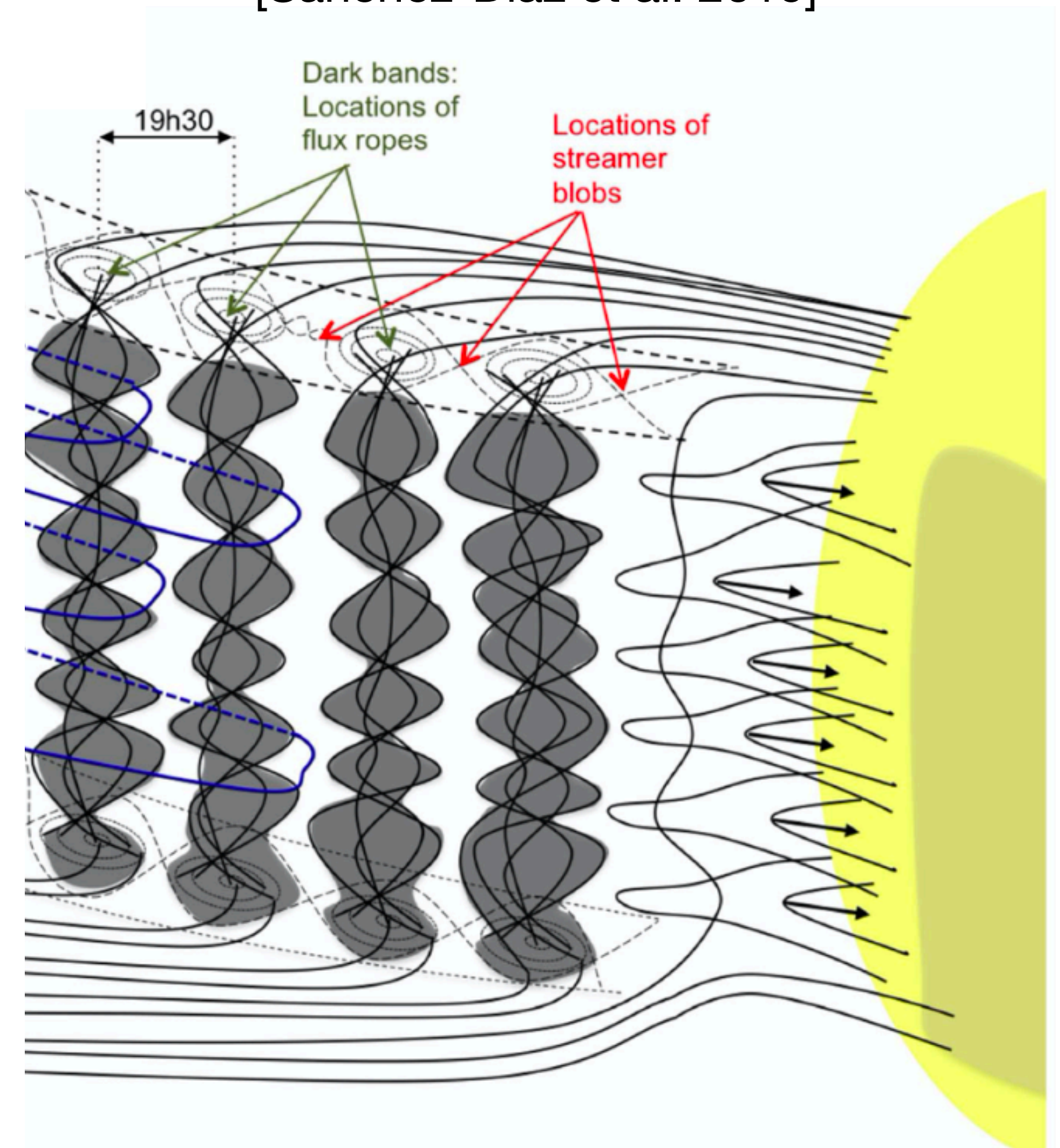# On flux ropes born in helmet streamers

V. Réville

A. Rouillard, M. Velli, B. Lavraud, N. Fargette, N. Poirier, O. Panasenco, C. Shi, A. Tenerani, A. Strugarek, A.S. Brun, S. Parenti, PSP and SolO teams
