Imaging the Solar Corona during the 2015 March 20 Eclipse using LOFAR

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Cover Image: PROBA2/SWAP 174 Å

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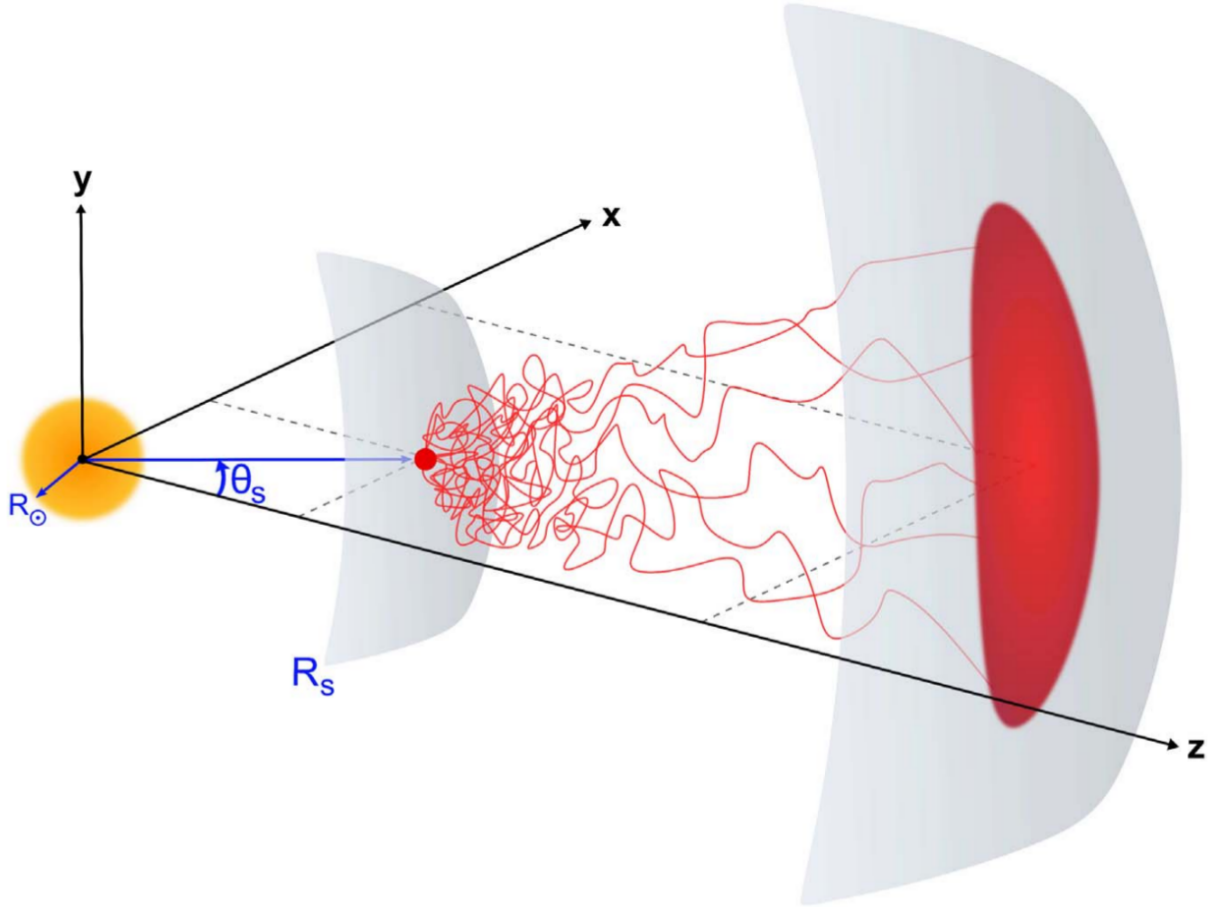
Motivation

How does turbulence in the corona affect observed source size?



