Solar S-bursts Bursts with LOFAR

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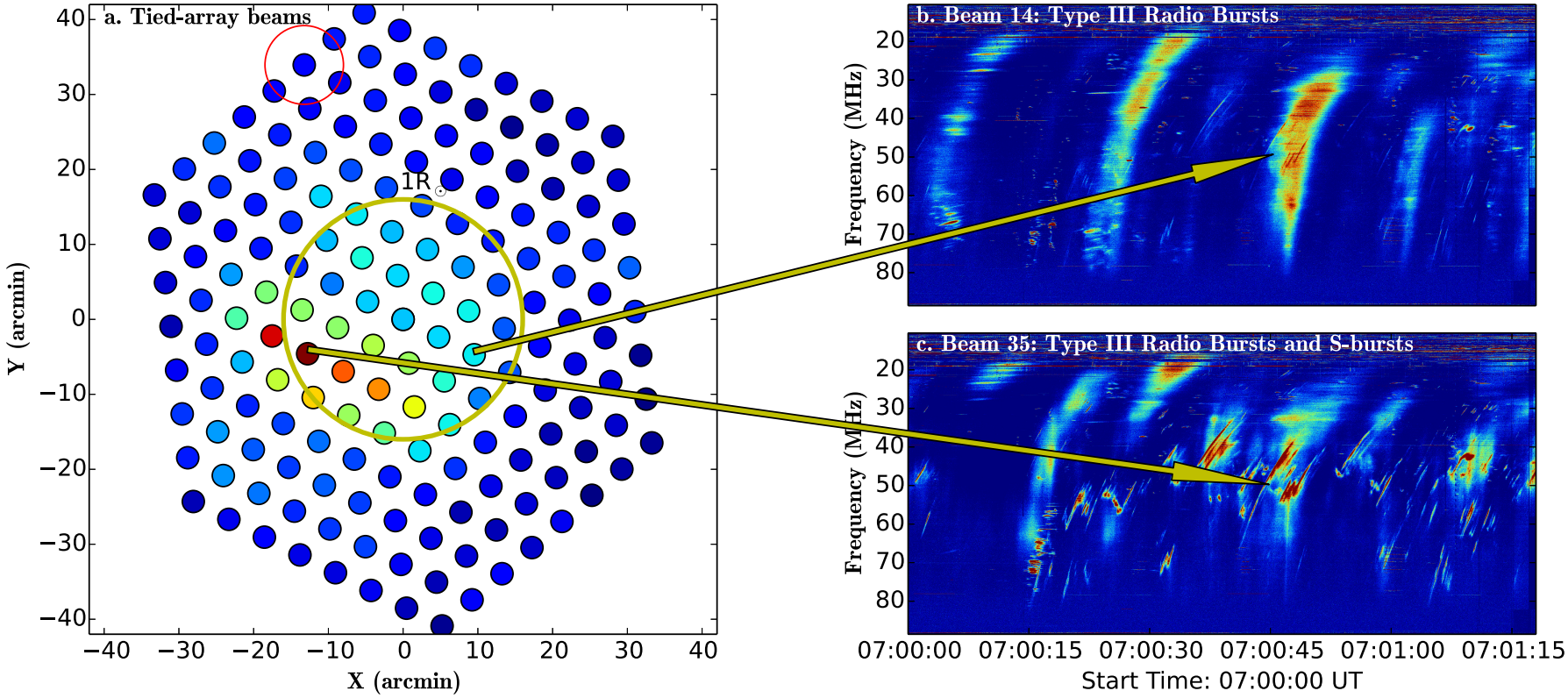
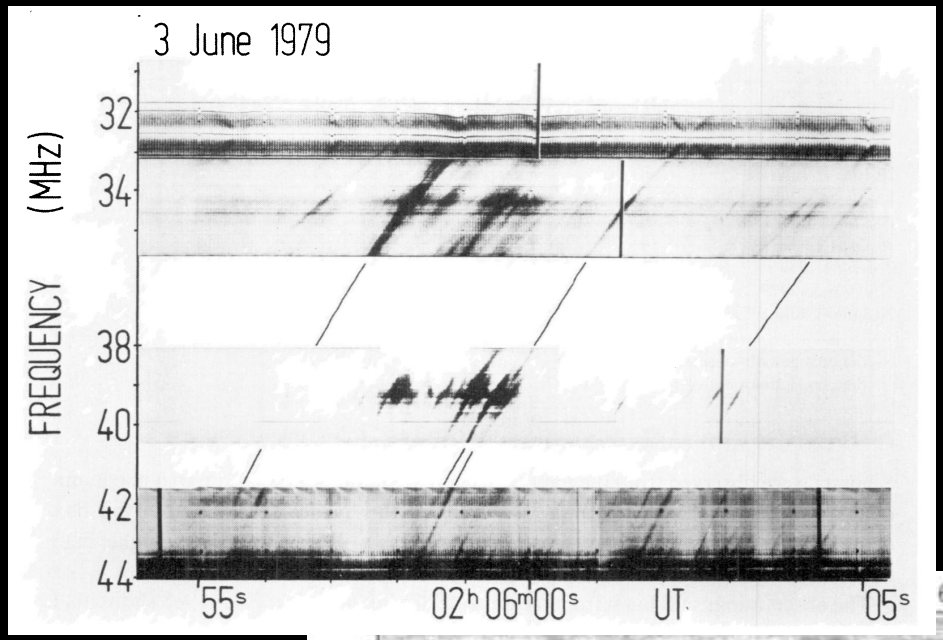
Tied-Array Beams Observations of the Sun Using LBAs from the Full LOFAR Core

