What Hi-C told us about the structure and dynamics of an AR transition region

Loops 7 July 2015

Richard J Morton
Northumbria University
Newcastle Upon Tyne, UK

Also contributed: J. McLaughlin, A. Winebarger, H. Warren, A. Bagley

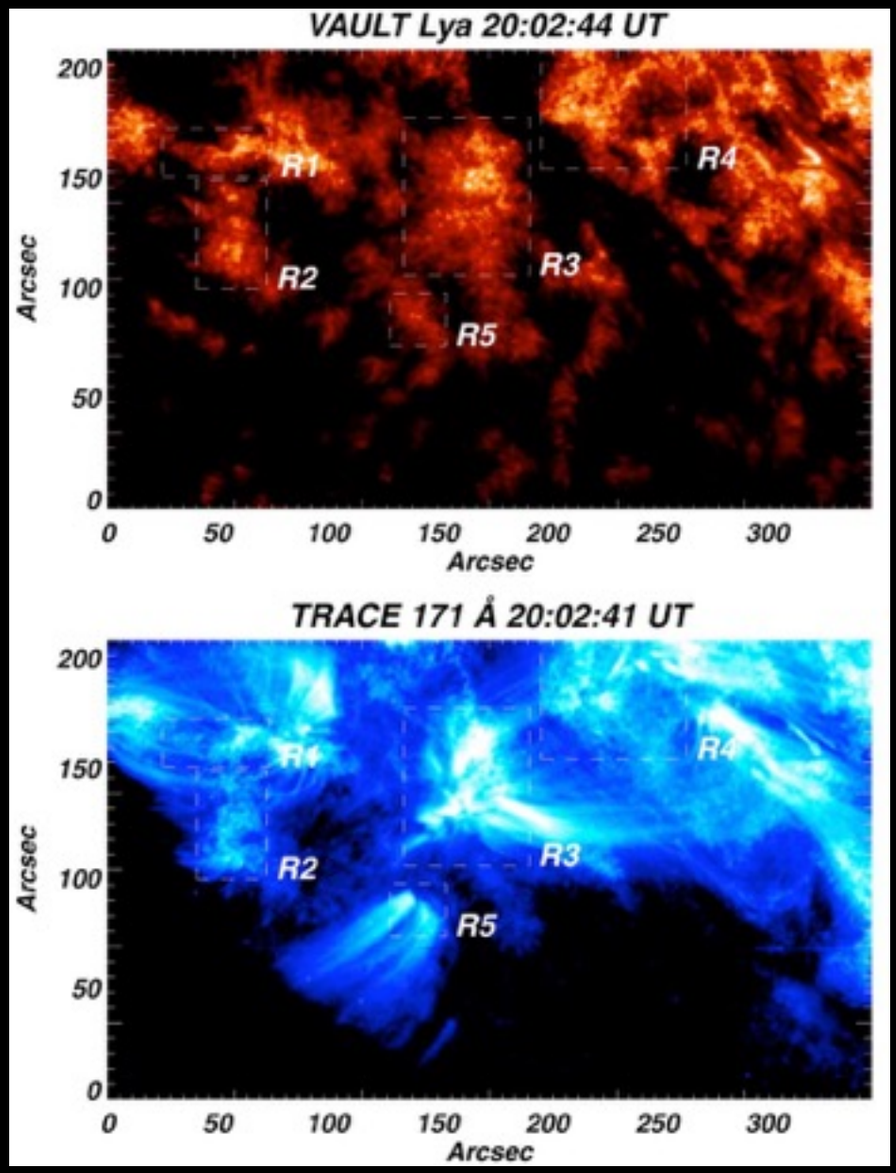
northumbria UNIVERSITY NEWCASTLE

The Leverhulme Trust

Hi-C
High-Resolution Coronal Imager

Moss and coronal heating

Moss variability could provide a good indicator for the pattern of heating events in the corona (*Martens et al. 2000)*.



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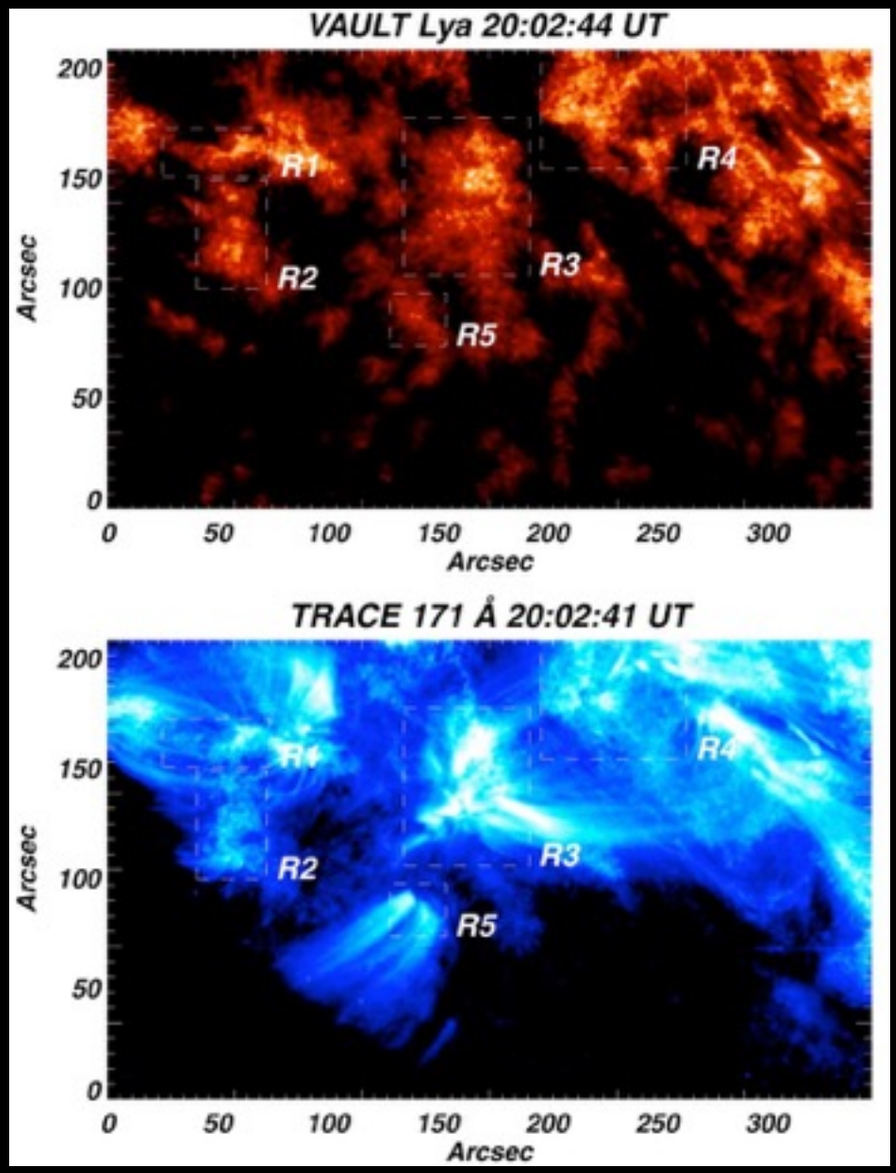
Low Moss variability:
Intensity (TRACE - *Antiochos et al 2003*)
Doppler velocity and non-thermal widths (EIS - *Brooks & Warren 2009*).

Heating must be quasi-steady.



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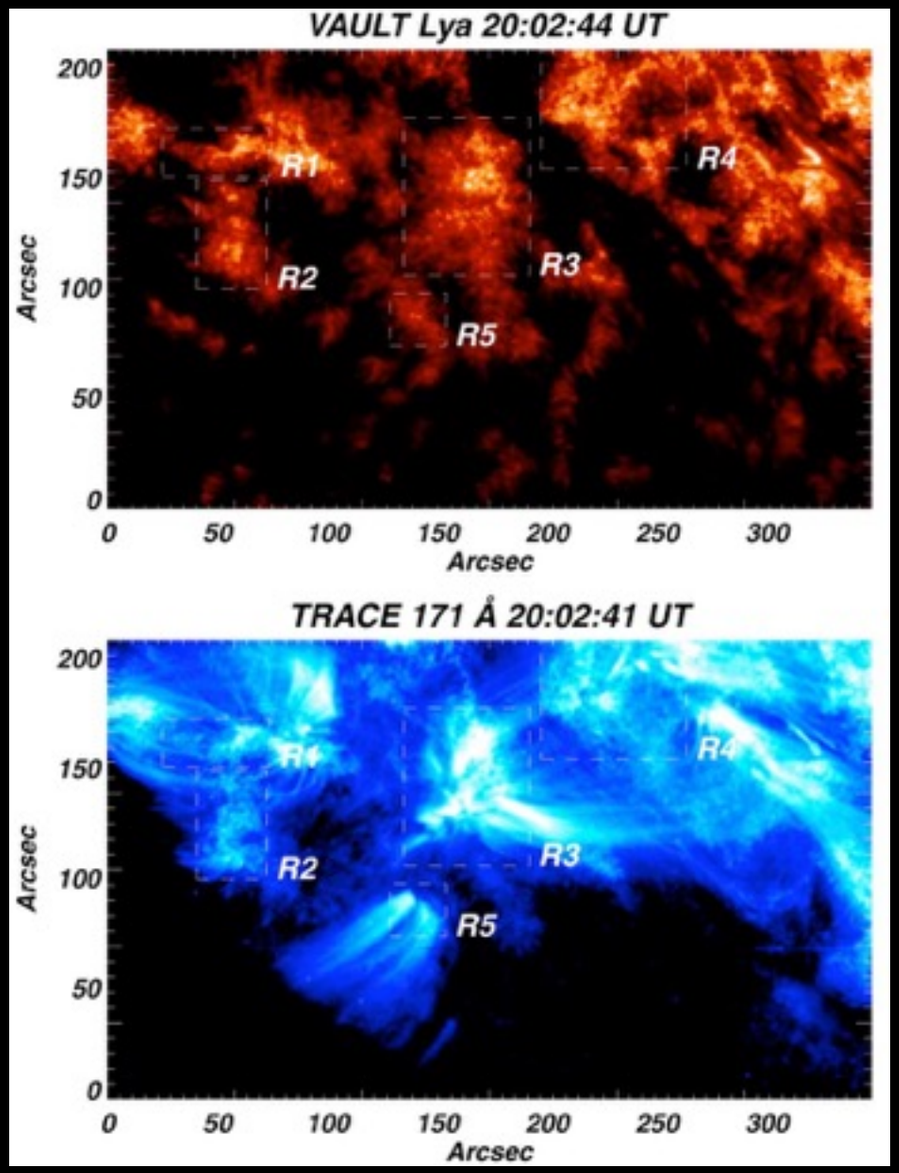
Higher resolution needed - spatial/temporal....Hi-C!