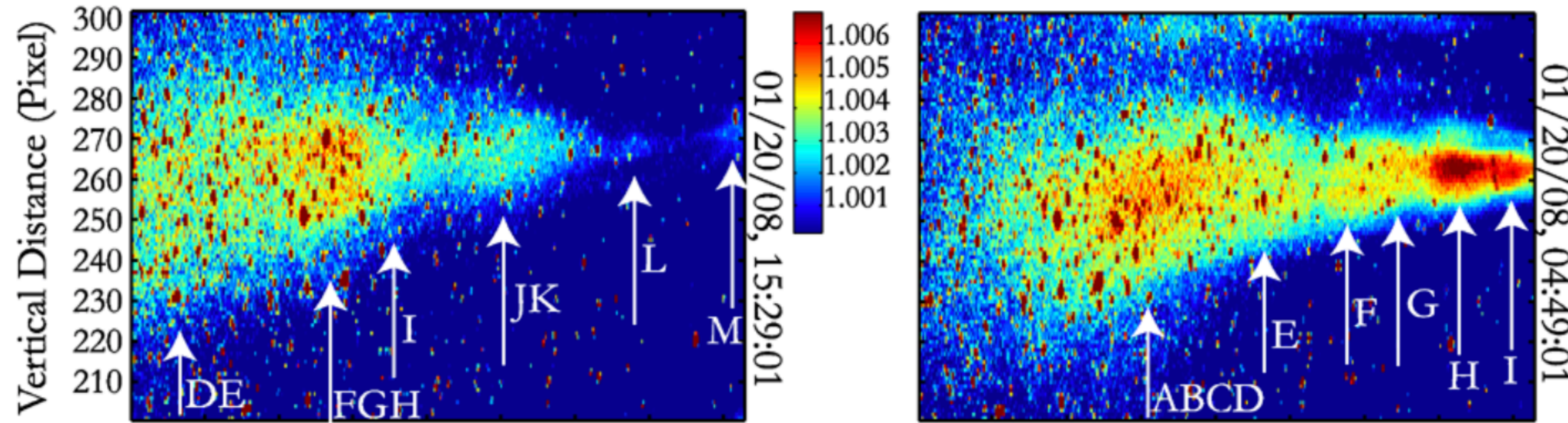
[Sanchez-Diaz et al. 2019]

European Solar Physics Meeting 16, Sep. 2021

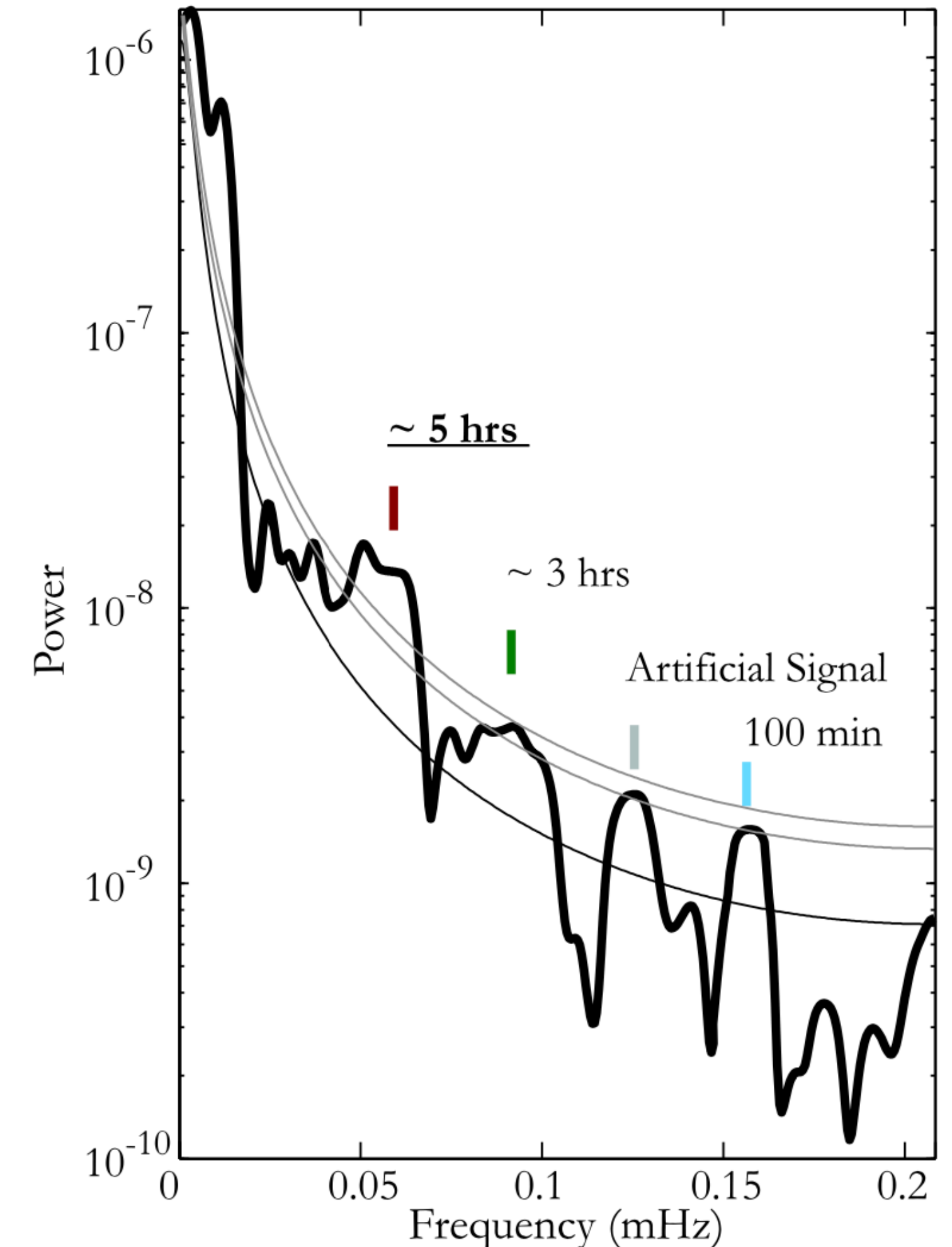# Periodic density perturbations
White light and in situ observations