170 Tied Array Beams covering a FOV of ~1.3°

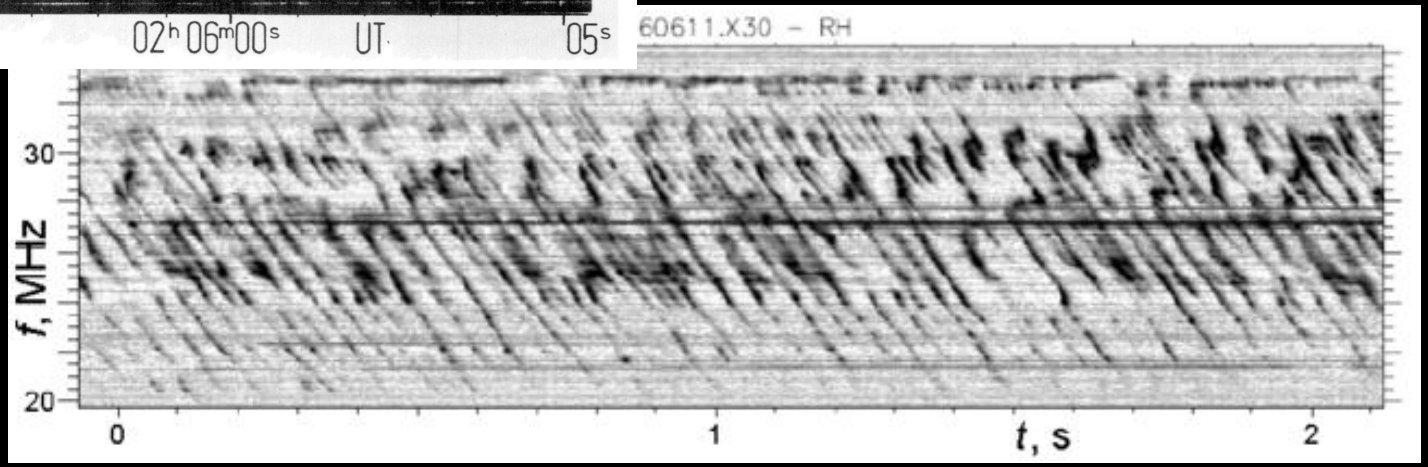


Solar S-bursts and Jovian S-bursts

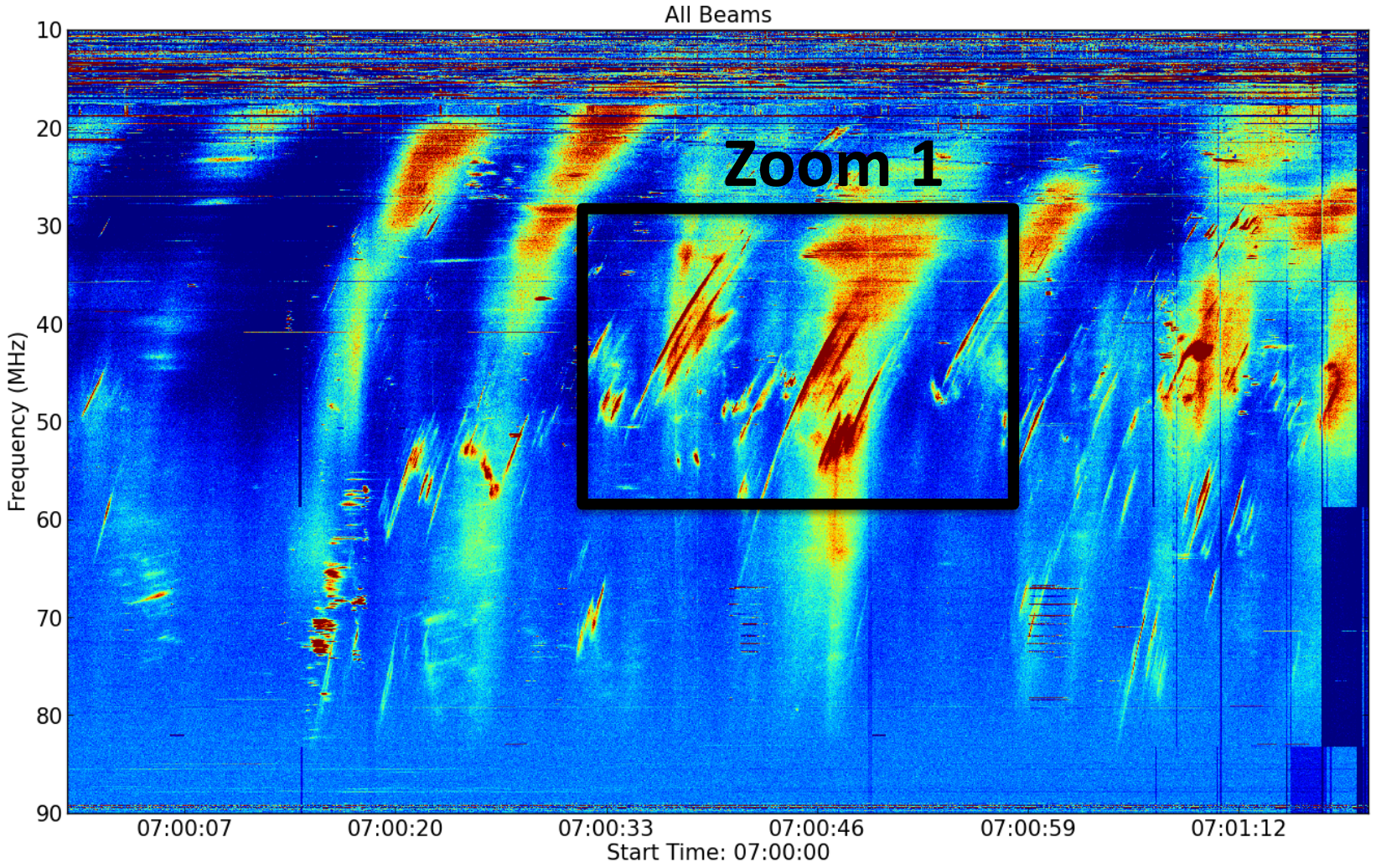


McConnell, 1982,
