

LOFAR Family Meeting 2023

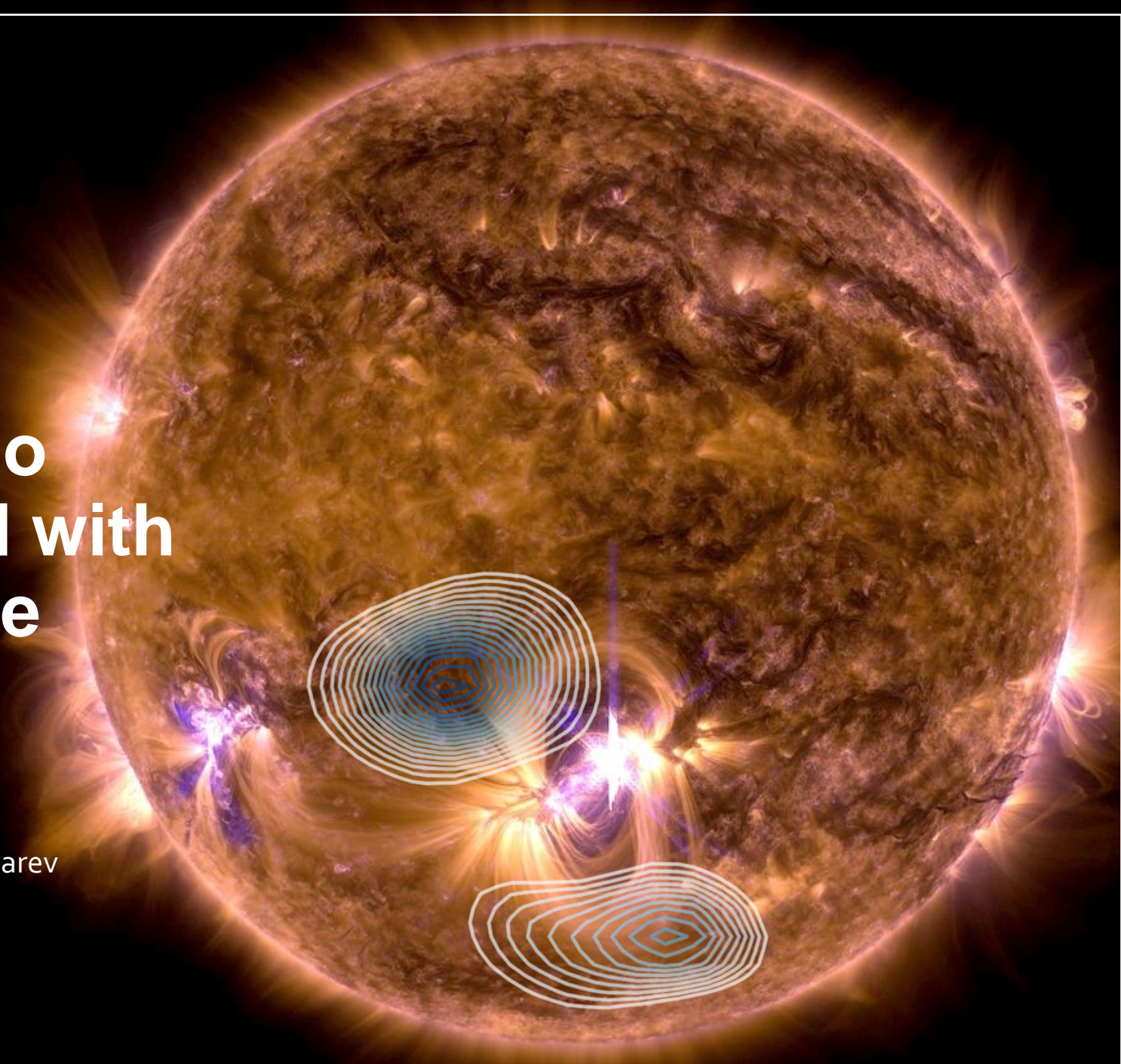
Low Frequency Radio Emission associated with a CME and EUV Wave