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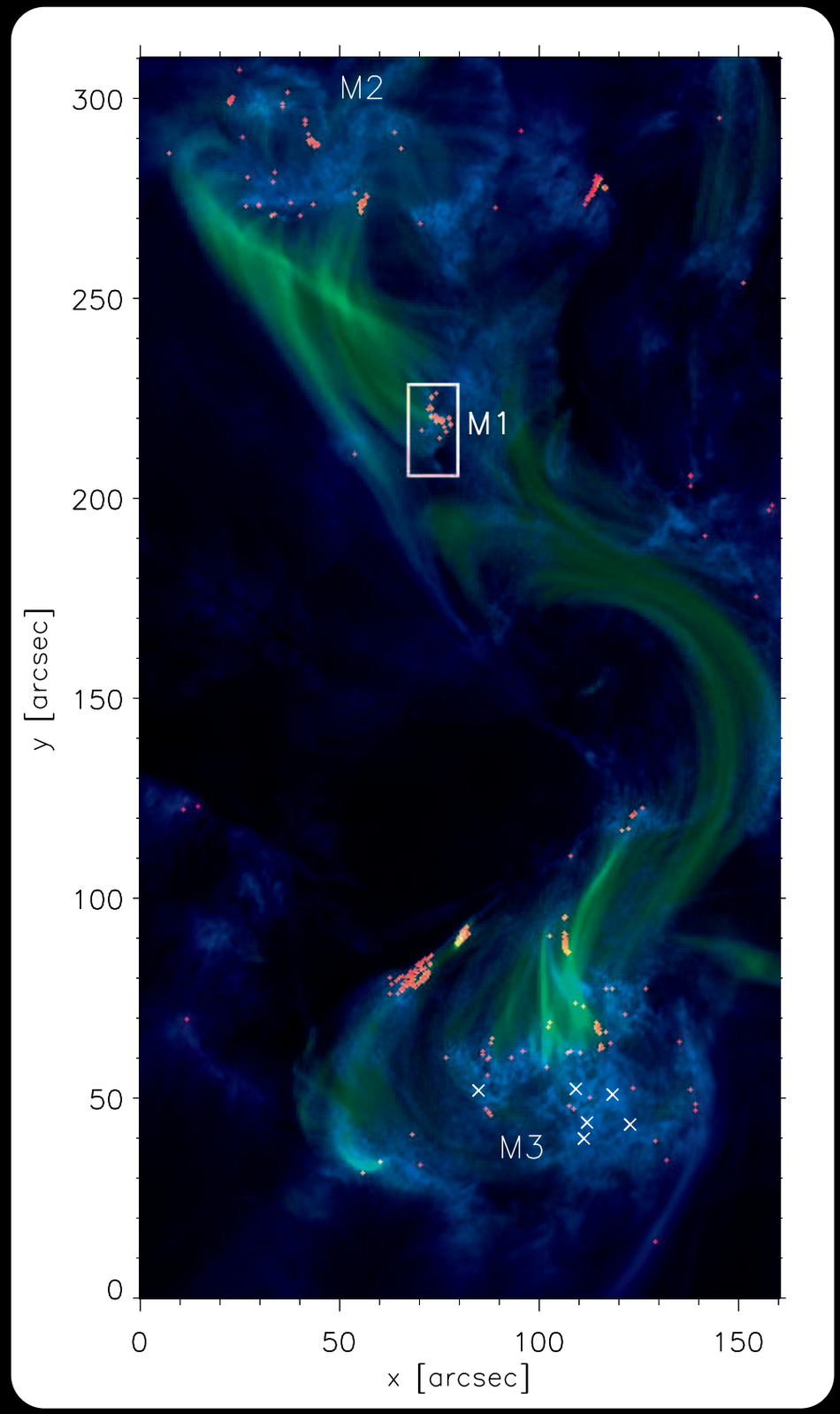
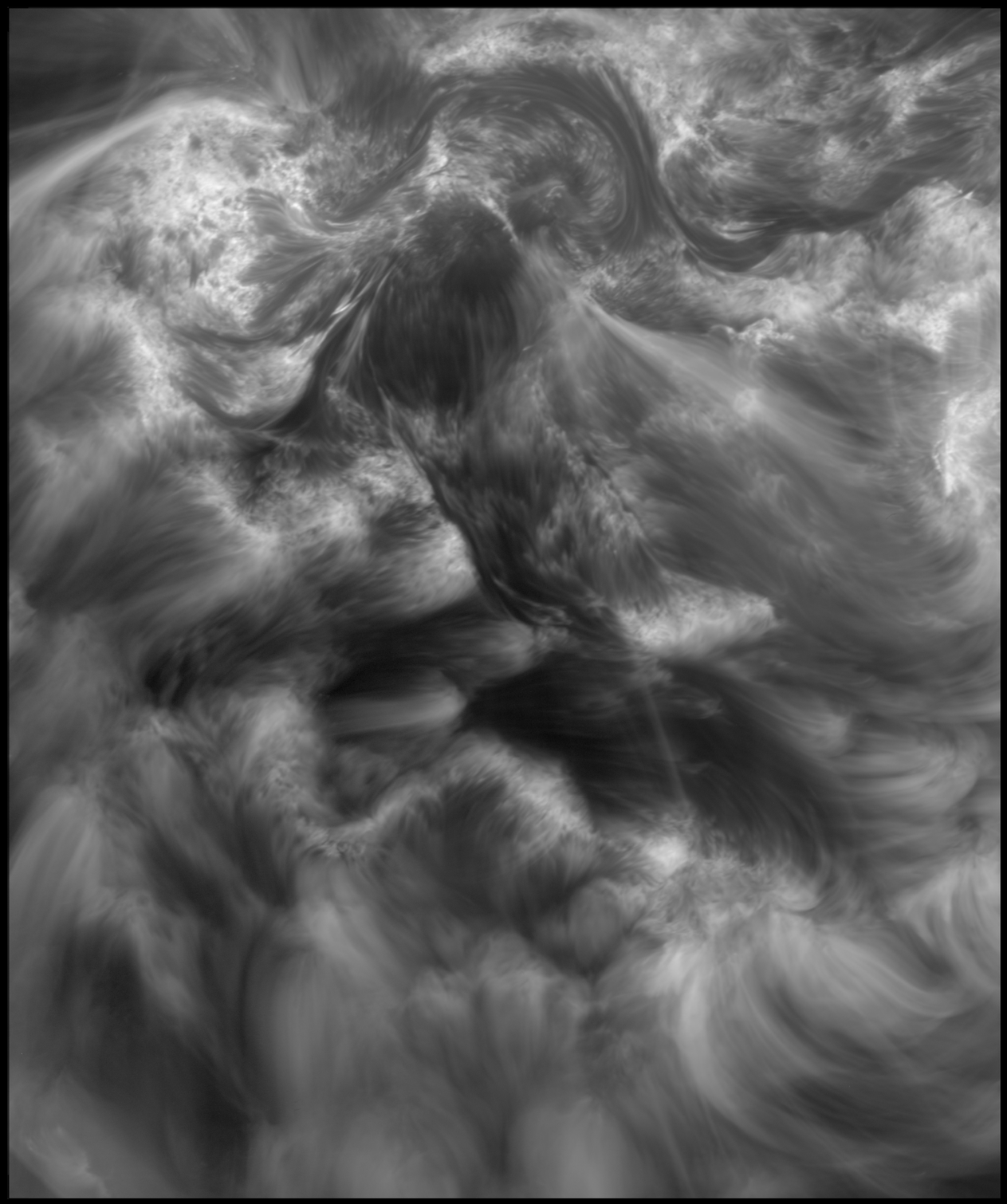
Evidence for rapid variability in certain moss elements - *Testa et al. (2013)*

Brightening's lasting for 20 s - suggestive of coronal energy deposition and conductive cooling of plasma.



Moss fine structure



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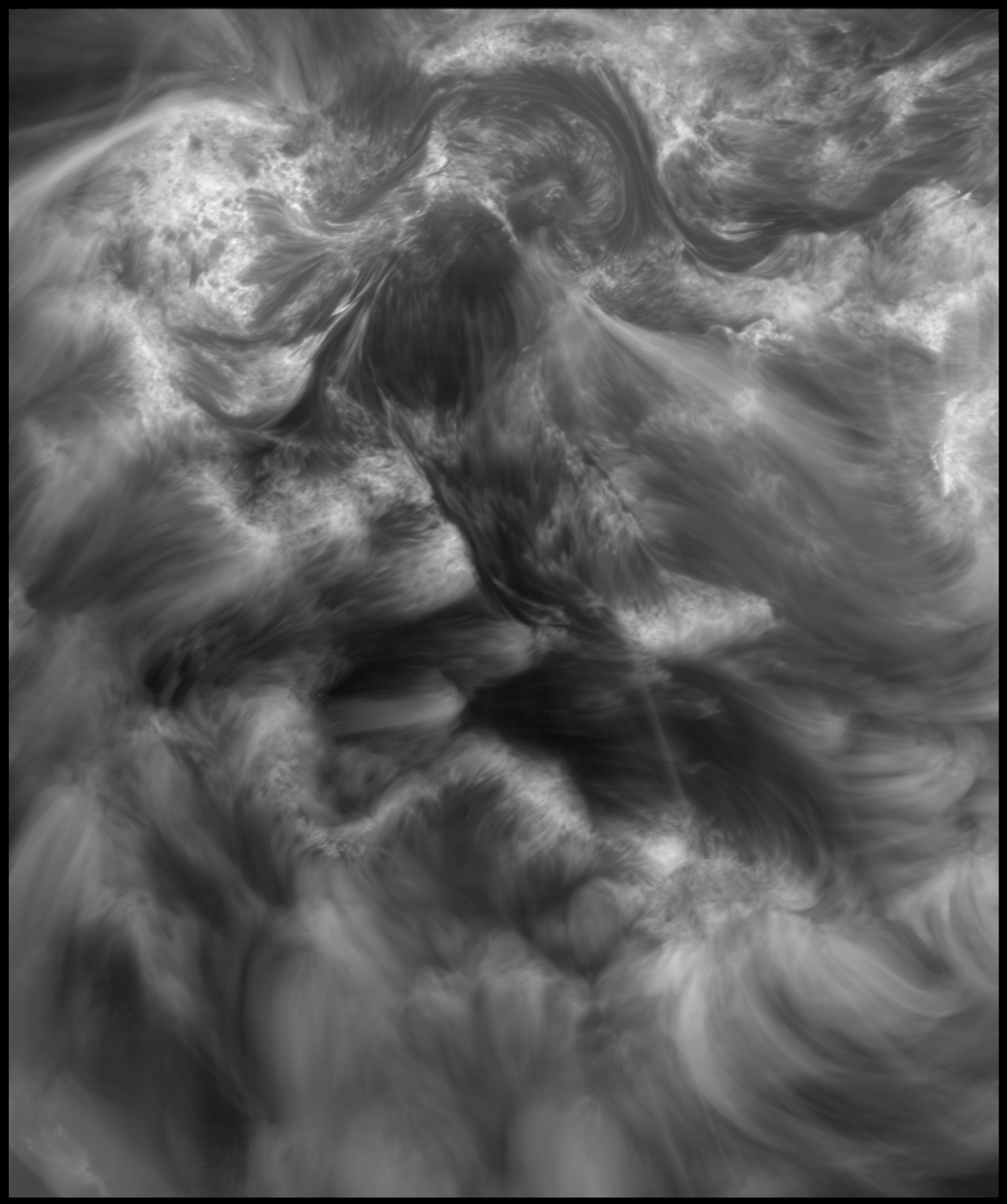

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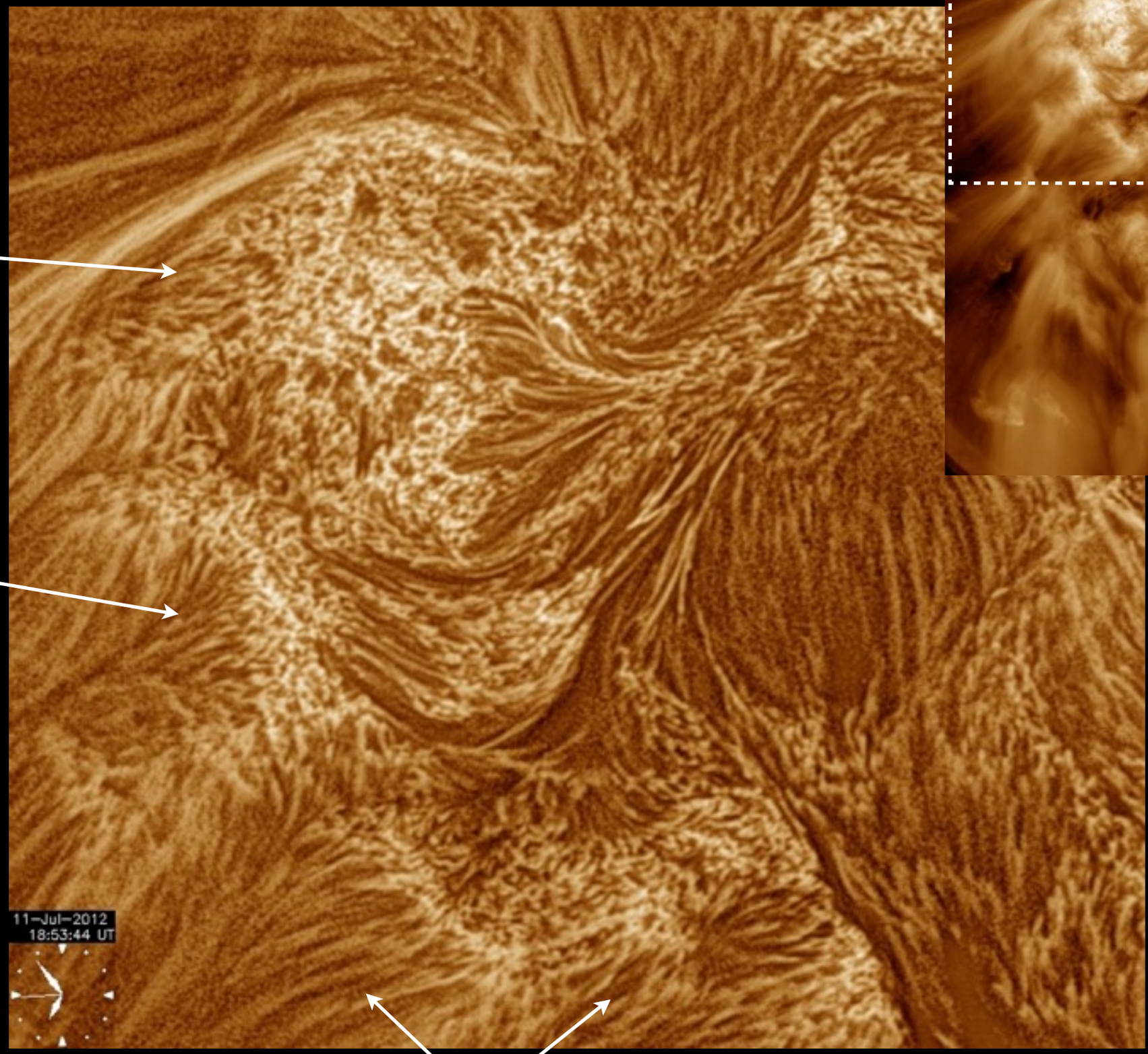

