ISSI Team - coronal rain 23-27 February 2015

Dynamical instabilities associated to coronal rain

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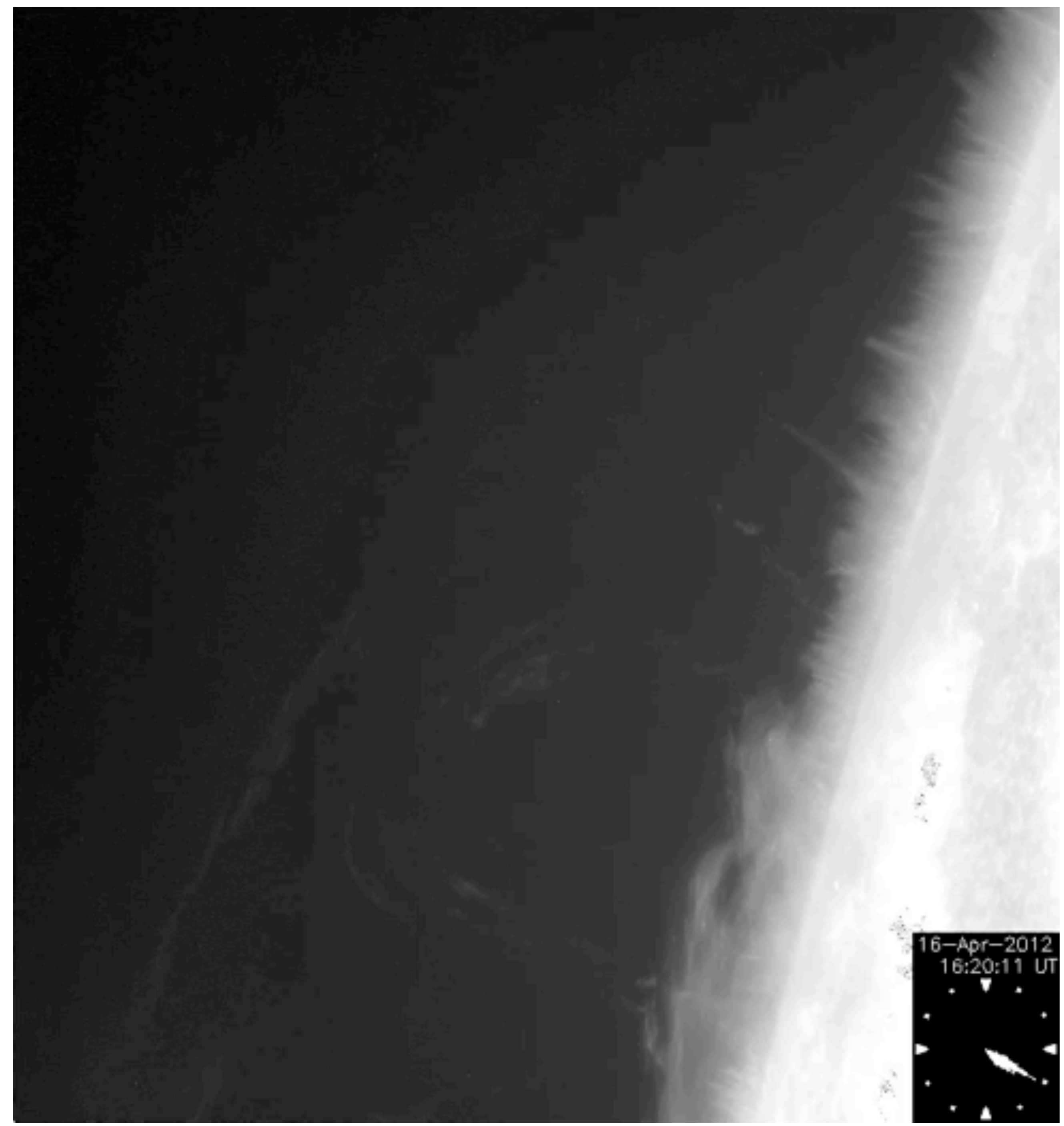
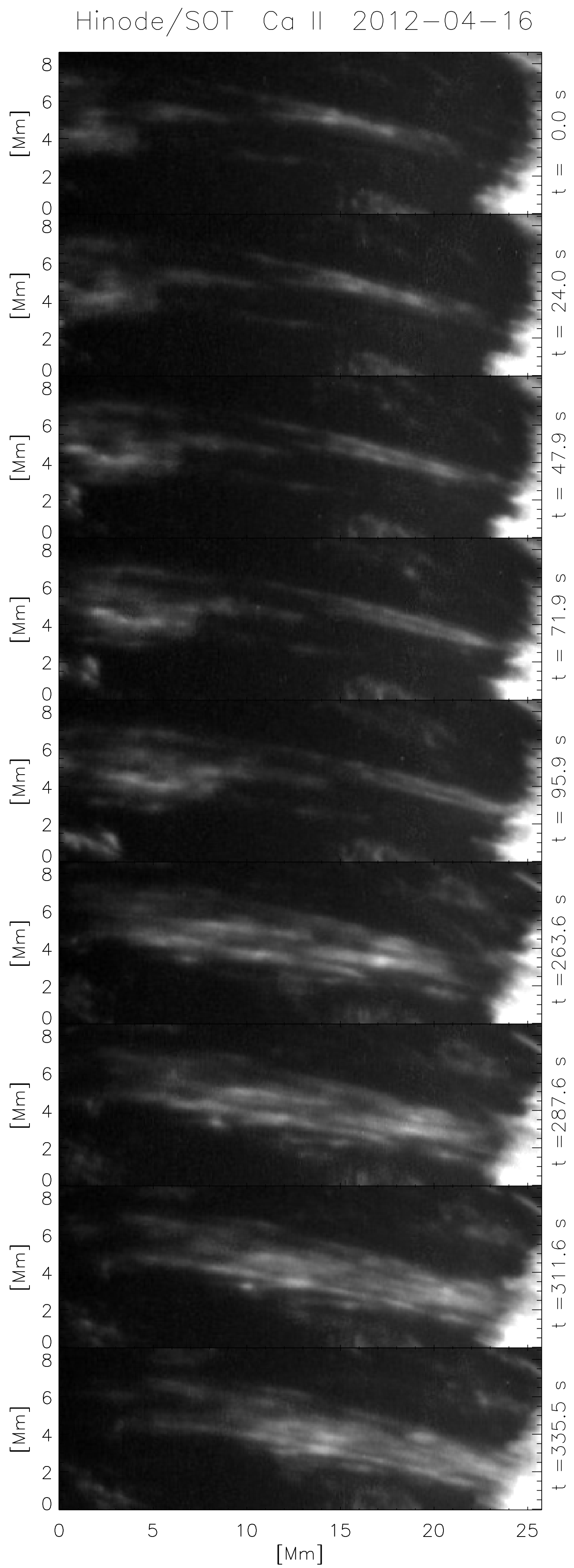
Clumpy structure