Kontar et al., ApJ, 2019

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Aim

Novel techniques to probe coronal source sizes

Partial solar eclipse observed by LOFAR

→ **WP1** Interferometric Imaging

→ **WP2** Lunar De-occultation Technique

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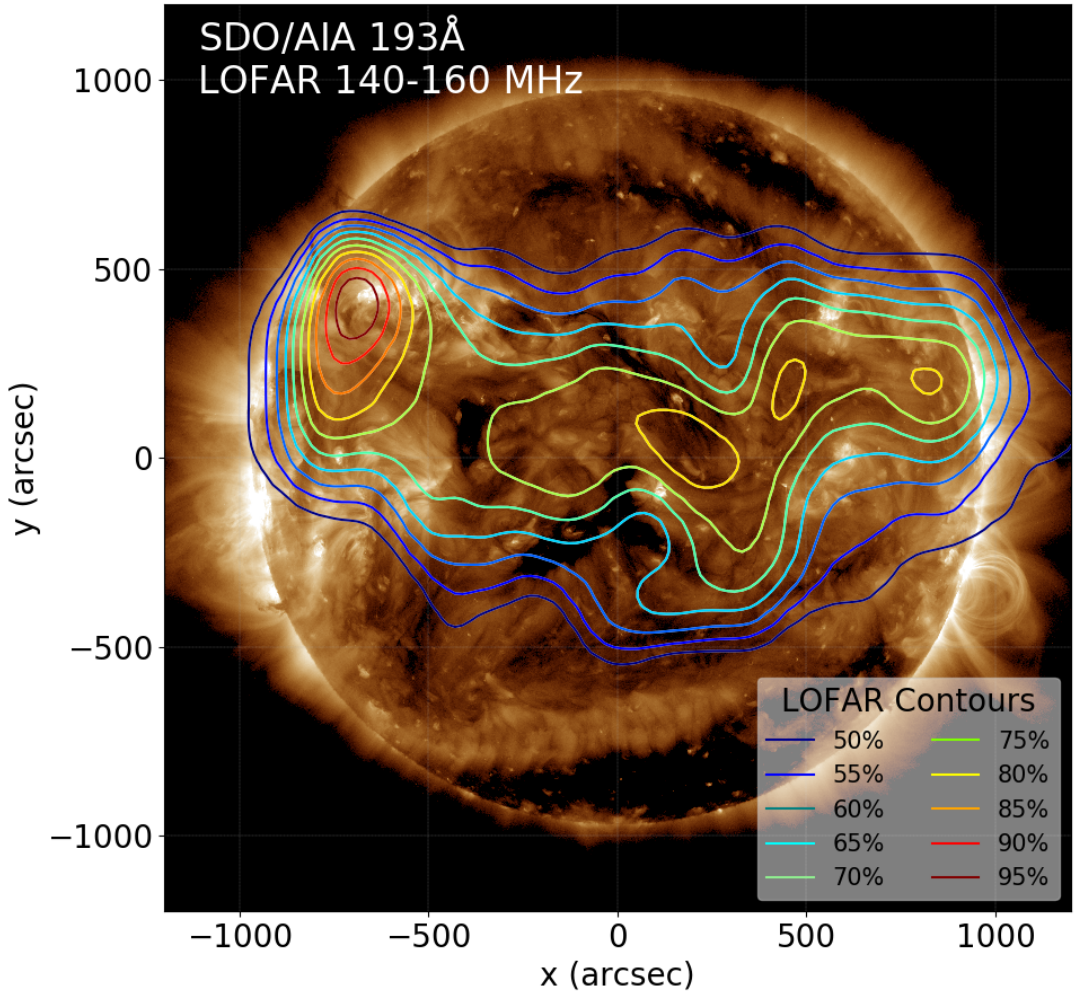
WP1 Interferometric Imaging

- 20-03-2015, 07:20 – 12: 00 UT
- Interferometric Imaging
- Max baseline ~3.5 km (beam size ~ arcminutes)
- HBA observation (120 MHz – 180 MHz)
- Source sizes ~5 – 10’