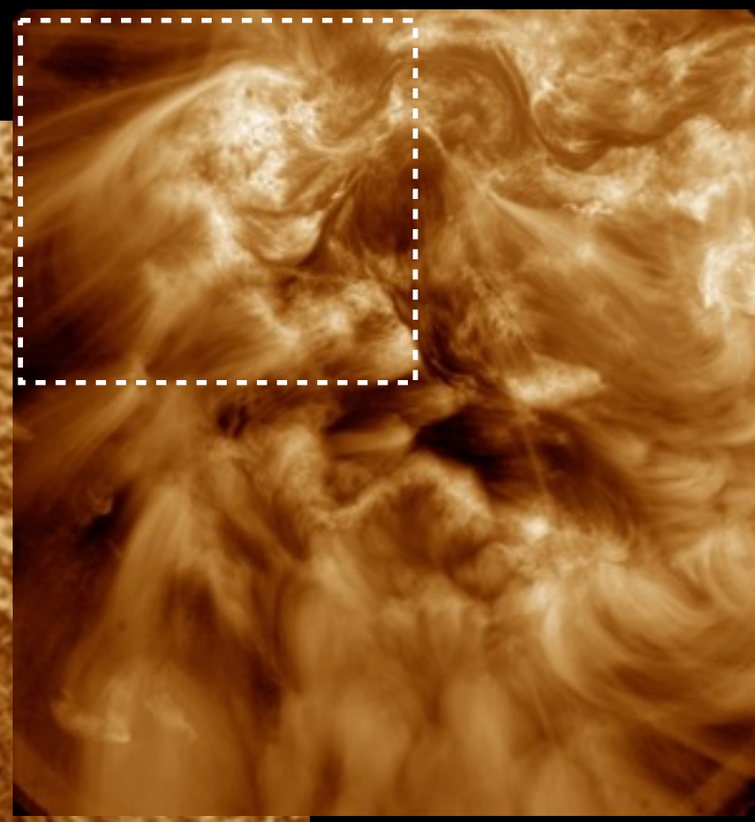

Morton & McLaughlin (2014)

Small-scale elongated & inclined structure

Inclined fields in photosphere - Katsukawa & Tsuneta (2005)

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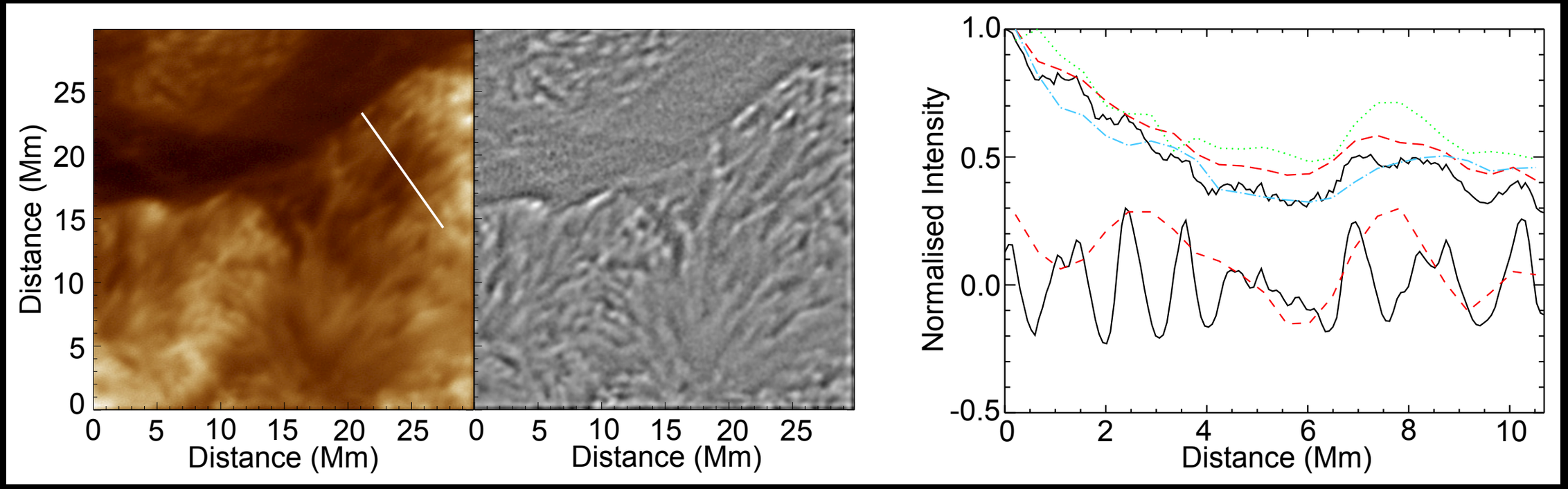

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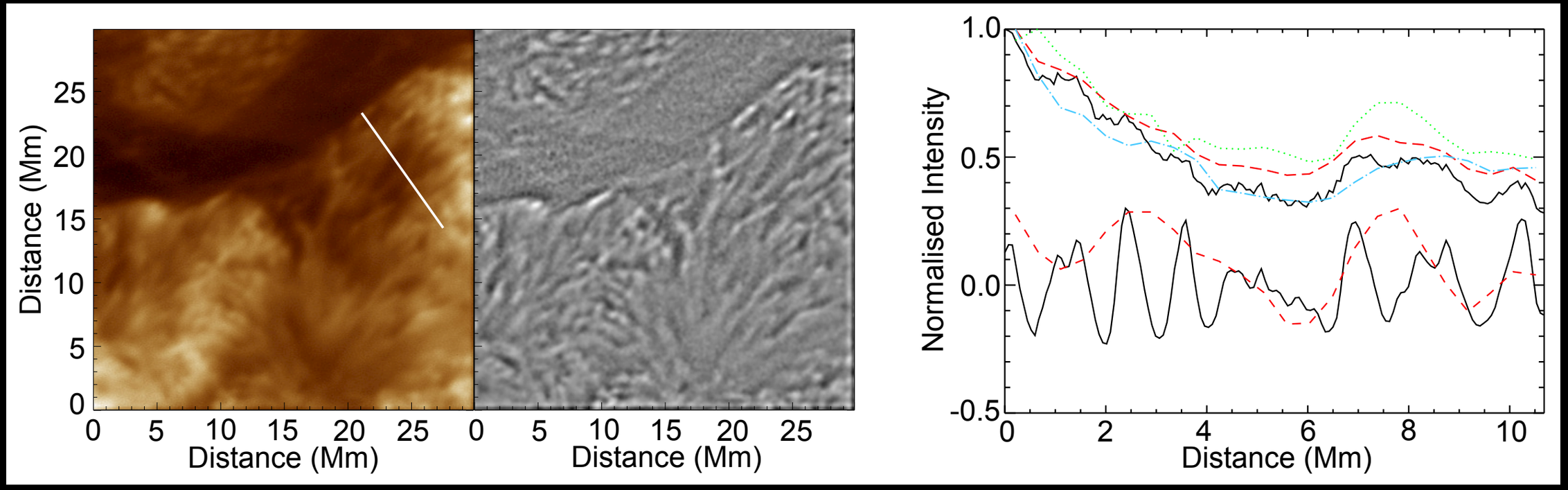
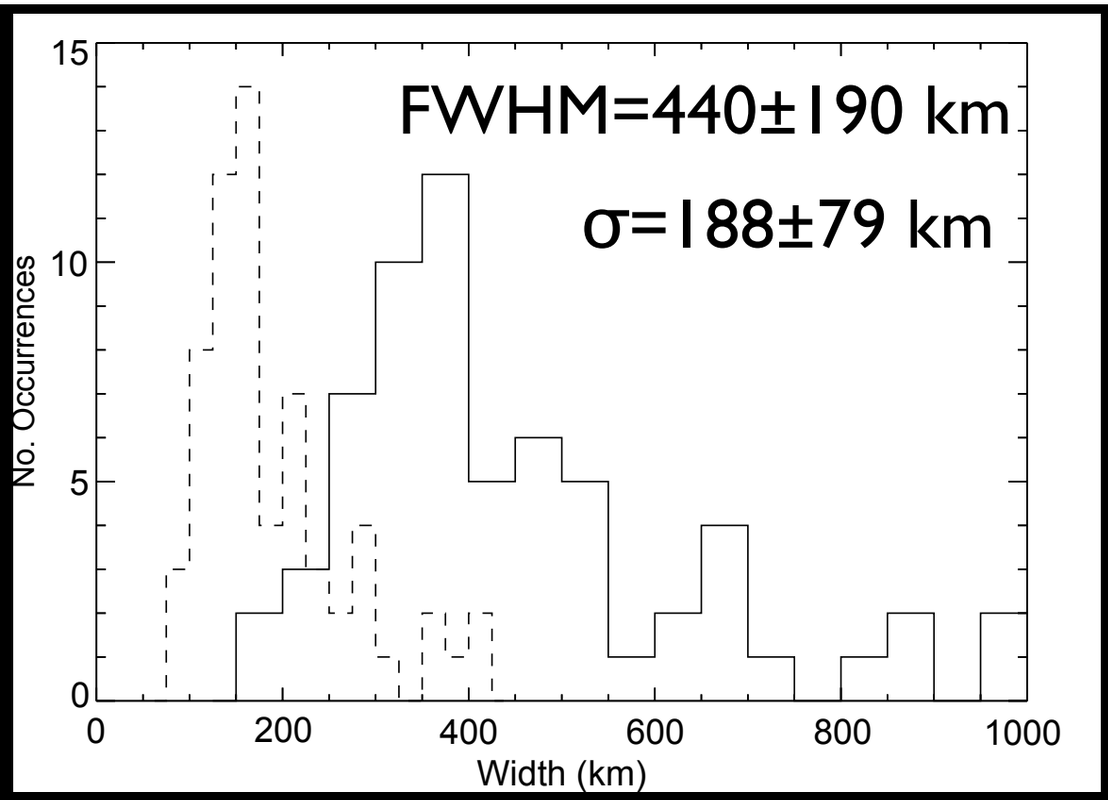
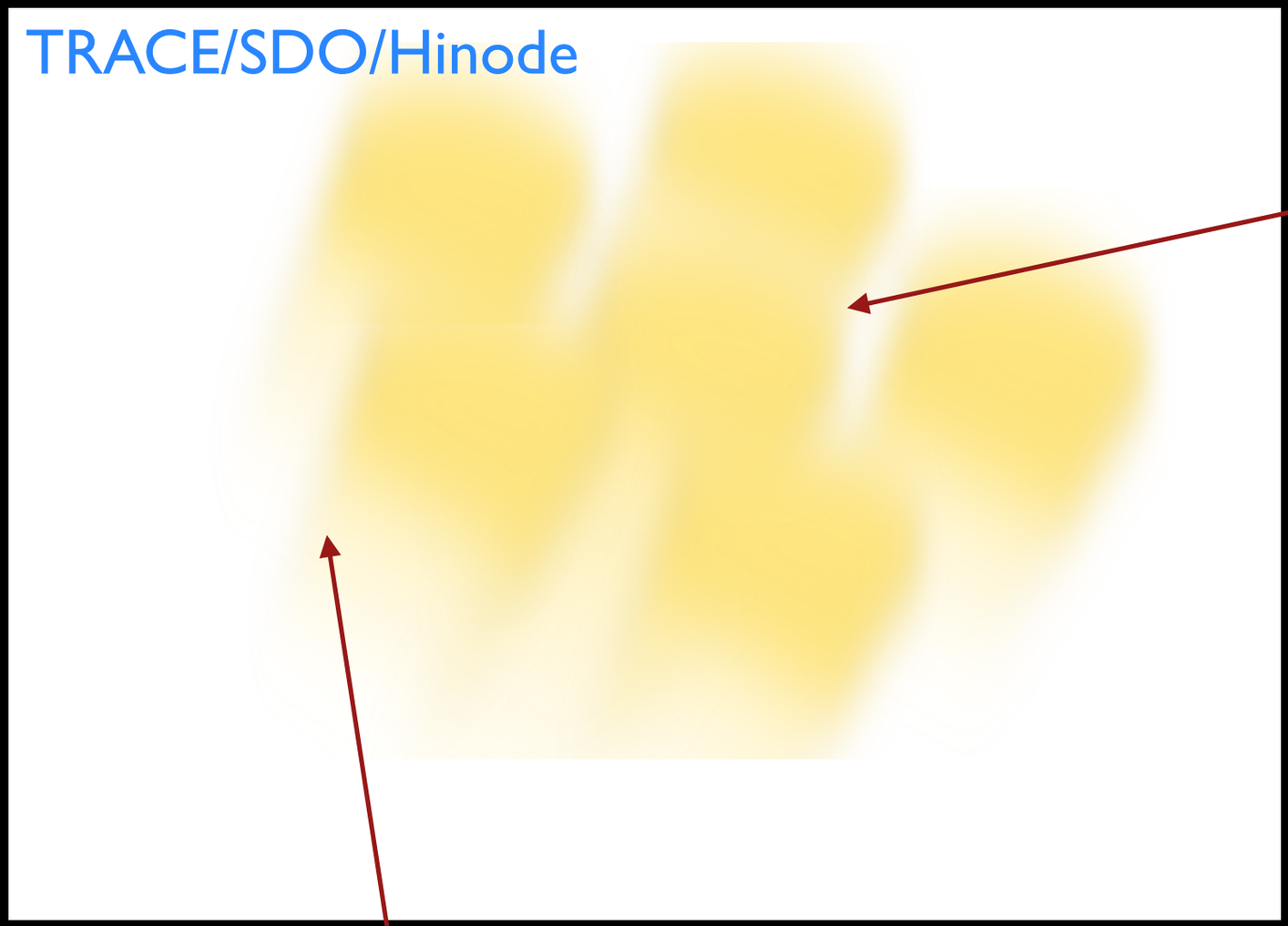