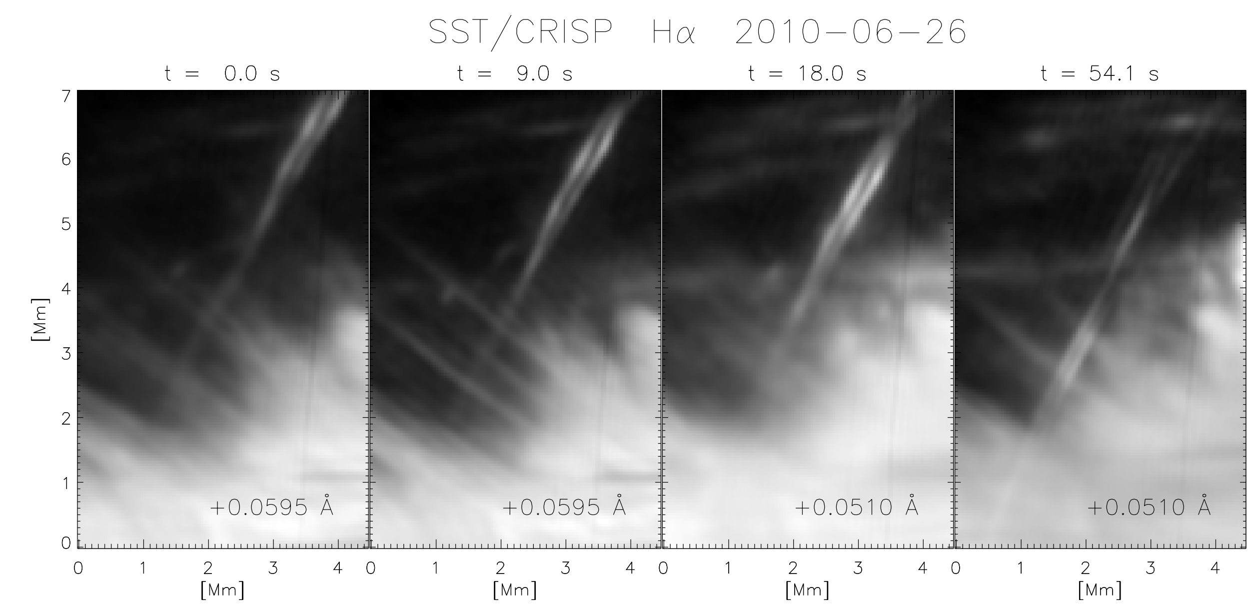
- Morphology differences
  - pre-eruptive prominence flows appear more continuous
  - coronal rain & post-eruptive return material appears more clumpy
- Dynamics
  - Prominence: ≲40 km/s
  - Fall-backs: close to free-fall
  - Rain: [30,200], ~80 km/s

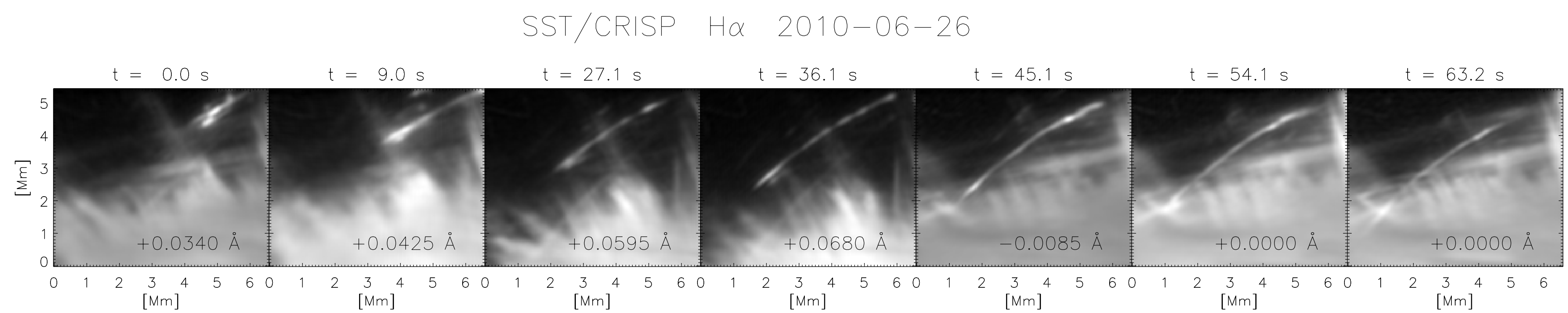
Do dynamics play a role in the morphology (clumpy structure)?

