



LOFAR Tied-array Imaging of Type III Solar Radio Bursts

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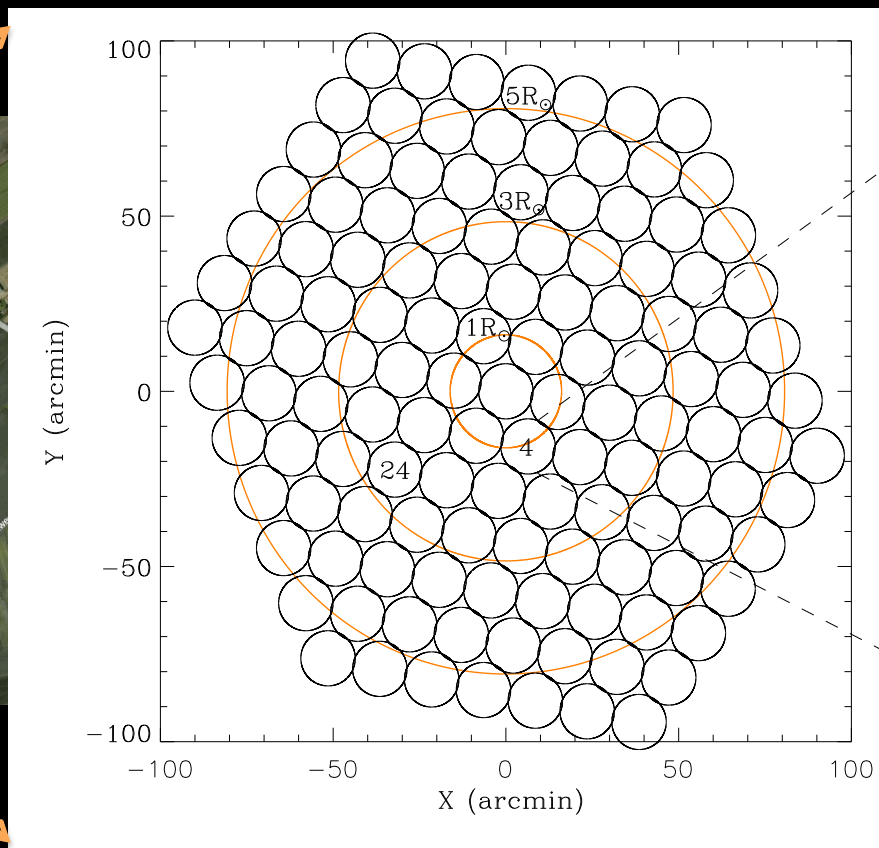
Pietro Zucca, Richard Fallows, Peter T. Gallagher

Trinity College Dublin, Ireland

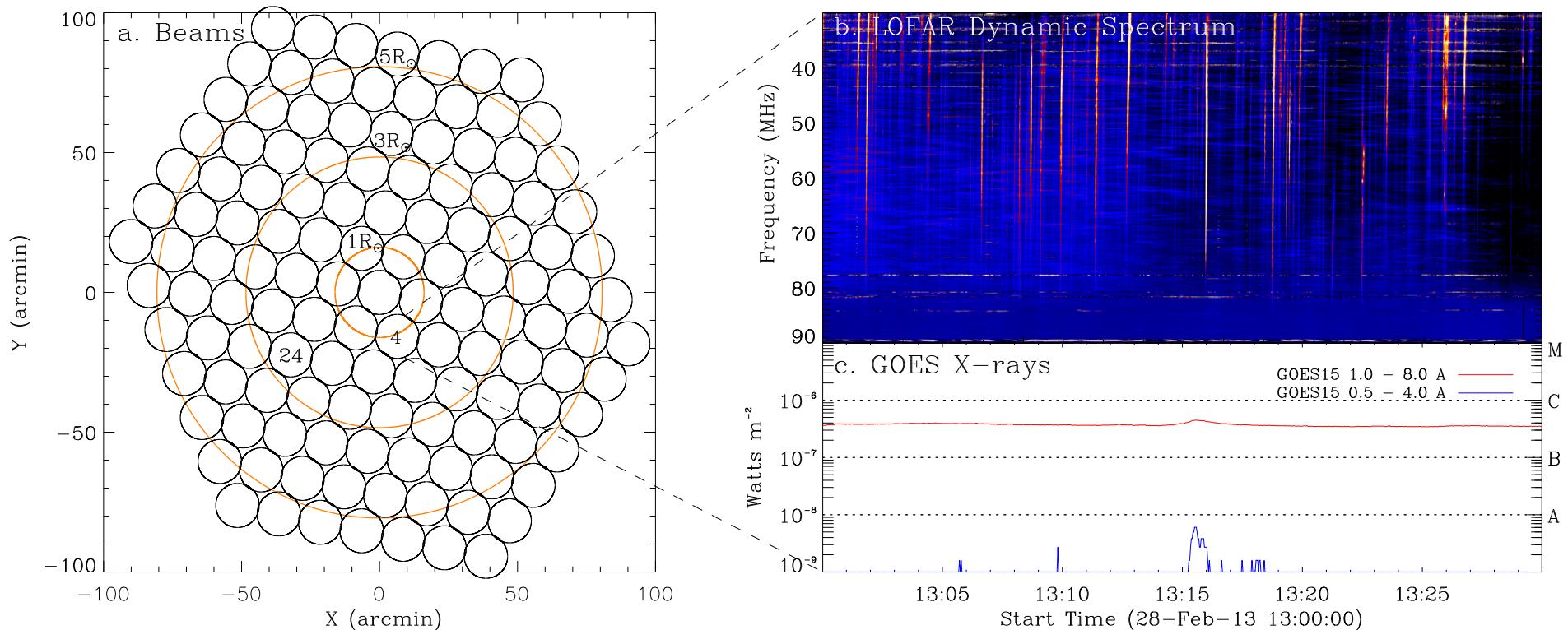
Netherlands Institute for Radio Astronomy (ASTRON), Dwingeloo