[Viall et al. 2010,2015]

SECCHI HI1 A Image Sequence, Event 1

MTM Spectral Estimate, Event 1

~ 5 hrs

~ 3 hrs

Artificial Signal

100 min

- STEREO observations of density structures

- Small scales down to ~1 Rs, propagating

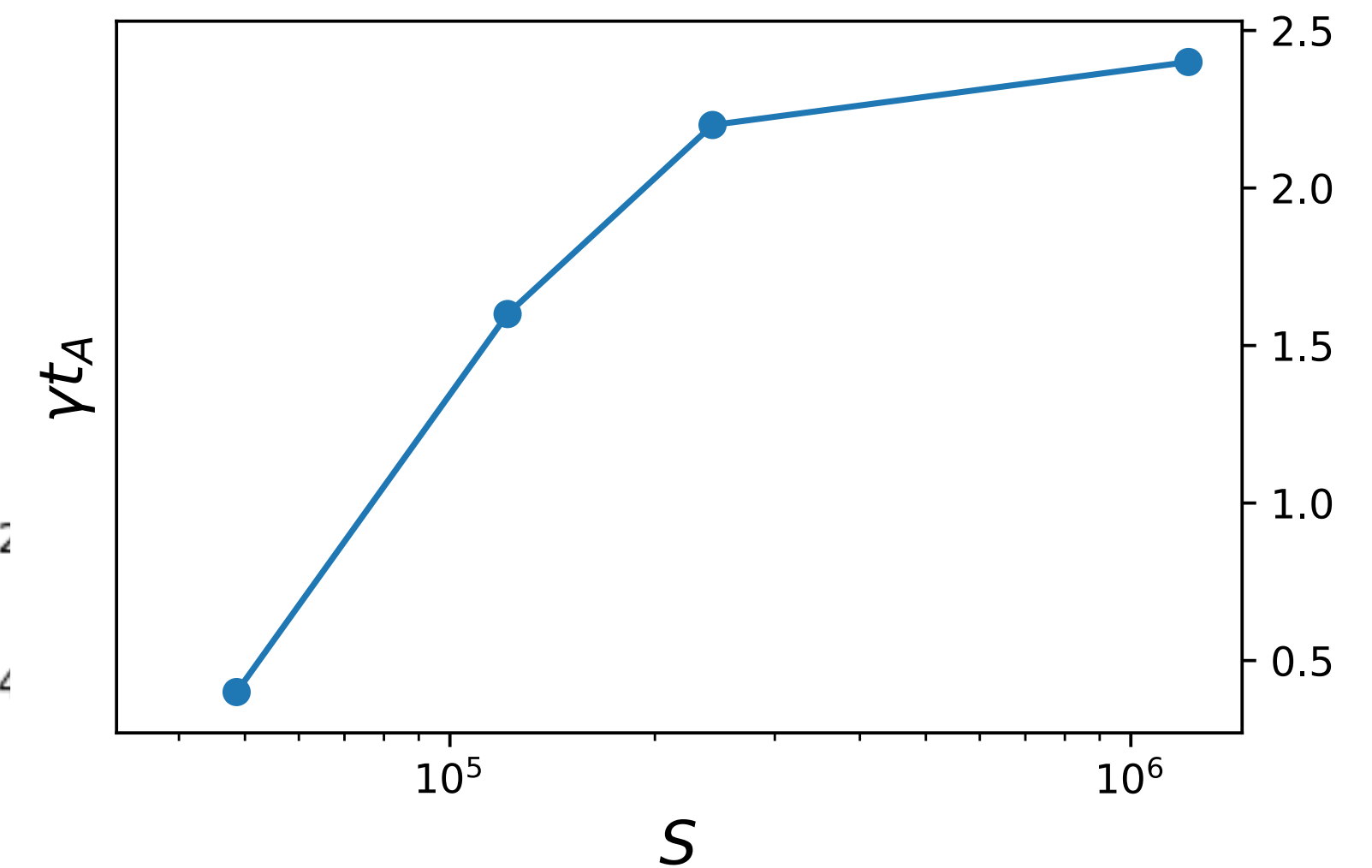- Discrete spectrum with peaks at several hours down to 100 min