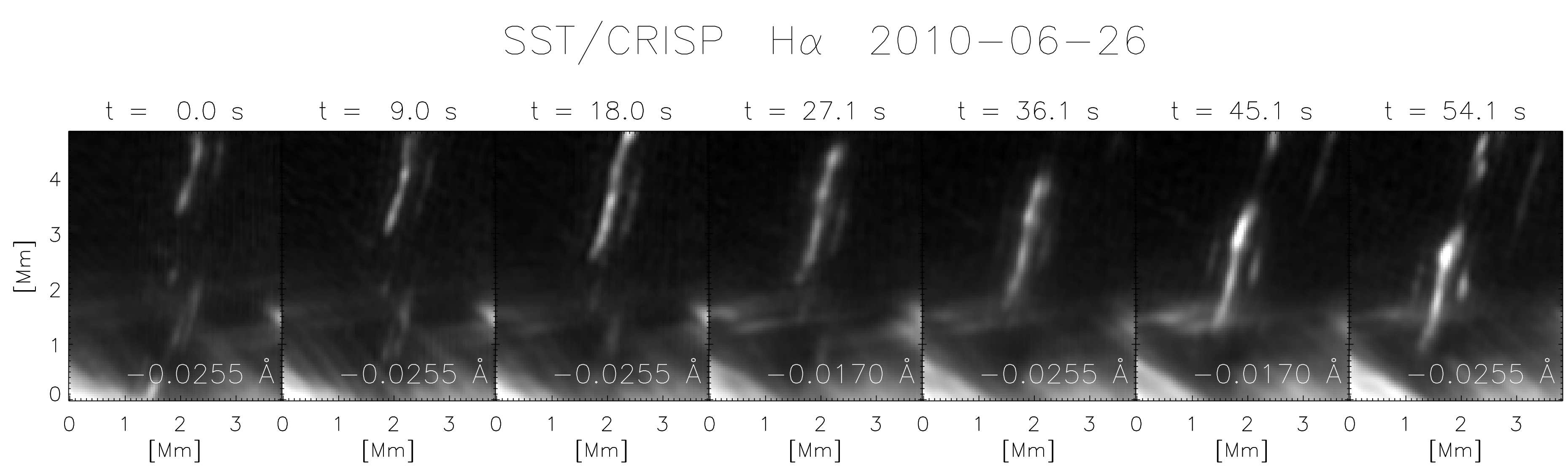


Clumpy structure

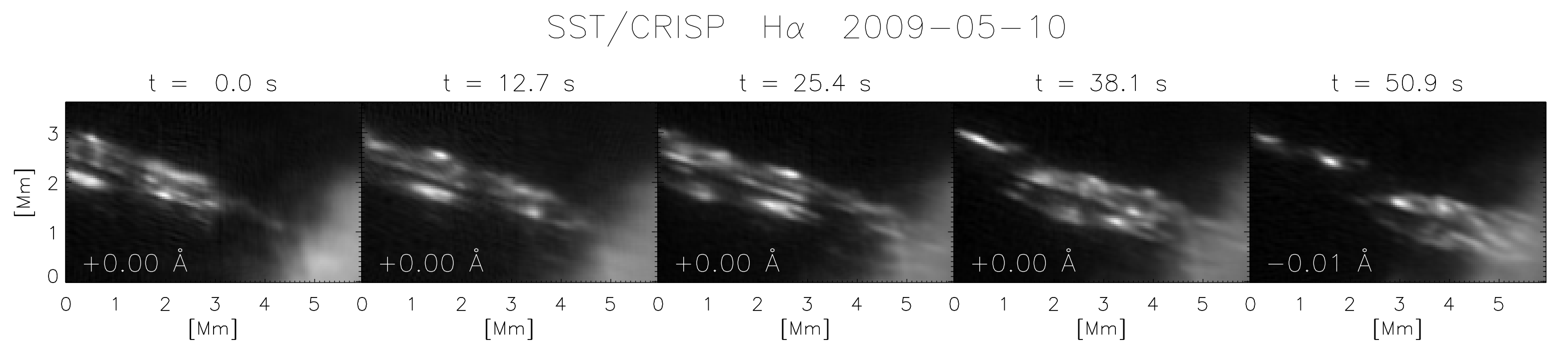


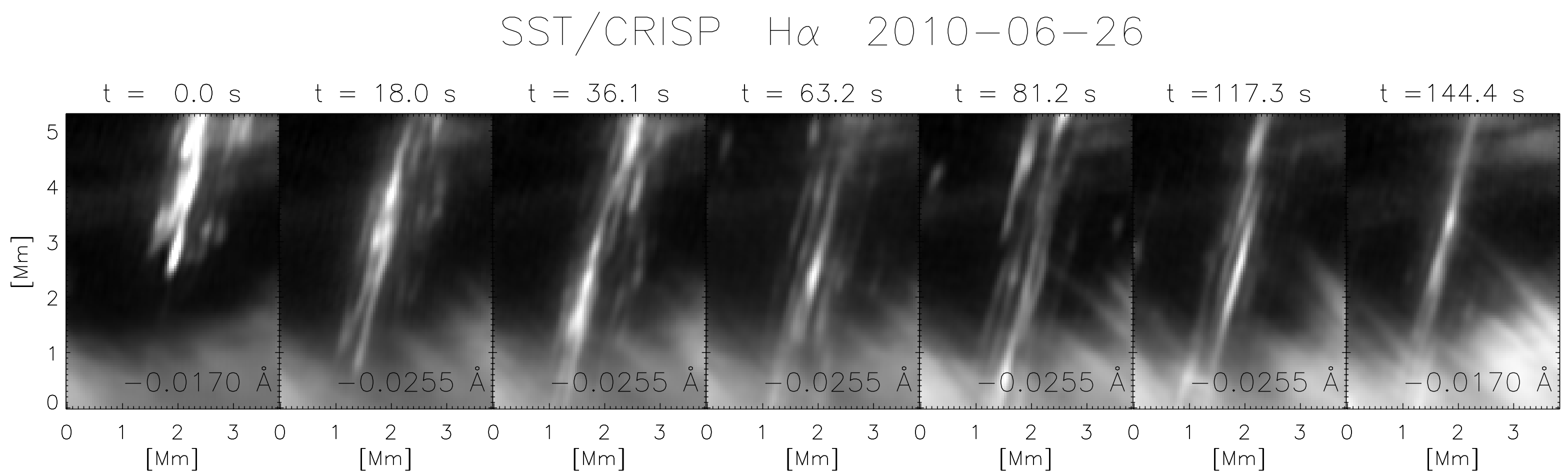