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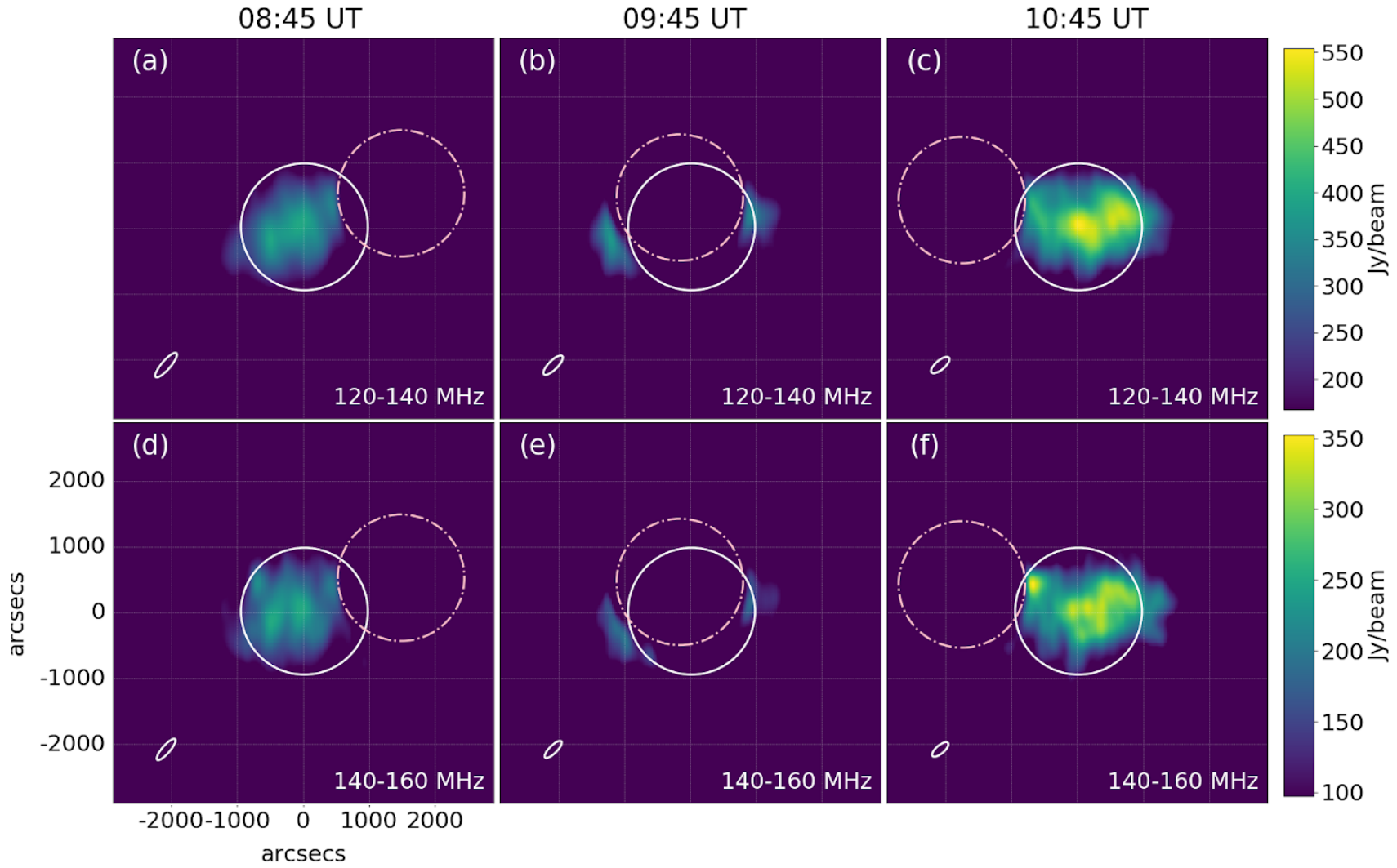
WP1 Interferometric Imaging



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WP2 Lunar De-Occultation Technique

- Not limited by PSF
- Better spatial resolution
- Difference dirty maps (no need for deconvolution)

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Step 1. Subtract consecutive visibilities