Morton & McLaughlin (2014)

Cartoon of moss fine structure



Moss

Dark inclusion or
Edge of moss region

Cartoon of moss fine structure

TRACE/SDO/Hinode

Moss

Dark inclusion or
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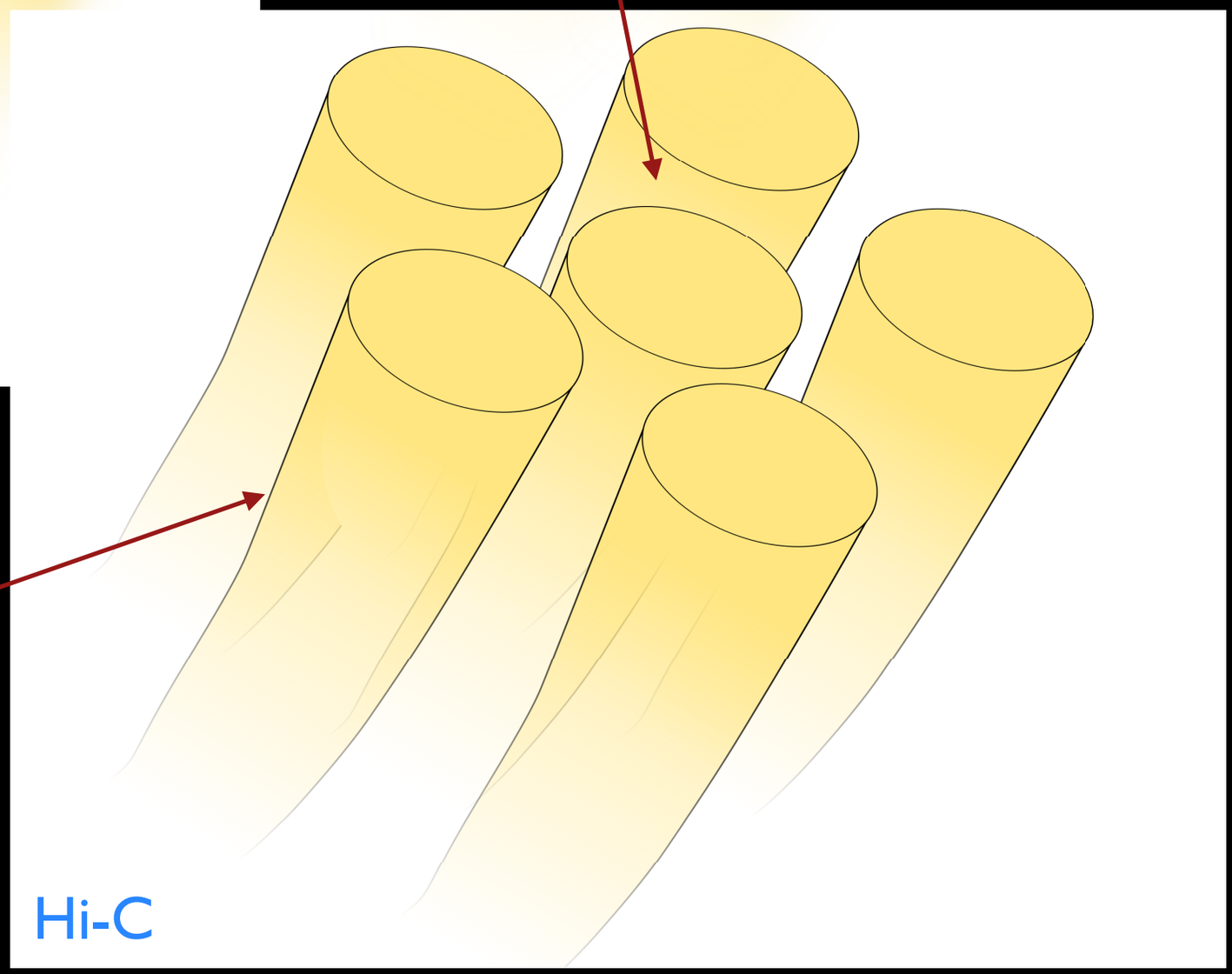
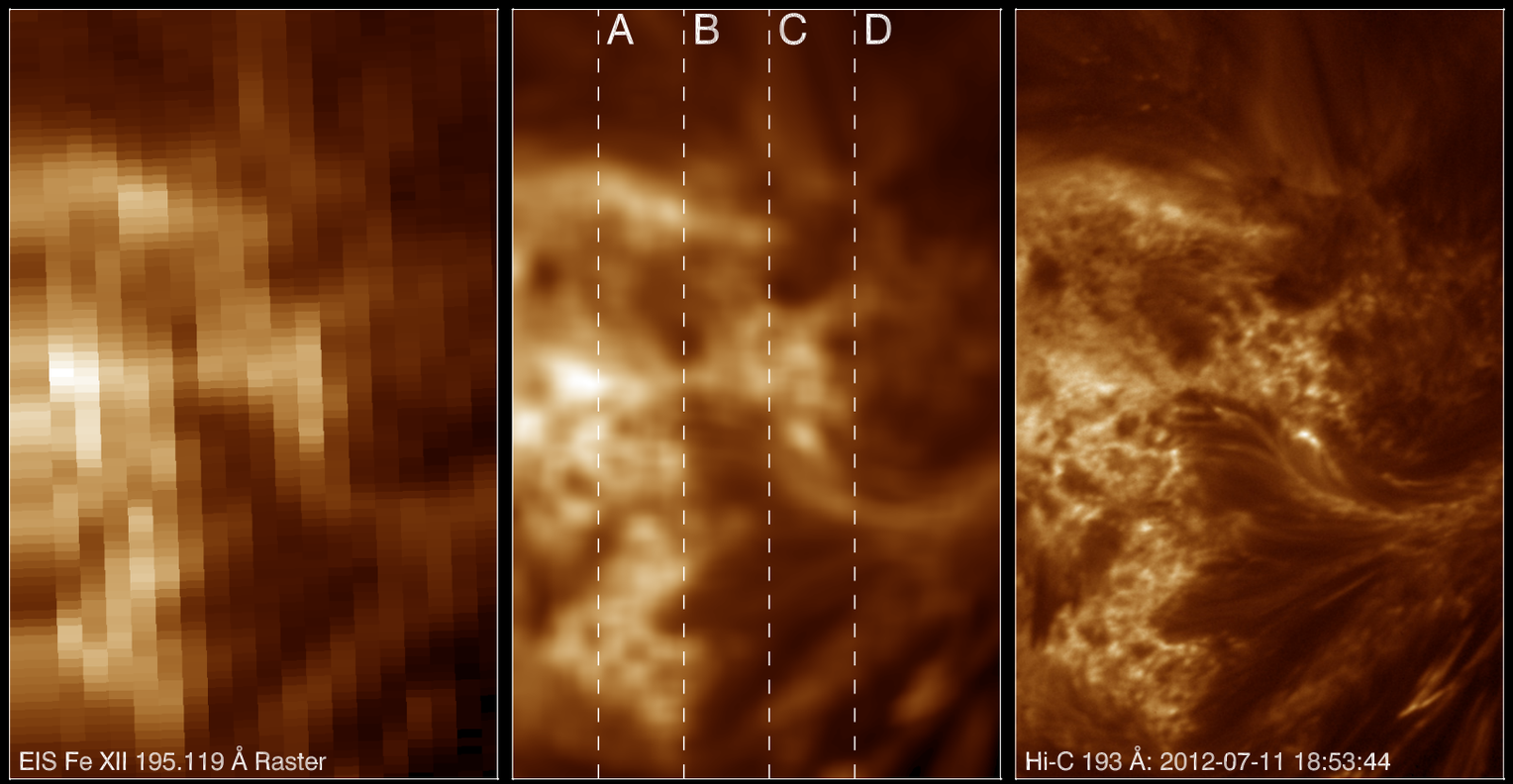


Hi-C

Filling factor comparison with Hinode/EIS



Winebarger et al., *In Prep.*

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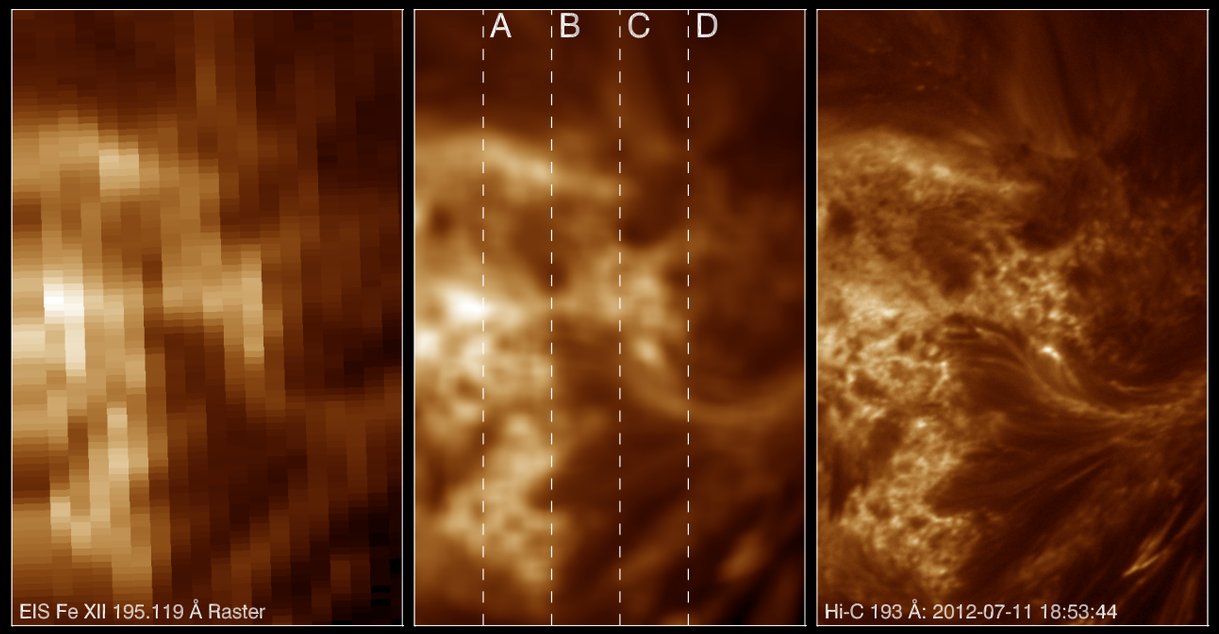