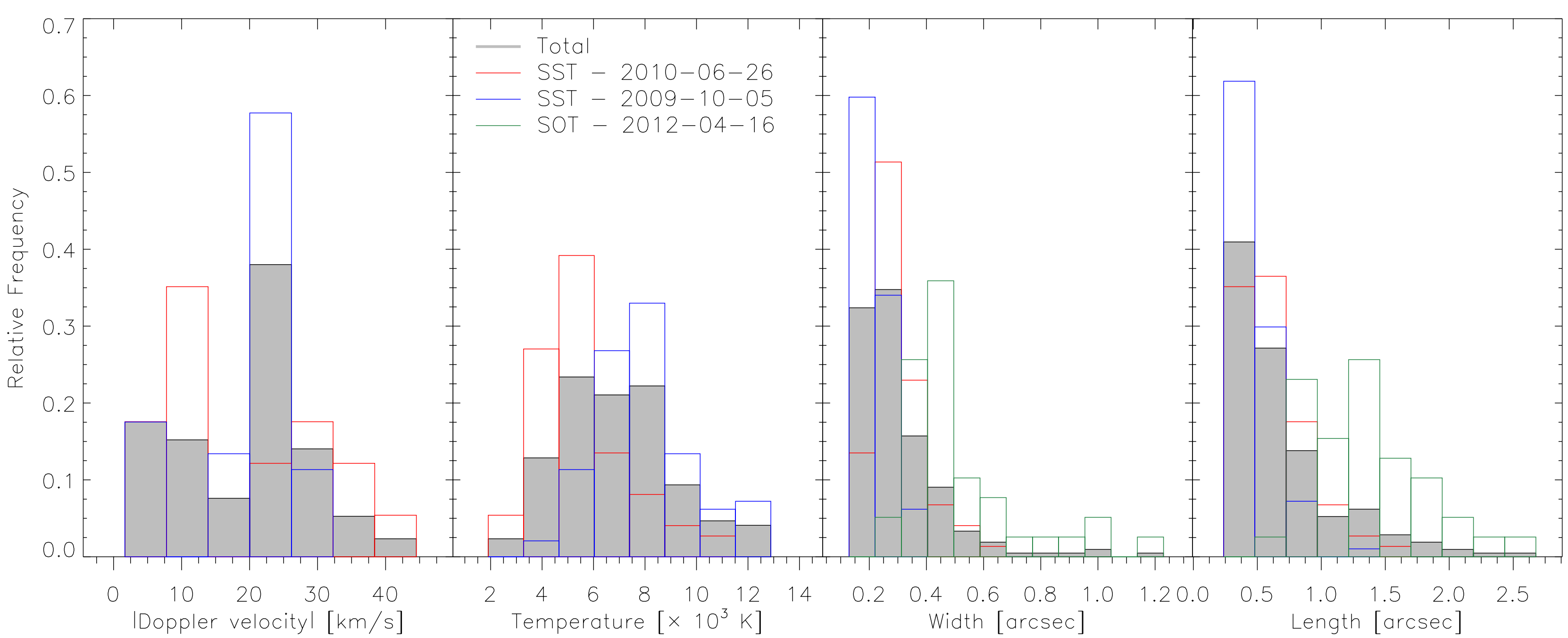


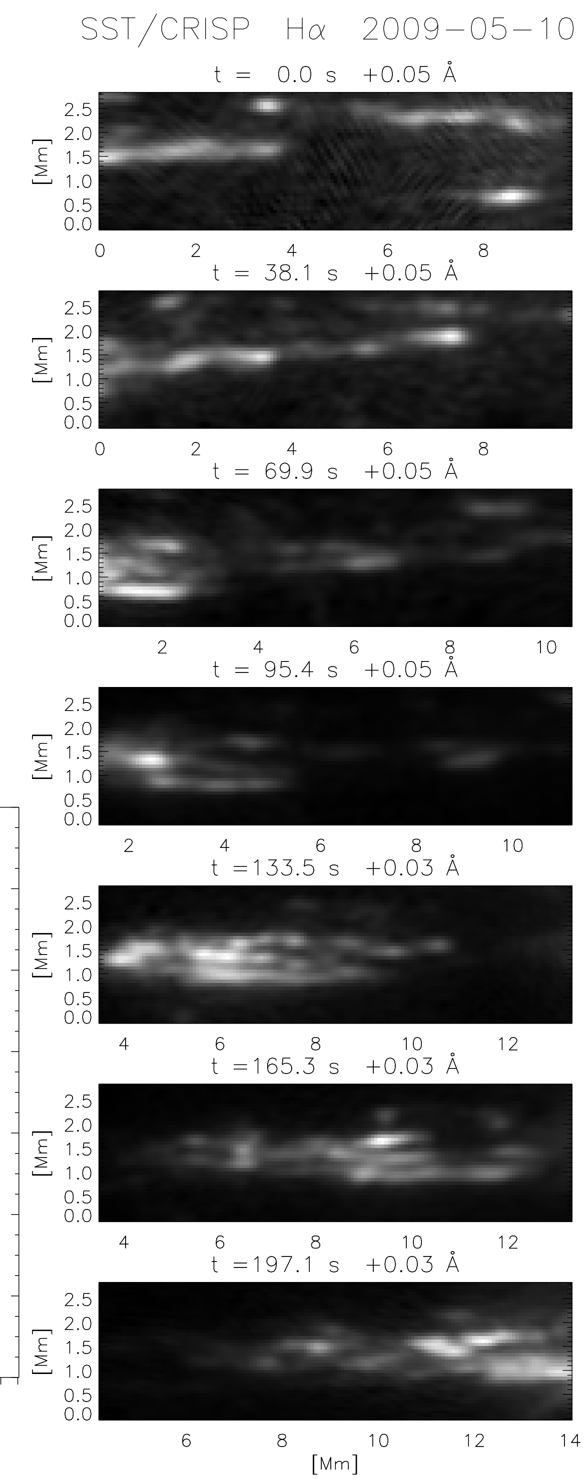


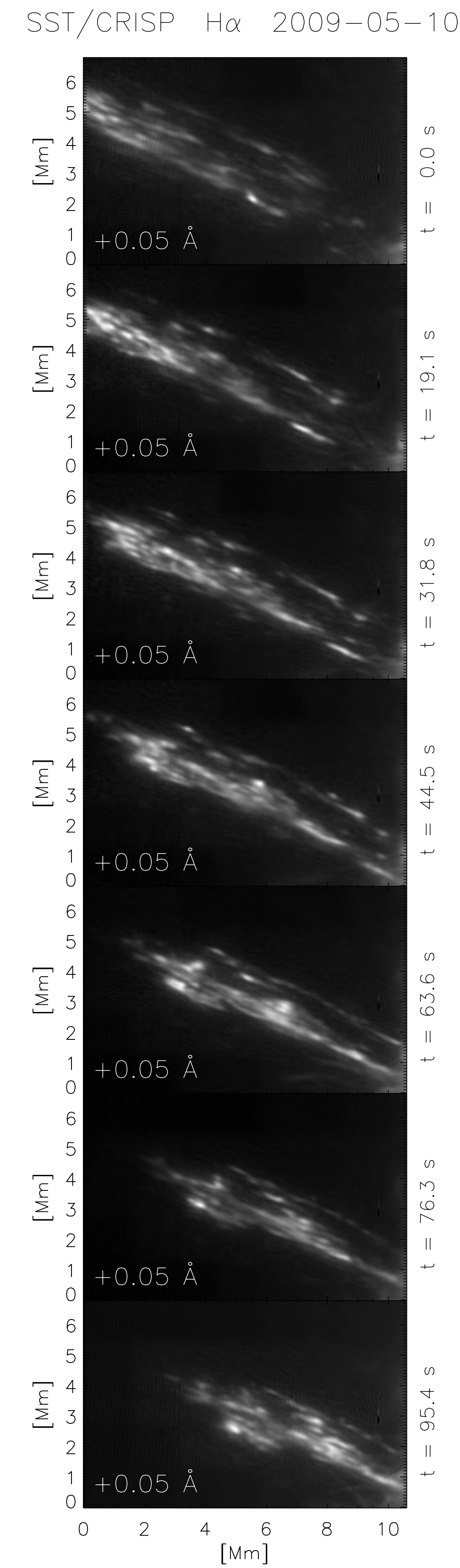
