Kelvin-Helmholtz Instability in the solar atmosphere

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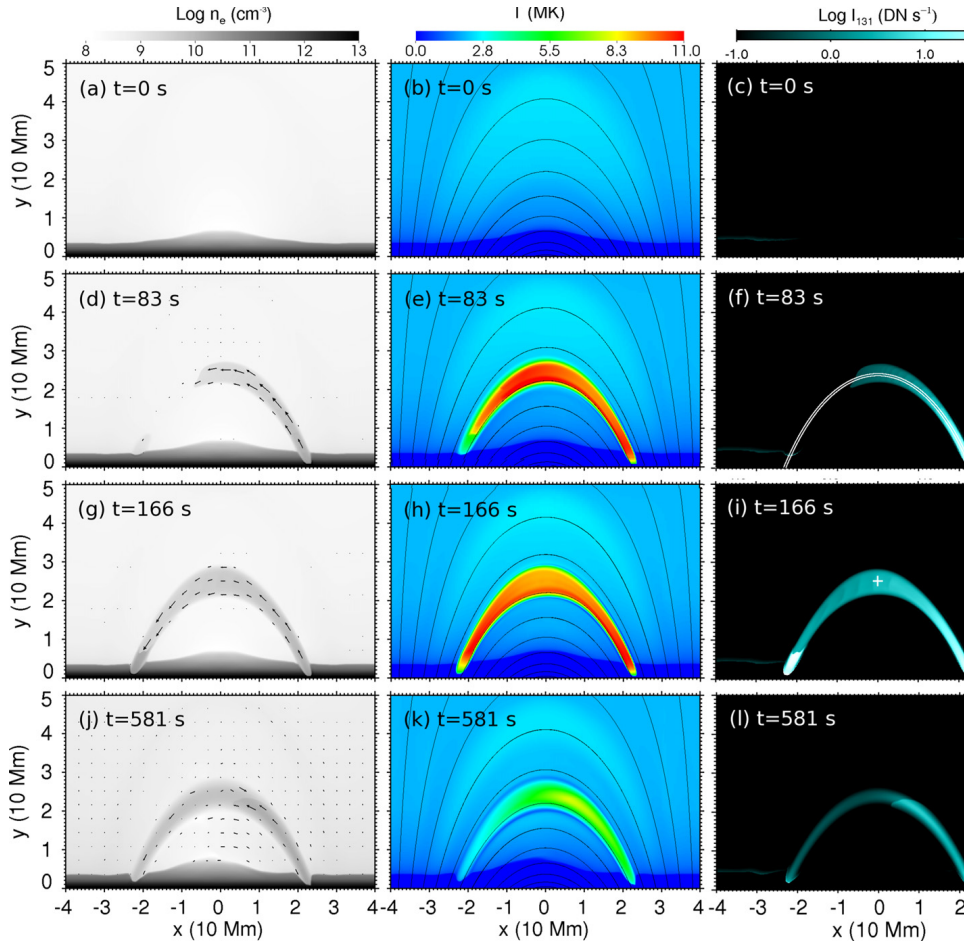
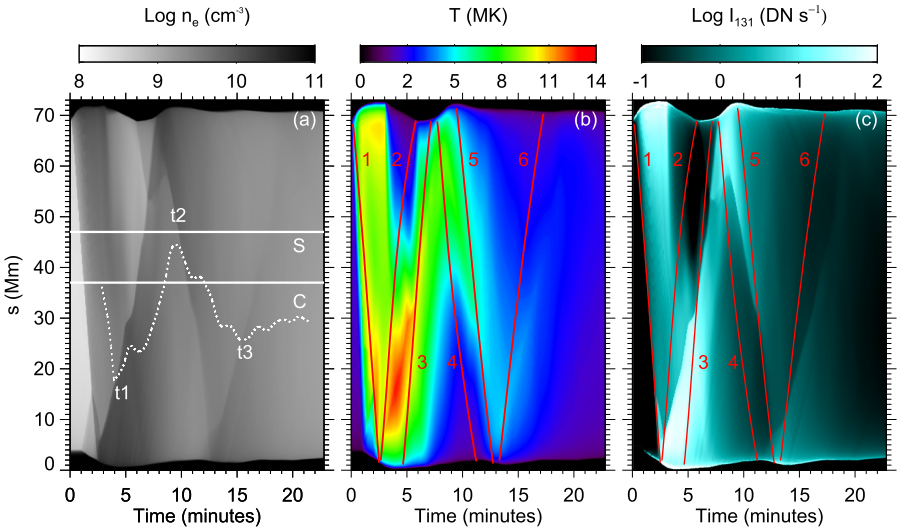
Wave & Flow