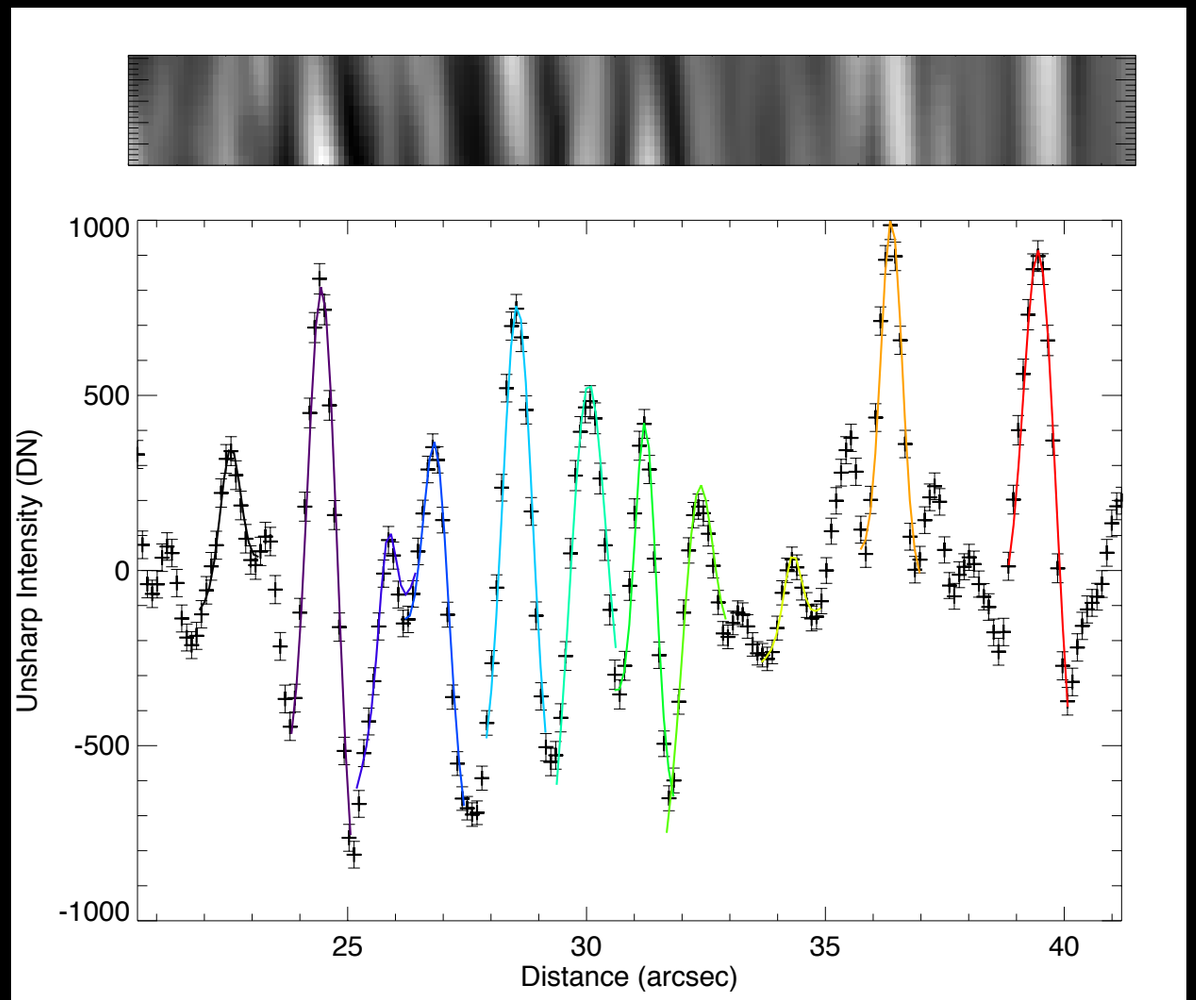

Find moss patches in both EIS & Hi-C.

Fit Gaussians to moss features in Hi-C to measure widths - calculate filling factor over 1".

EIS filling factor derived from Fe XII line ratio (Warren et al., 2008)

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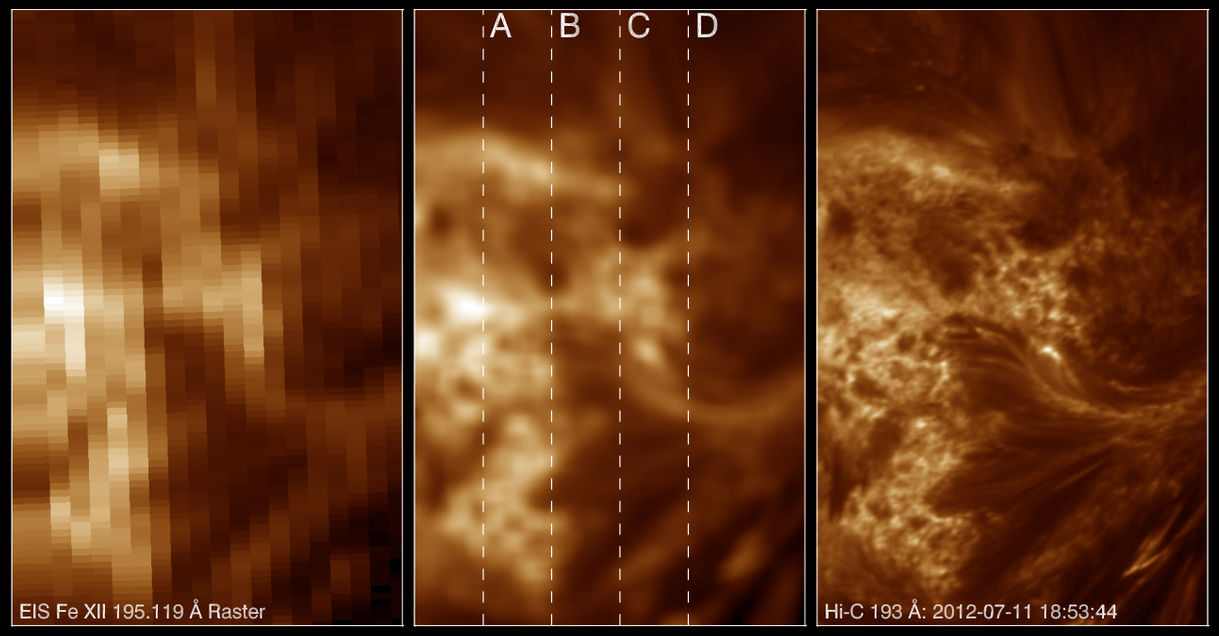