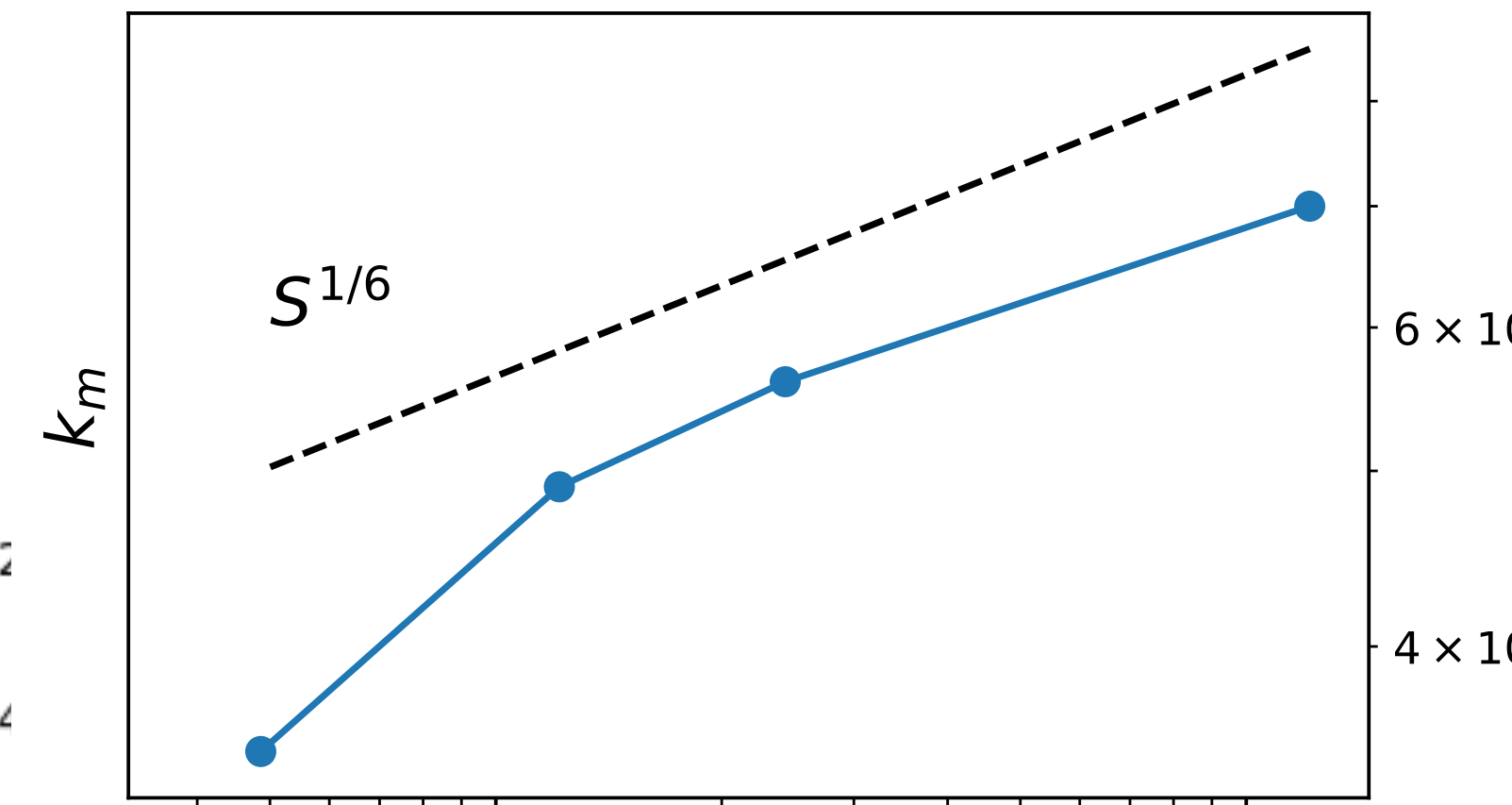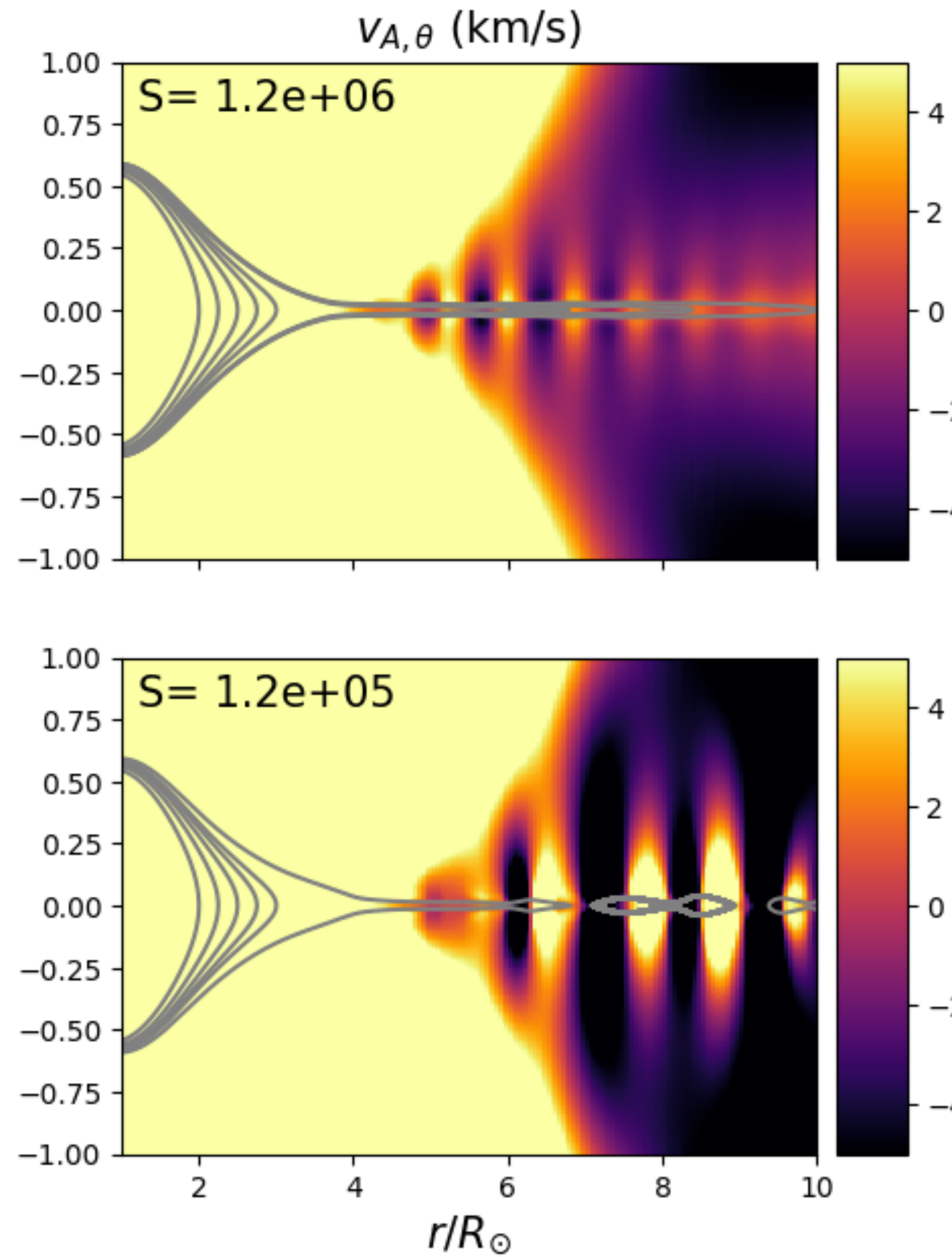