$V_{i+1} - V_i = V_{diff}$

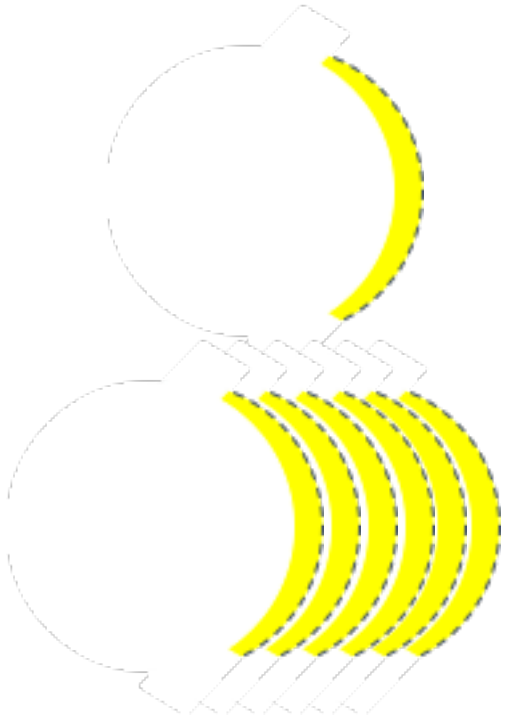
$(a+bi)_{t1} - (a+bi)_{t2}$

Step 2. Make dirty image from Vdiff

$Im_{diff} = FT^{-1}(V_{diff})$

Step 3. Sum together the differenced images

$\Sigma\, Im_{diff}$



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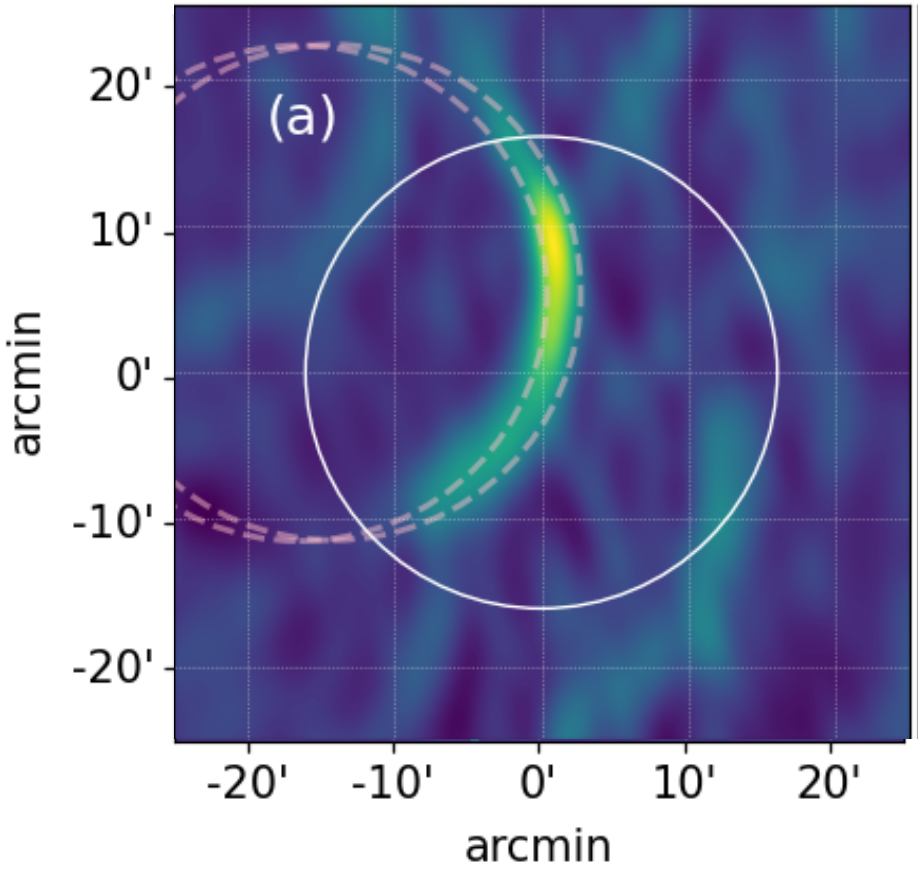
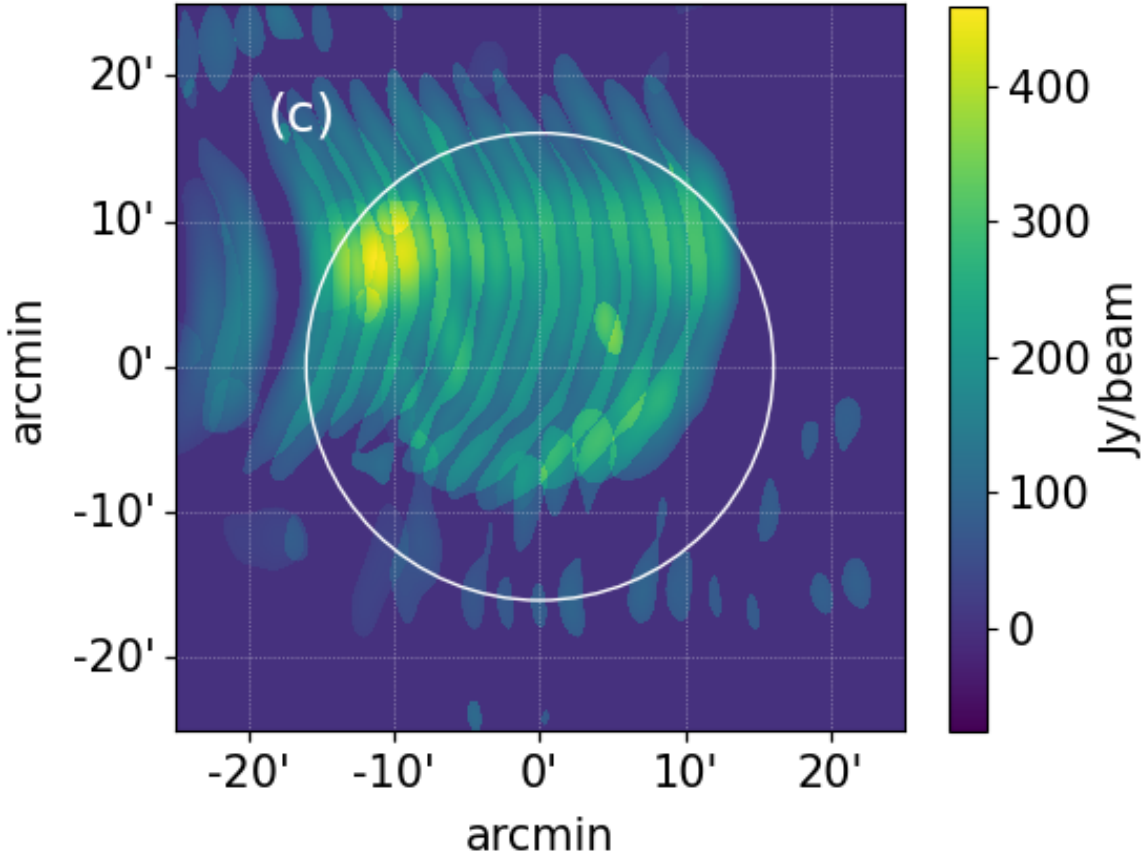
Steps 1 & 2