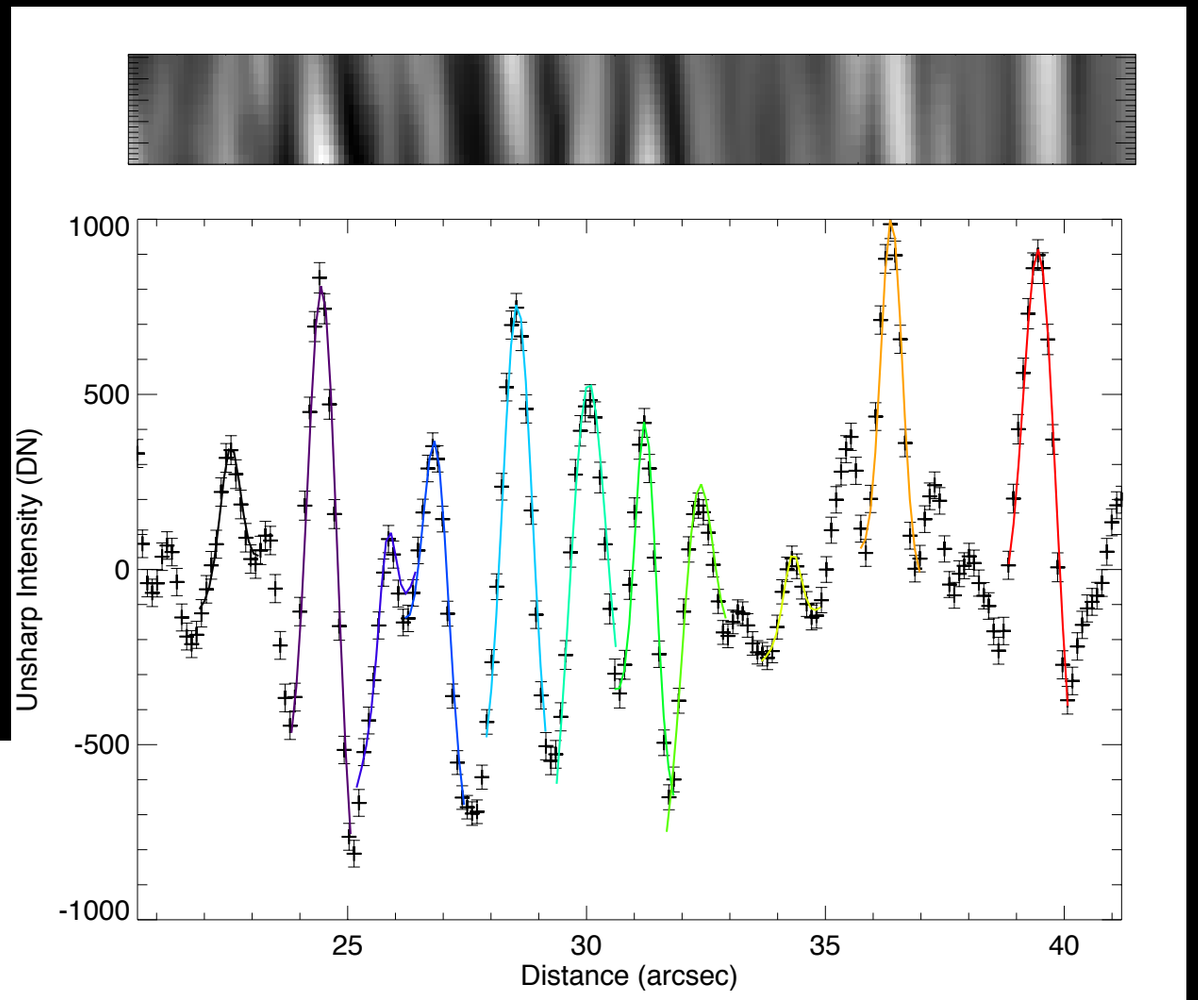

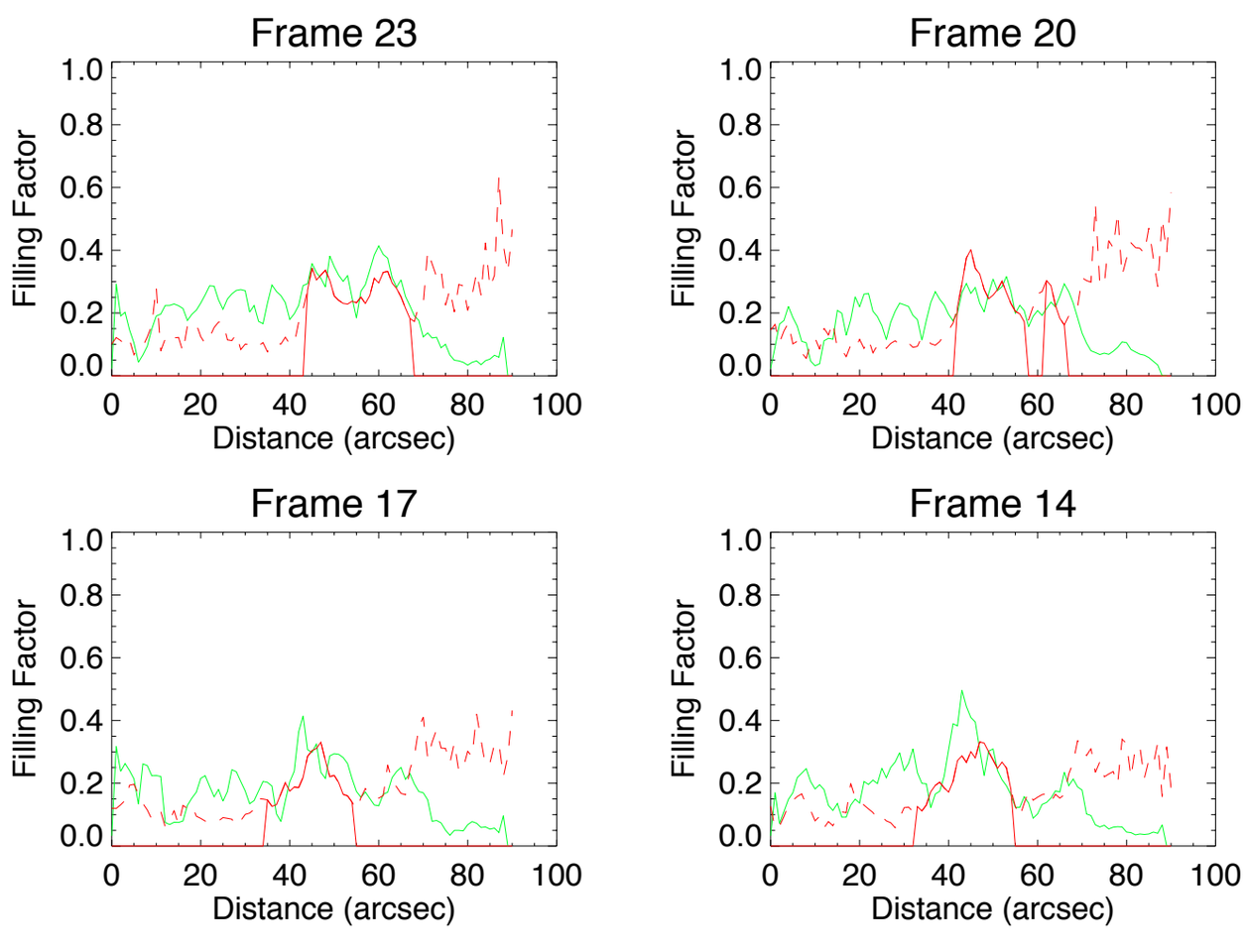

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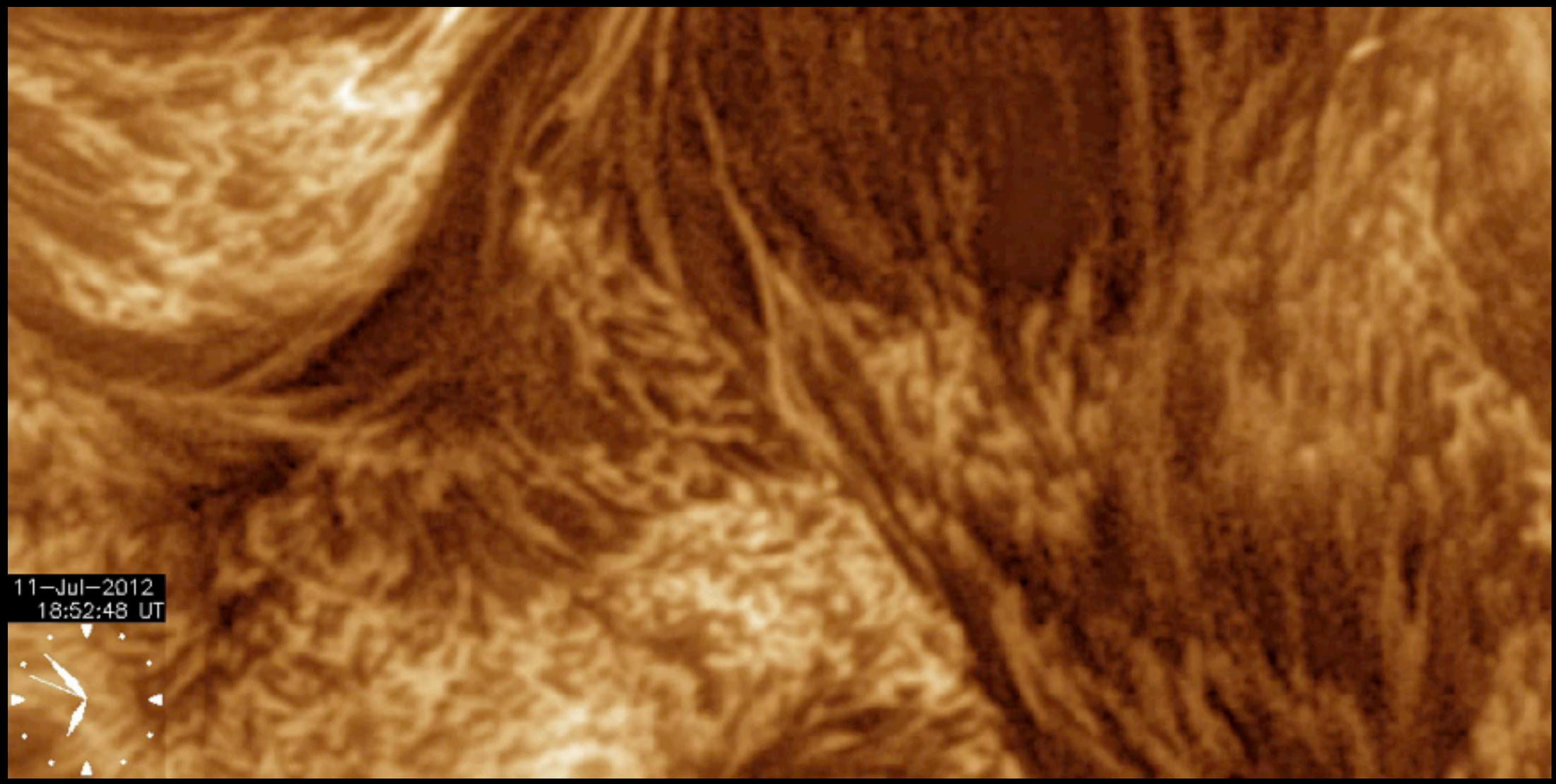

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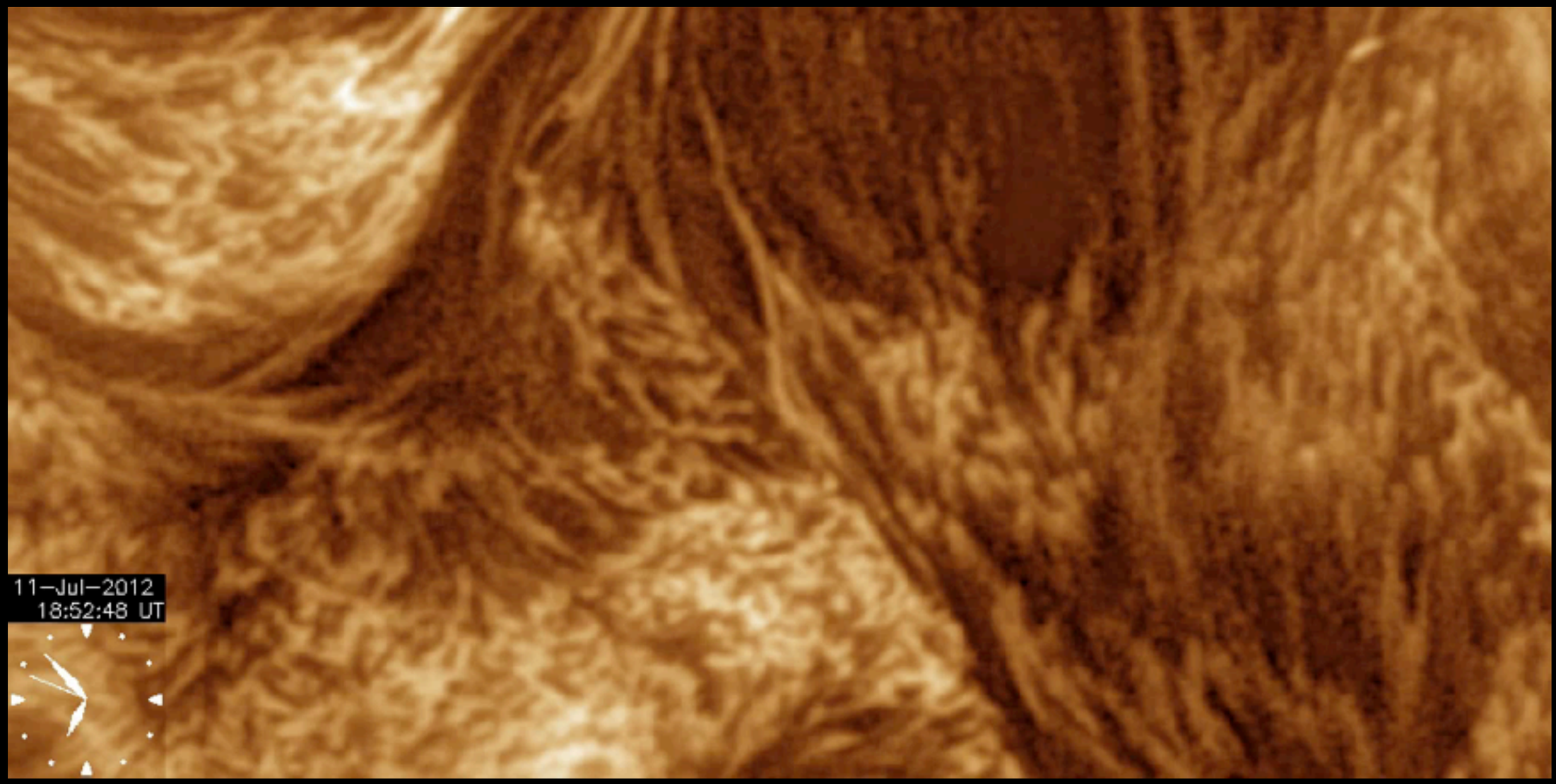