Solar S-bursts

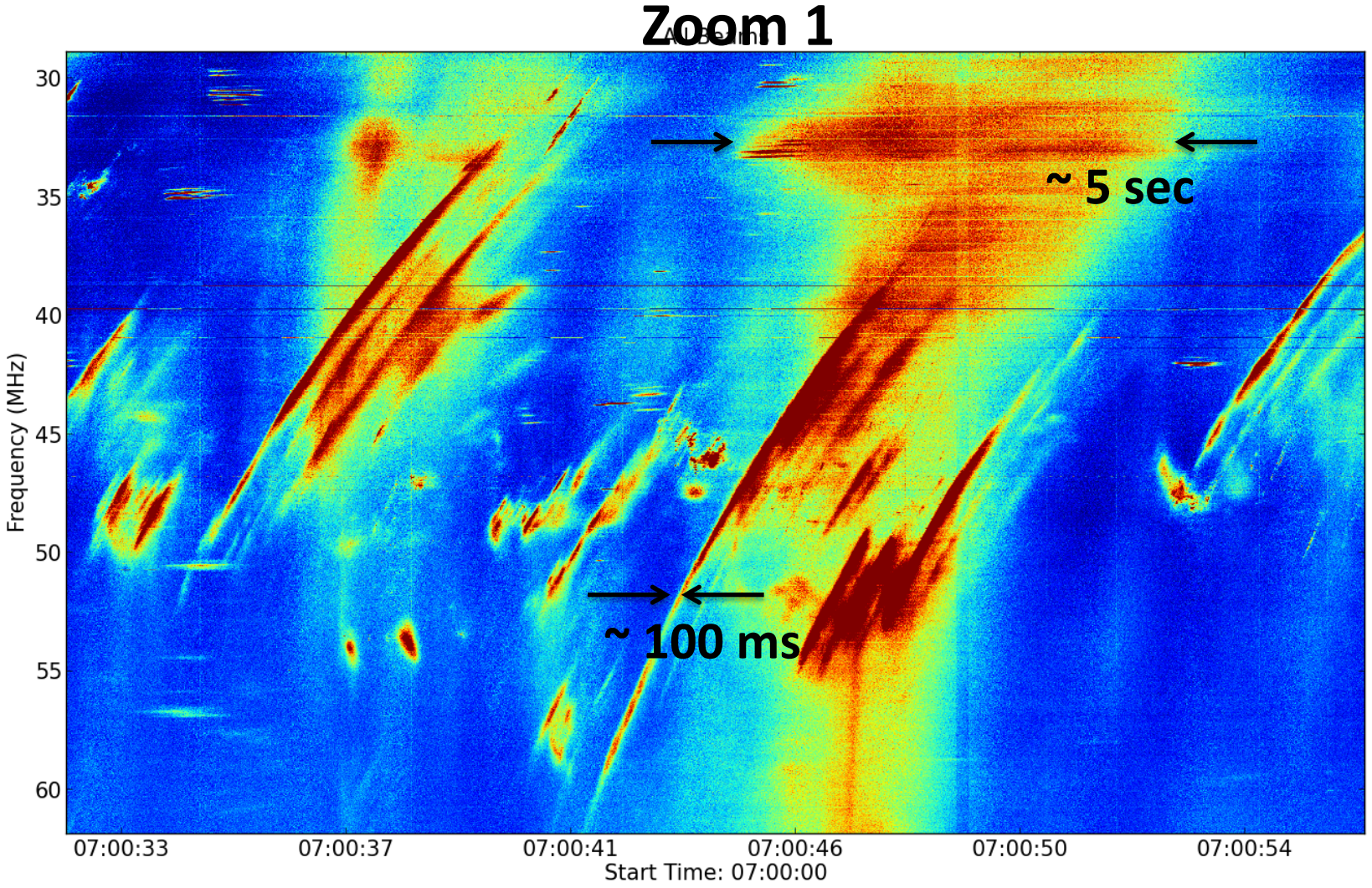
Jovian S-bursts



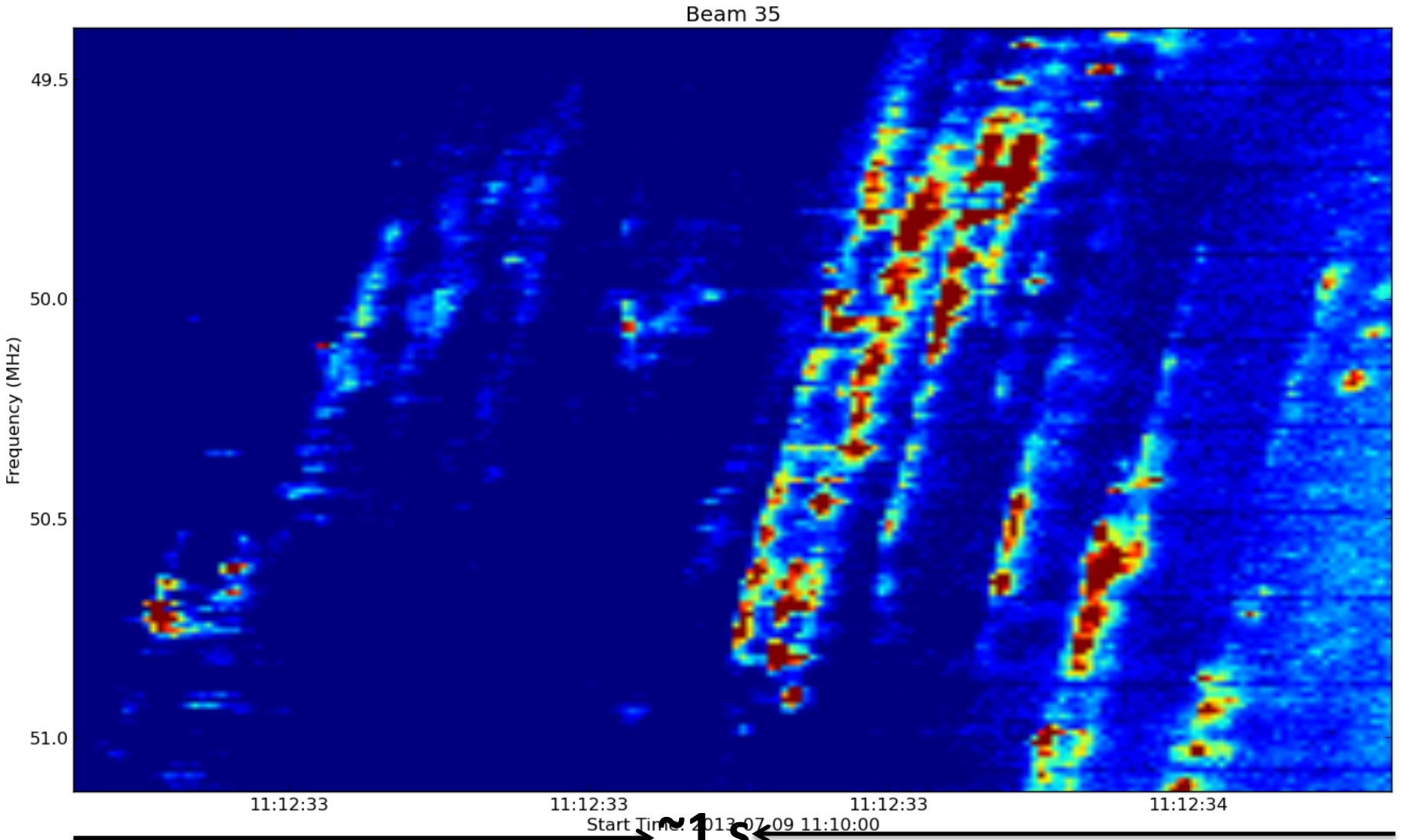
S-bursts with Full LOFAR Core



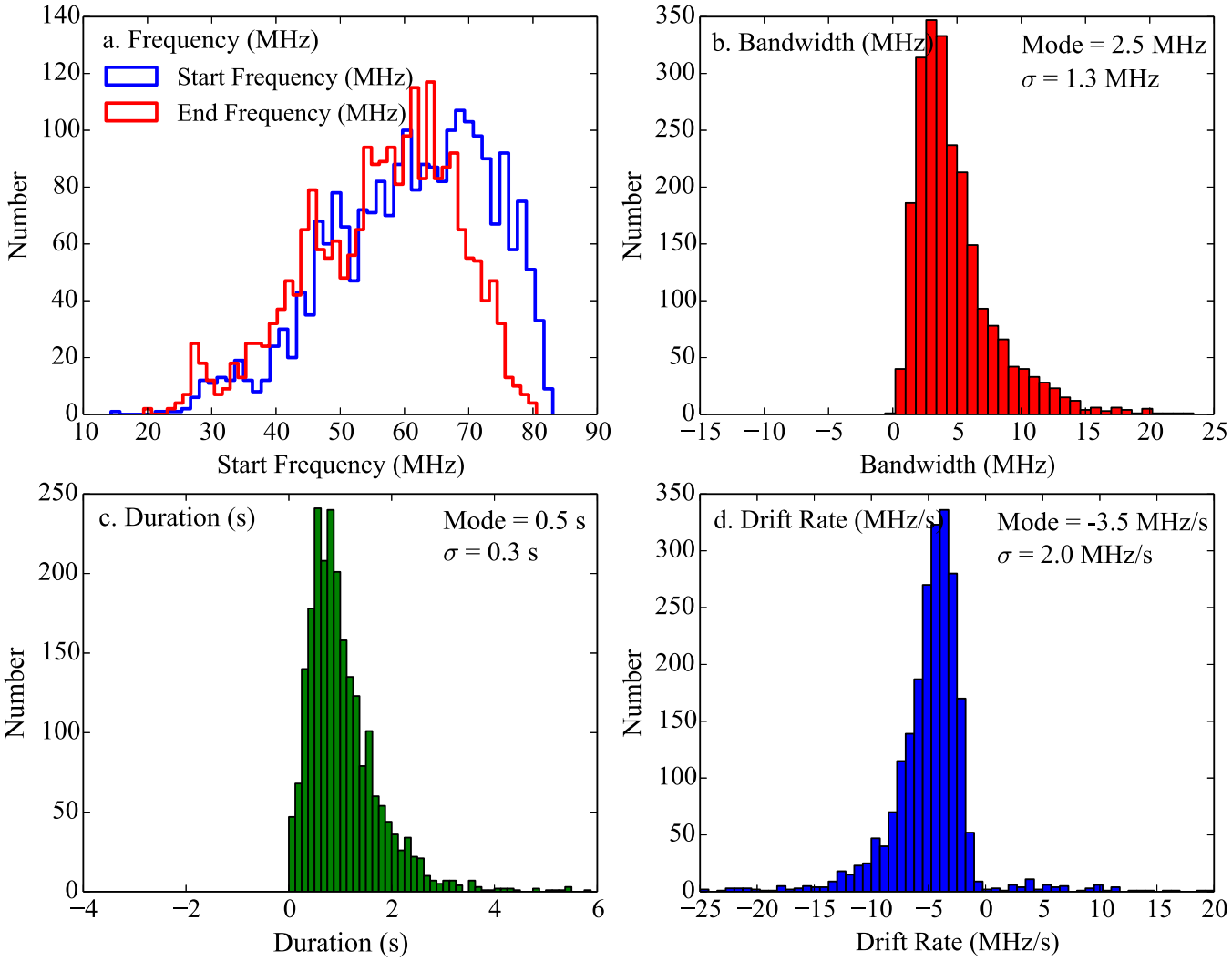