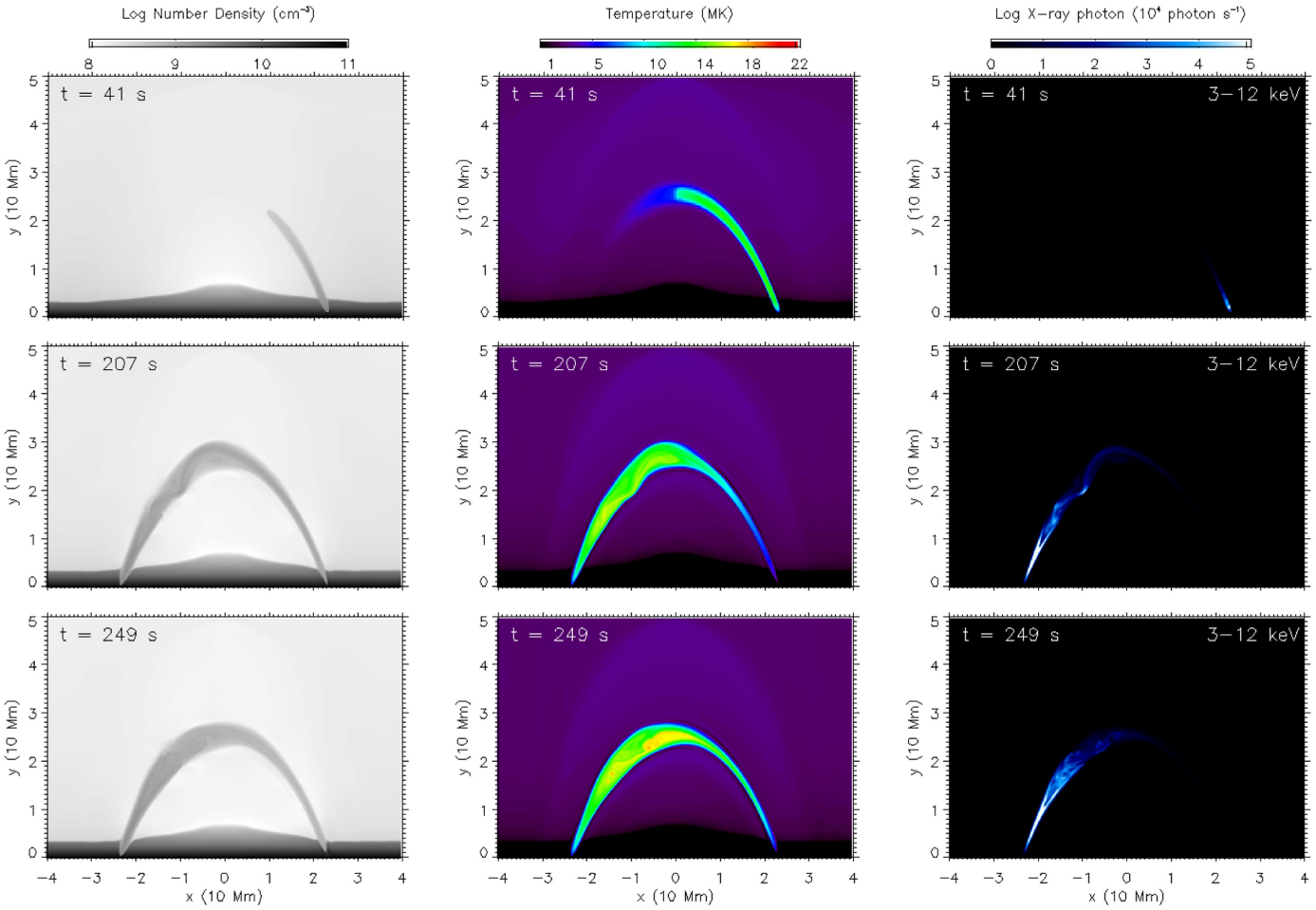




Fang et al 2015

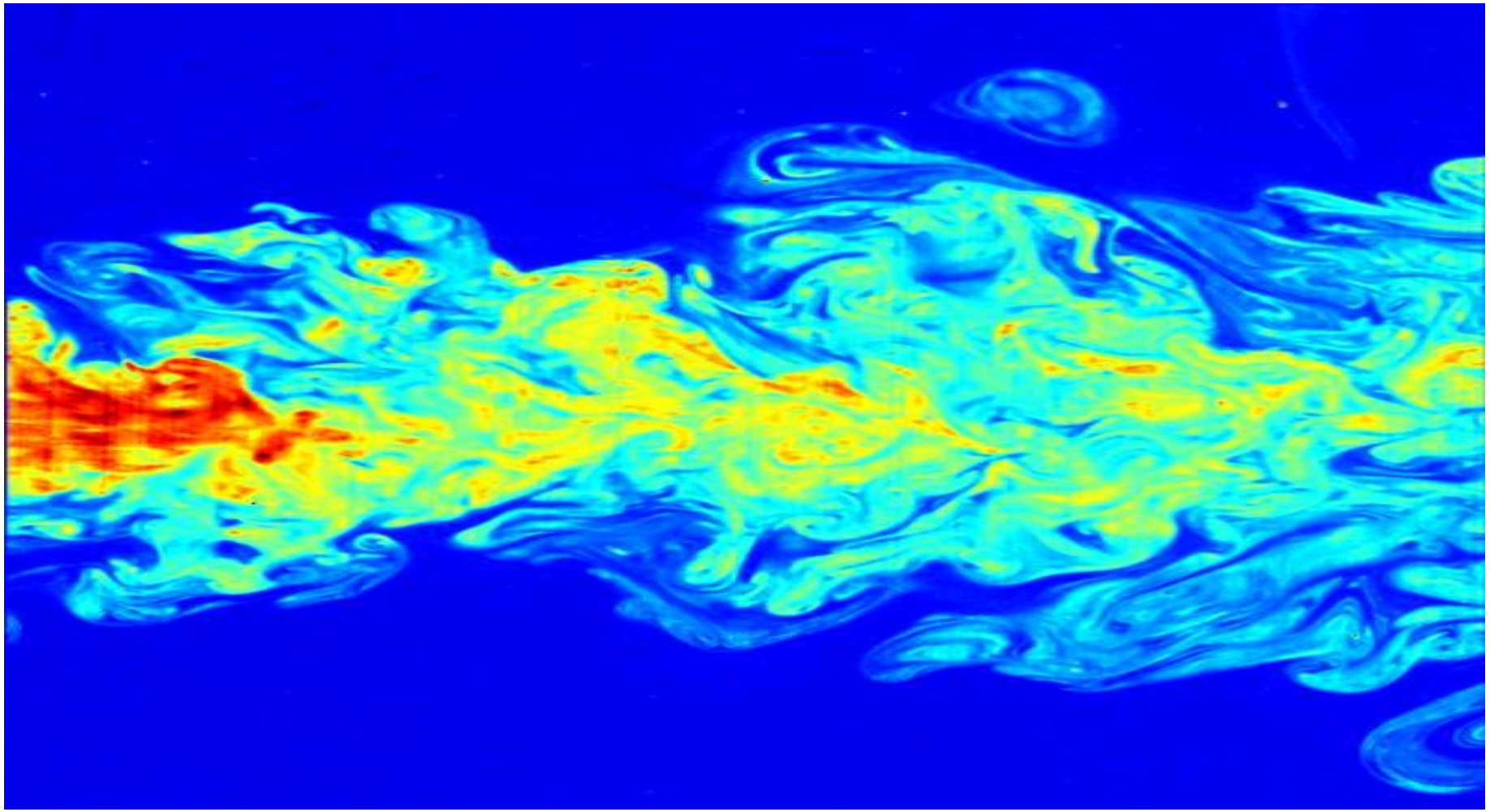
- Slow wave dominate at loop top
- Flow is strong at footpoint