Tied-Array Beams Observations of the Sun Using LBAs from the Full LOFAR Core

127 Tied Array Beams covering a FOV of 3.3°



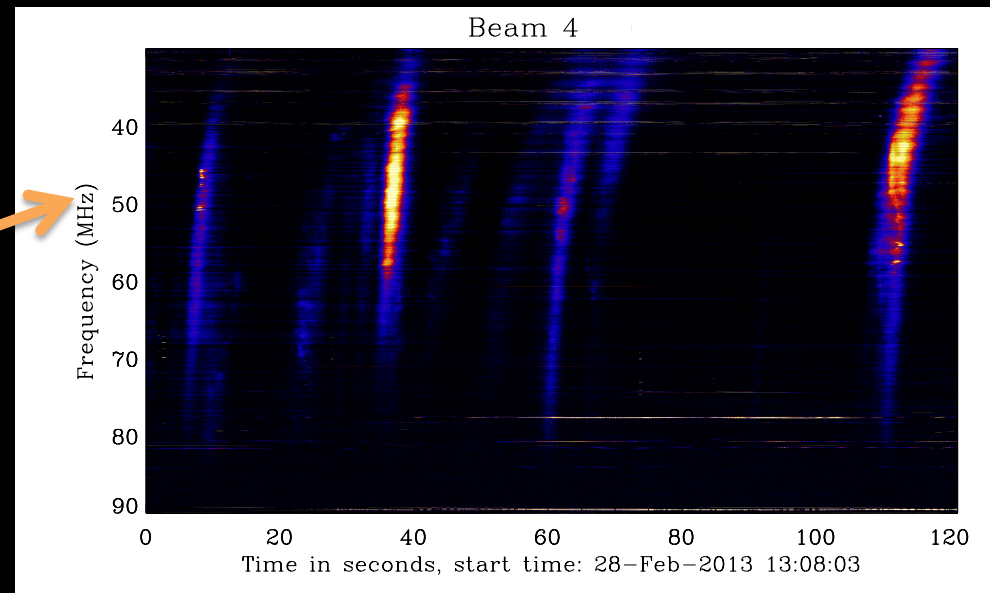
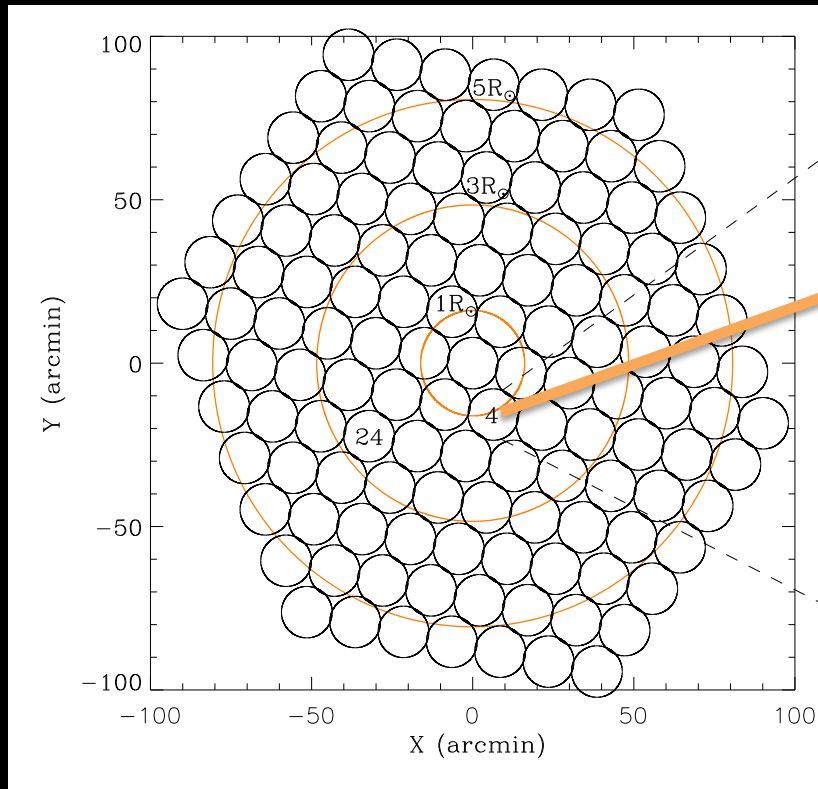
Tied-Array Beams Observations of the Sun Using LBAs from the Full LOFAR Core



Multiple Type III Radio Bursts - fast frequency drift bursts occurring in groups or storms