Clumpy structure



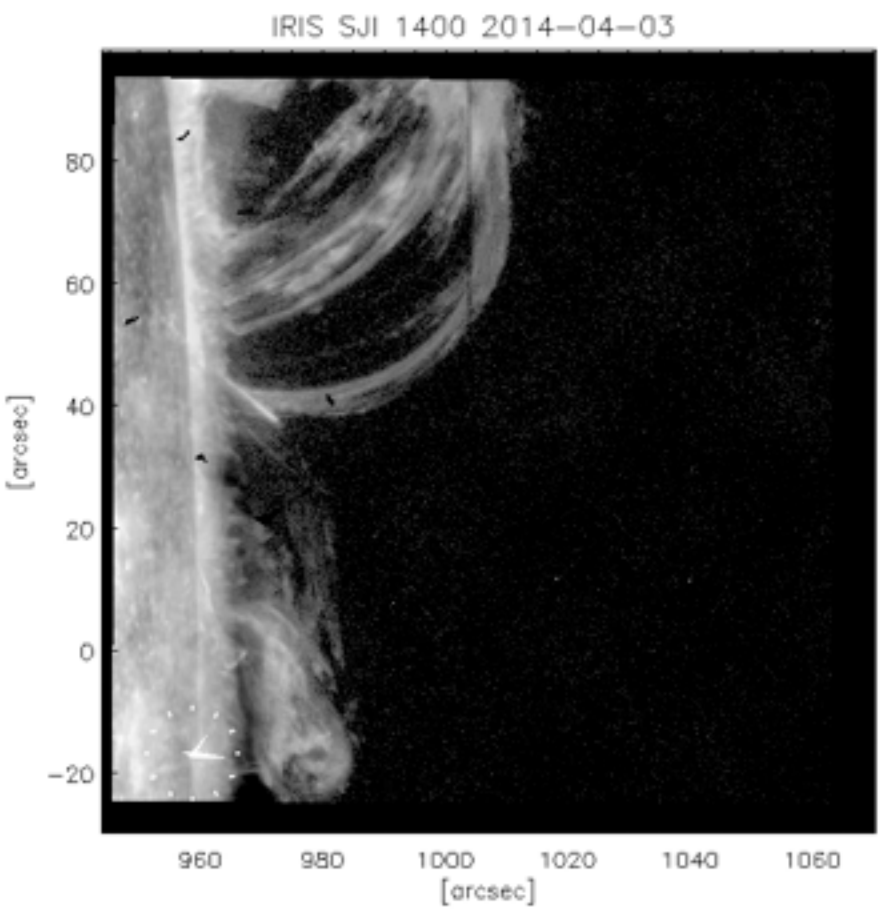


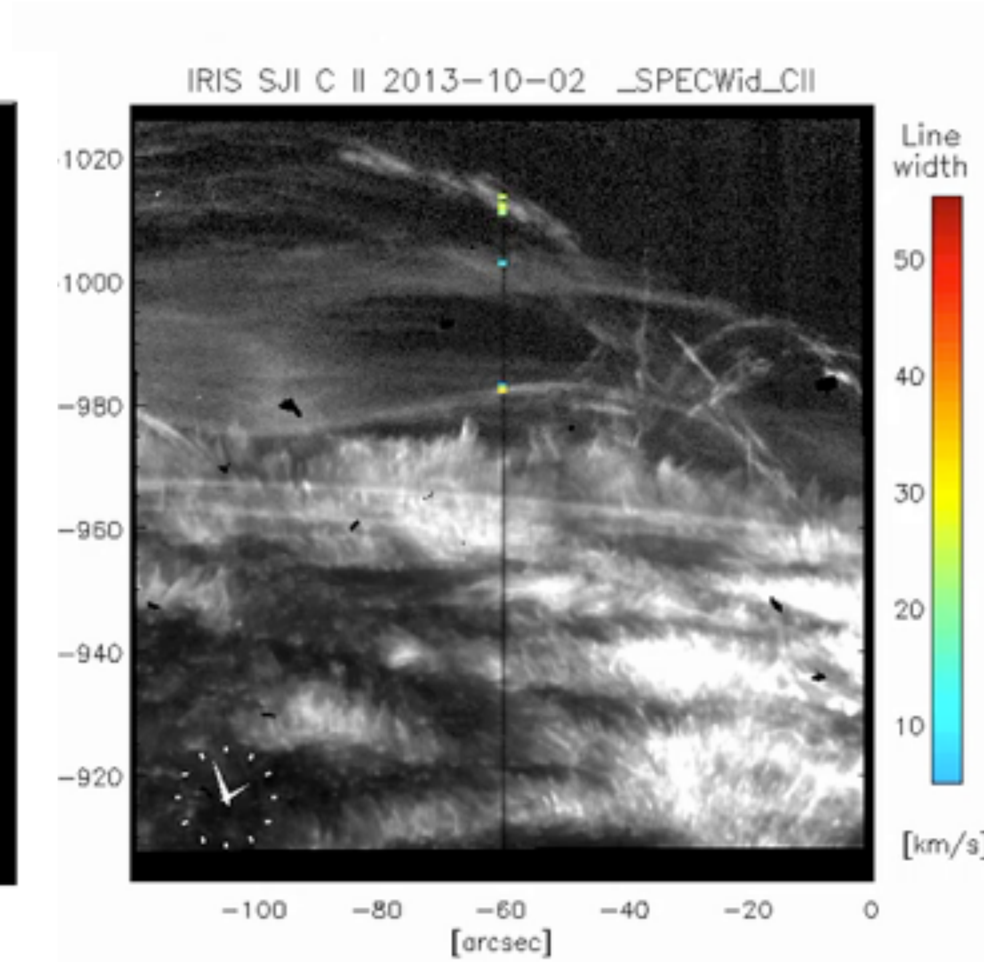


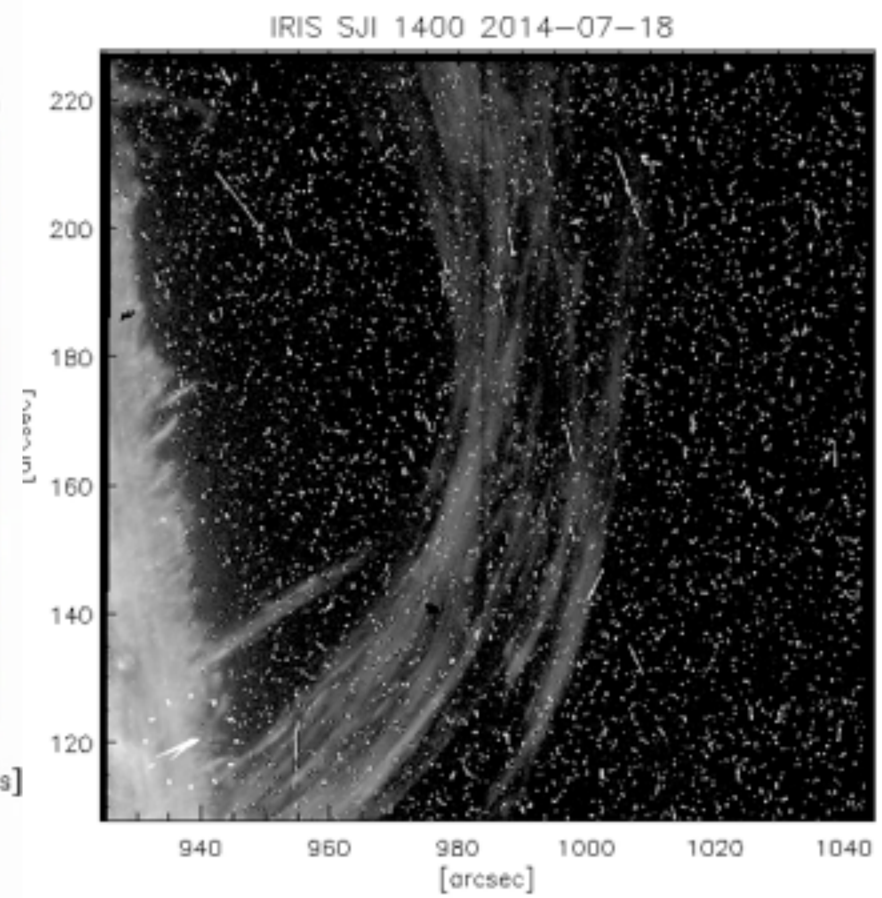