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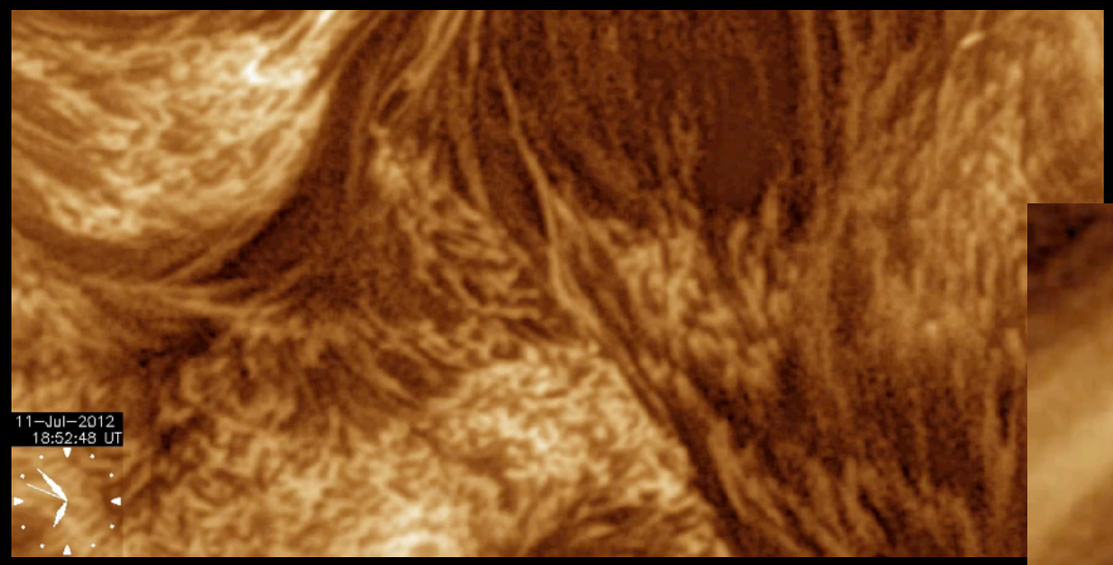
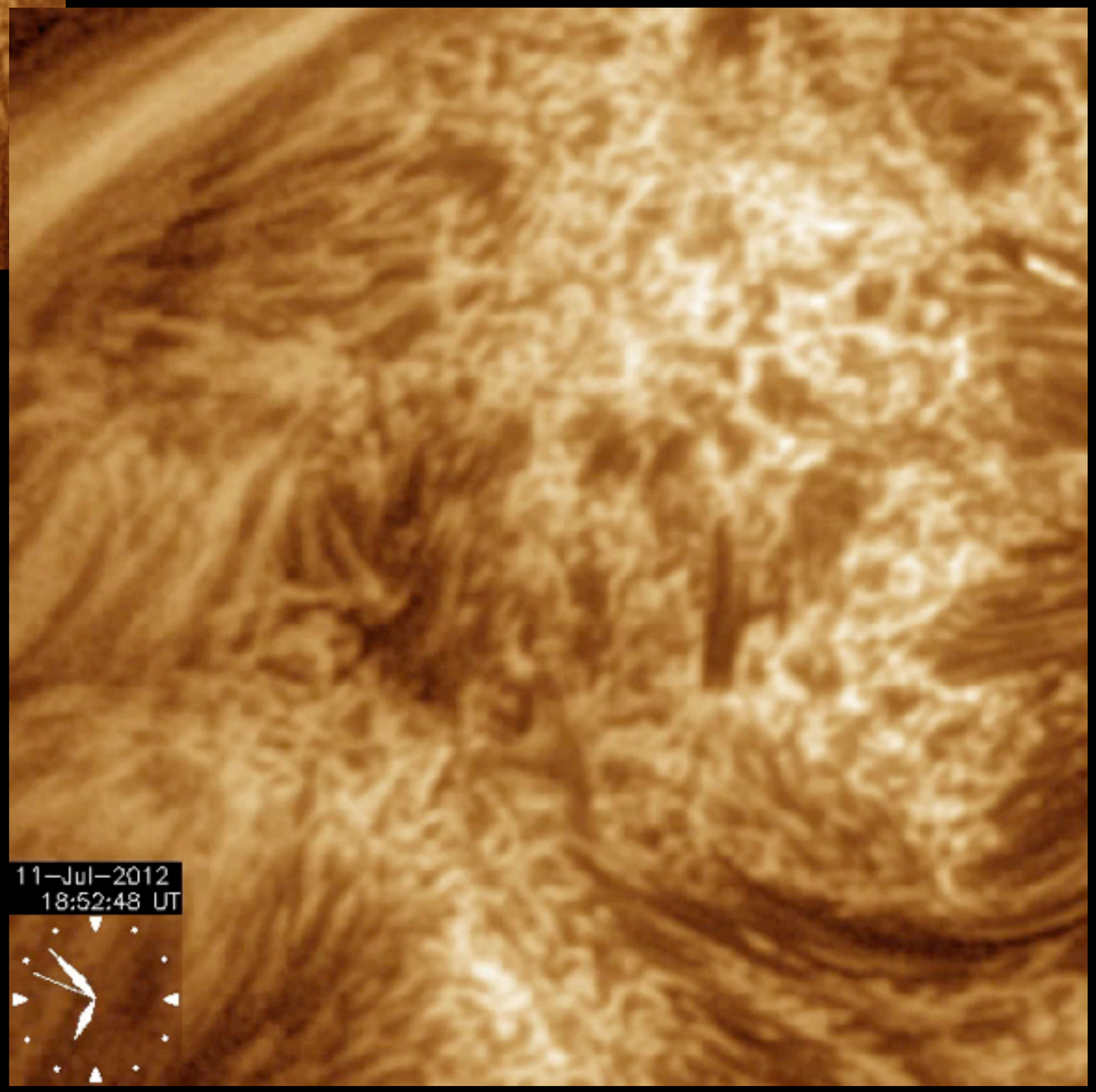
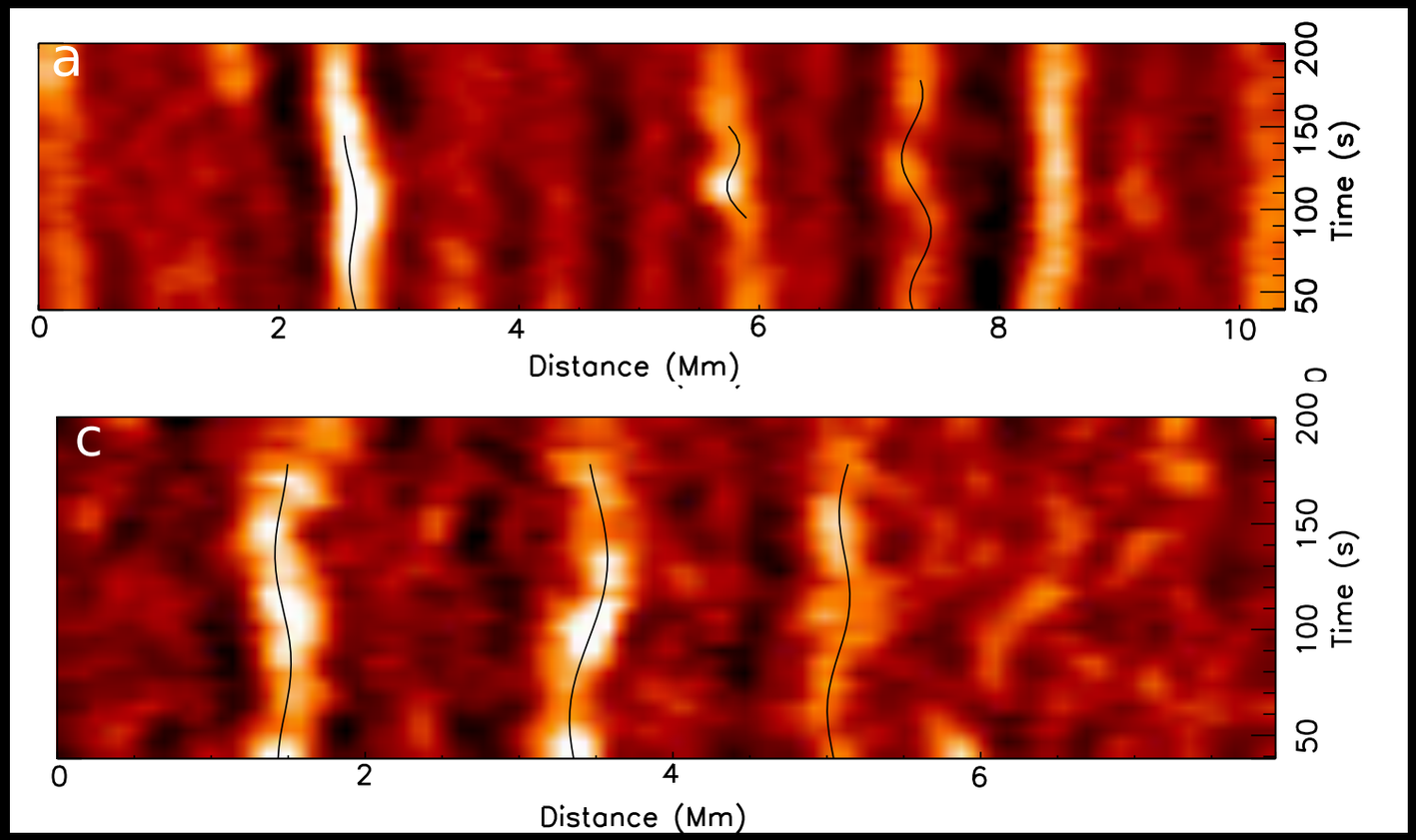




MHD kink waves



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- Weighted fit cross-sectional flux profile with a Gaussian.
- Fit Gaussian centroids with sinusoid

Morton & McLaughlin (2014)

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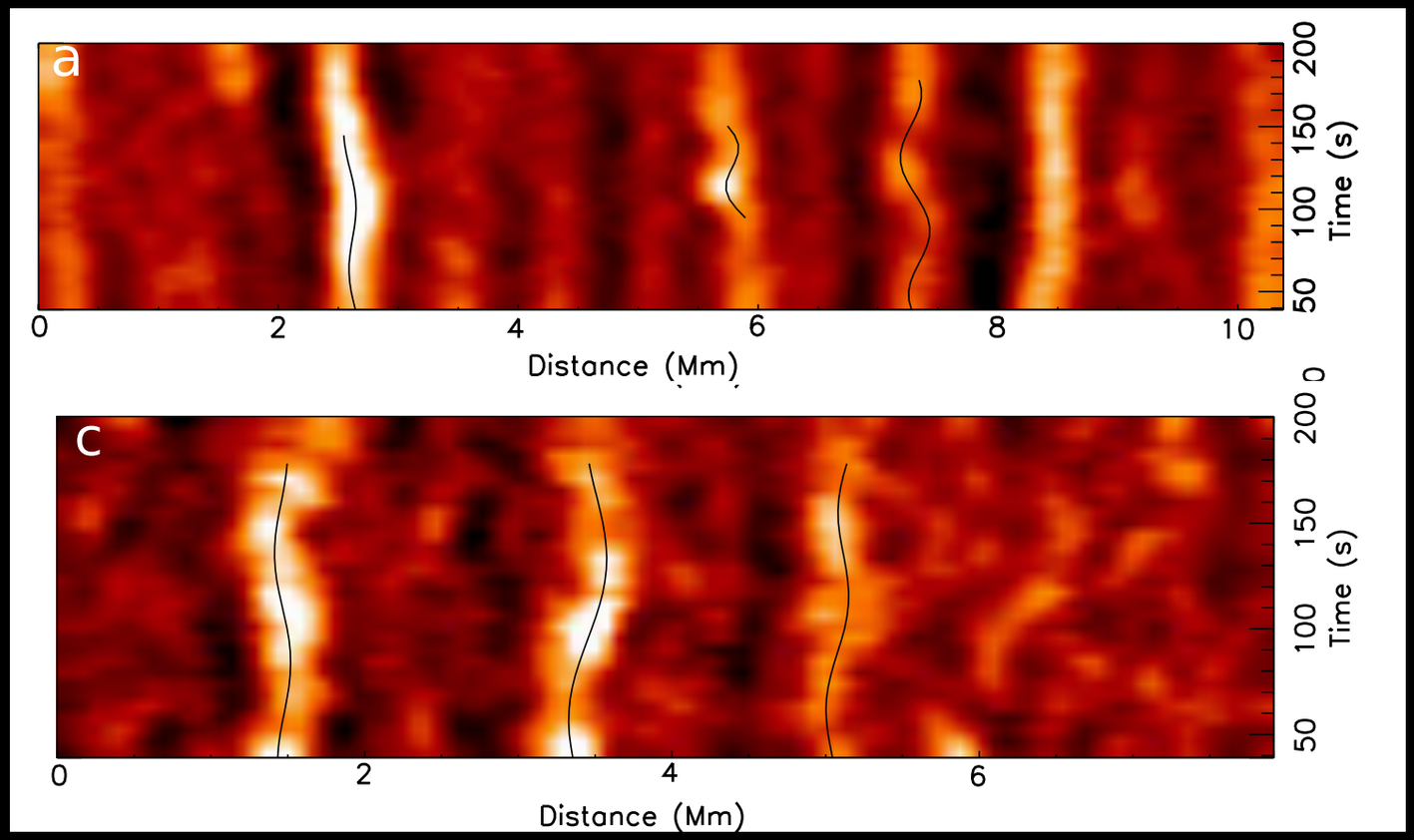

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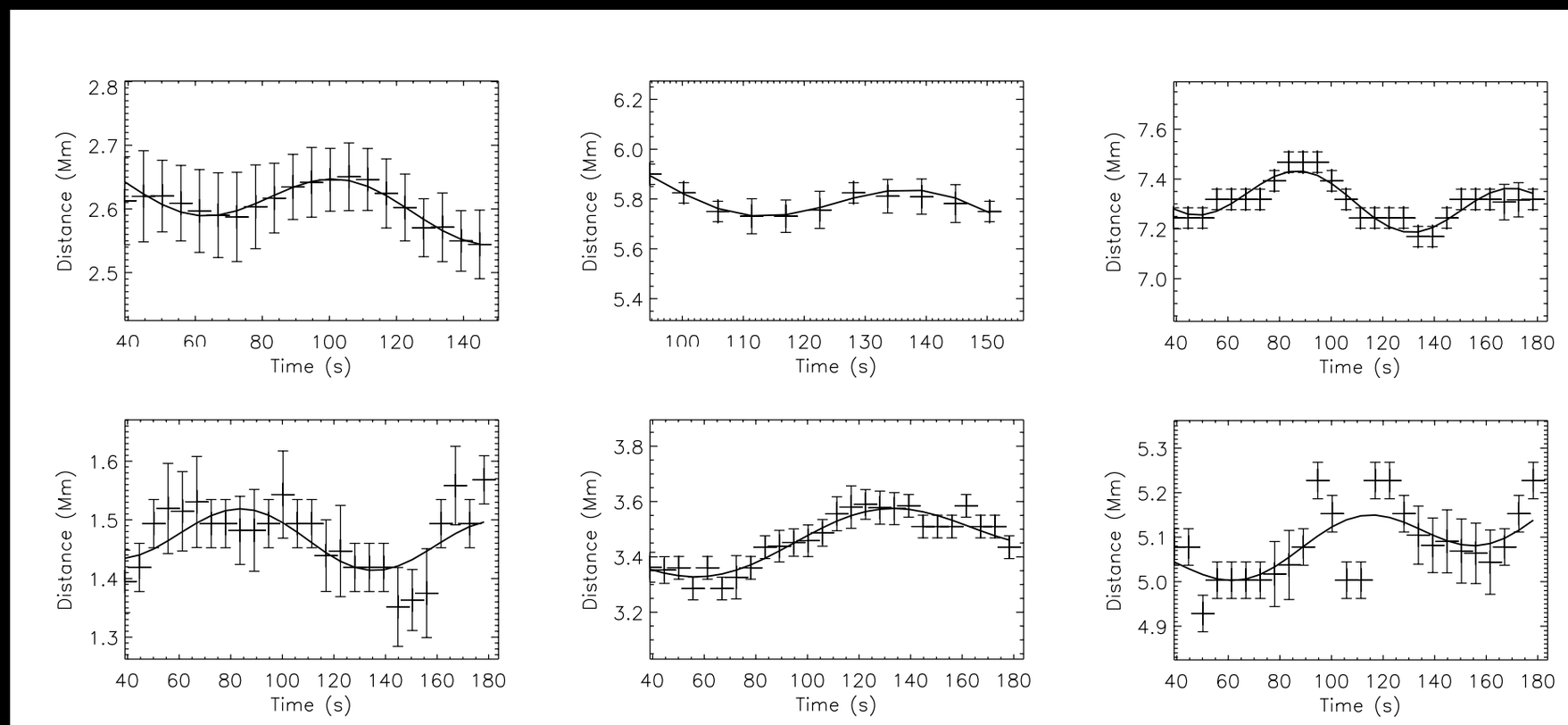