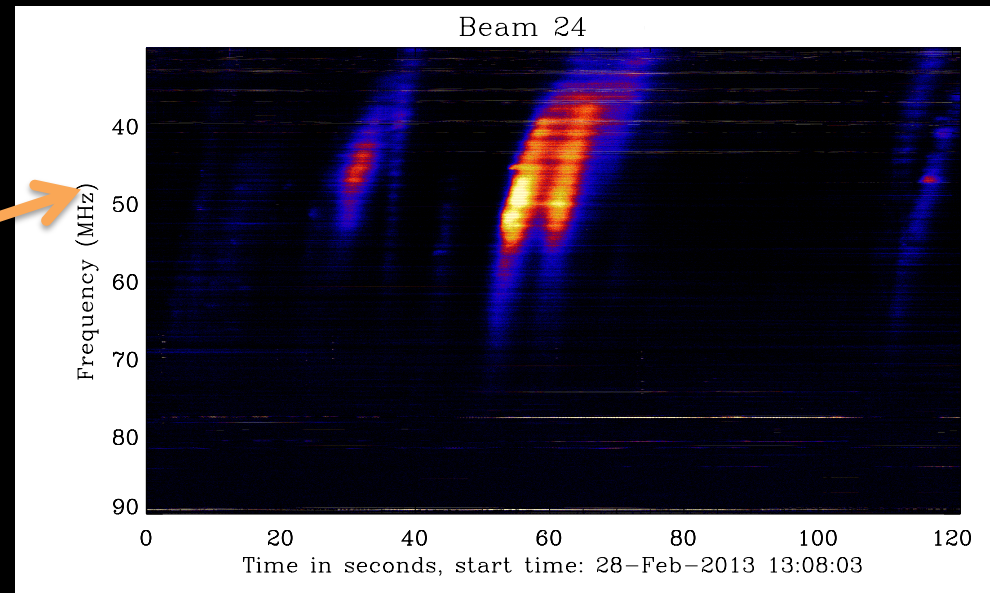
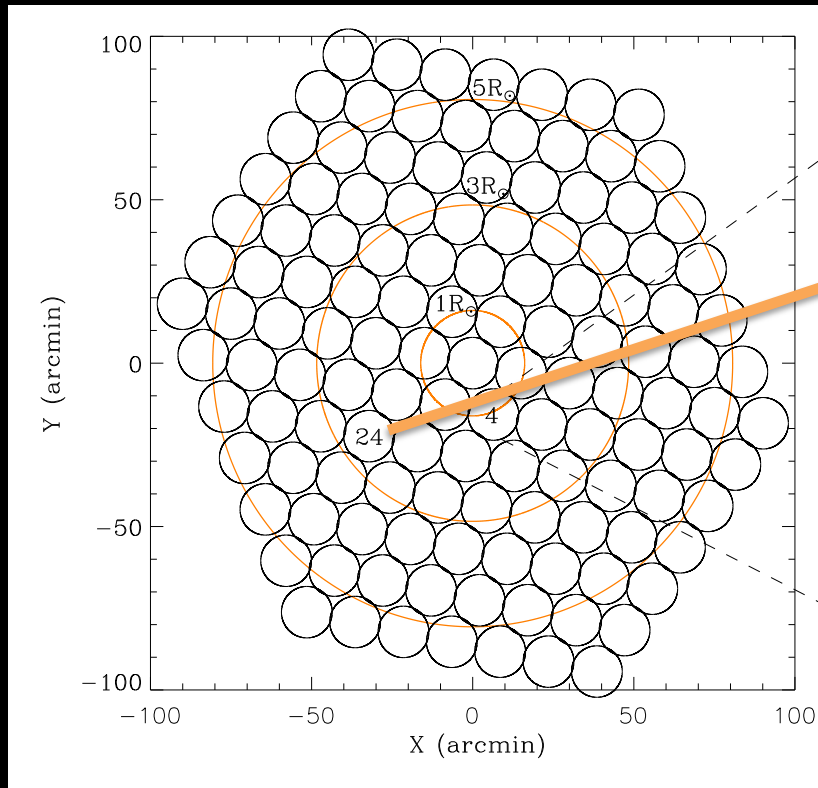
Dynamic Spectra Extracted from Tied-Array Beams using Low Band Antennas



Multiple Type III Radio Bursts - fast frequency drift bursts occurring in groups or storms