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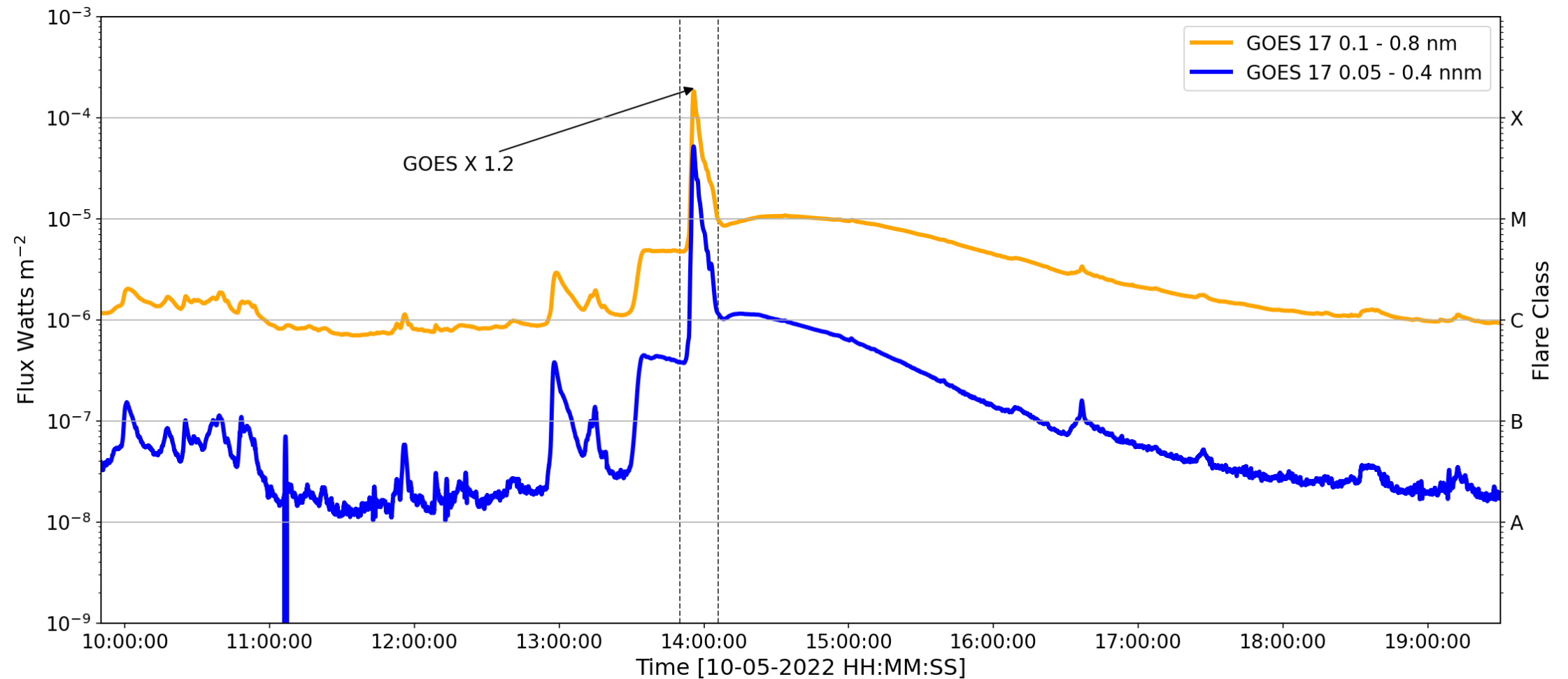
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DIAS
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 ARMAGH
OBSERVATORY &
PLANETARIUM