Self-developed KHI

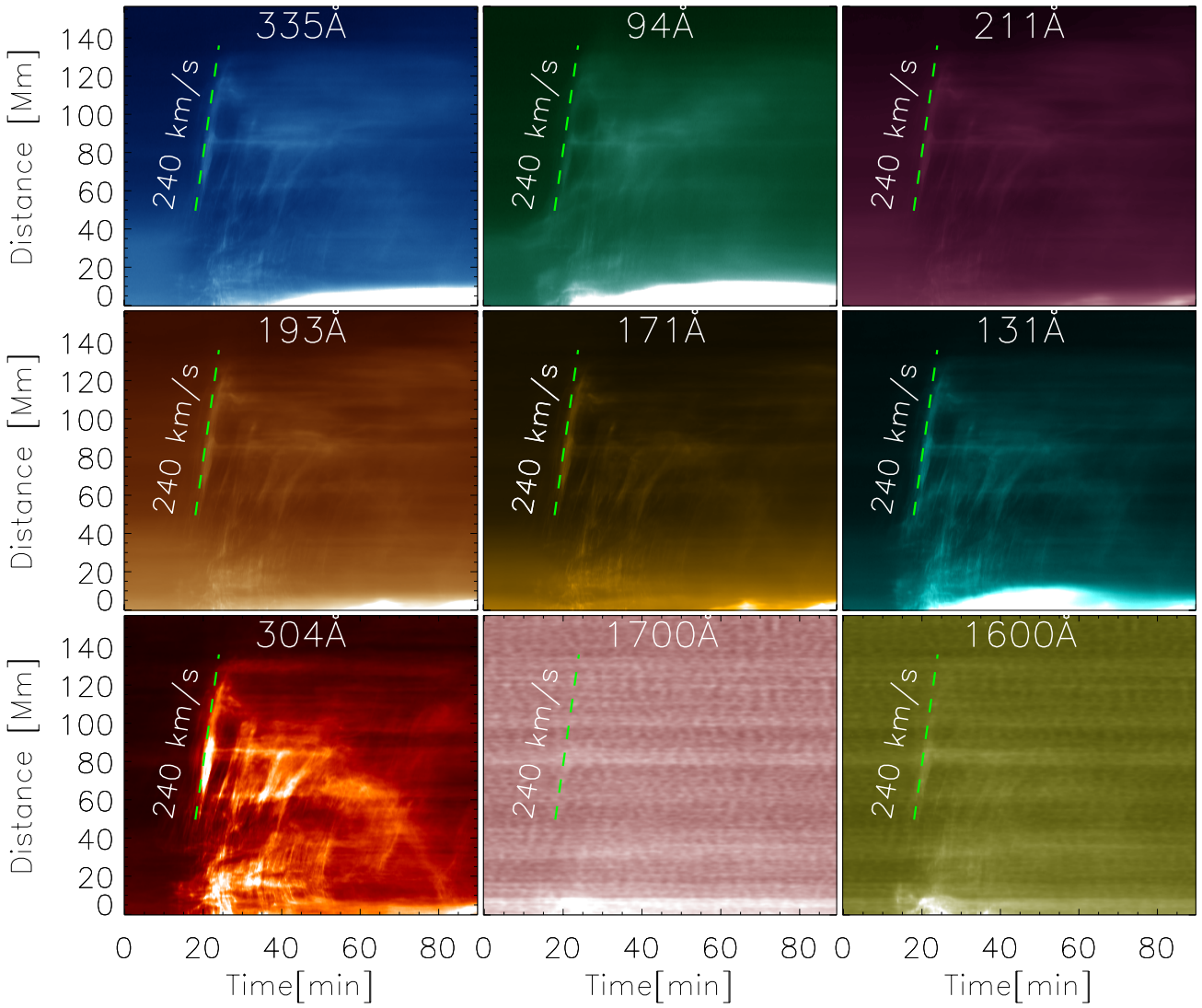


Fang et al 2016

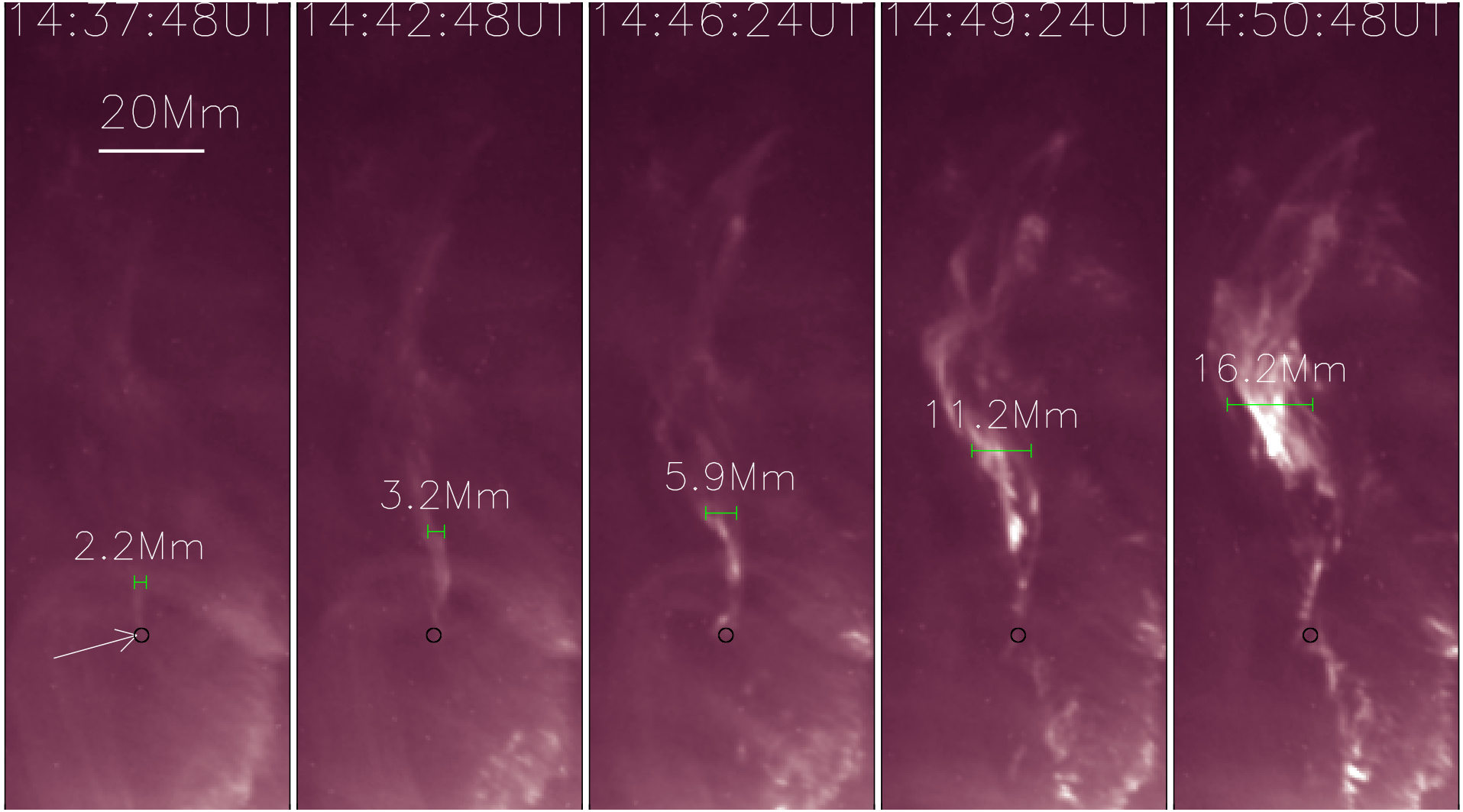
Free turbulent jets (movie)