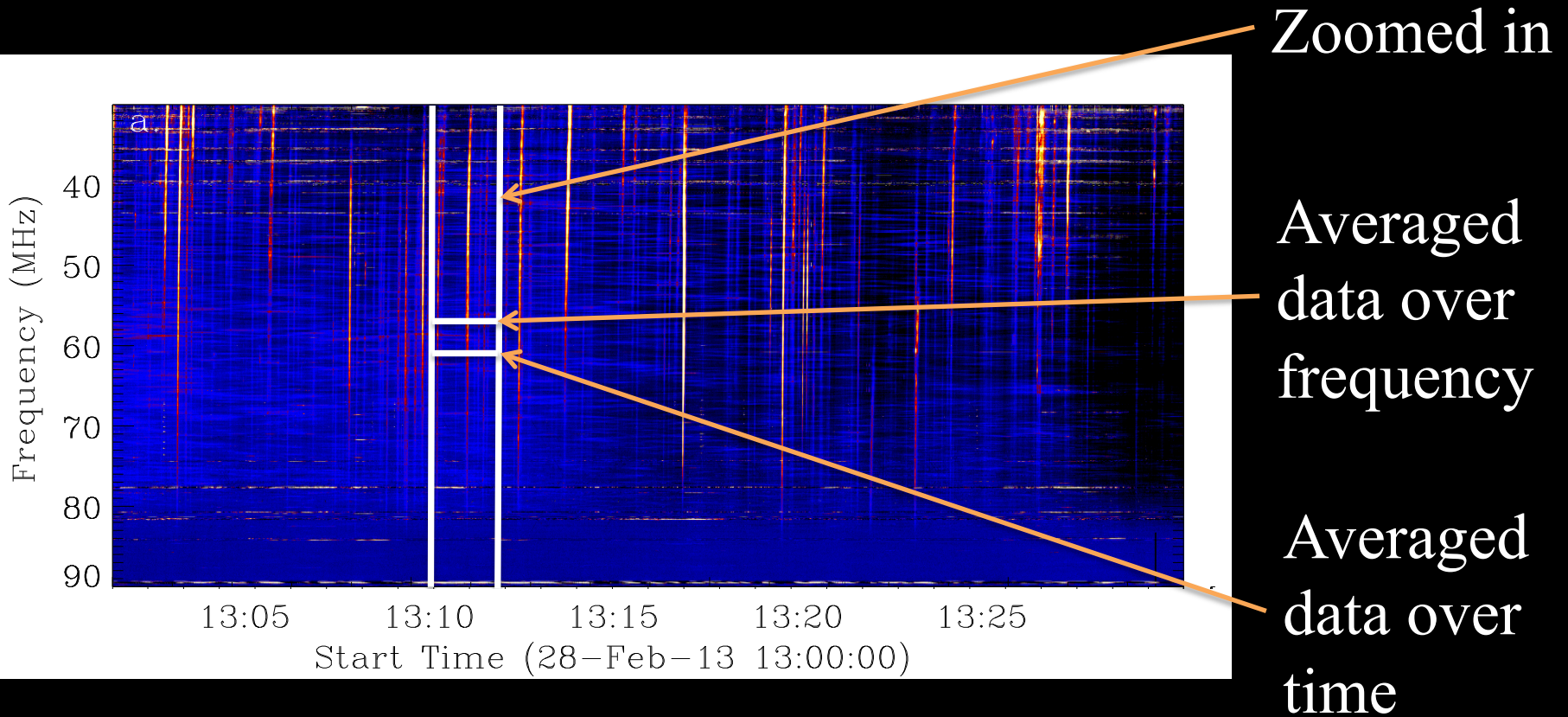
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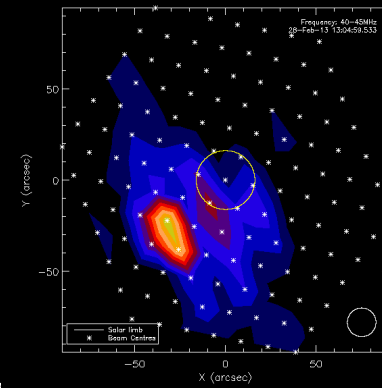
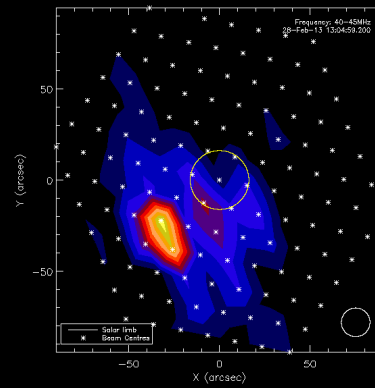
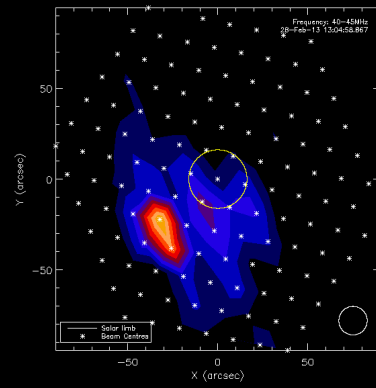
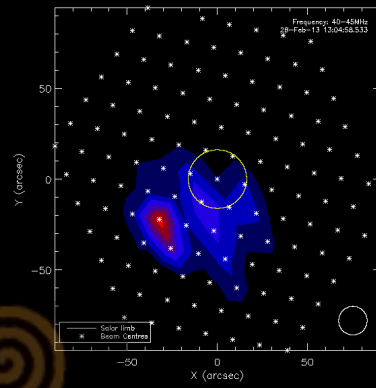
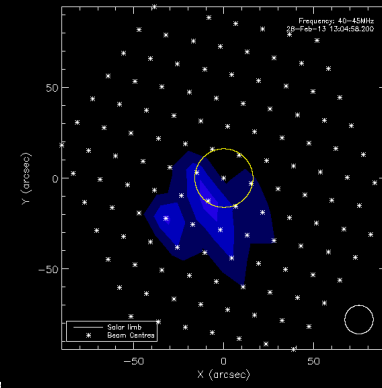
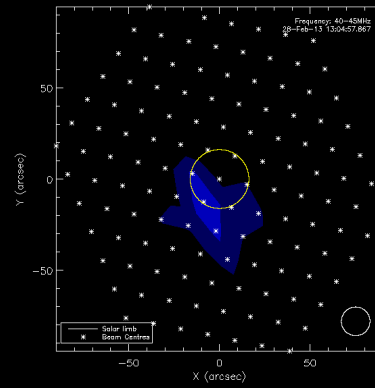
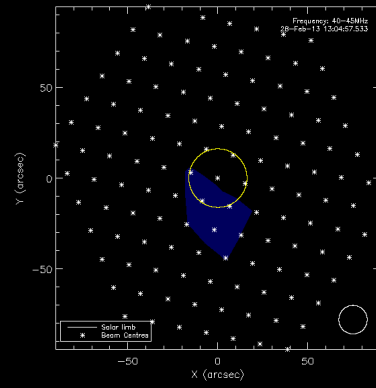
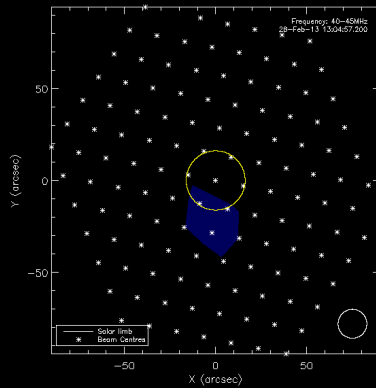
LOFAR - 30 Minute Data Set