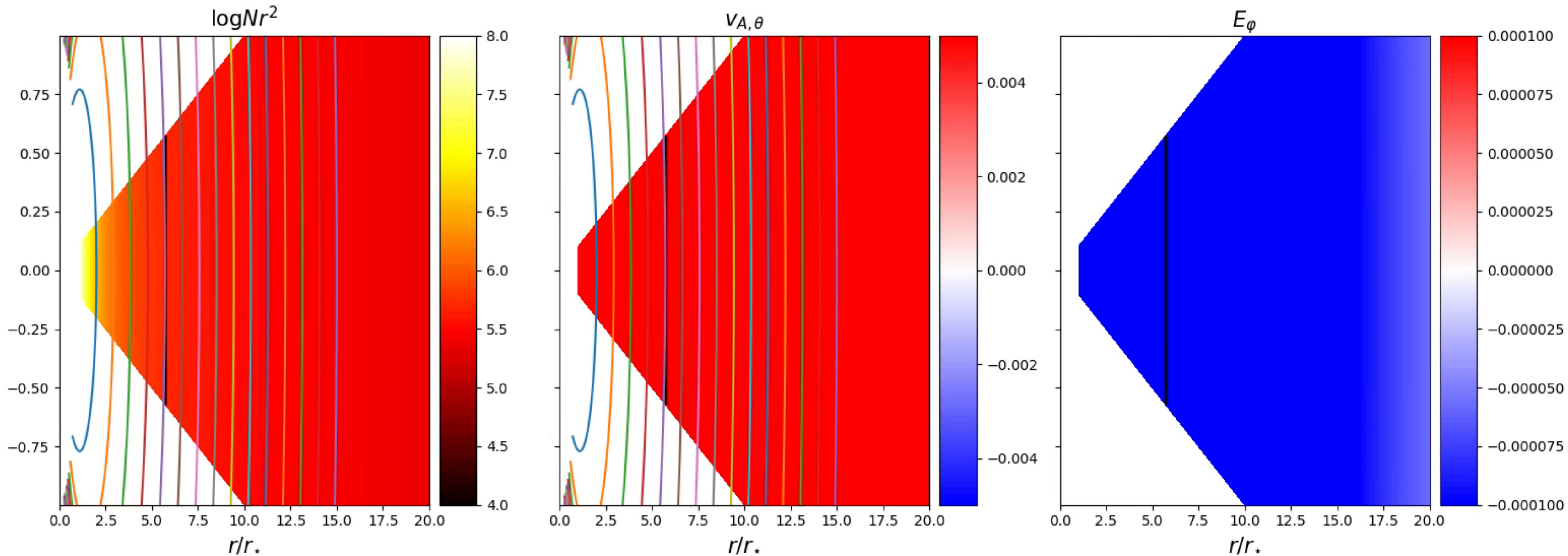# Blobs and the tearing mode