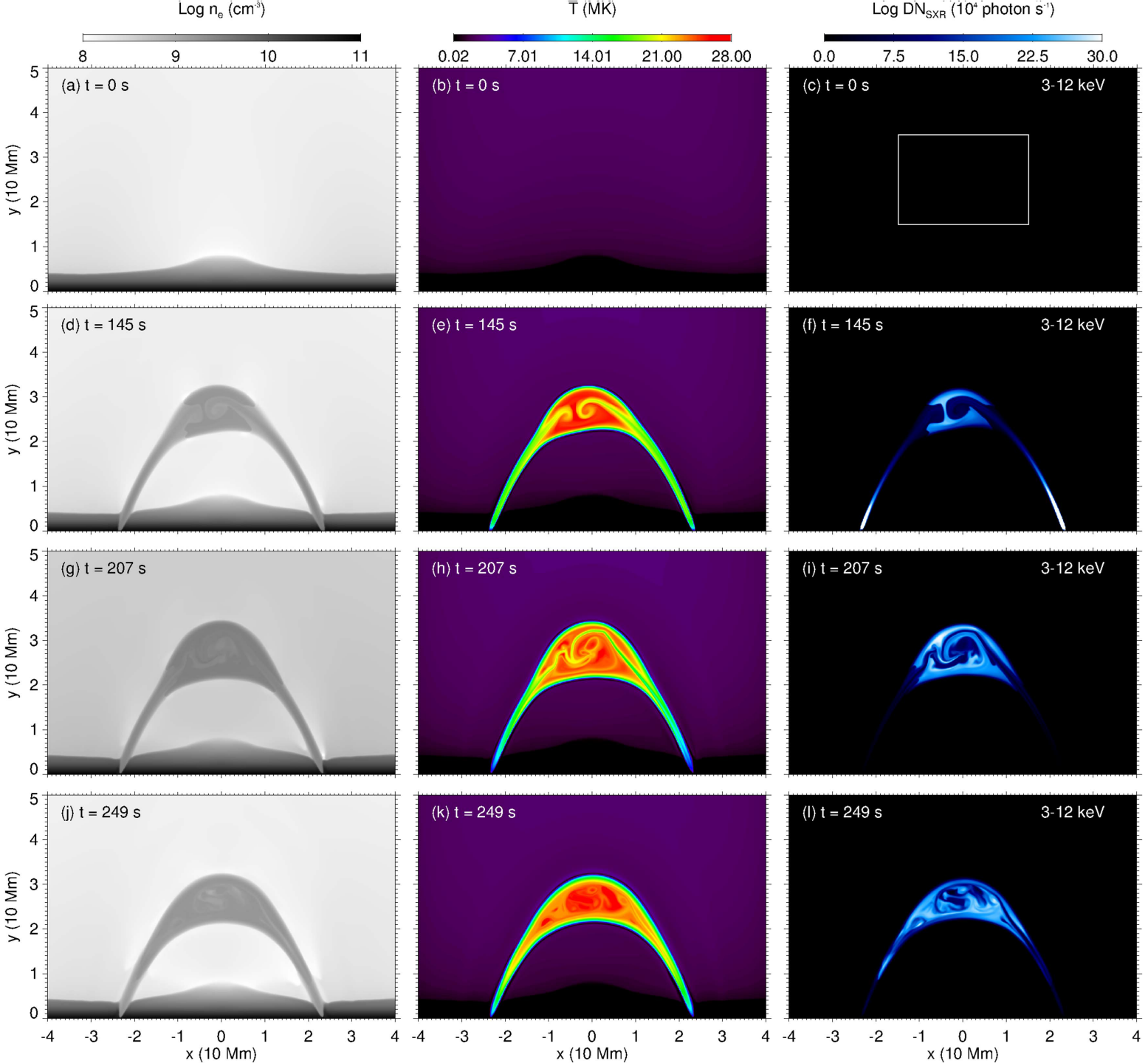
Propagation speed



Turbulence growth

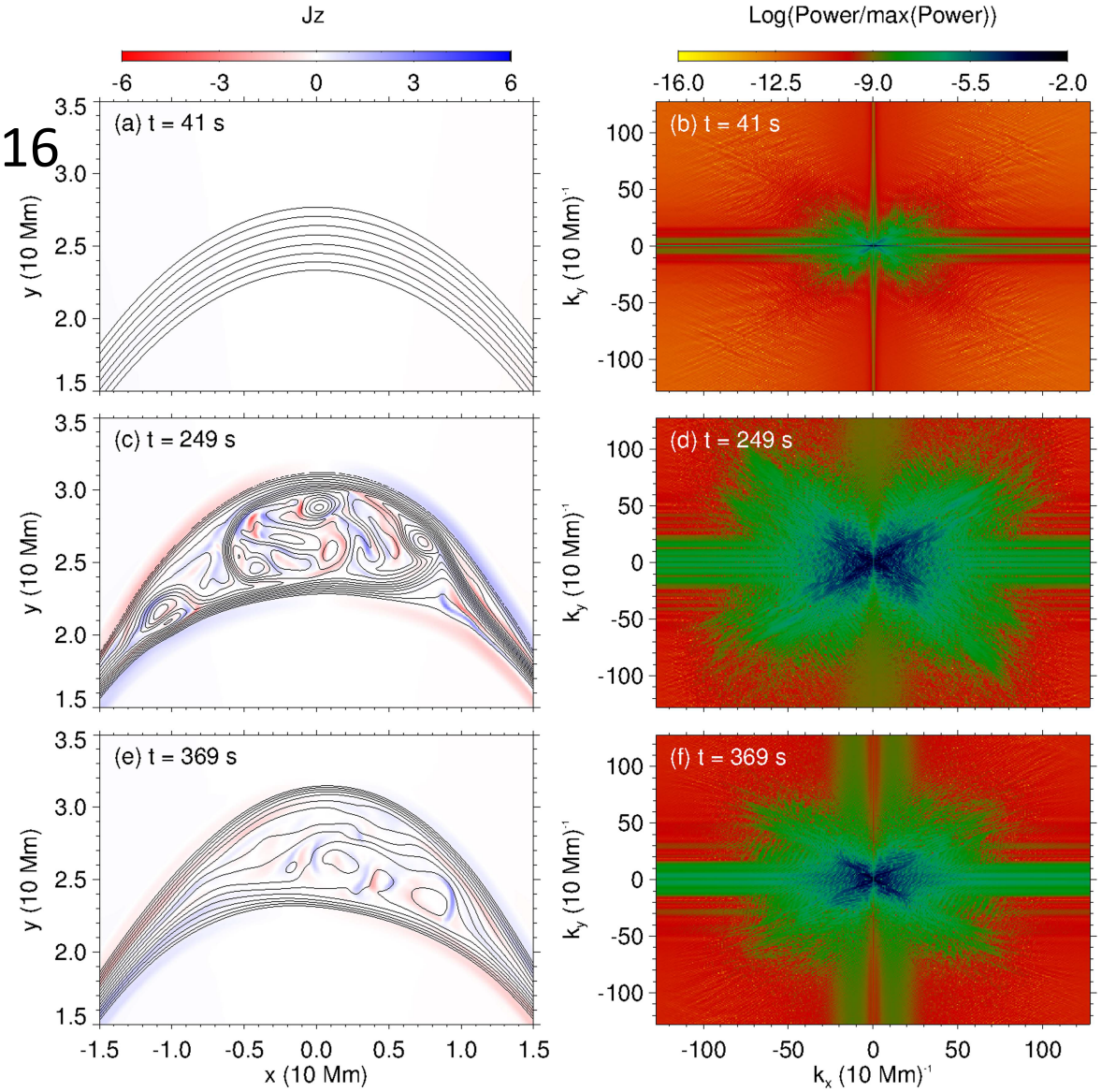


Collision of counter-streams

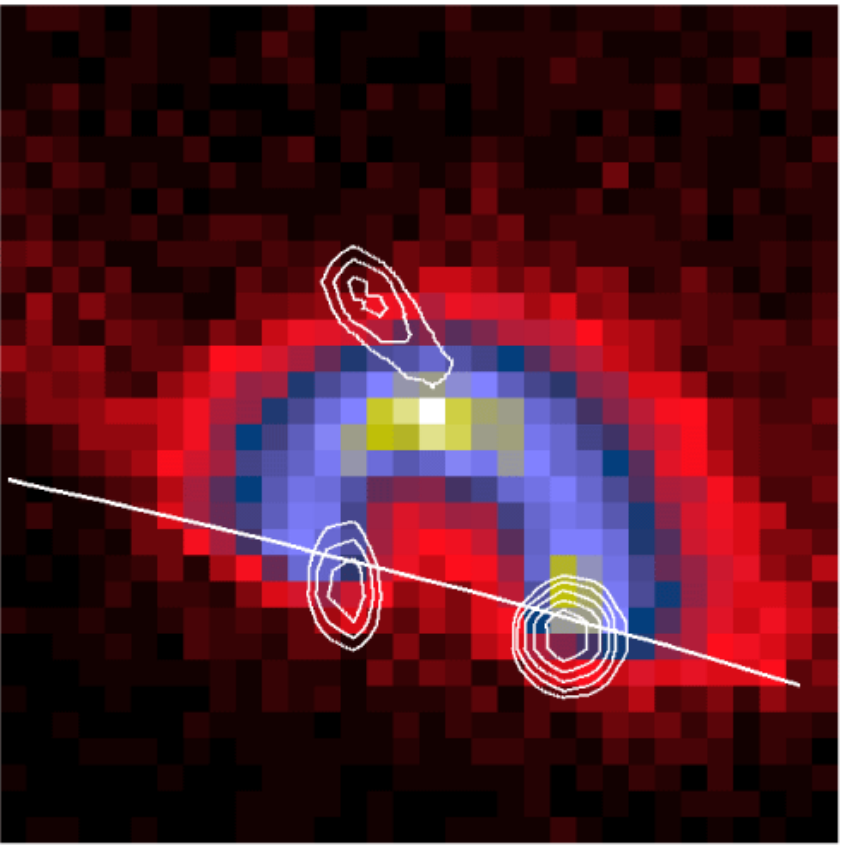


Large to small length scales

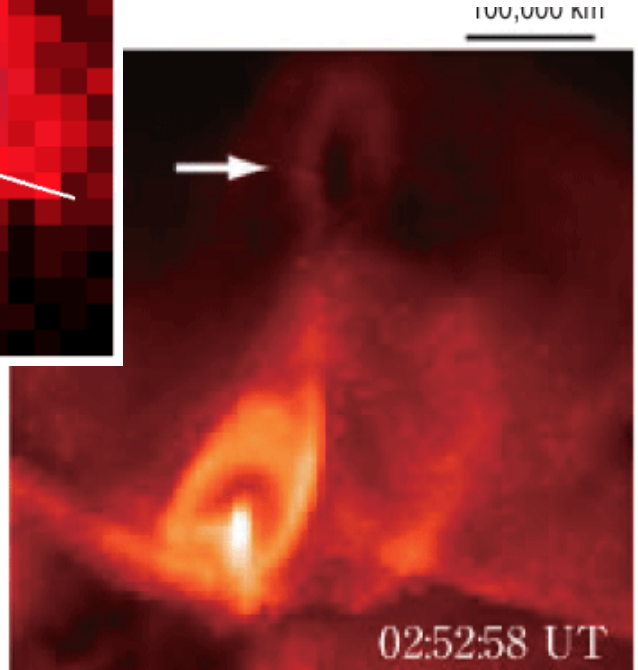
Fang et al 2016