S-bursts with Full LOFAR Core

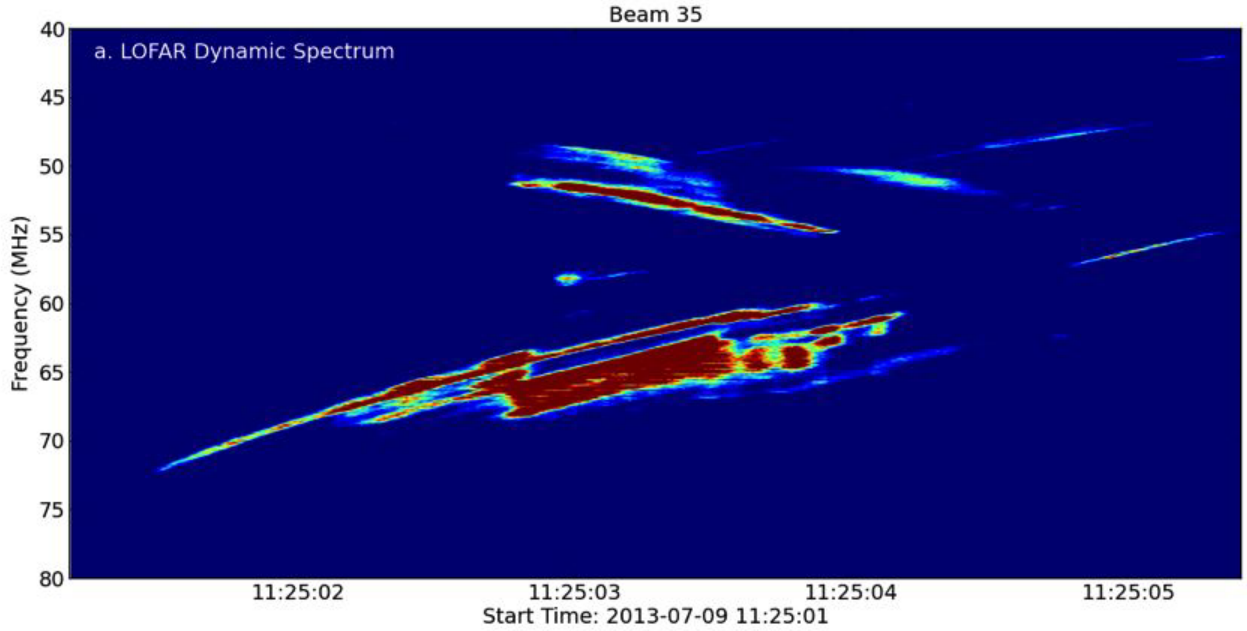


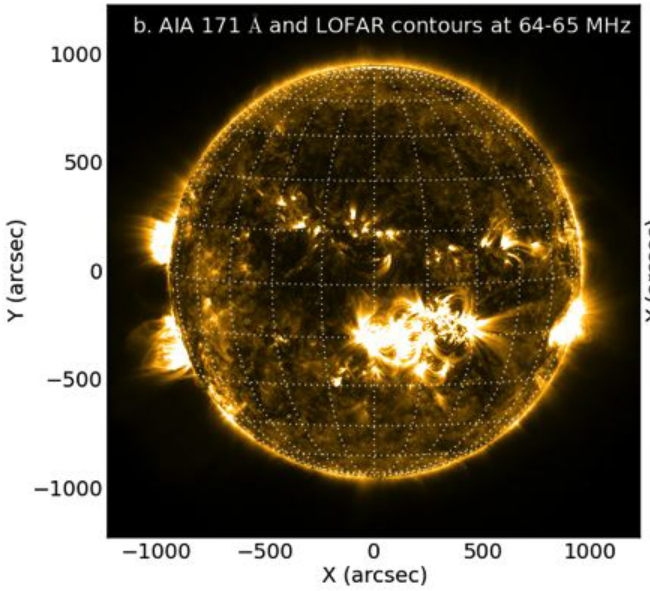
S-bursts with Full LOFAR Core
Need temporal resolution <10ms

