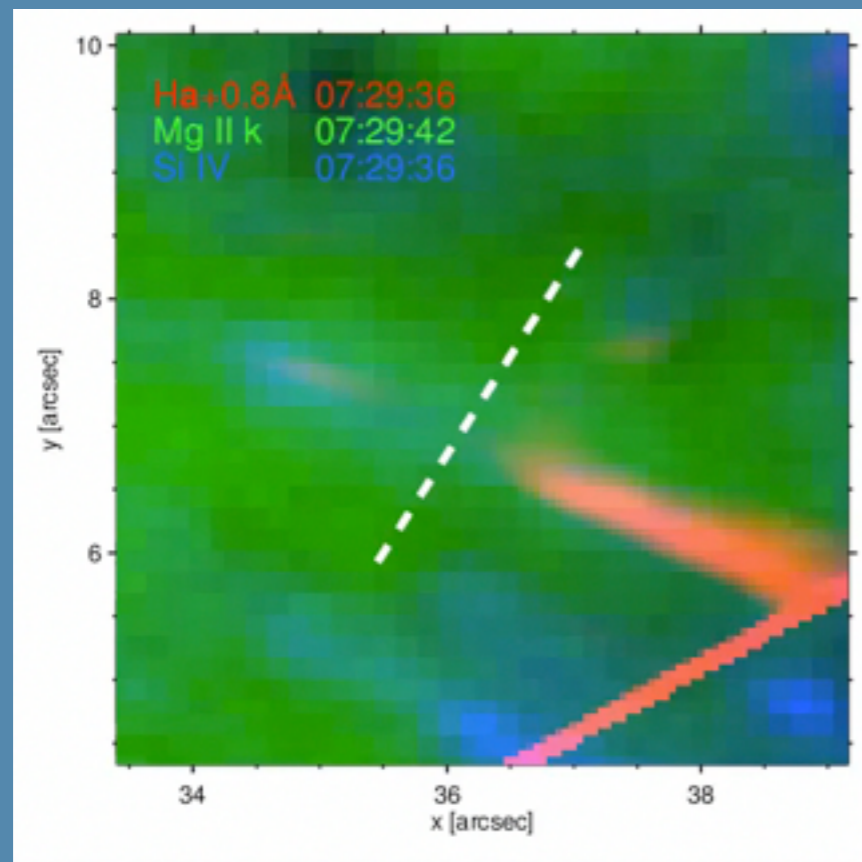
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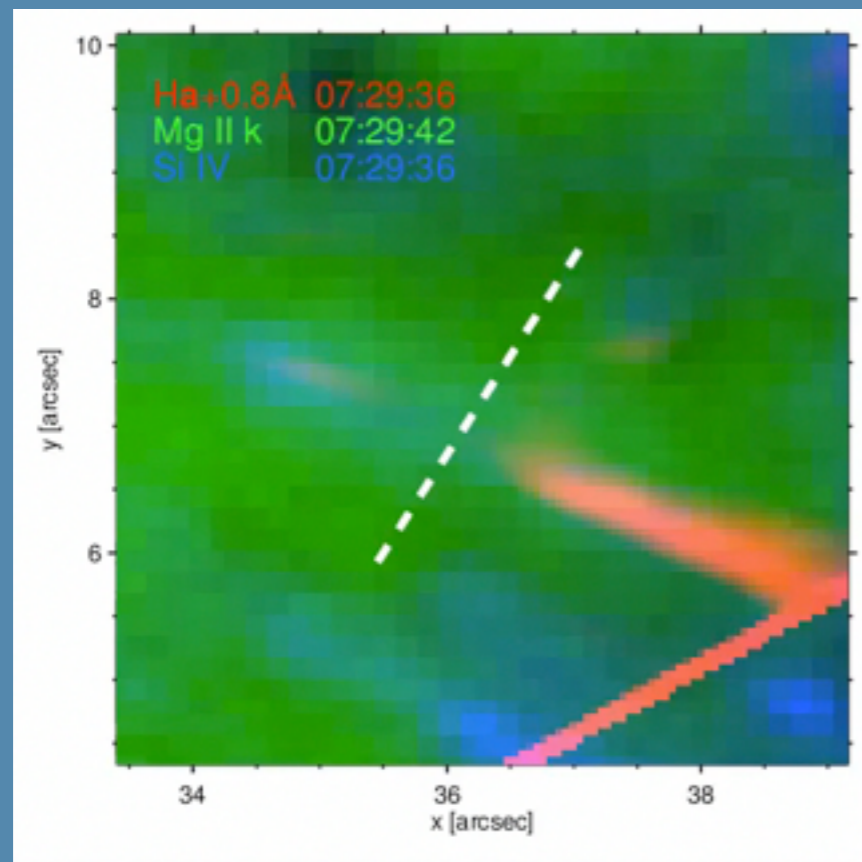


## Formation and driving

Waves? Maybe, but unlikely...

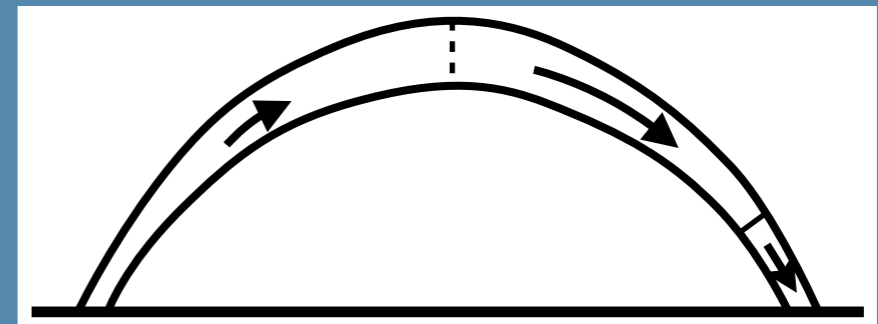
# Co-spatial to the clumpy flows in H $\alpha$ we find similarly intermittent streams with IRIS

## Multi-thermal flows?



## Formation and driving

Waves? Maybe, but unlikely...



Siphon flow?  
In combination with thermal instability?