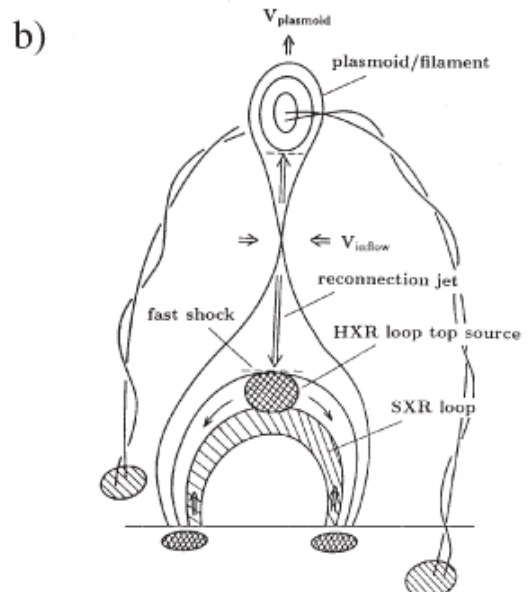


HXR source at loop top



Flare model: shibata et al 1995

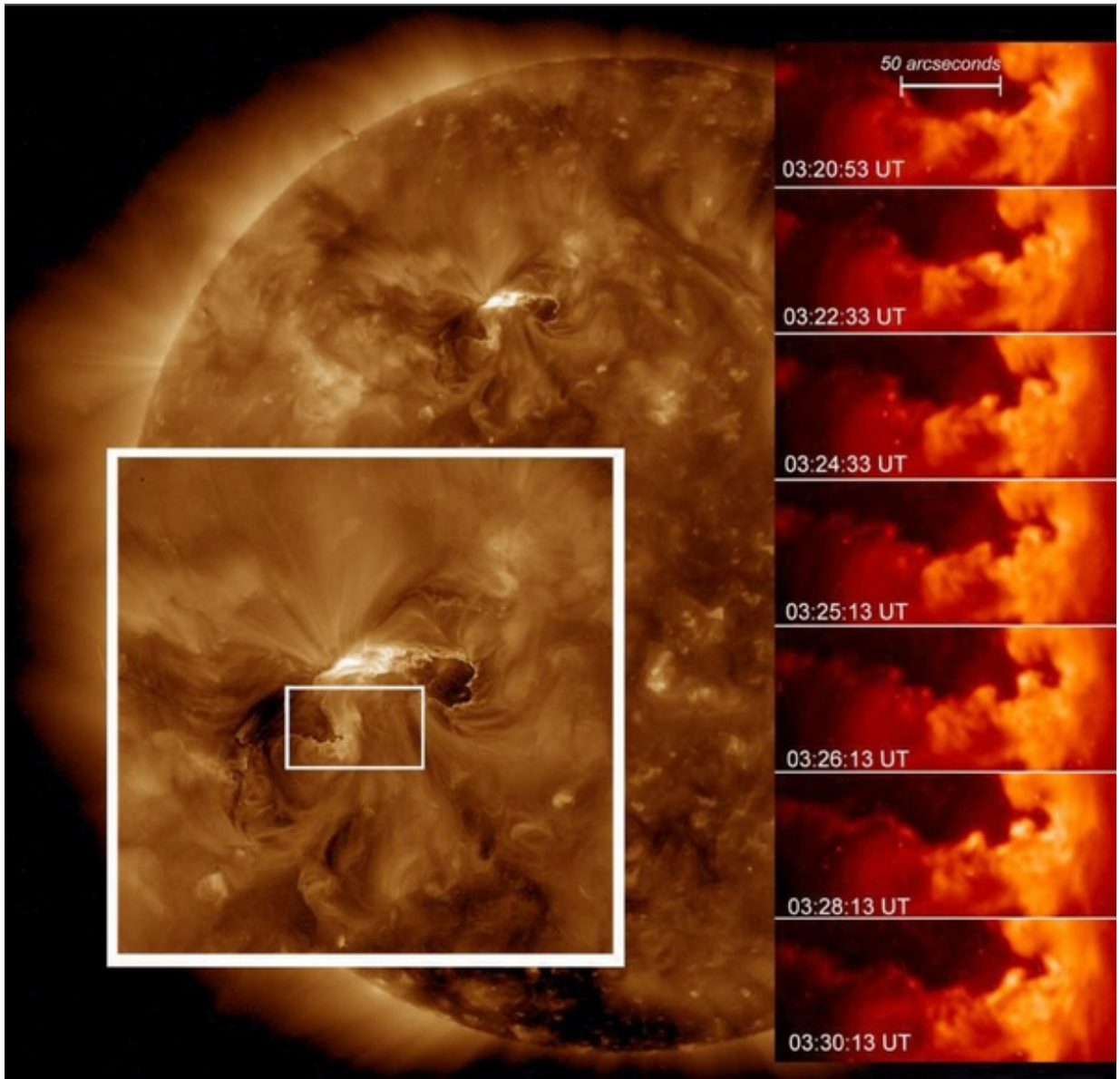




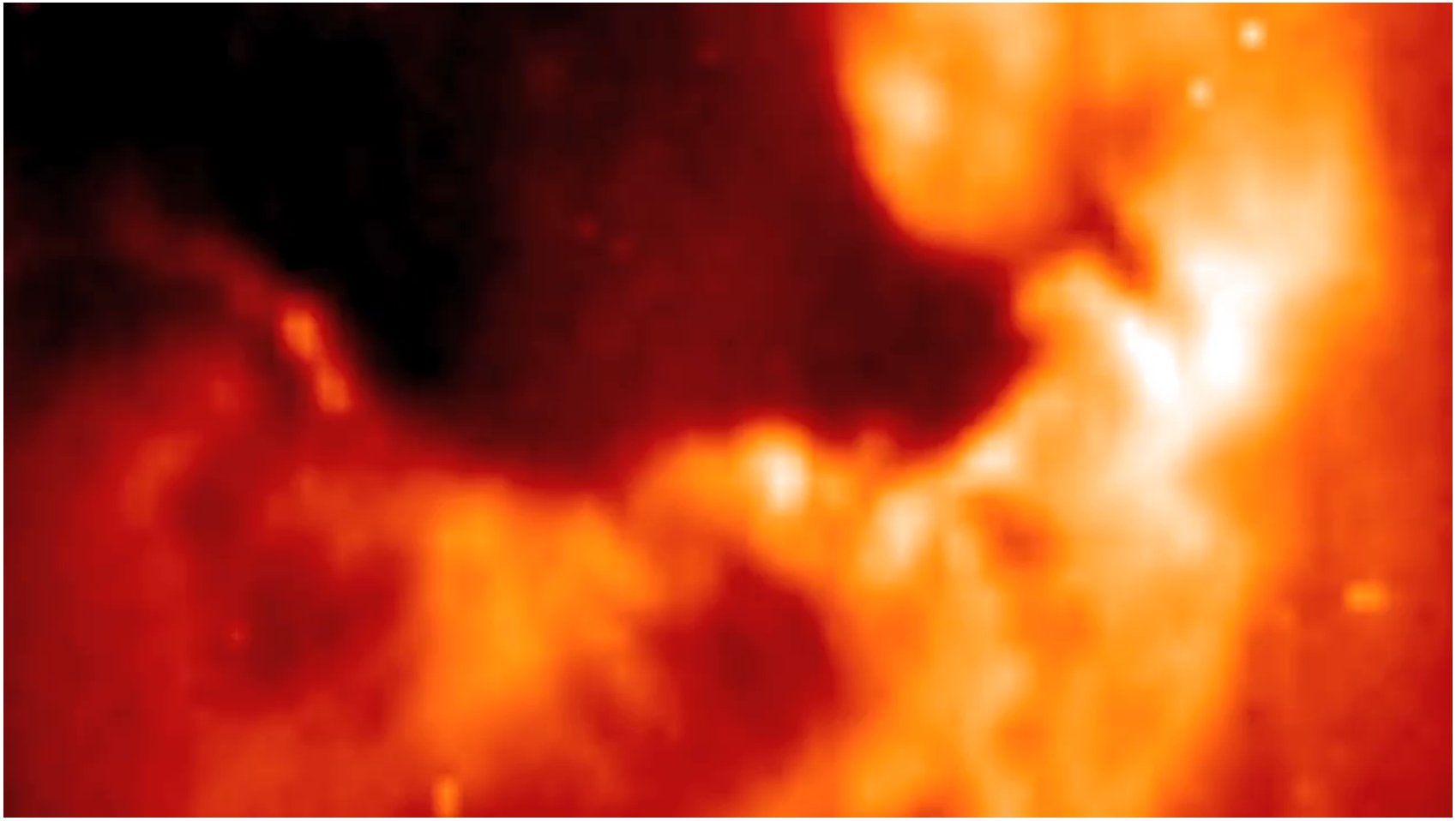
Masuda et al 1994

KHI at solar corona

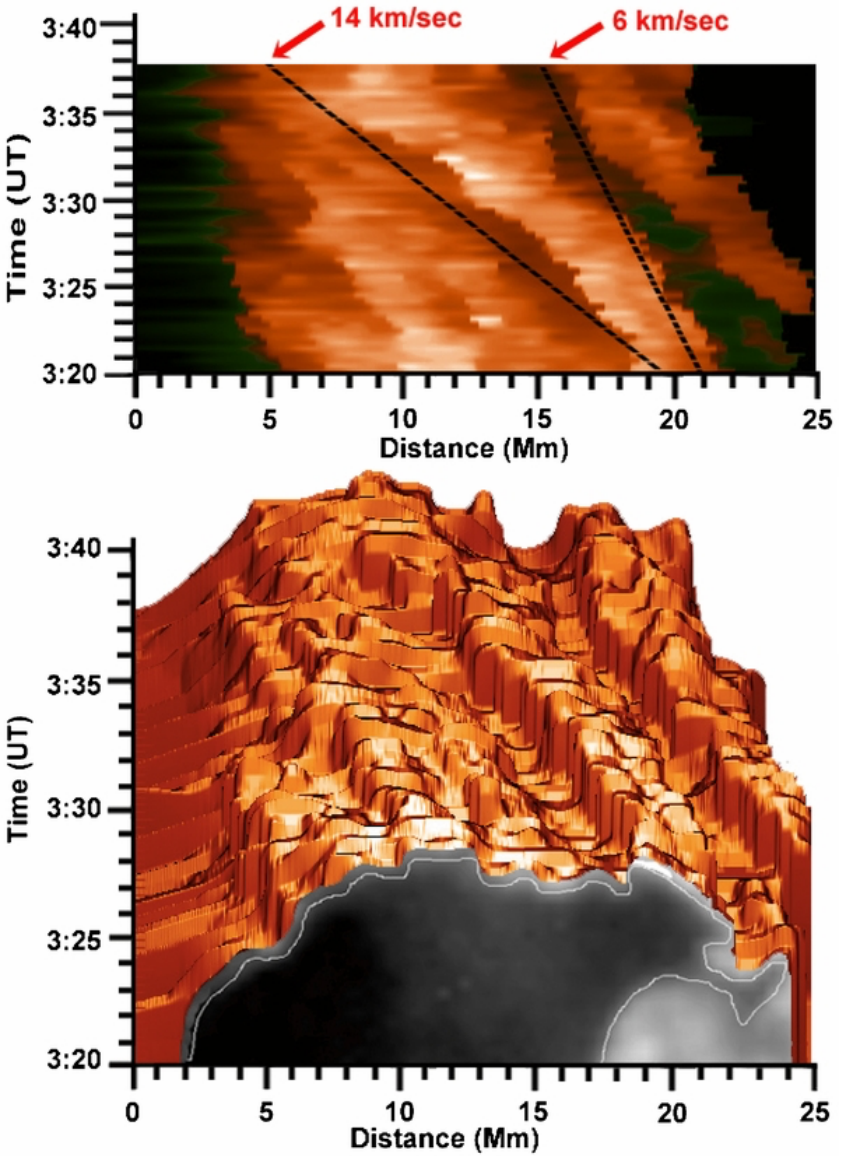
Ofman et al ApJ 2011