Longitudinal shear flows







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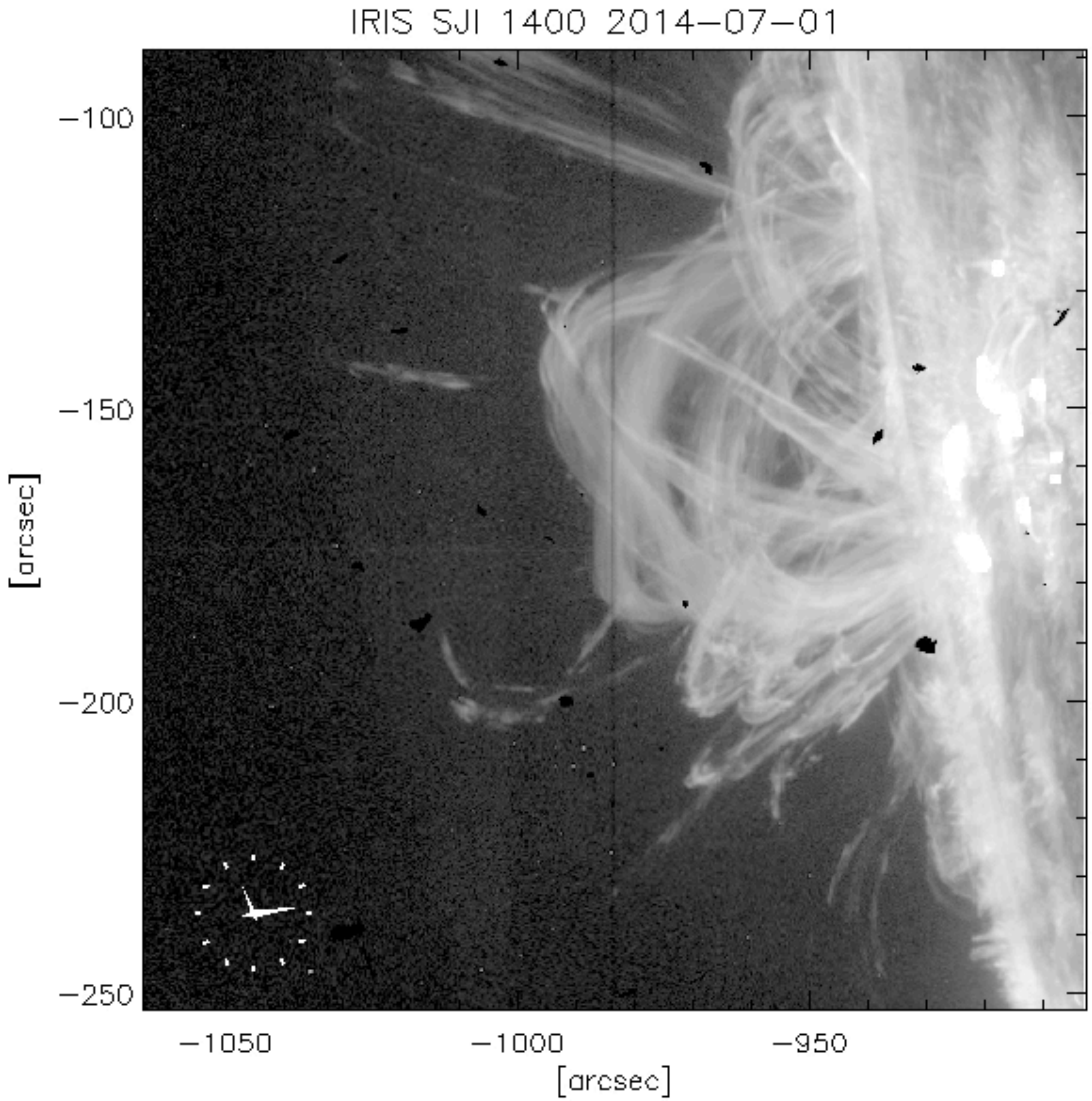