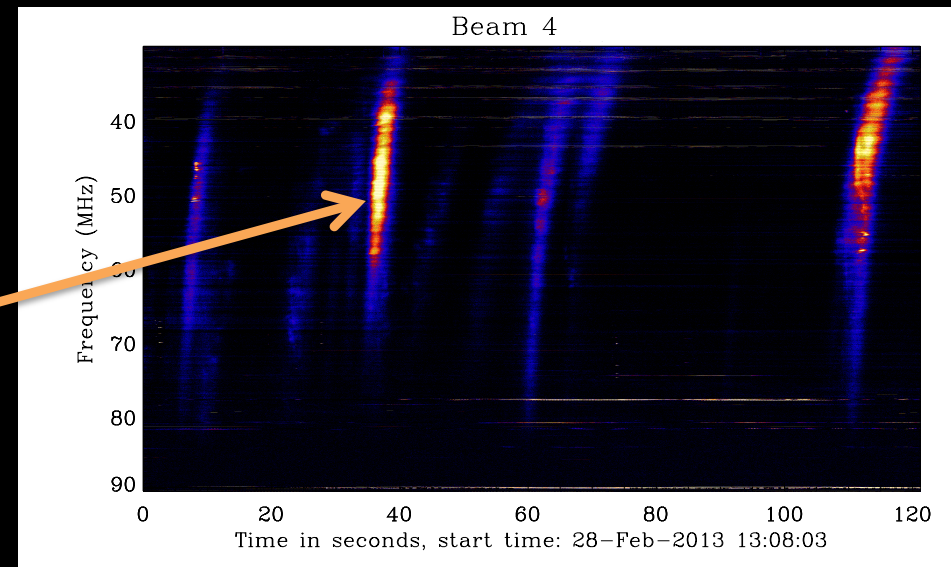
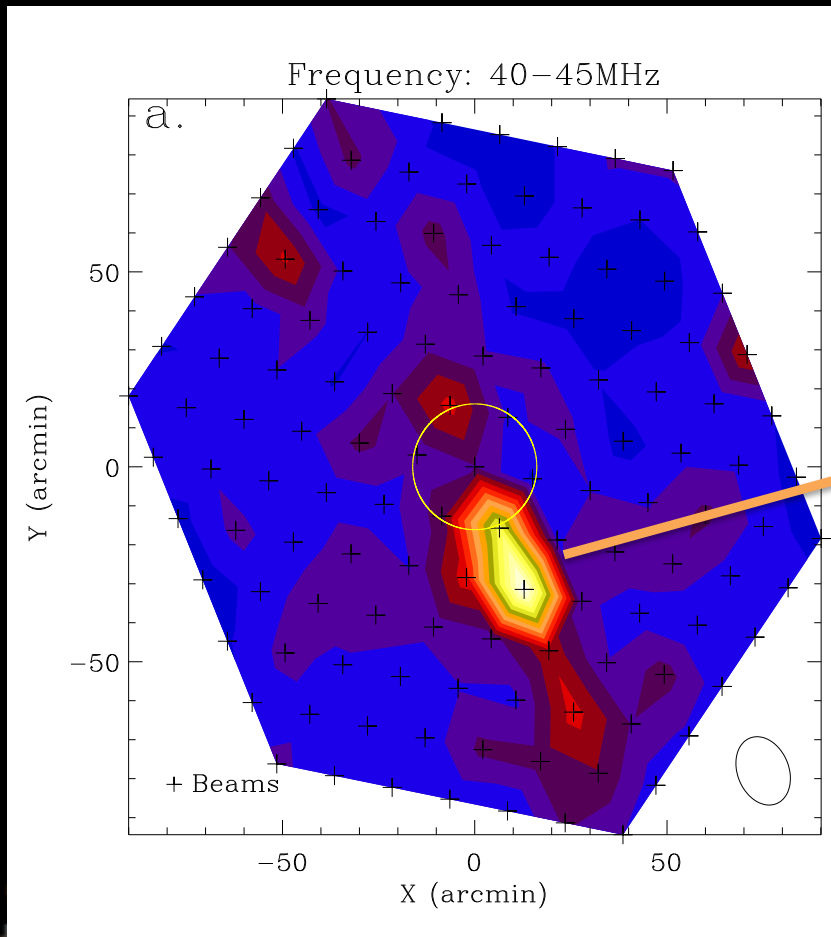
→ Sequence of images in time



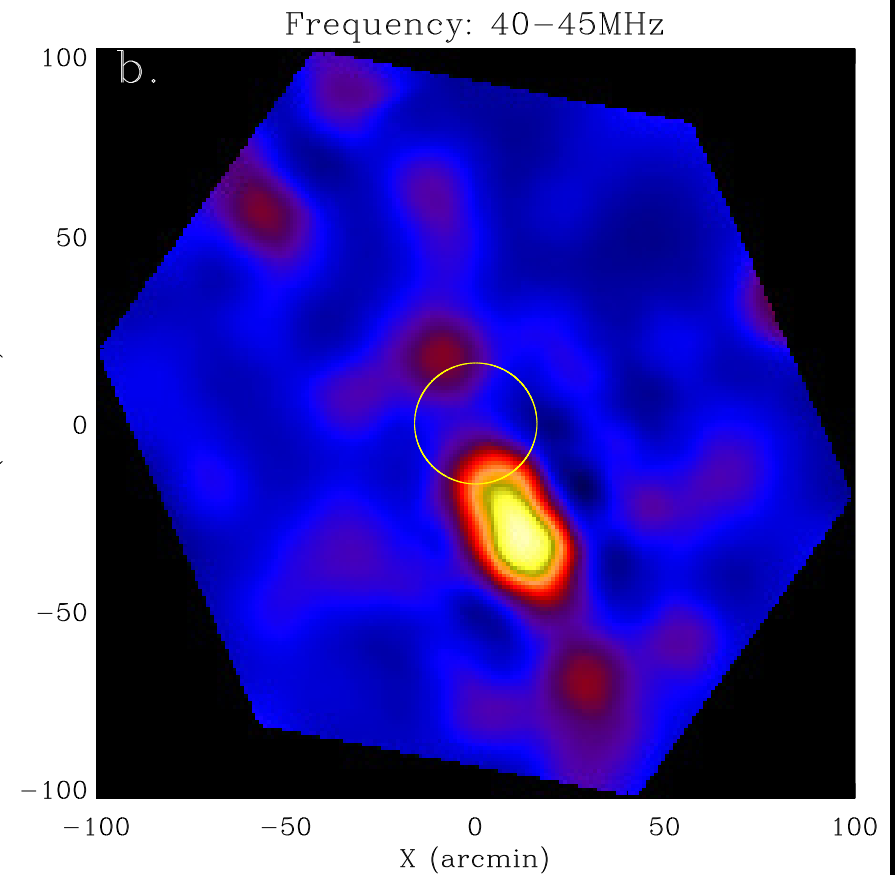
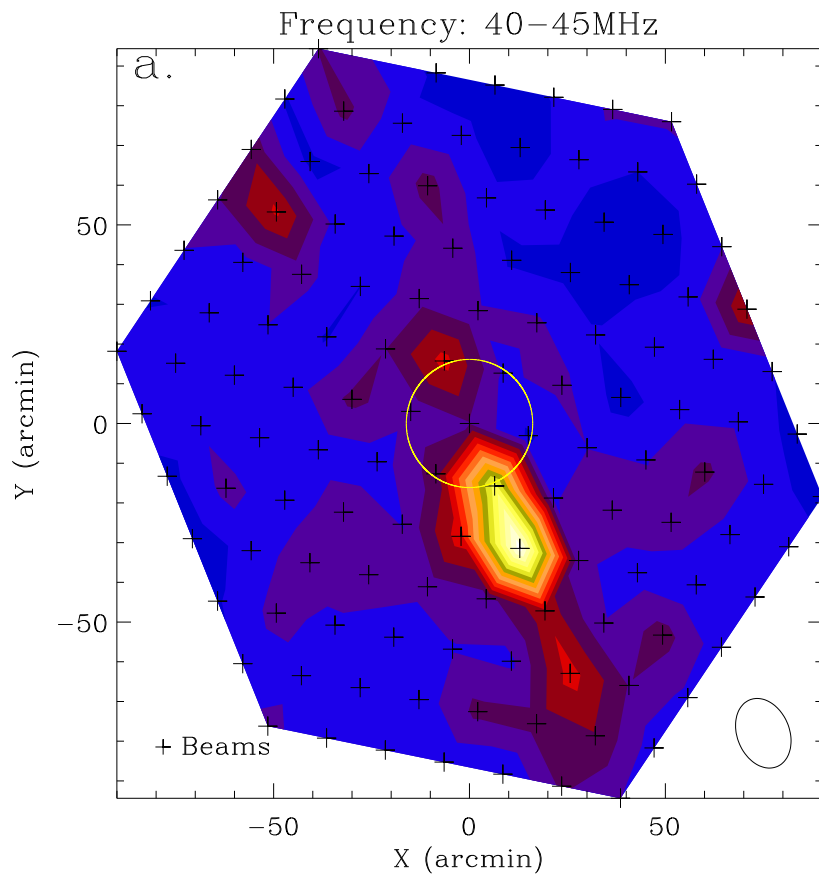
Example of data points plotted as a sequence of images in time at 40-45 MHz:



Spatial Information of Type III Radio Bursts Using Tied-Array Beams

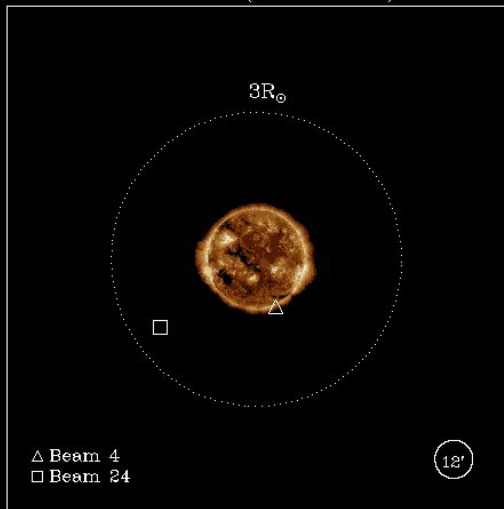


Spatial Information of Type III Radio Bursts Using Tied-Array Beams

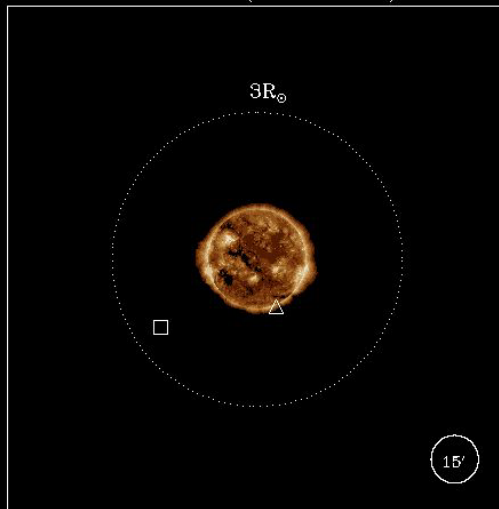


Spatial Information of Type III Radio Bursts Using Tied-Array Beams

50–55MHz (13:08:00 UT)



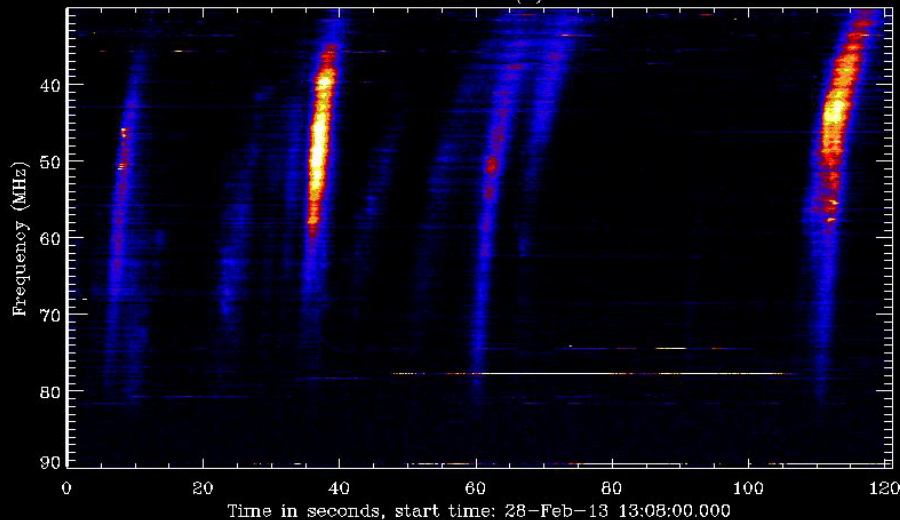
40–45MHz (13:08:00 UT)



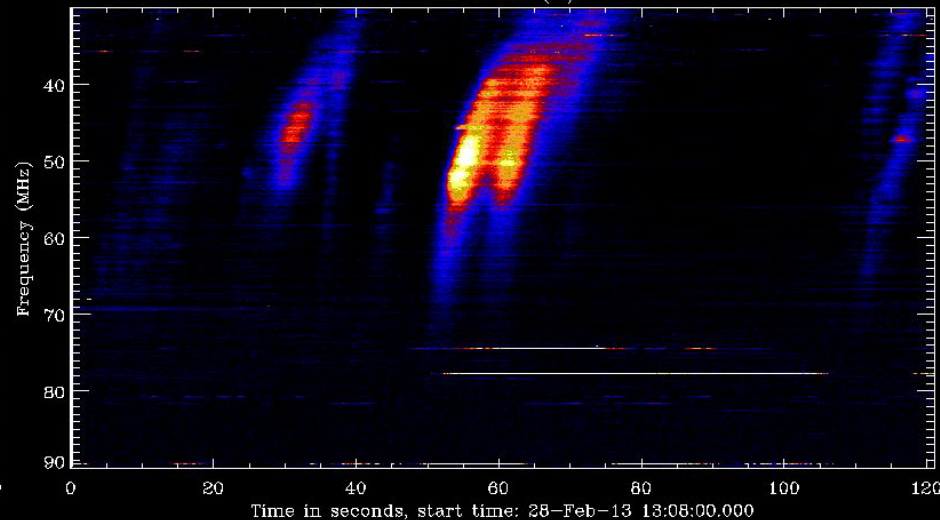
30–35MHz (13:08:00 UT)