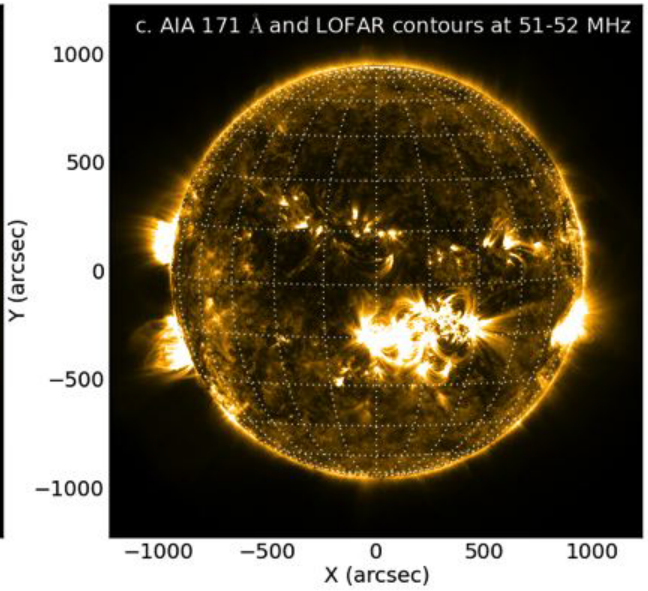


S-bursts with Full LOFAR Core Properties



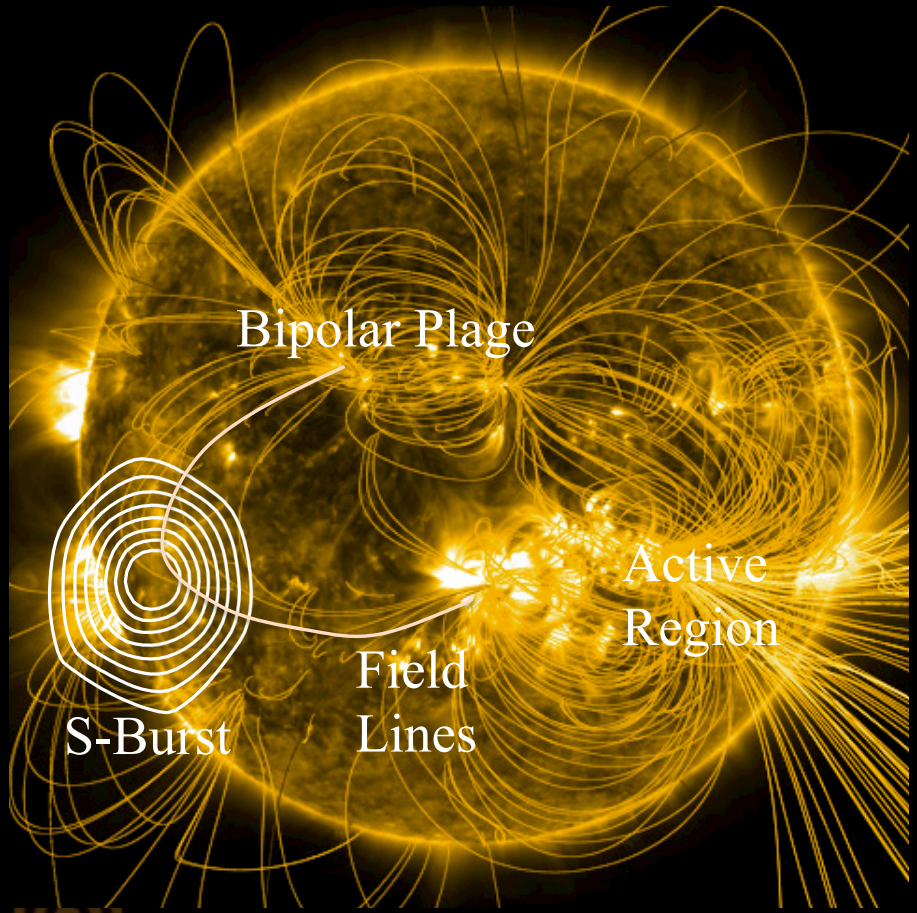


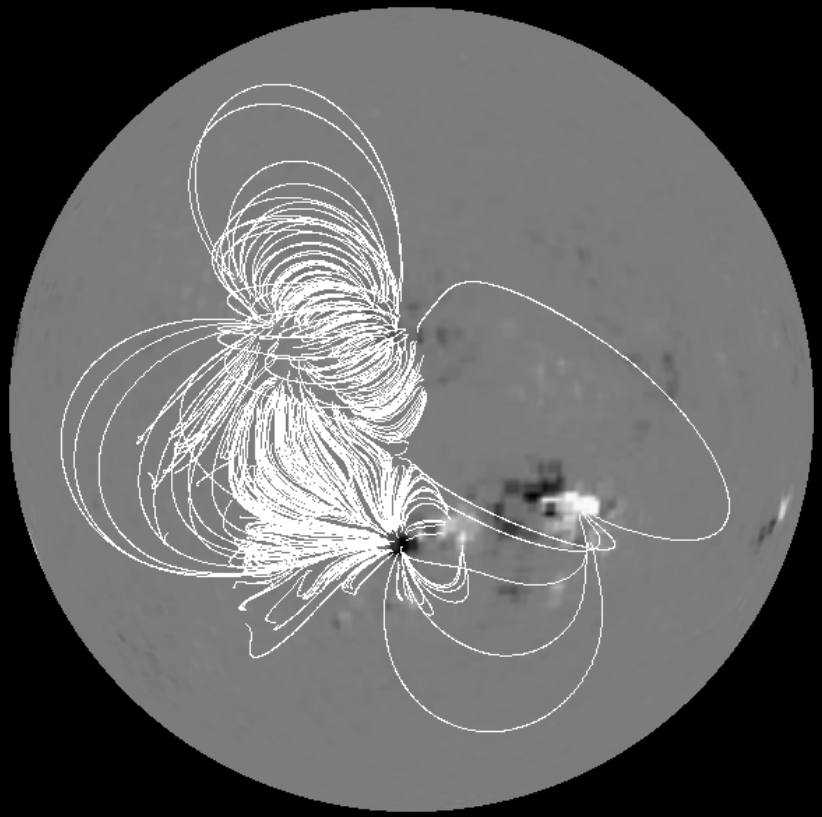




Morosan et al. 2015, in review A&A

S-bursts Properties - Plasma Emission?