May 10th 2022 X-Class Flare

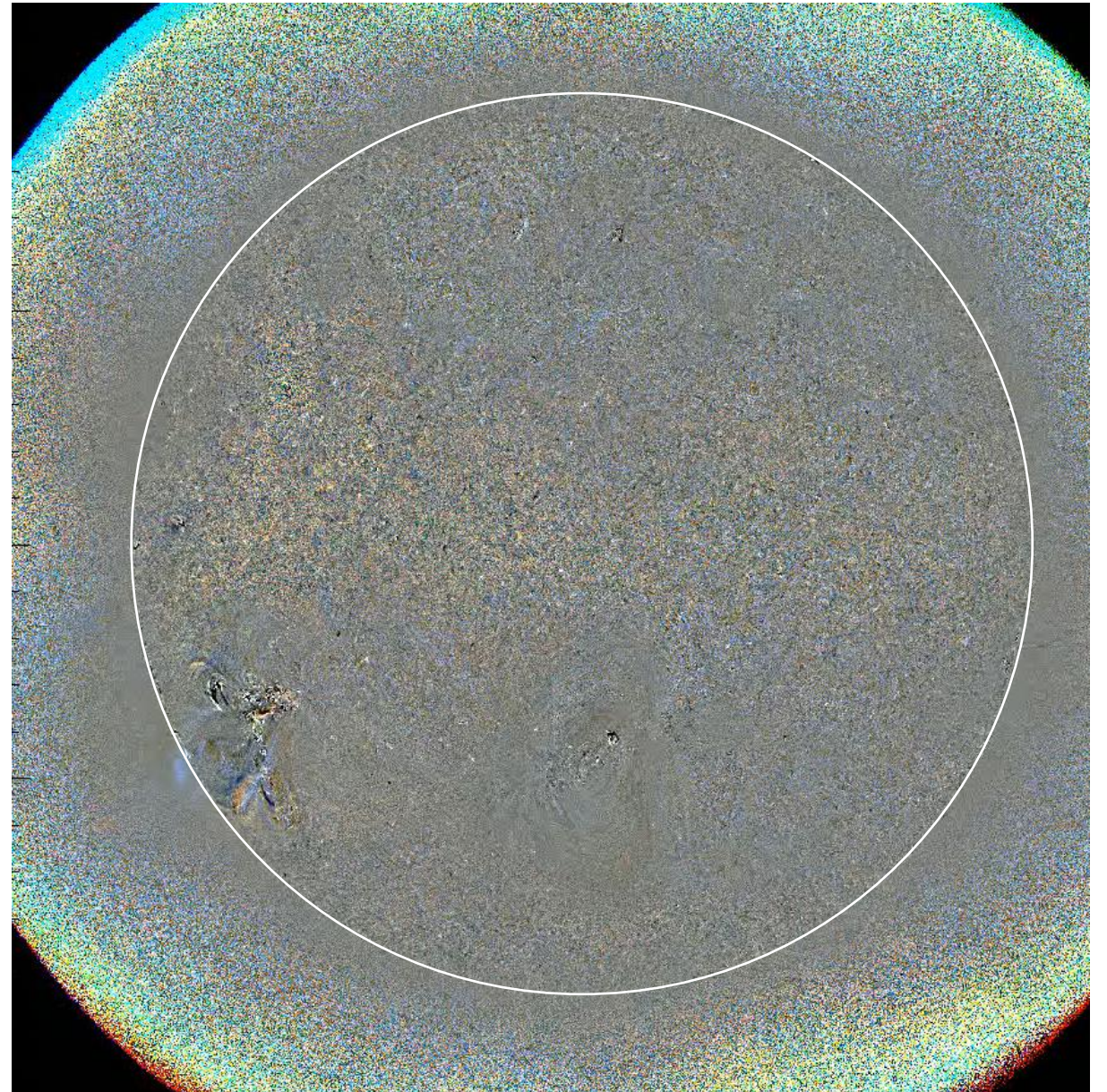


May 10th 2022 X-Class Flare

- AIA 171 Å Imaging
- SDO
- Cycles through filters every 11 seconds

EUV Wave

- AIA 171, 193, 211 Å
- Running Difference Imaging
- Large scale wavelike disturbance propagating in corona
- Compression and heating of plasma in low corona
- Move outward from eruptive active regions
- 'Footprint' of CME shock