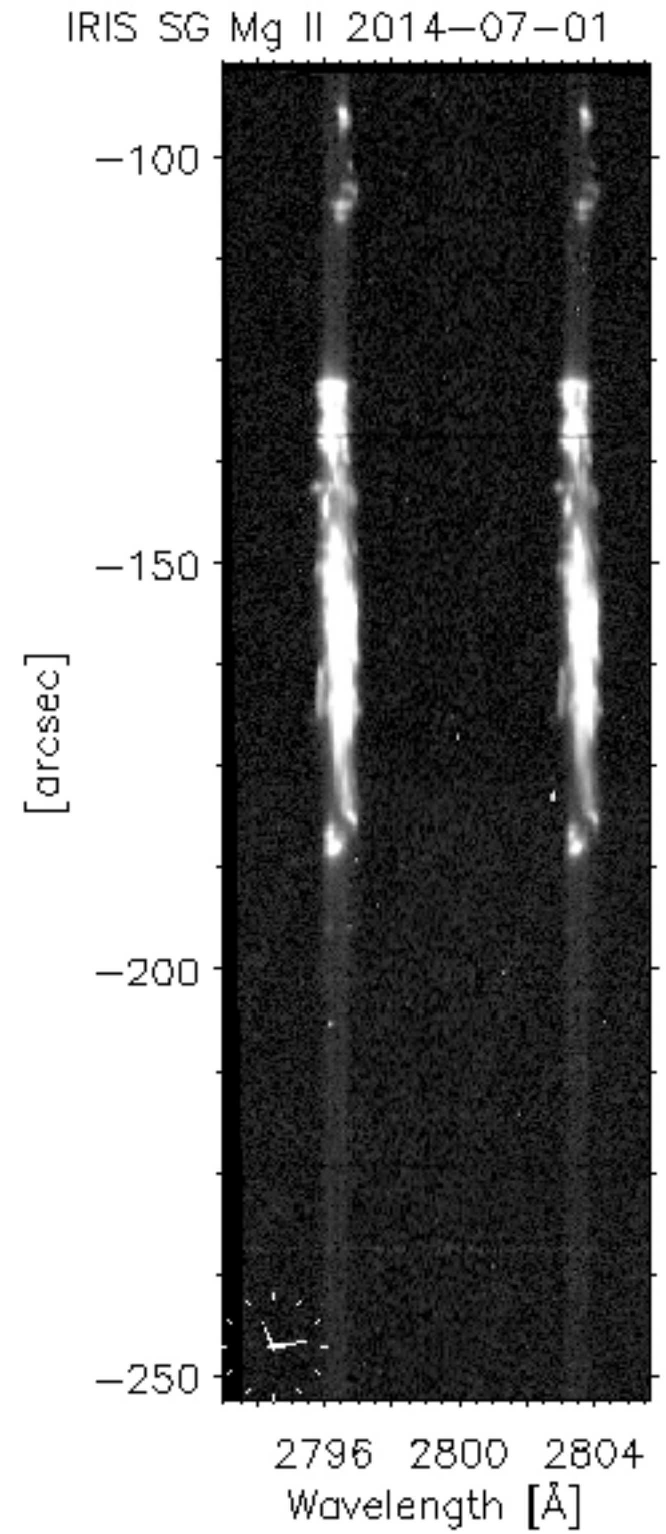

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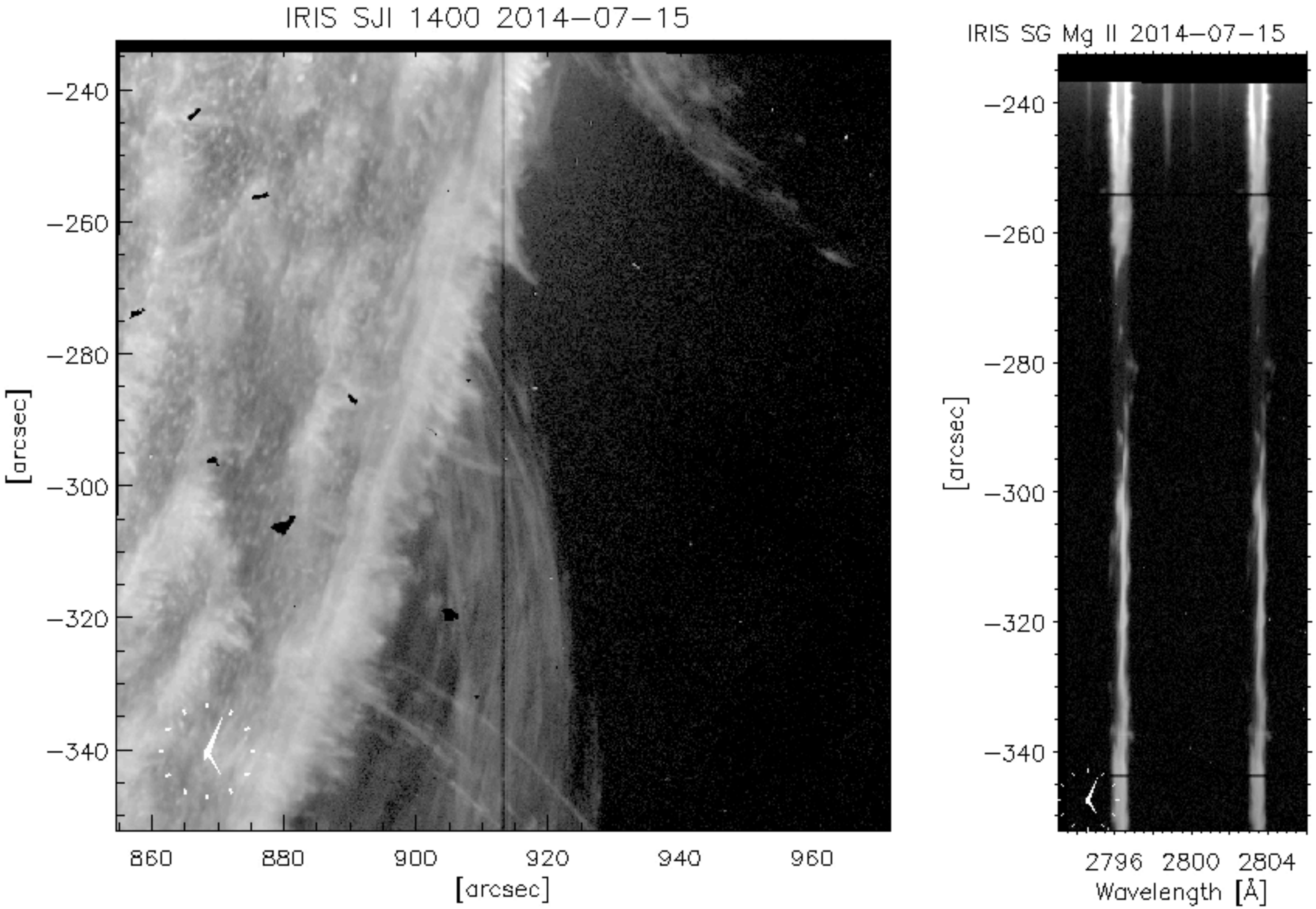
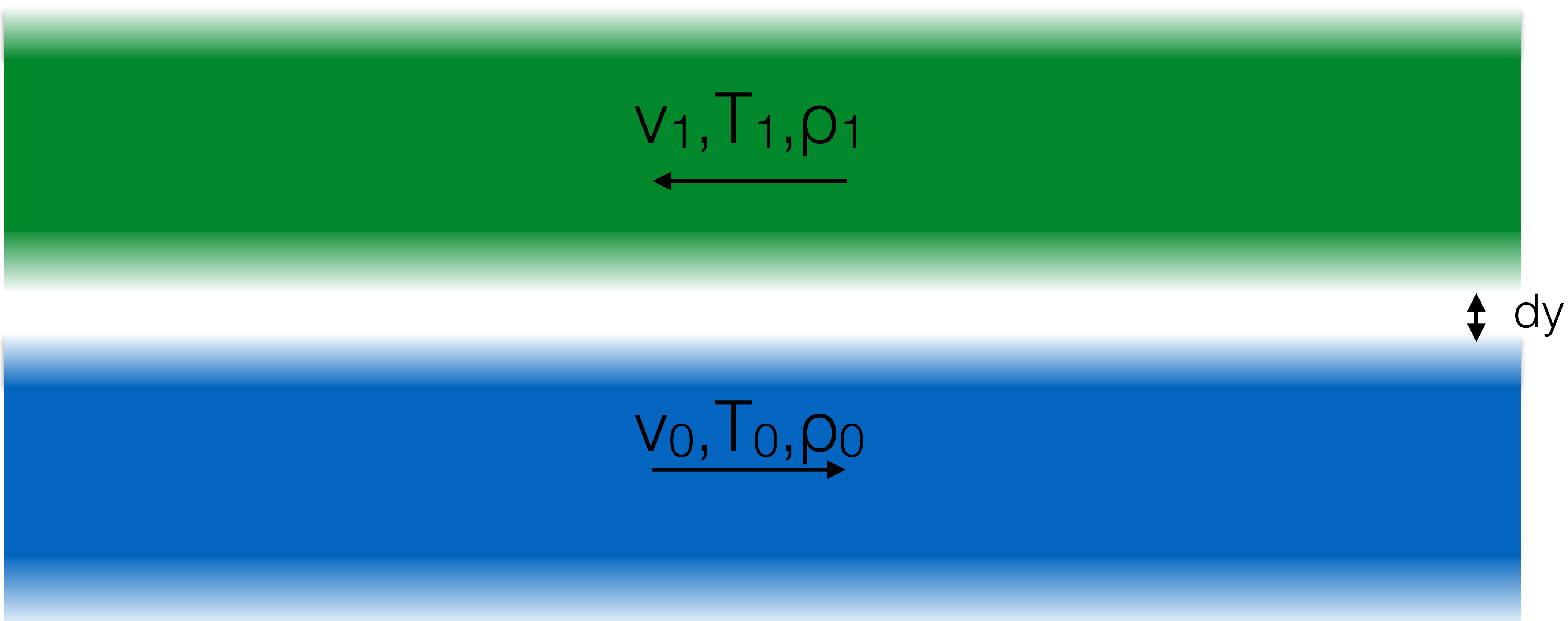


Future work



$dy << 1$, $\rho_0/\rho_1 \sim 1$, $v_0 \sim v_1$

Parameter space study & theoretical analysis

Theoretical analysis

- Kink waves are ubiquitous in the solar atmosphere
  Such waves can become unstable to KHI if:

$$M_A > 1 + \frac{b}{\sqrt{\eta}} \qquad M_A = \frac{v_0}{v_{A_i}} \quad b = \frac{B_e}{B_i} \qquad \eta = \frac{\rho_e}{\rho_i}$$