Model of the linear onset of the tearing instability

- 2.5D model, axisymmetric

- Computes the dynamics of the HCS, and growth of a tearing mode

- Parametric study as a function of the Lundquist number to get asymptotic behavior (ideal tearing)

$v_{A,\theta}$ (km/s)

Blobs and the tearing mode
## Model of the linear onset of the tearing instability

Periodicity of flux ropes

**Propagation and expansion in
the slow wind**

- Density structures and FRs are kinematically advected in the slow wind

- Several onsets of the tearing instability creates two timescales:

- A long one ~30 h

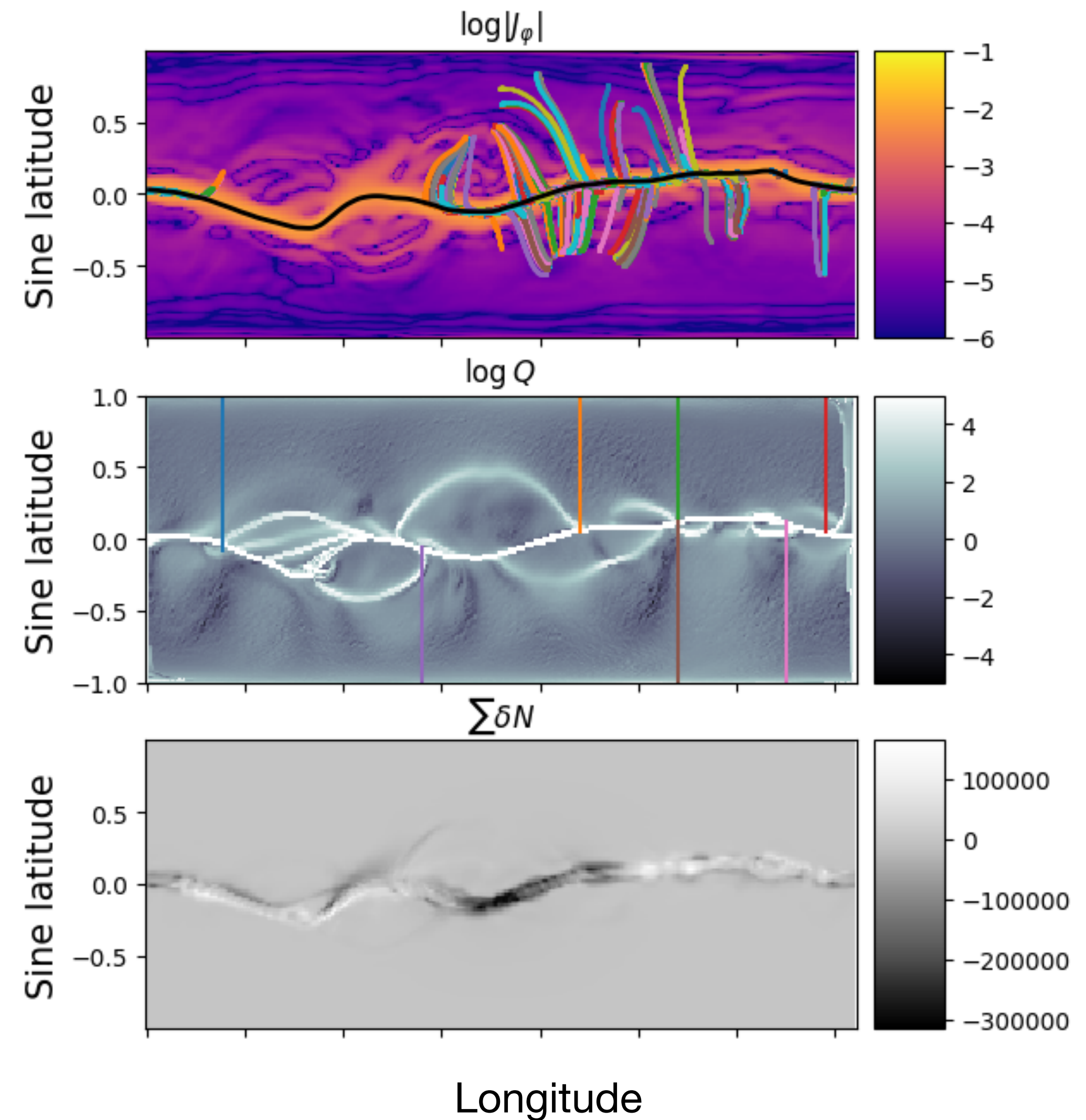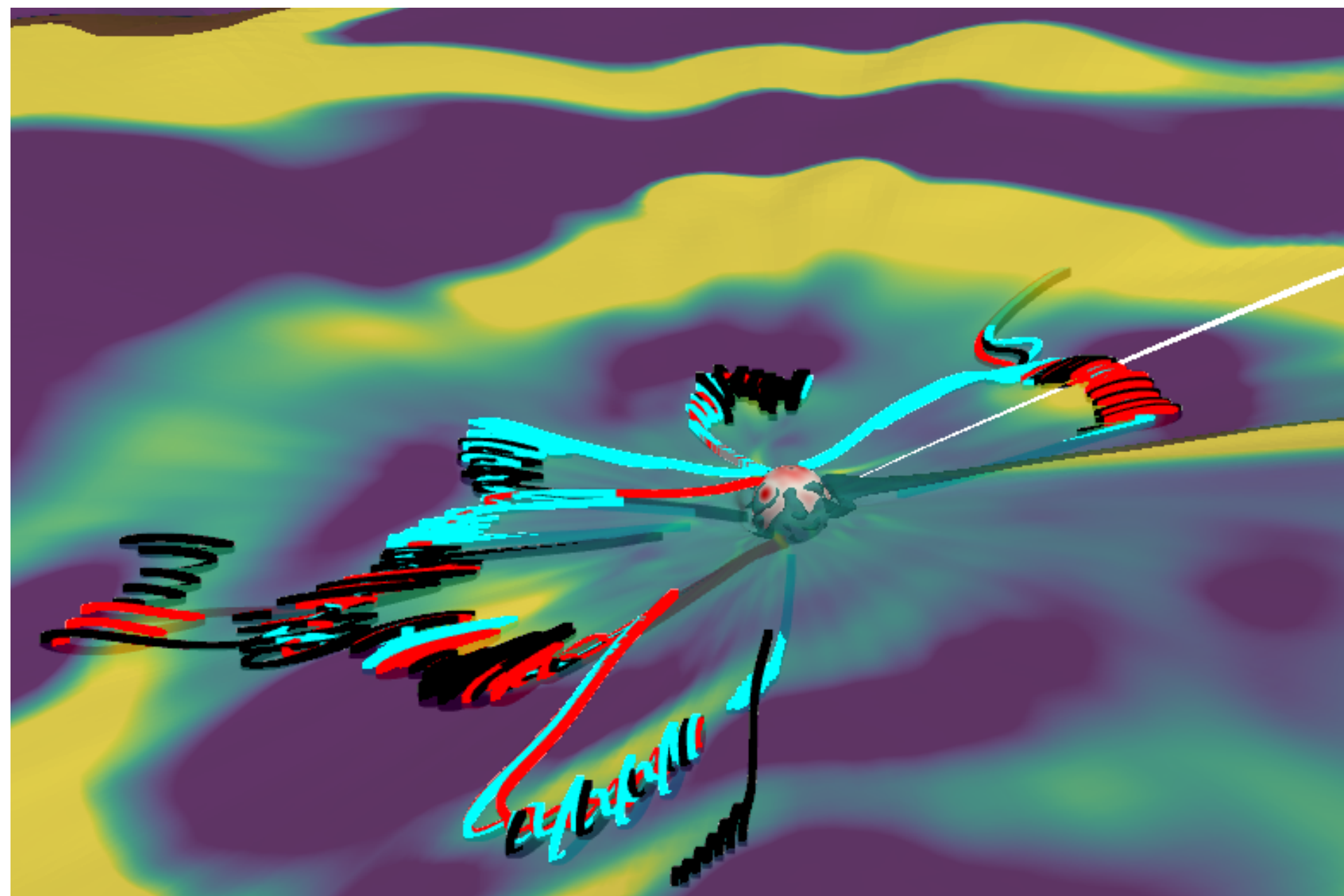- Small one associated with km

- Scaling km with S, we get ~80 min.