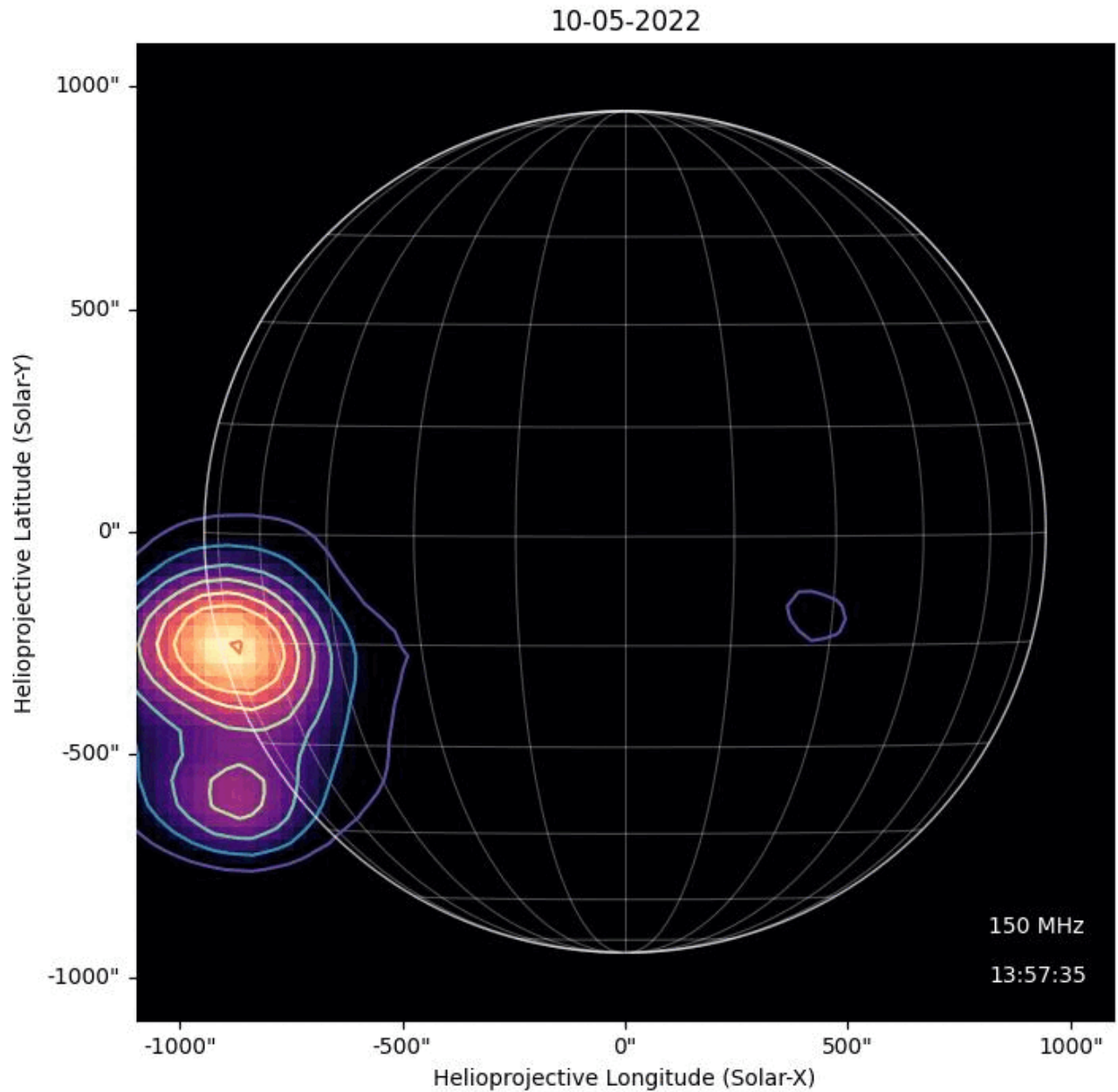


NRH Imaging

Nançay Radio Heliograph

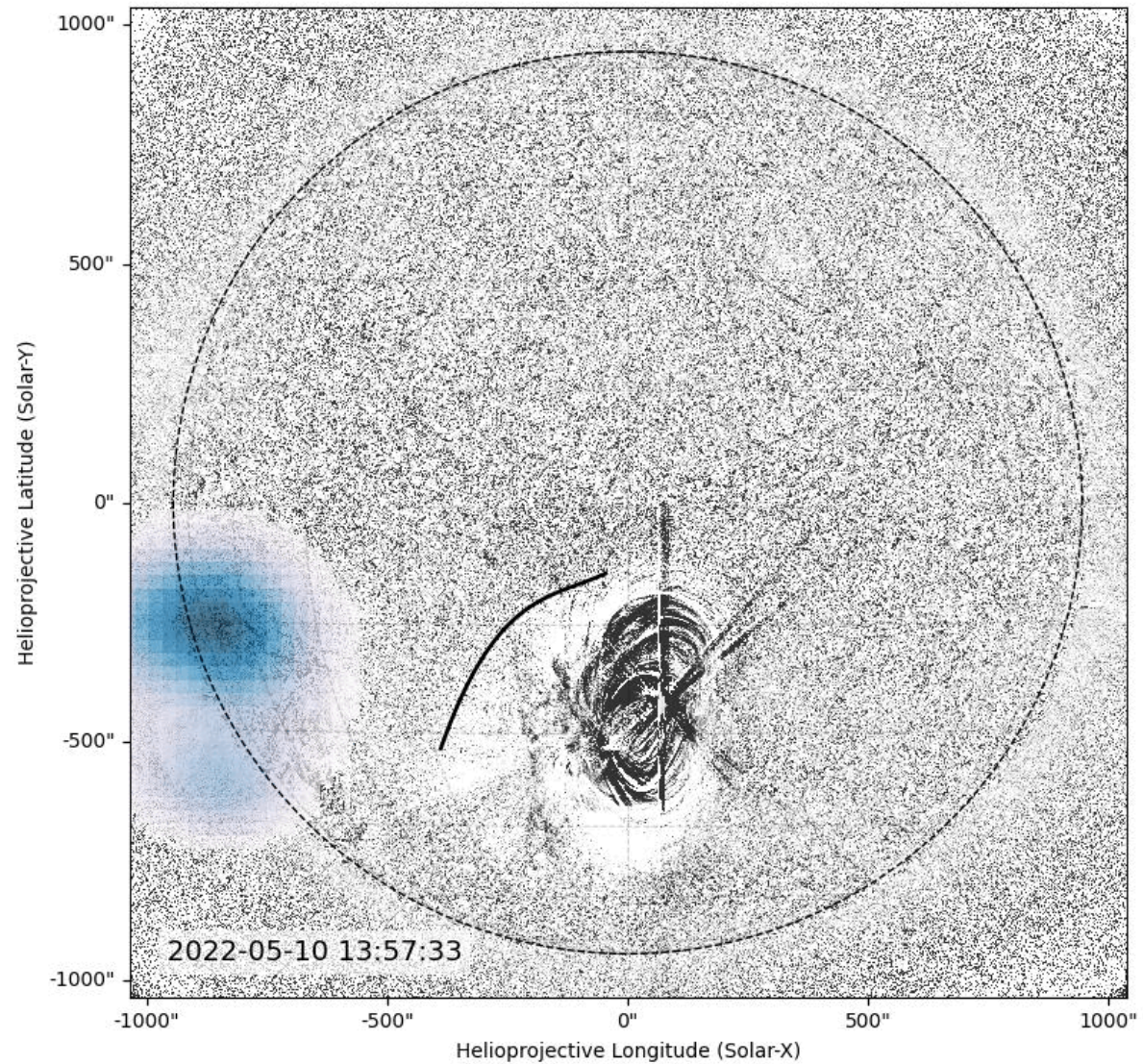
150 MHz

Images every 10s



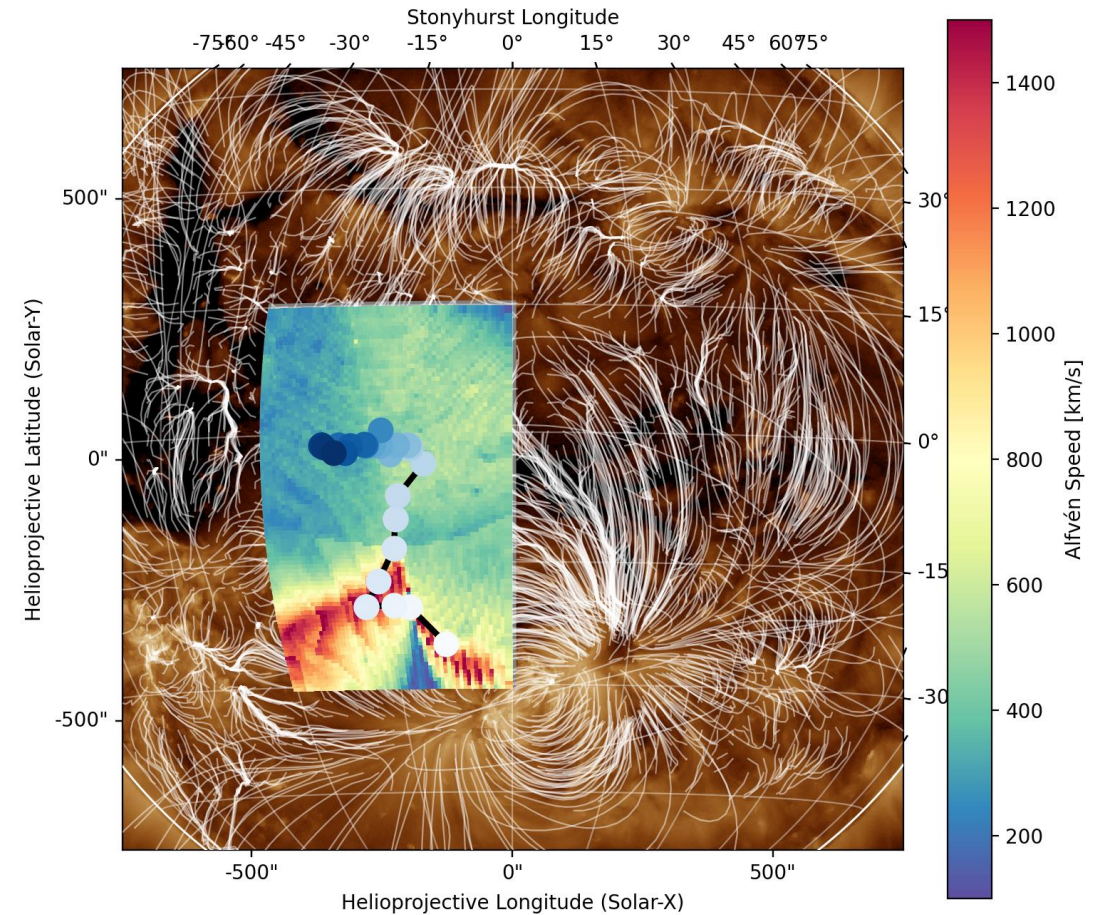
Combining Data

- Radio Emission and EUV wave follow same path



Correlating Radio and EUV Emission