KHI at solar corona



KHI at solar corona



Growth rate suppressed by magnetic field

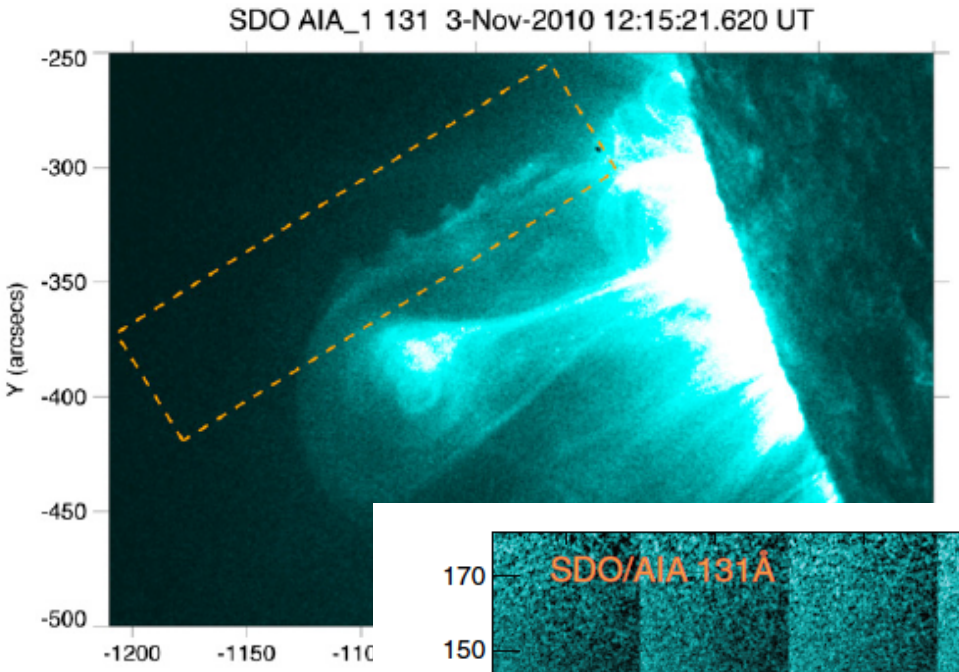
Chandrasekhar 1961

$$\gamma = \frac{1}{2}|\mathbf{k}\cdot\Delta\mathbf{V}|[1-(2V_A\hat{\mathbf{k}}\cdot\hat{\mathbf{B}})^2/(\hat{\mathbf{k}}\cdot\Delta\mathbf{V})^2]^{1/2}$$