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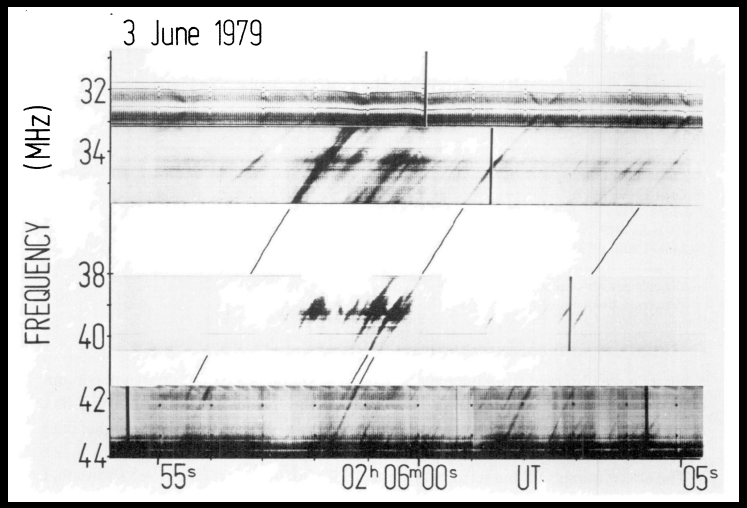
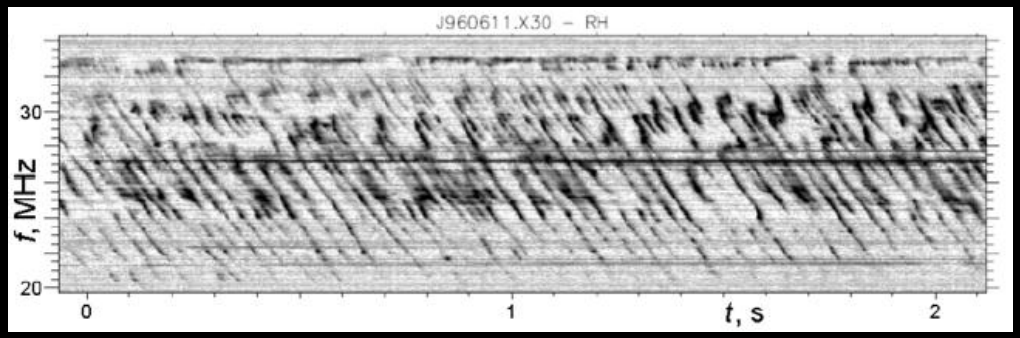
Solar S-bursts and Jovian S-bursts Emission Mechanisms



Solar S-bursts

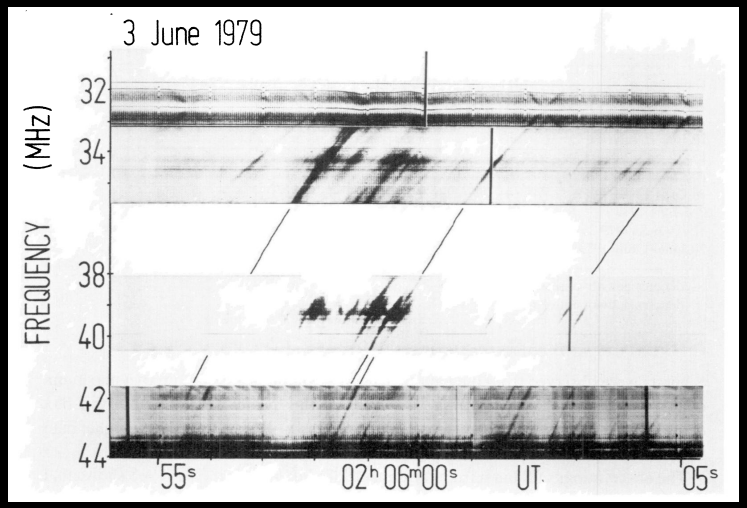


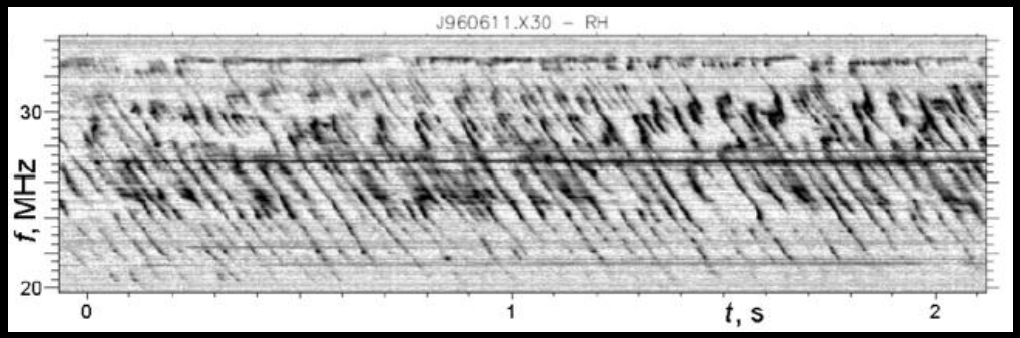
Jovian S-bursts

Electron-cyclotron Maser

$f_c = eB/2\pi m$

Solar S-bursts and Jovian S-bursts Emission Mechanisms





Solar S-bursts
Plasma Emission?