- Measure velocity of wave and emission
 - Alfven Mach number estimations of radio emission
 - Differential Emission Maps - Temperature
 - Potential Field Source Surface extrapolations – B-field
- =
- Density maps



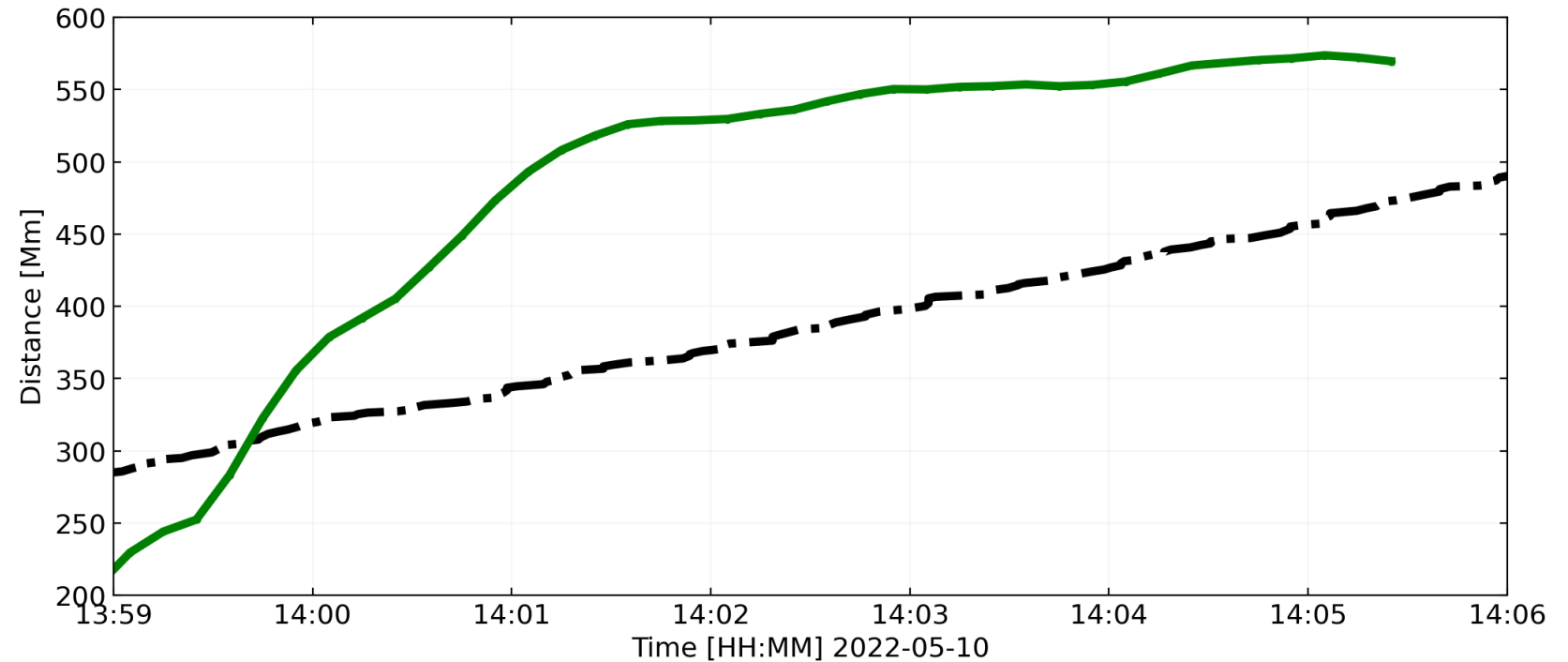
Results

- EUV Wave Speed:

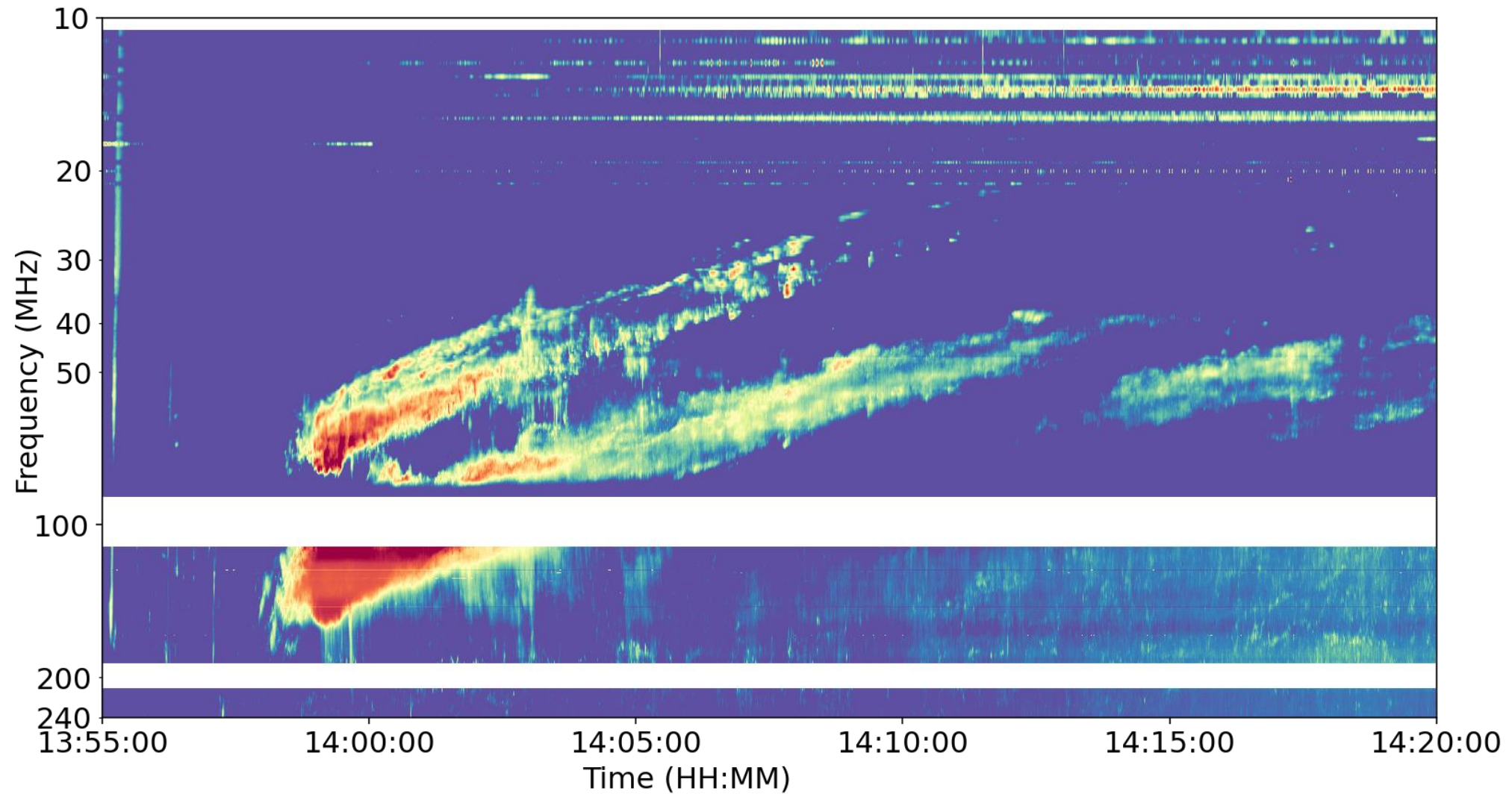
- Initial ~1500 km/s
- Slows to ~900 km/s

- Radio Imaging 150 MHz Speed:

- Initial >1500 km/s
- Slows to 500km/s



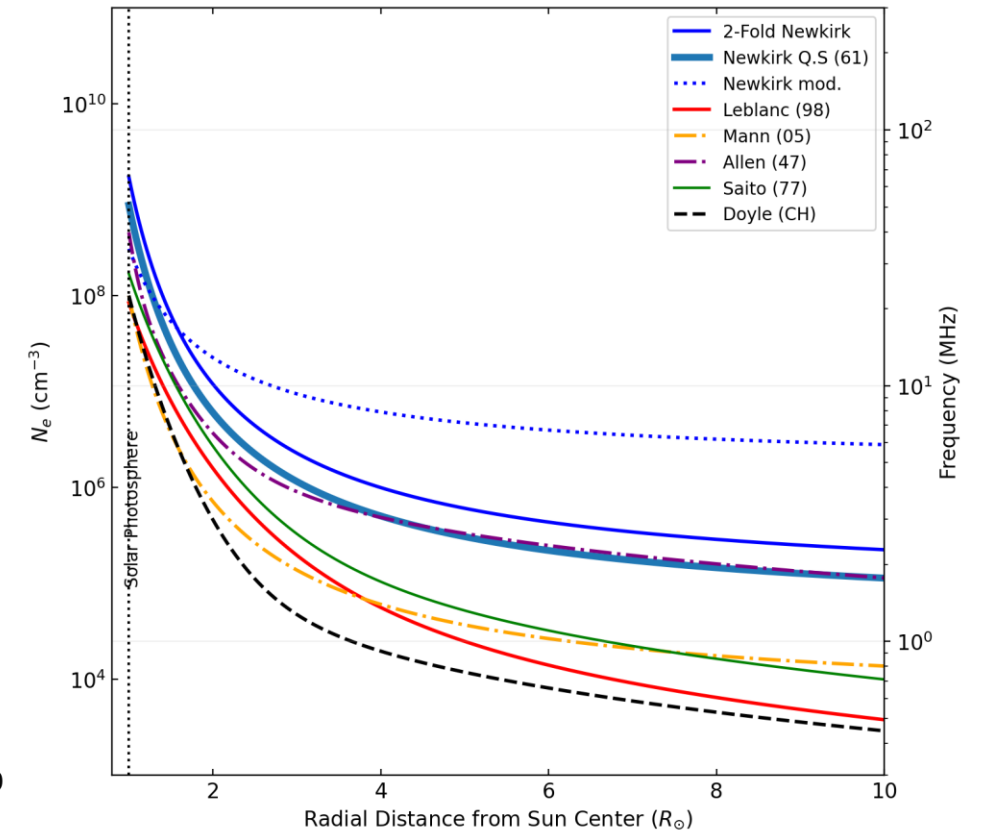
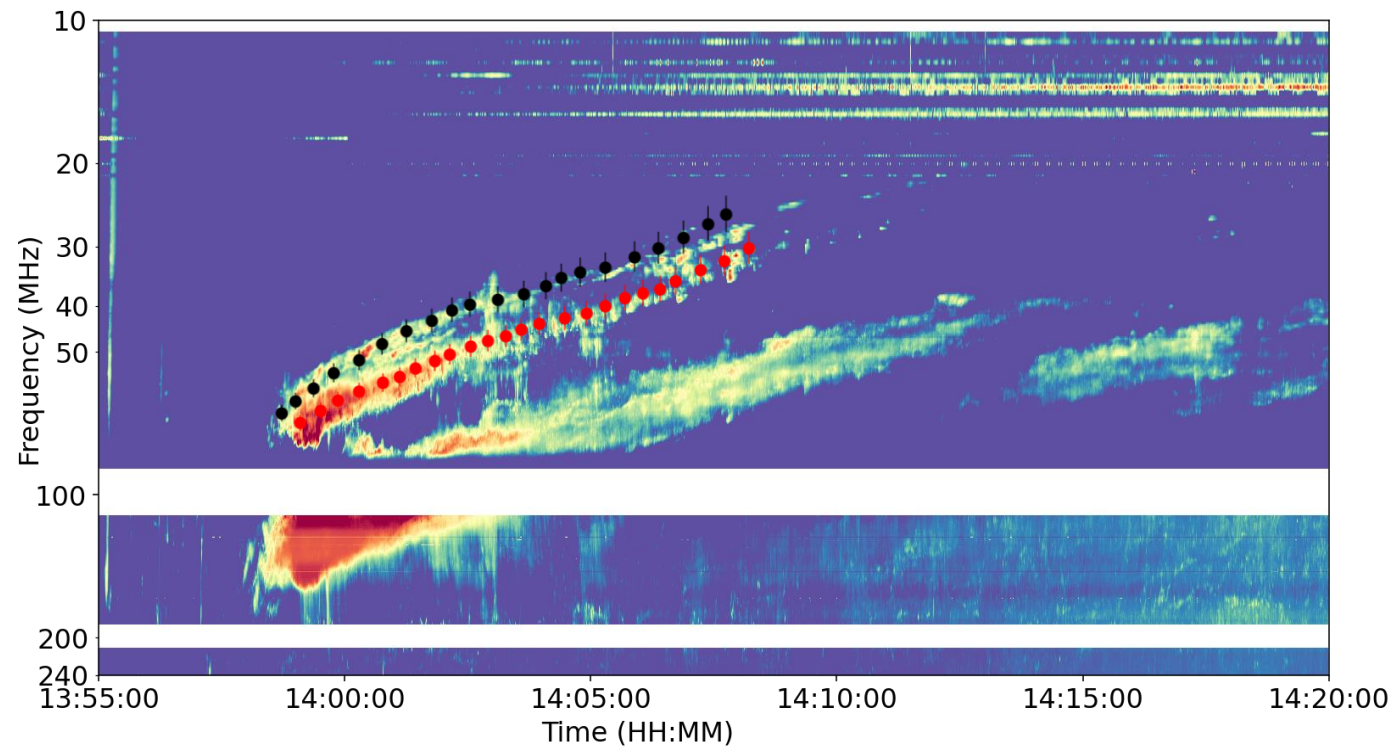
I-LOFAR – Dynamic Spectrum