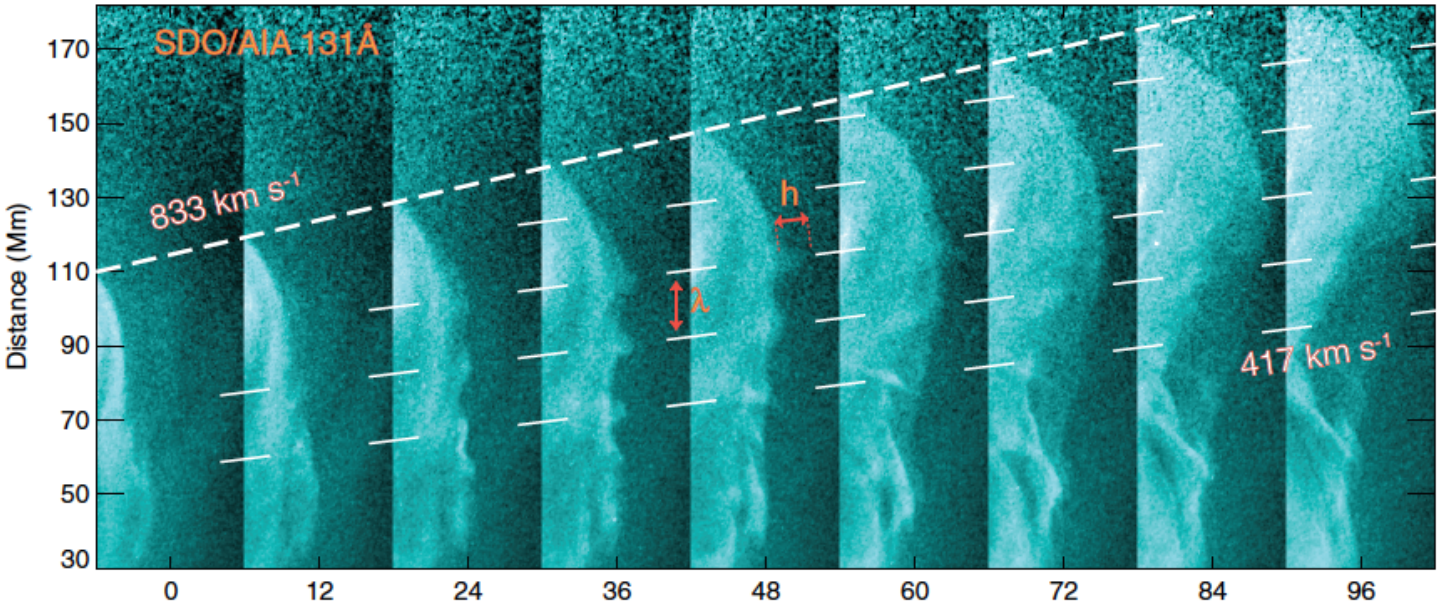
Numerical Simulations

Ofman et al 2011

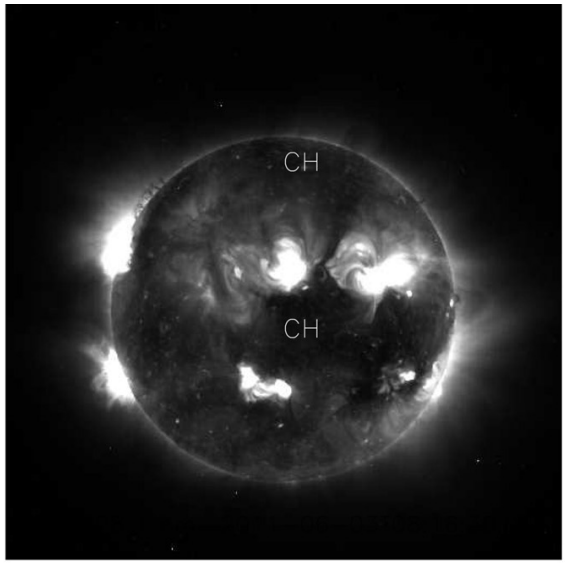
KHI at CME flank

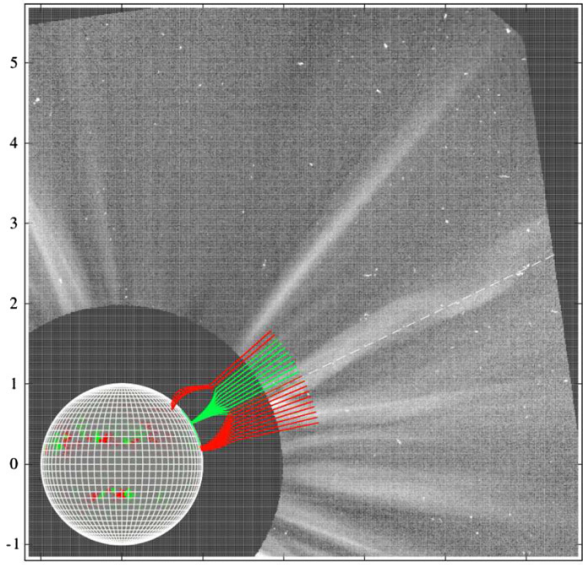


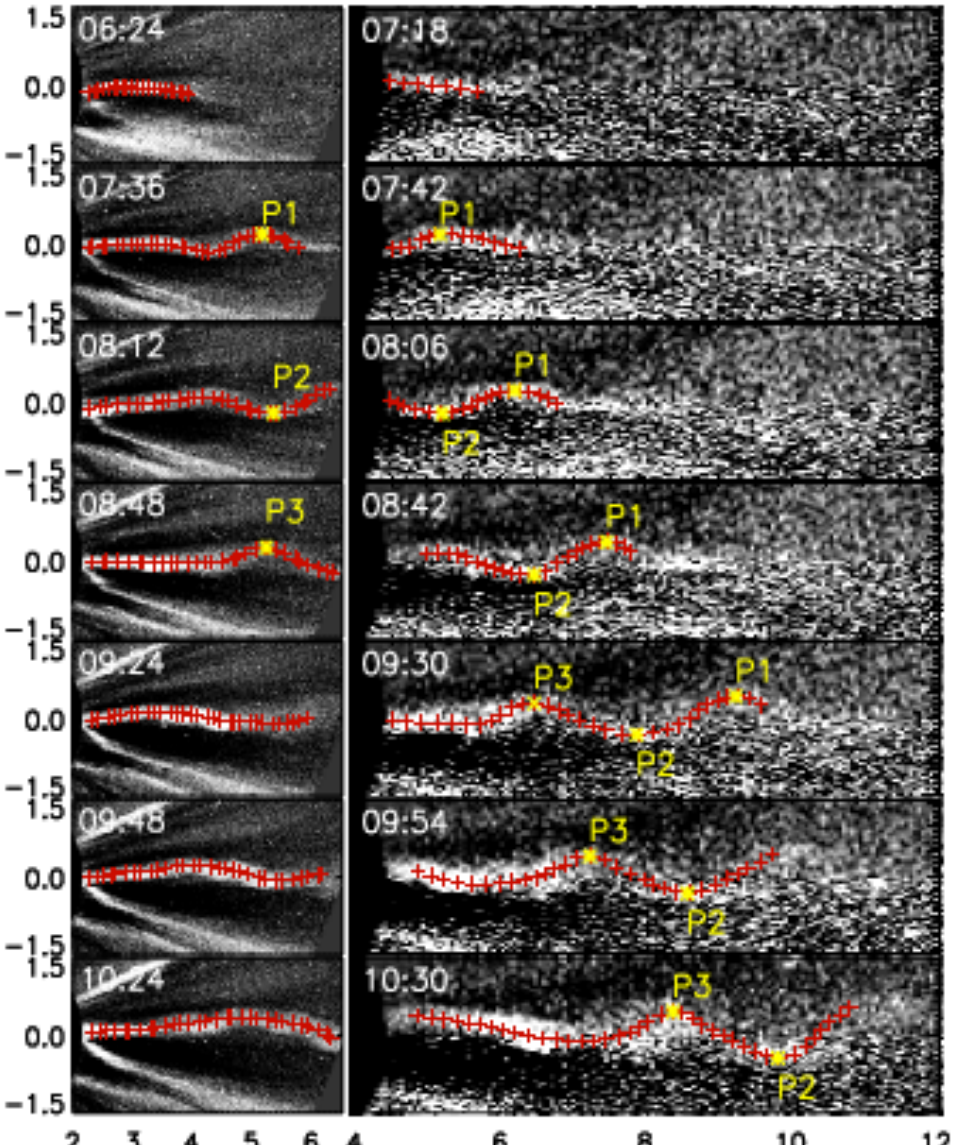
Foulon et al 2011



Wavy motions but not a wave?