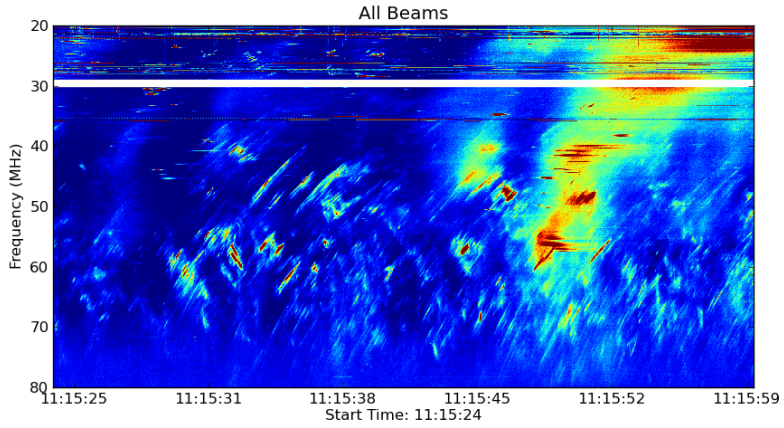
$f_p = 9000\sqrt{n_e}\,Hz$

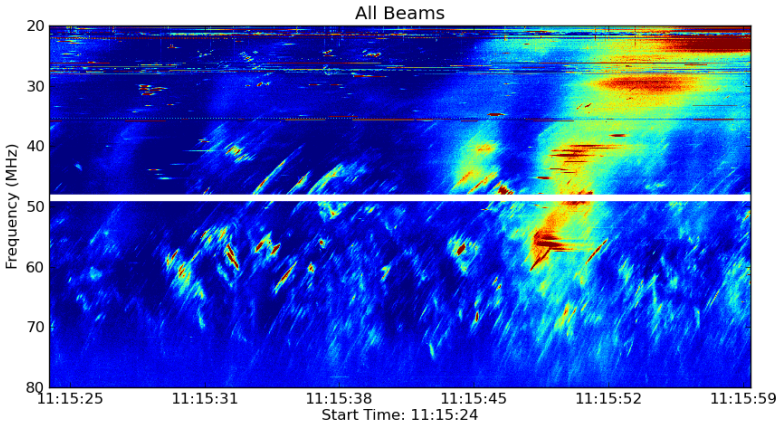
(Alfven velocity not high enough to allow for maser emission.)

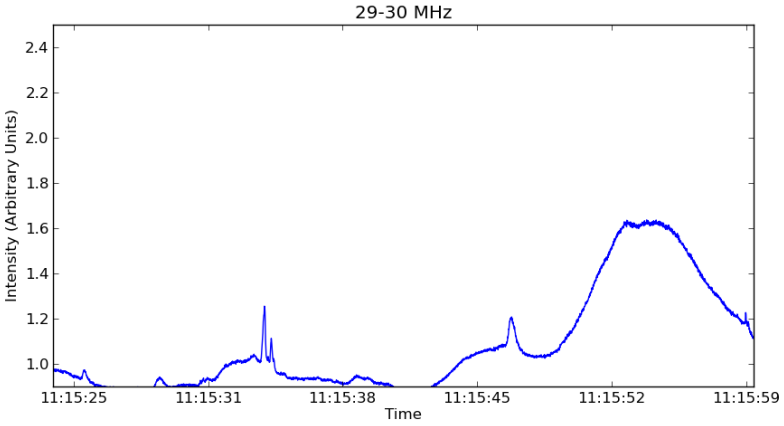
Jovian S-bursts
Electron-cyclotron Maser

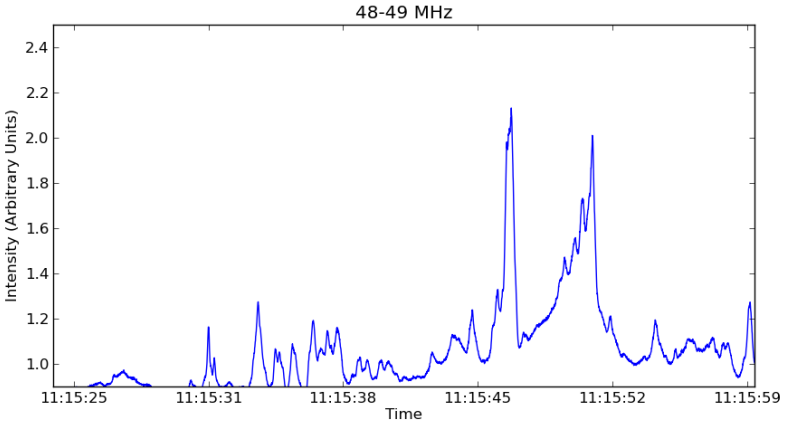
$f_c = eB/2\pi m$

S-bursts Properties - Plasma Emission?









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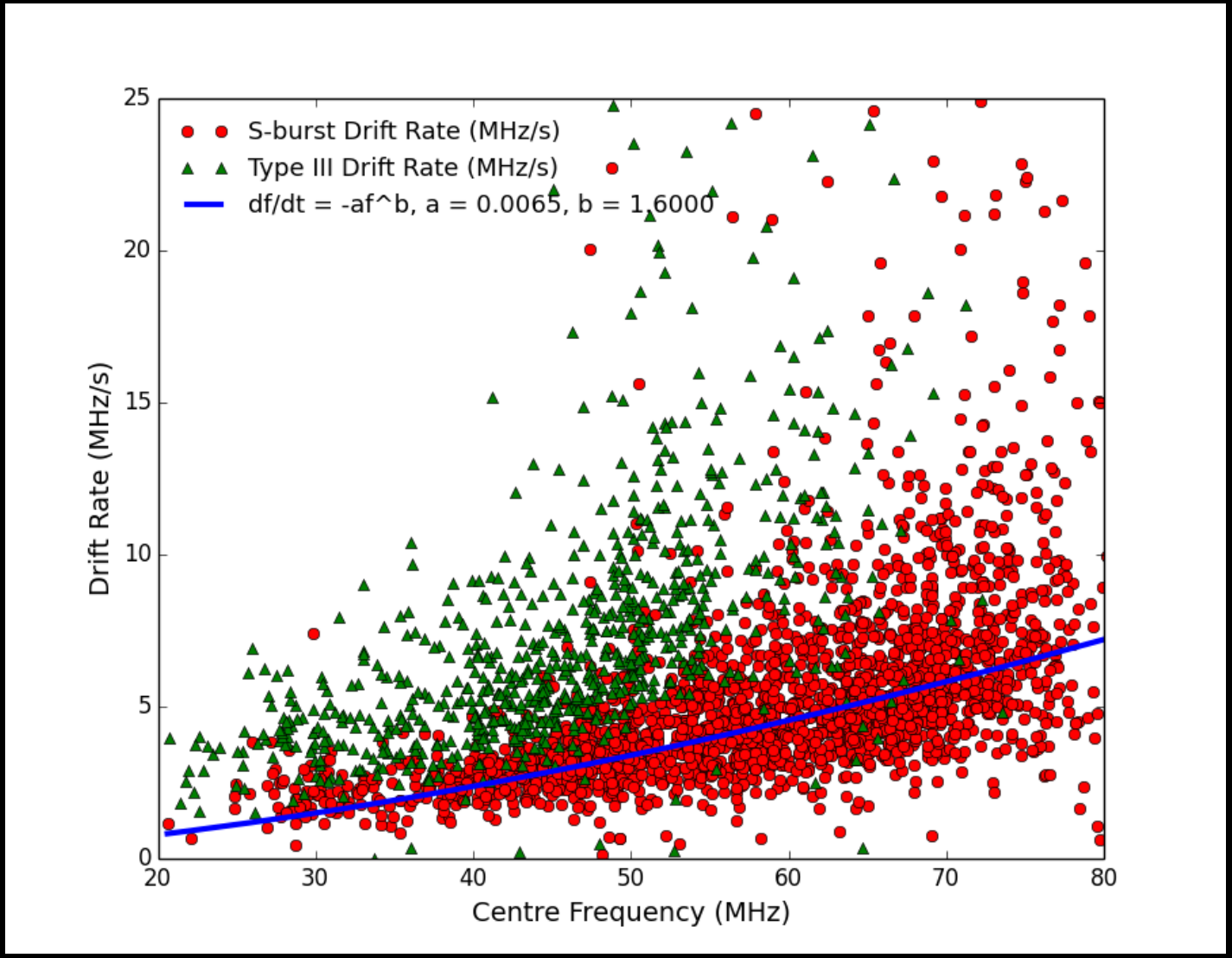
S-bursts (red) and Type III (green) Drift Rate