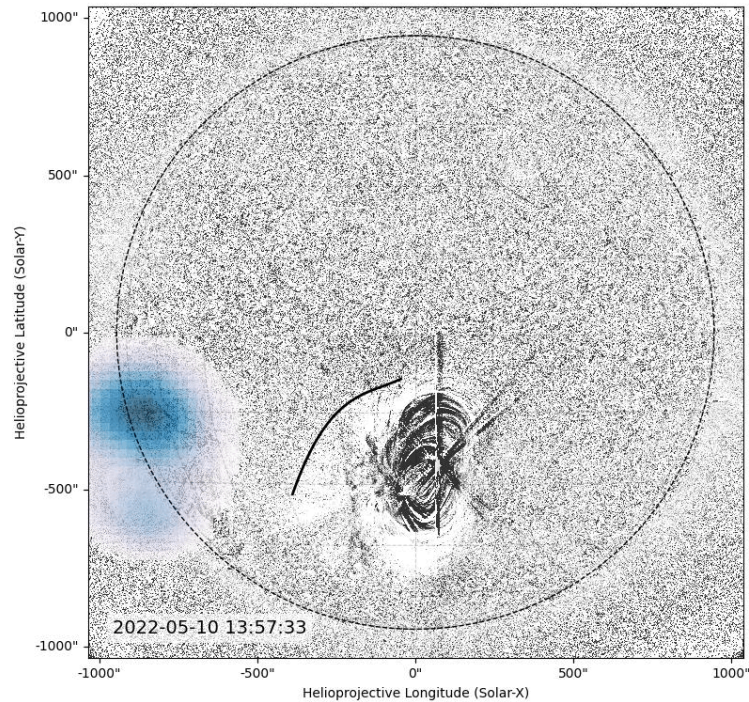
Shock Speed from Dynamic Spectrum

- Drift rate of Type II fundamental
- Modified density model assuming non-radial propagation

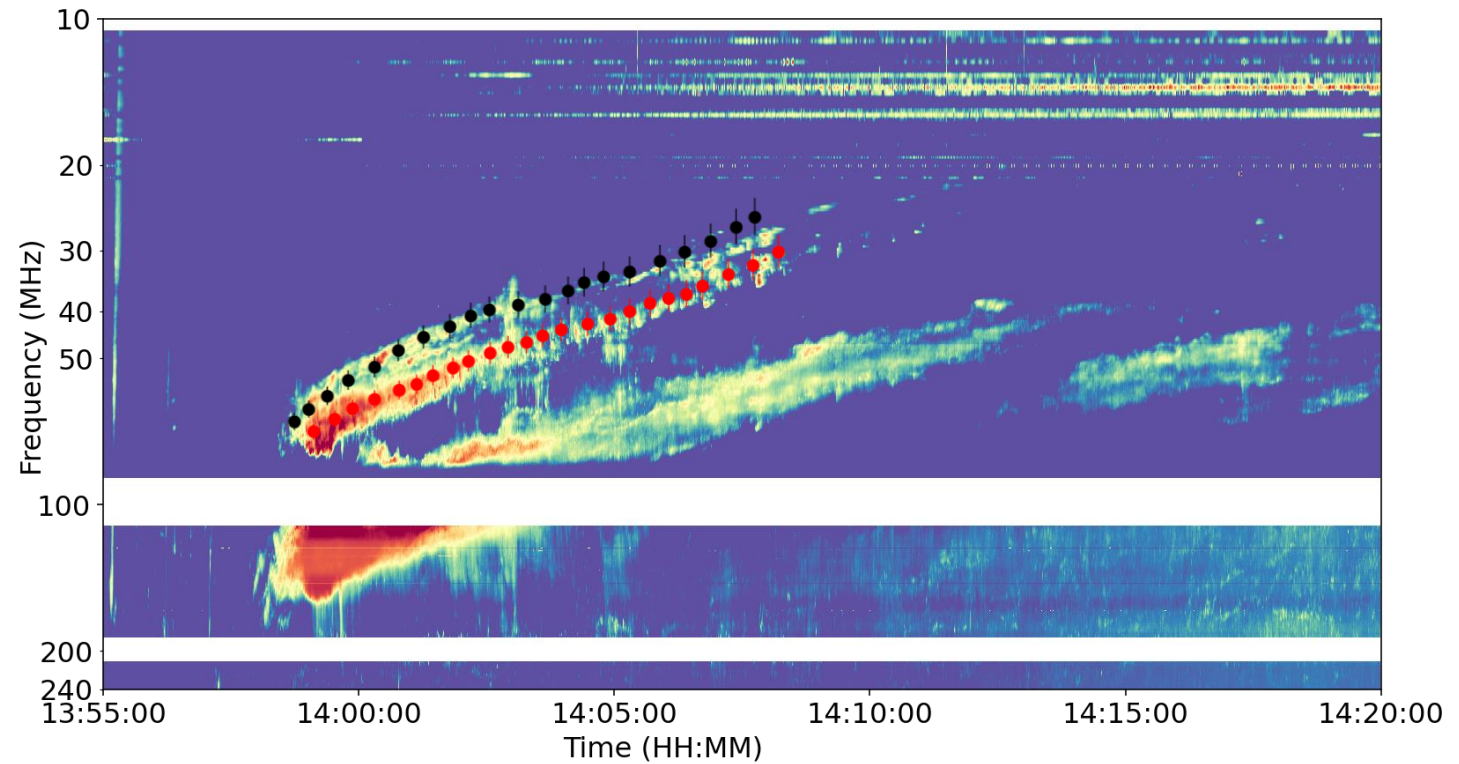
- Mean shock speed: >650 km/s



Connecting the results



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- Measure velocity of wave and emission
- Alfvén Mach number estimations

Better Observation Possibilities in the Future



- LOFAR ILT interferometric imaging campaigns
 - High time + frequency + spatial resolution
- Dedicated continuous solar monitoring to capture more events
 - Large catalogue of high-resolution dynamic spectra

Letter in prep.