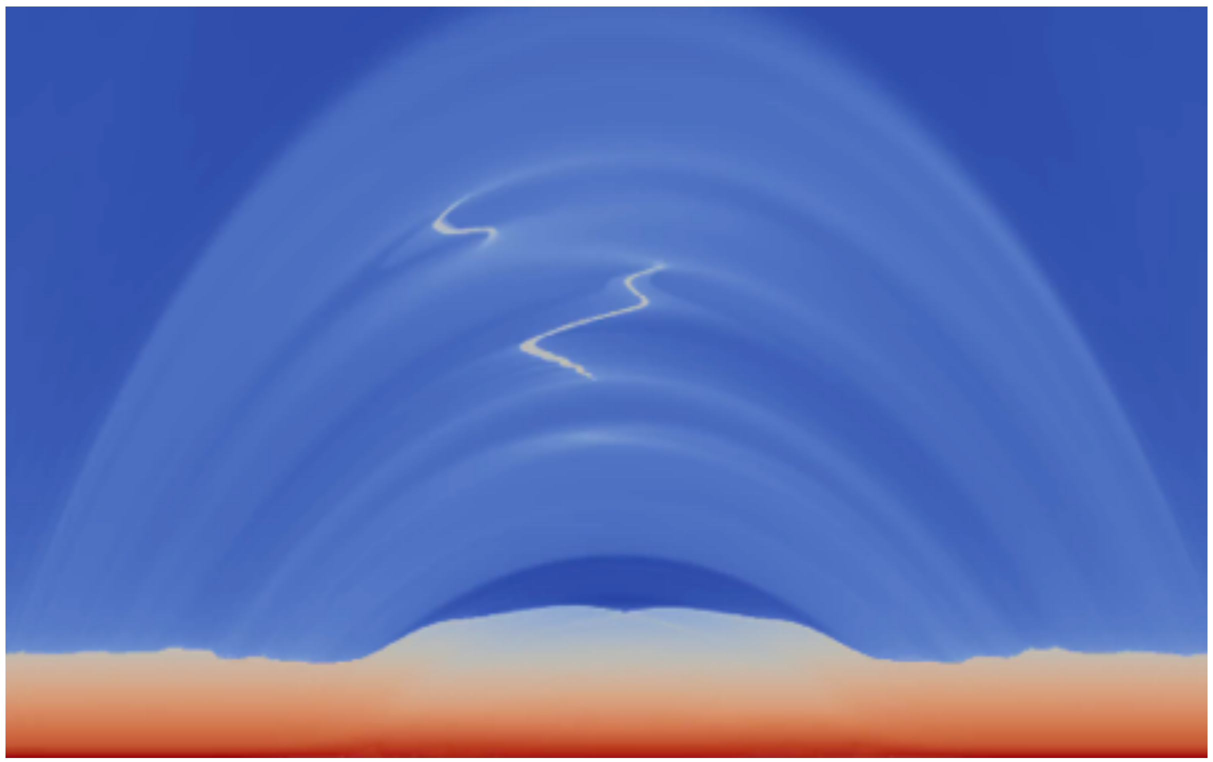
Shear flows in coronal rain & prominences: $\eta \sim 1$, $B \sim 10$ G, $\rho \sim 10^{11}$ cm^{-3}

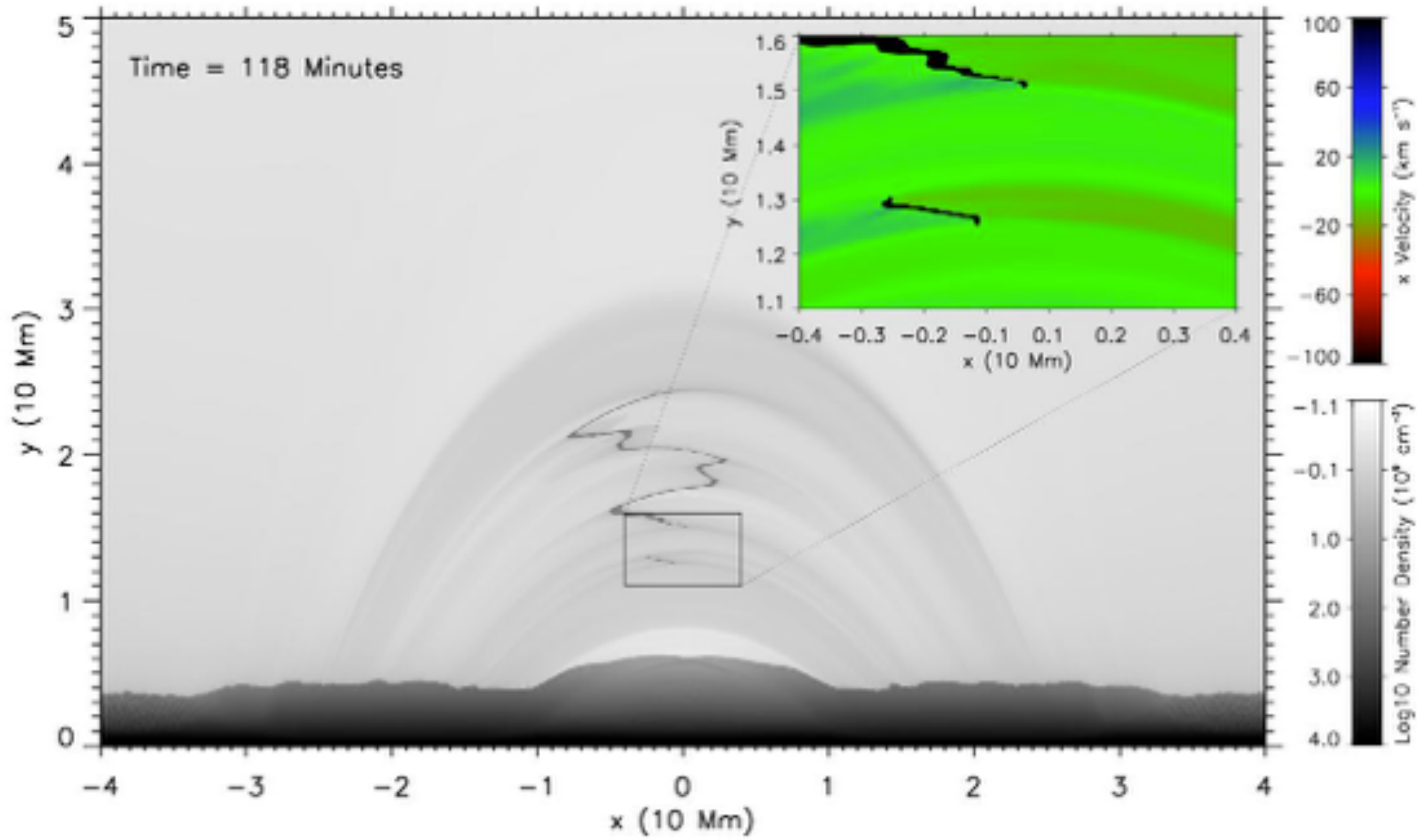
-> $v_{Ai} \sim 70$ km/s. Criterion: $M \gtrsim 2$ -> $v_0 \gtrsim 140$ km/s

Kleint+(2014): v_0 up to 200 km/s

- What is the effect of small twist?
- Positive and negative azimuthal mode numbers may have different instability criteria
- How about pinch instability?

Numerical simulations





Simulations by X. Fang (KU Leuven)

Possibility of KHI?

Simulations by X. Fang