~3000 S-bursts and ~700 Type III radio bursts in ~8 hours



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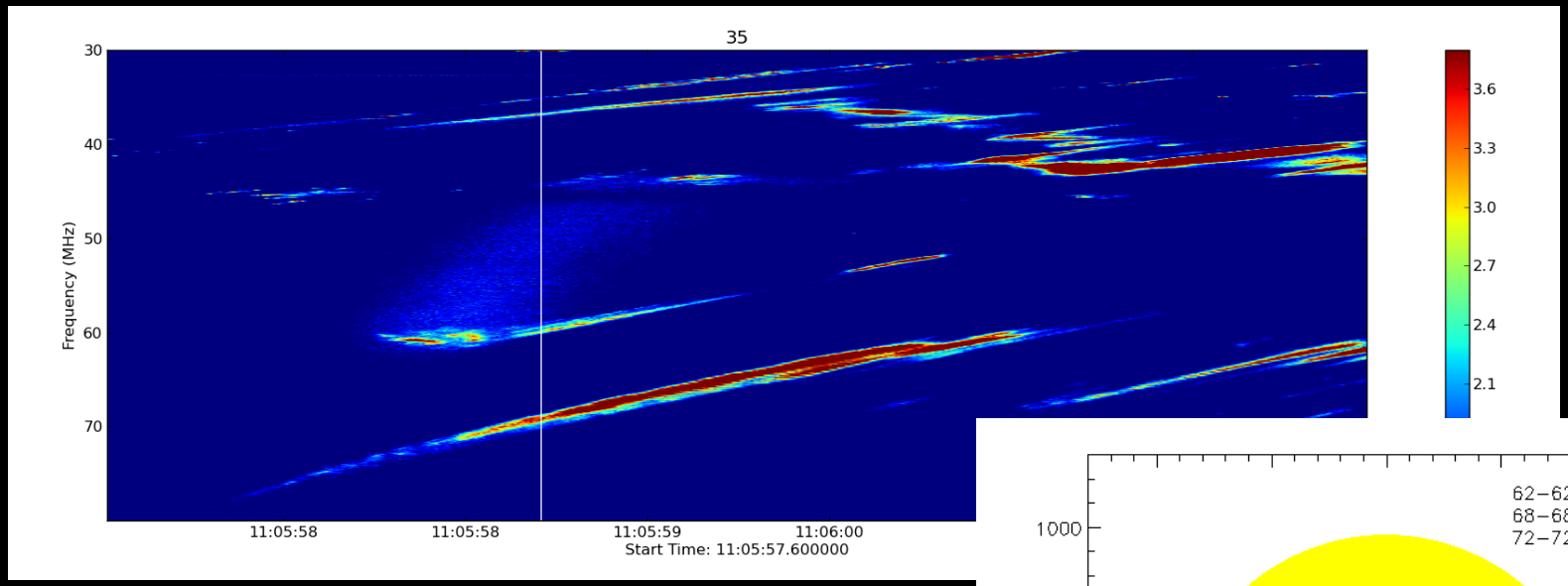
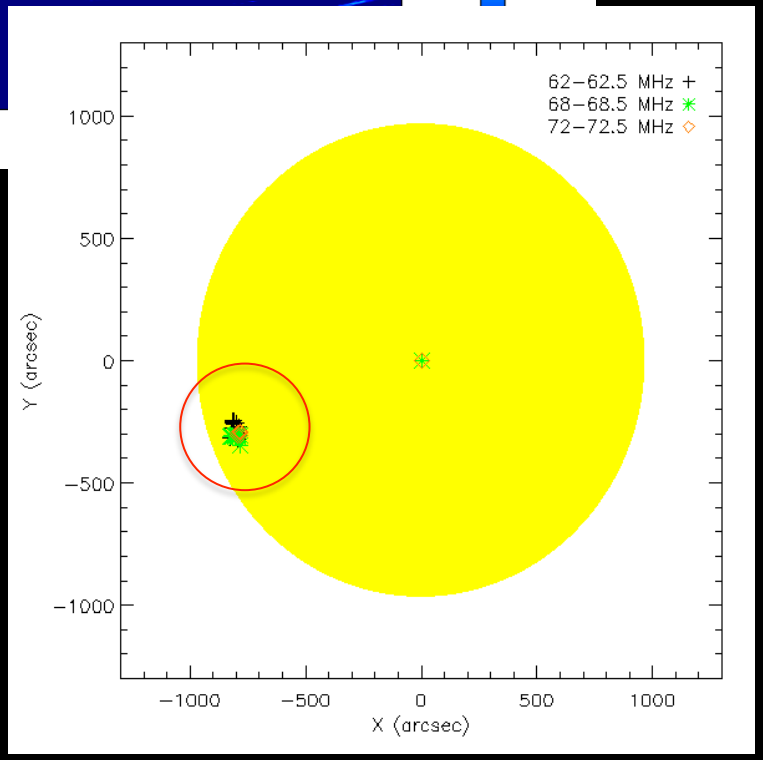
S-bursts Properties - Plasma Emission?





Centroids are at the same location independent of frequency.

Plasma frequency: $f_p = 9000\sqrt{n_e}\,Hz$

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Conclusions and Future Observations

- First images of solar S-bursts at 50 ms cadence
- High cadence interferometric observations of solar S-bursts needed during the presence of complex active regions (<0.25 s) with LBA and HBA
- Calibrated polarization measurements of solar S-bursts at <10 ms temporal resolution and other radio bursts coordinated with UTR-2

Conclusions and Future Observations

	Plasma Emission	Maser Emission	Solar S-bursts
Emission Frequency	f = 9000sqrt(n_e)	F = eB/m	10-140 MHz
Source Height	Low corona to interplanetary space	Very low corona (<1.1 solar radii)	>1.5 solar radii
Duration	A few seconds to minutes	<1 s	<1s
Bandwidth	Broad (up to a few hundred MHz)	Narrow (a few MHz)	Narrow (3 MHz)