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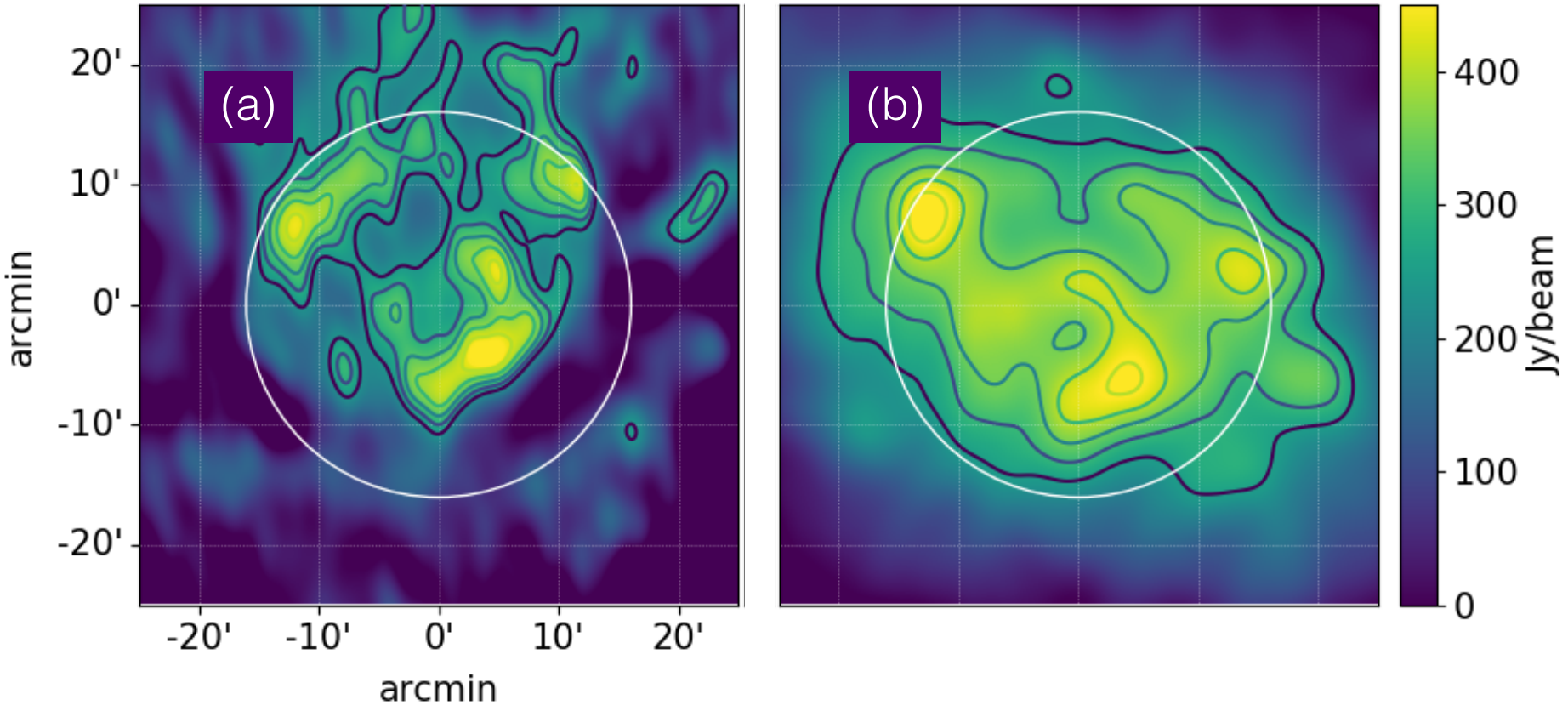
De-occultation vs. Interferometry