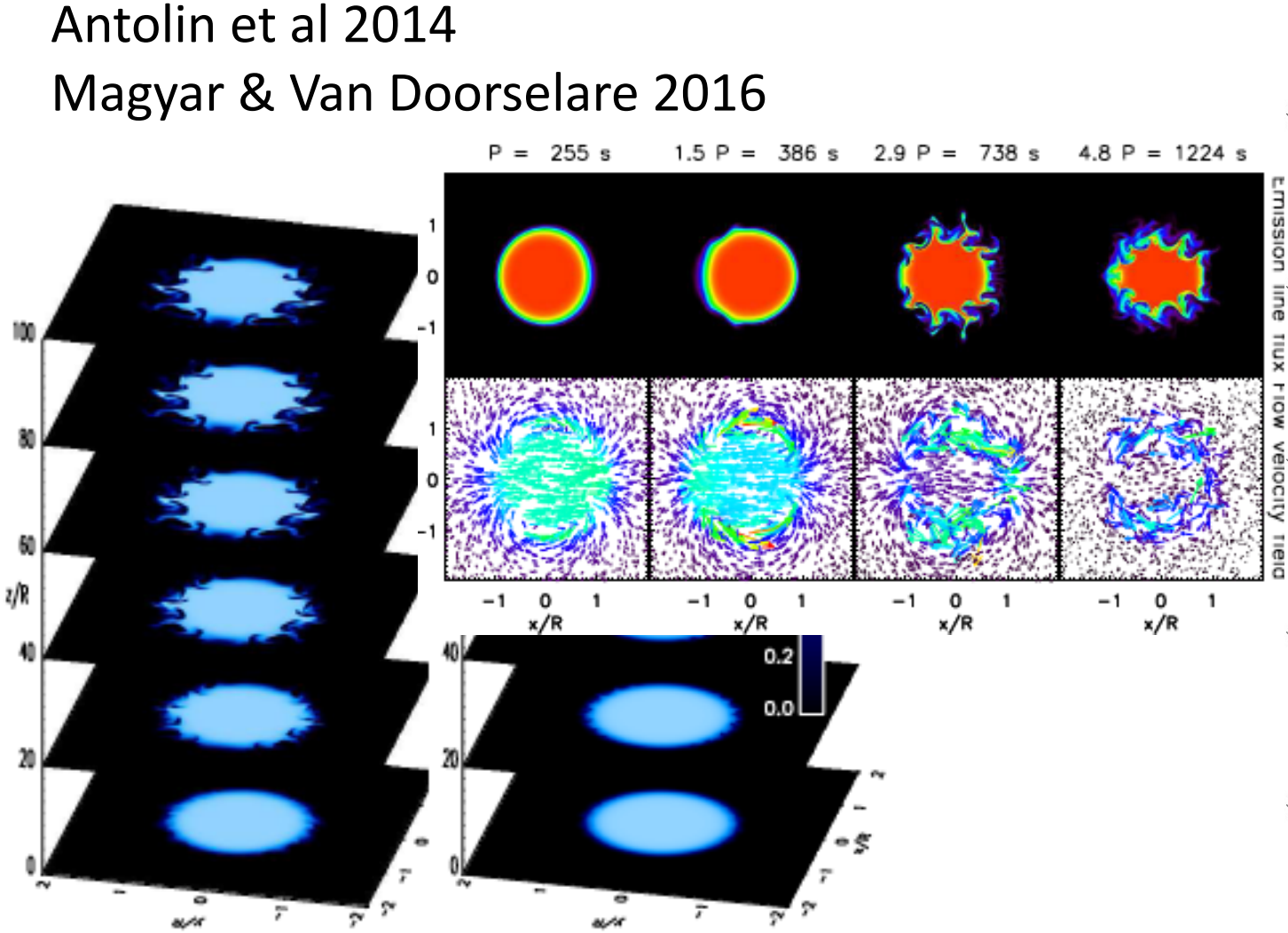


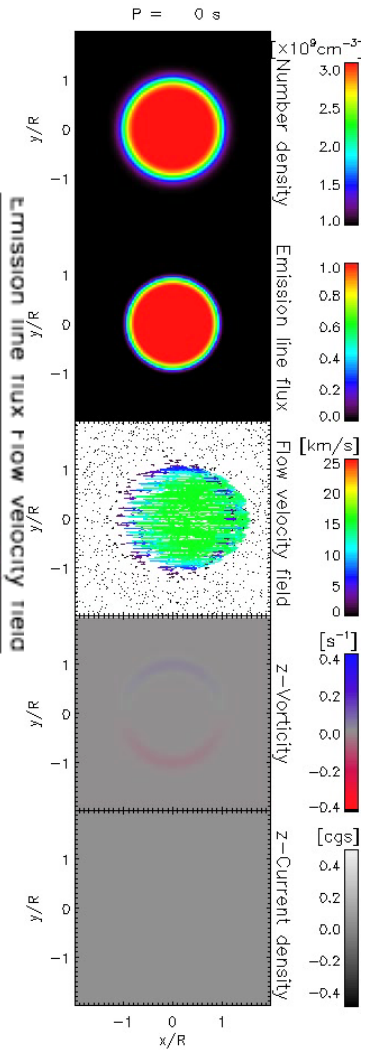


Feng et al 2013

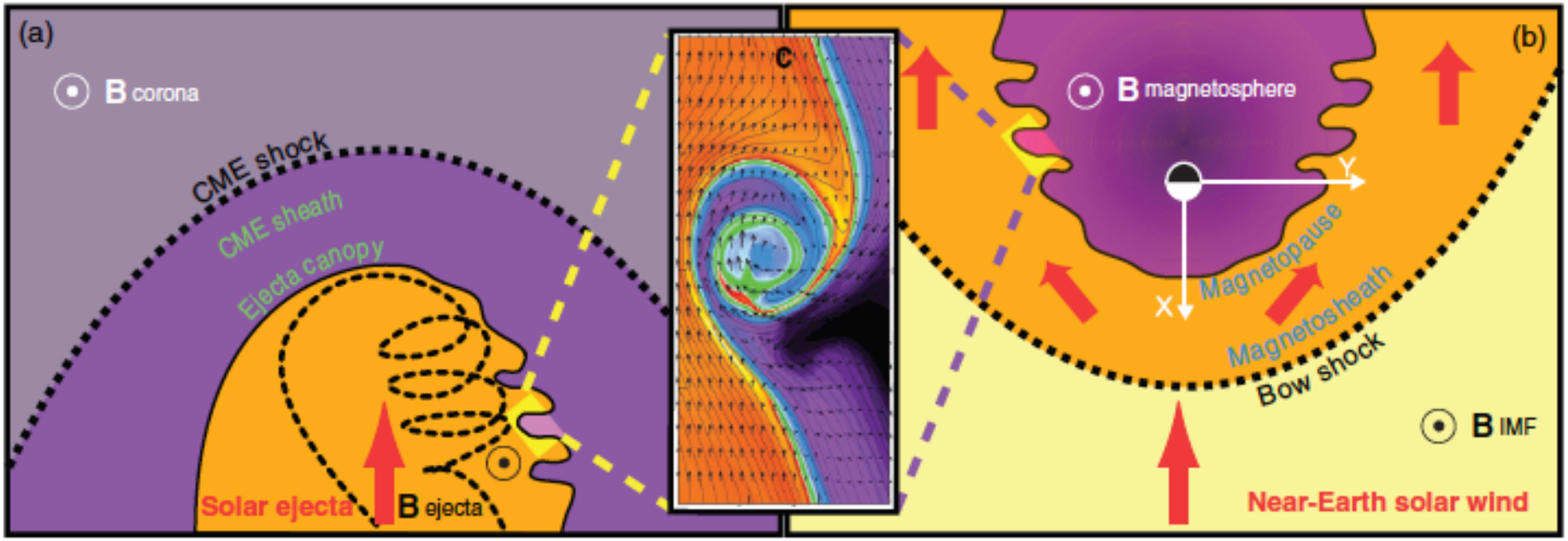
KHI in coronal loops during transverse motion

Antolin et al 2014
Magyar & Van Doorselare 2016





KHI at magnetosphere of the earth



Summary

- KHI is found at a variety of length and time scales
- Energy is transferred from large scale to smaller scale motion; KHI contributes to plasma heating.
- We simulate KHIs within a reflective flow and the collision of counter-streams.
- Magnetic islands is form at region with strong shearing motions during KHI, which may contribute to plasma heating and particle acceleration.
- Free turbulence could develop by KHI after ejection.