[Réville et al., 2020 ApJL]

FR and blobs

nr^2 (cm^{-3} AU^2)

$r/R_\odot$

$|v_{A,\theta}\hat{}(k_m)|^2$

t (hours)

30h
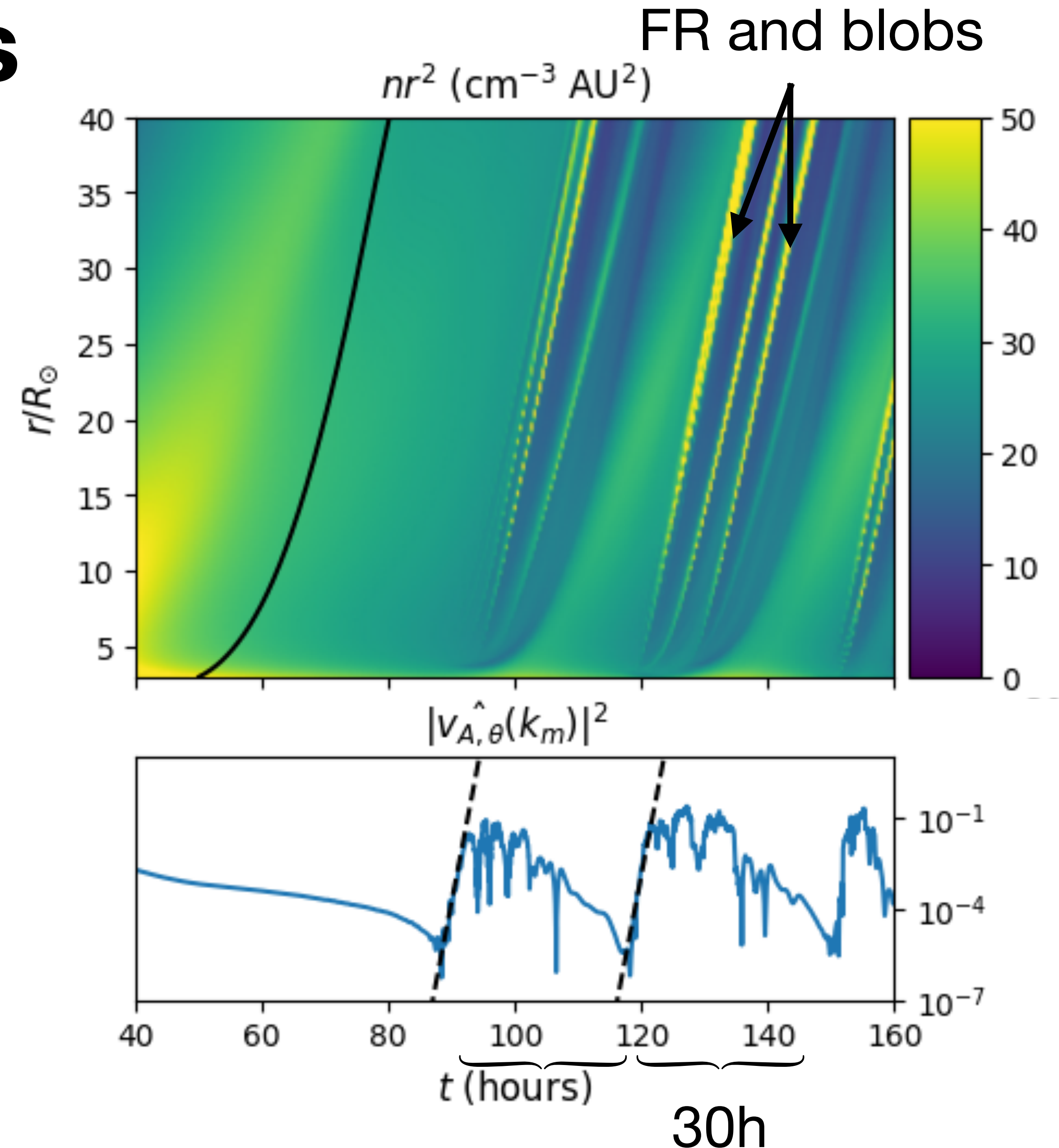
What about 3D ?

Using realistic magnetic field configurations

[Réville et al., 2021, in prep]

- 3D MHD w/ ADAPT magnetograms (June 2020)

- Flux ropes are triggered at the HCS with structure related to quasi-separatrices

Conclusions & perspectives

- Helmet streamers are unstable and give birth to flux rope structures and density perturbations.

- We show with 2.5D high resolution resistive MHD simulations that the HCS triggers a tearing instability at high Lundquist numbers (S).

- This process follows the ideal tearing scenario and predicts periodicities consistent with observations.

- Using 3D simulations and realistic magnetic fields, we observe a similar process. Flux ropes' spatial structure is tied with the network of quasi-separatrices. More work is needed to characterize this process in 3D at higher S.

Thanks!