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De-occultation vs. Interferometry

→Appears to produce higher resolution radio image of Sun

→Are we overestimating the effects of scattering?

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Conclusions

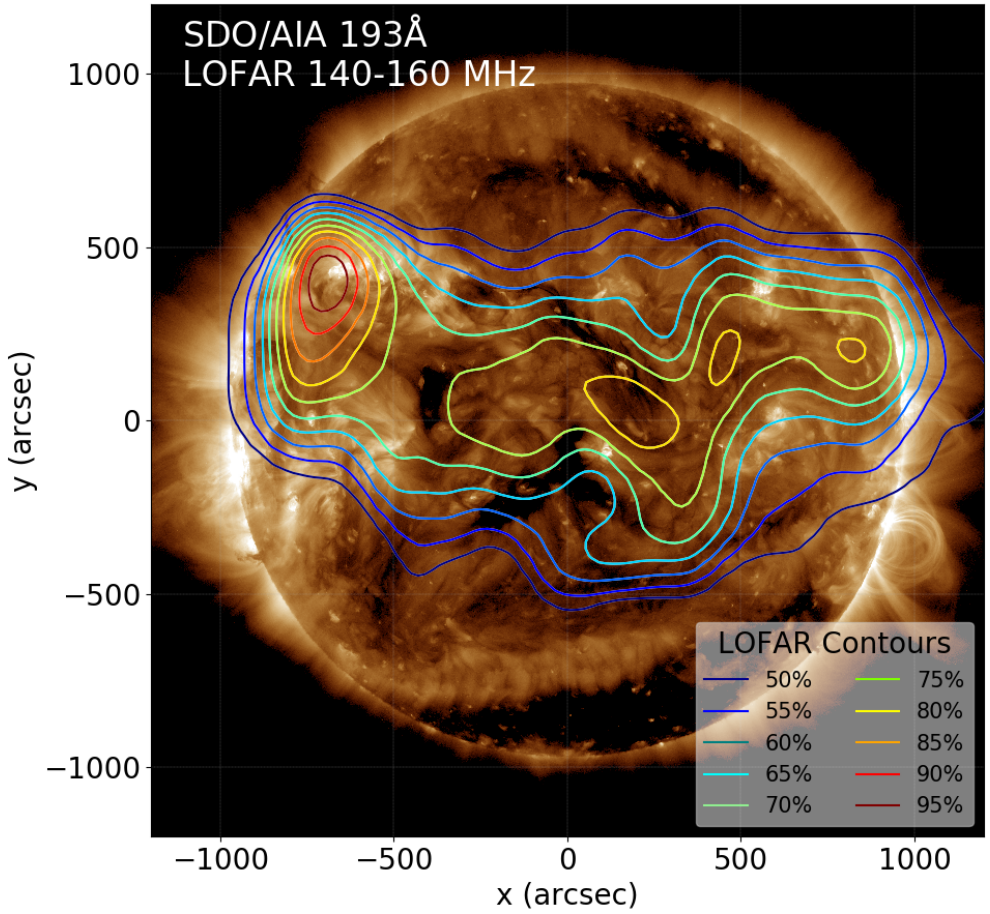
Ryan et al., A&A, 2019, (in prep).

WP1 Interferometric Imaging

- First interferometric imaging of solar eclipse using LOFAR

WP2 De-occultation Technique

- First use of lunar de-occultation technique for MHz radio astronomy
- Better resolution than classic interferometry



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