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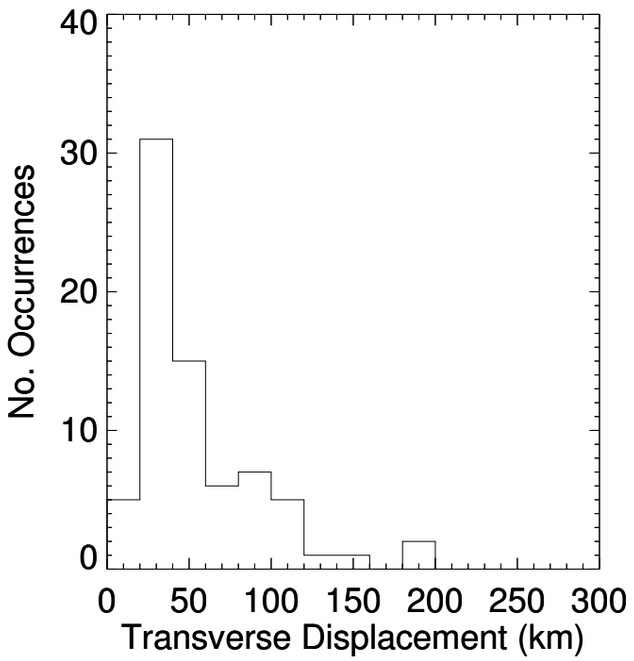

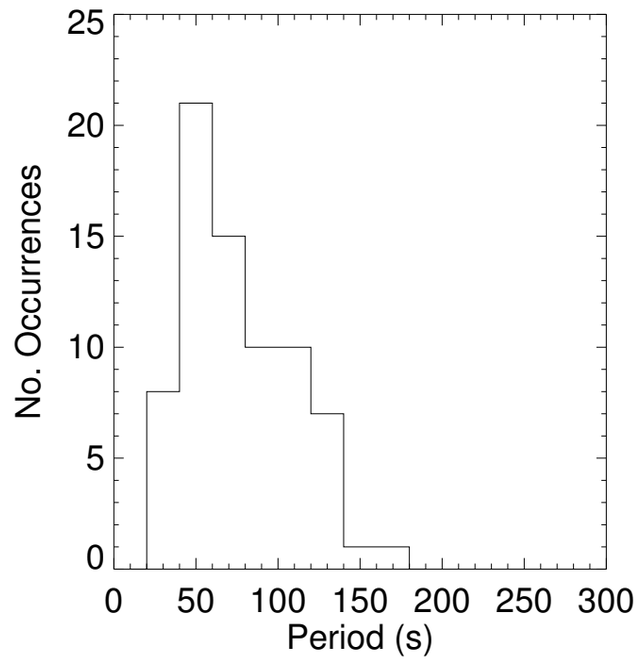

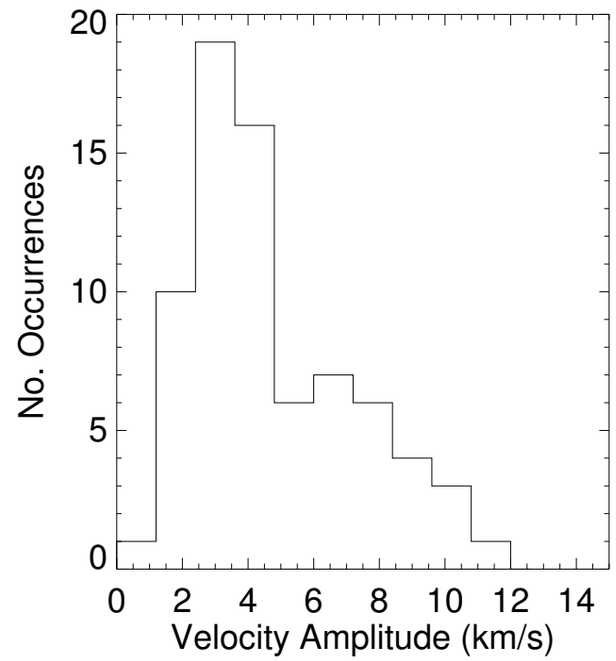

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Velocity - 4.7 ± 2.5 km/s
Period - 77 ± 33 s

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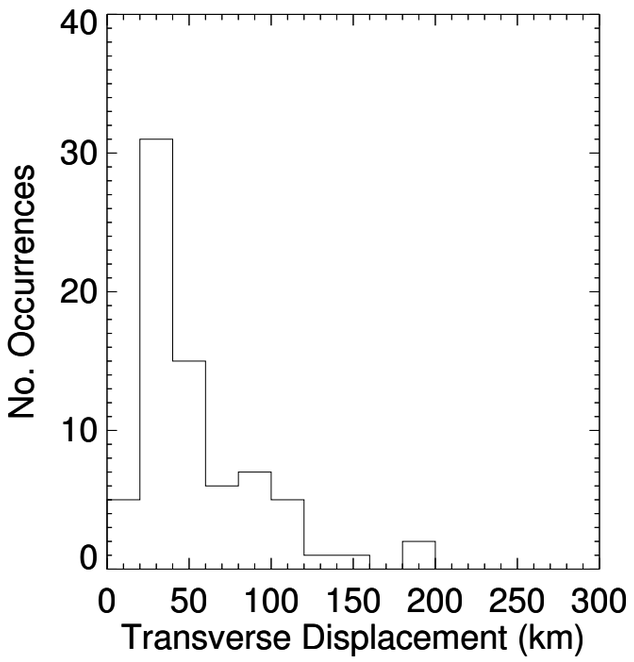

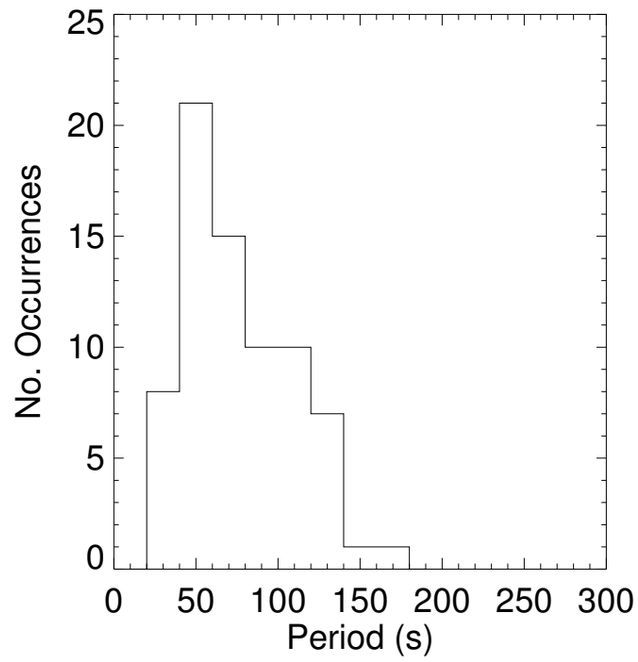

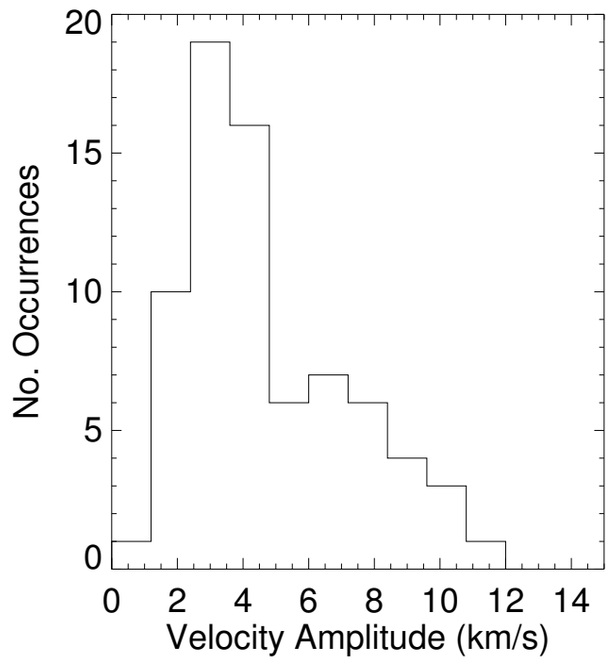

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Consistent with Doppler velocities measured by Brooks & Warren (2009), Tripathi et al (2012) $v < 6$ km/s.

Larger than those of oscillatory signal in Kitagawa et al. (2010)
$v < 1$ km/s with periods of 250-500 s.

Morton & McLaughlin (2014)

Wave energy

$$F_{\rm obs} = \frac{1}{2} f (\rho_{\rm i} + \rho_{\rm e}) \left(\frac{2\pi}{P_{\rm obs}} \right)^2 \xi_{\rm obs}^2 v_{\rm gr}.$$

van Doorsselaere et al. (2014)

n ~ 10^{10} cm^{-3} (*Tripathi et al 2010* - Fe XII)
P - 77 s
ξ - 55 km
v_{gr} - 200 km/s (*McIntosh et al.*, 2011)

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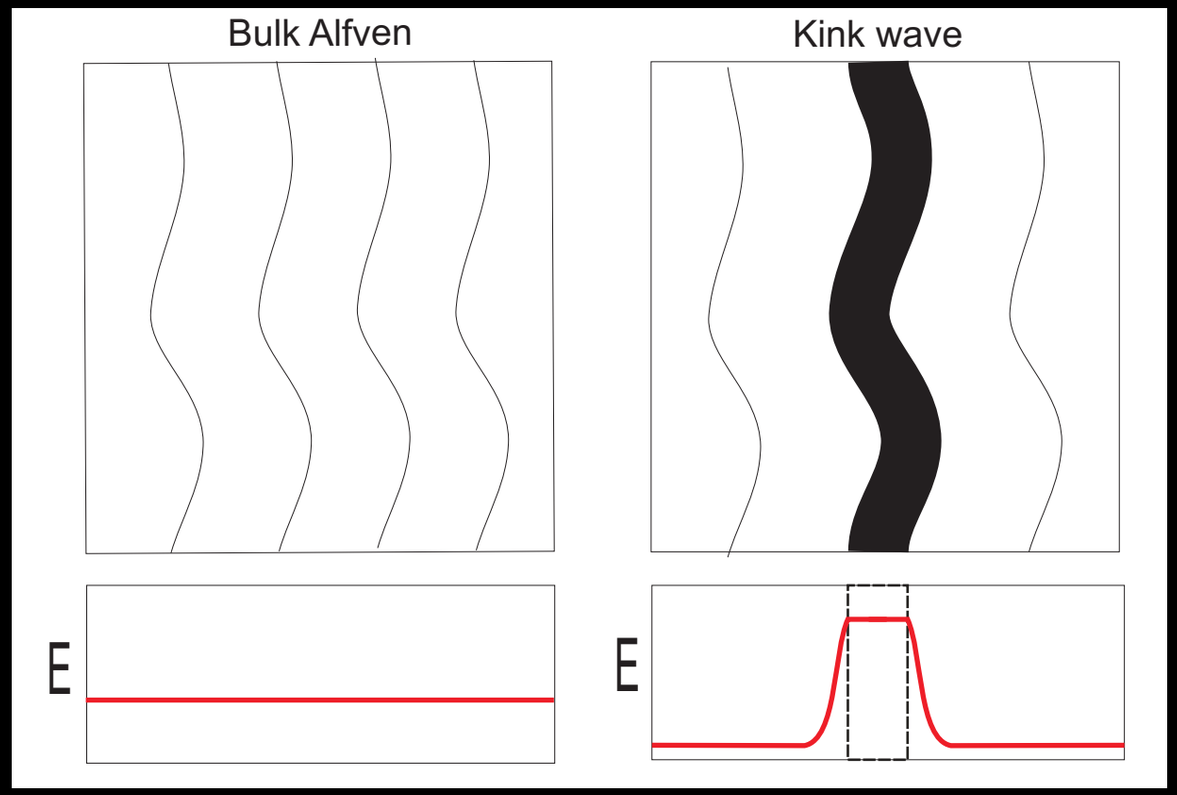
Bulk of wave energy is propagating along the density enhancement!

<u>Loop plasma only</u> - possible significant wave contribution.

<u>Heating of external plasma</u> - spatially averaged wave energy flux is too low.



Morton & McLaughlin (2014)

Conclusions

- **Hi-C revealed fine-structure of moss** - appears as a collection of inclined flux tubes?

- **Typical transverse scale of moss ~400 km** - similar to EUV loops (Brooks et al., 2013).

- **Motions of moss reveal presence of MHD kink waves** - (v~ 4 km/s) that could contribute to heating of hot loops - **a quasi-static component?**

Hi-C has clarified details of the moss and it's dynamics obtained from previous Hinode/EIS observations of moss.