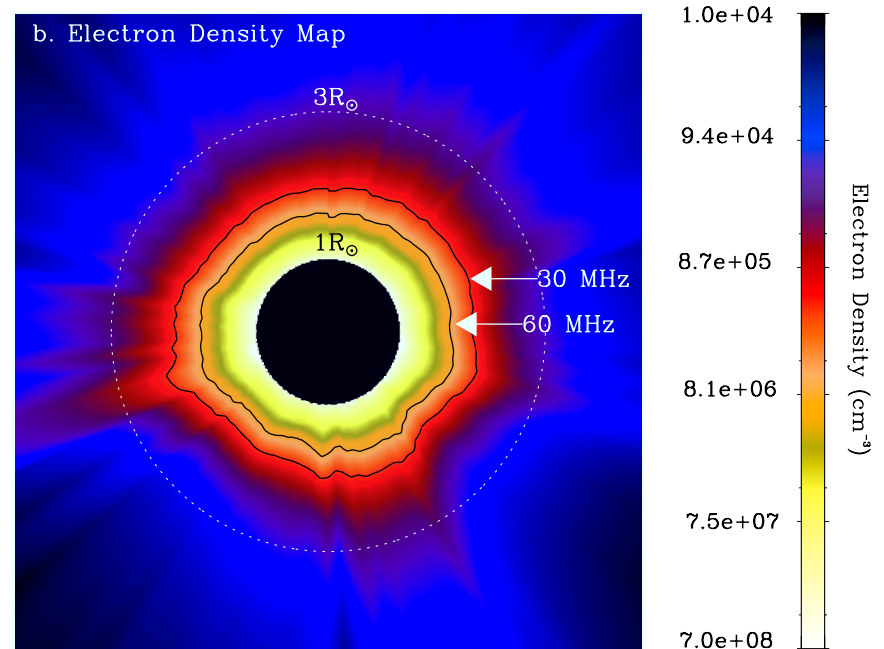
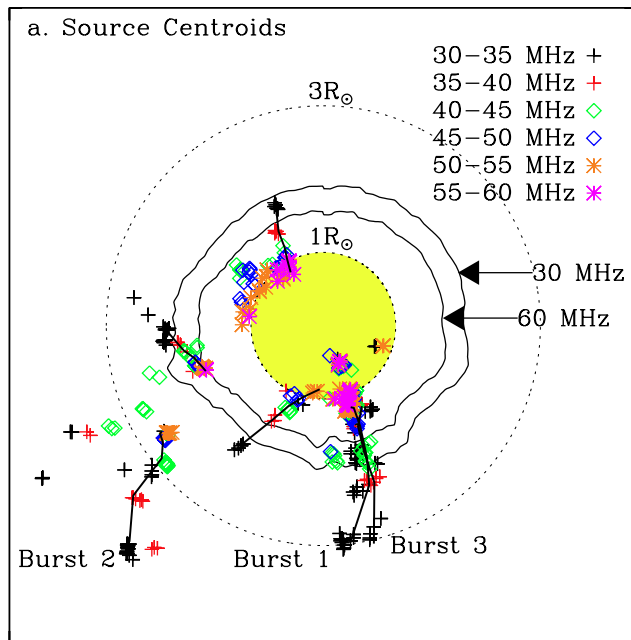
Beam 4 (Δ)



Beam 24 (\square)



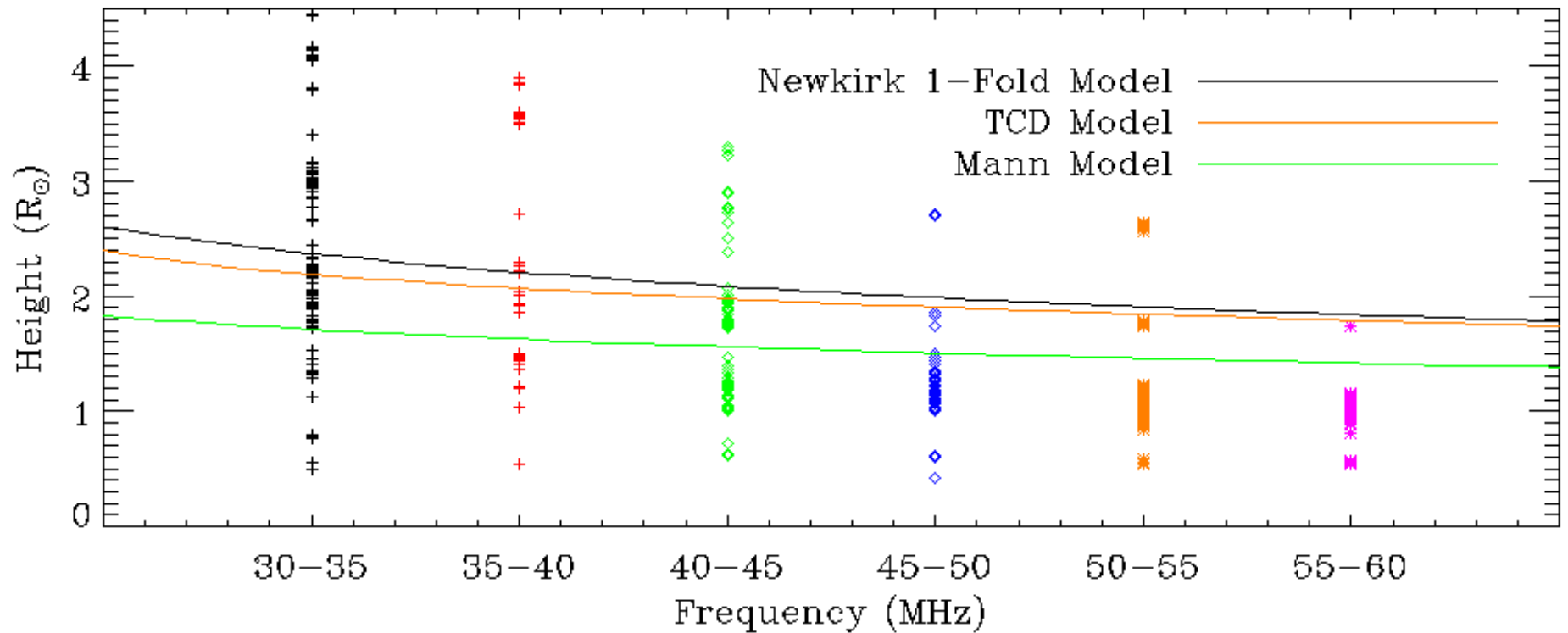
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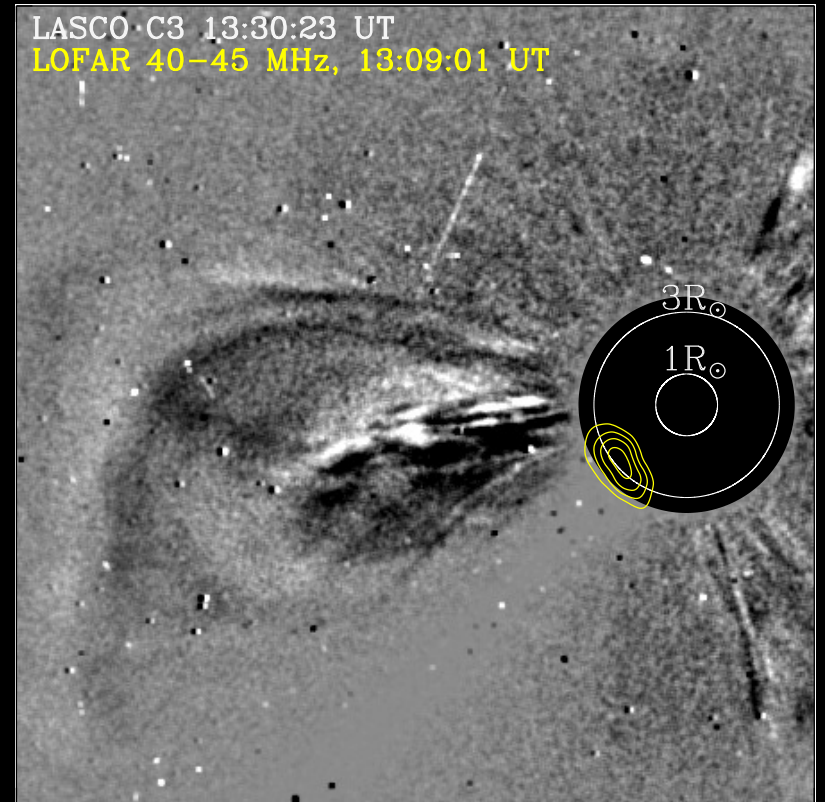
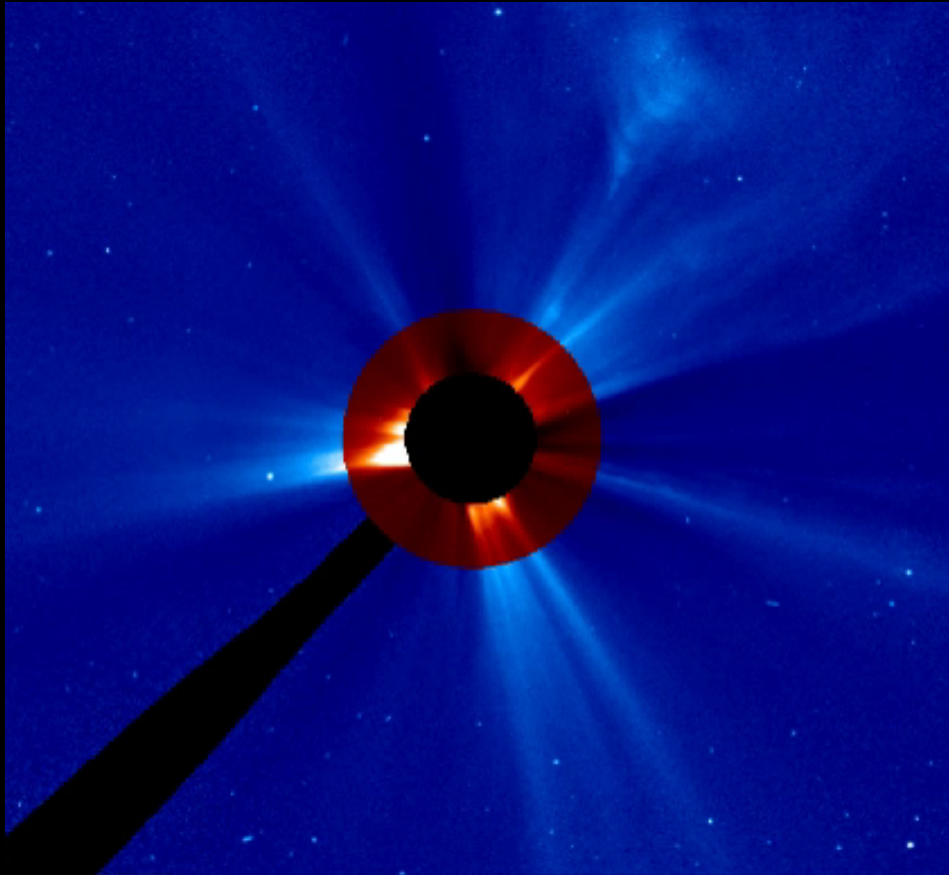
Type III Emission frequency decreases with increasing distance from the Sun: $f_p = 9000\sqrt{n_e} \text{ Hz}$



Spatial Information of Type III Radio Bursts Using Tied-Array Beams



Spatial Information of Type III Radio Bursts Using Tied-Array Beams



Conclusions and Future Observations

- First time LOFAR tied-array beams were used on the Sun to provide spatial information of radio bursts.
- Identifications of Type IIIs between 1-4 R_{\odot} .
- Discrepancy between observations and theory.
- Type III radio bursts related to the passage of a CME for the first time.

