Exploring *Weak Impulsive Narrowband Quiet Sun Emissions* (WINQSEs): Clues to coronal heating

Divya Oberoi[1] (div@ncra.tifr.res.in)
Surajit Mondal[2], Rohit Sharma[3], Ayan Biswas[1], Shabbir Bawaji[4], and Ujjaini Alam[4]
1 NCRA-TIFR, India; **2** NJIT, USA; **3** FHNW, Switzerland;
4 e4r, ThoughtWorks, India

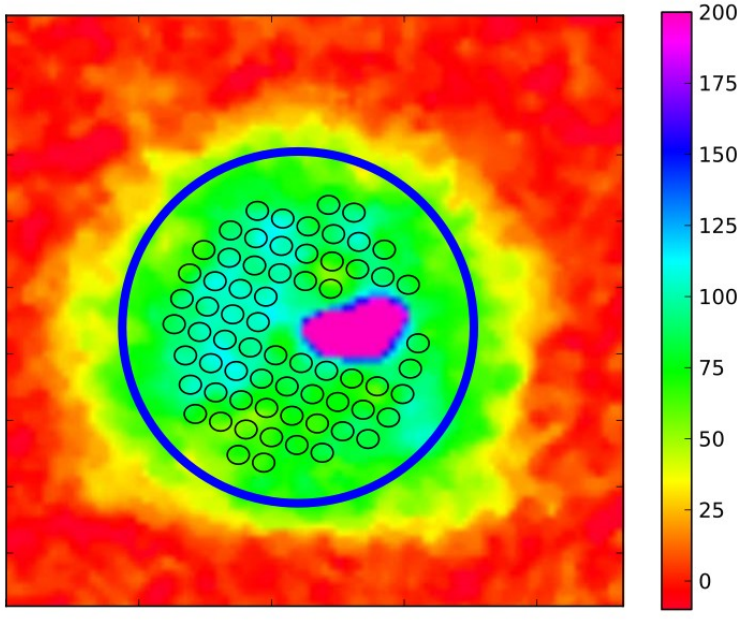
27 May 2022

Nanoflares at radio waves

- Small reconnections are expected to produce nonthermal electron beams
- These nonthermal electron beams on interaction with the thermal plasma can give rise to plasma emission
- Being a *coherent* emission this can produce a “disproportionately” large observational signature at low radio frequencies

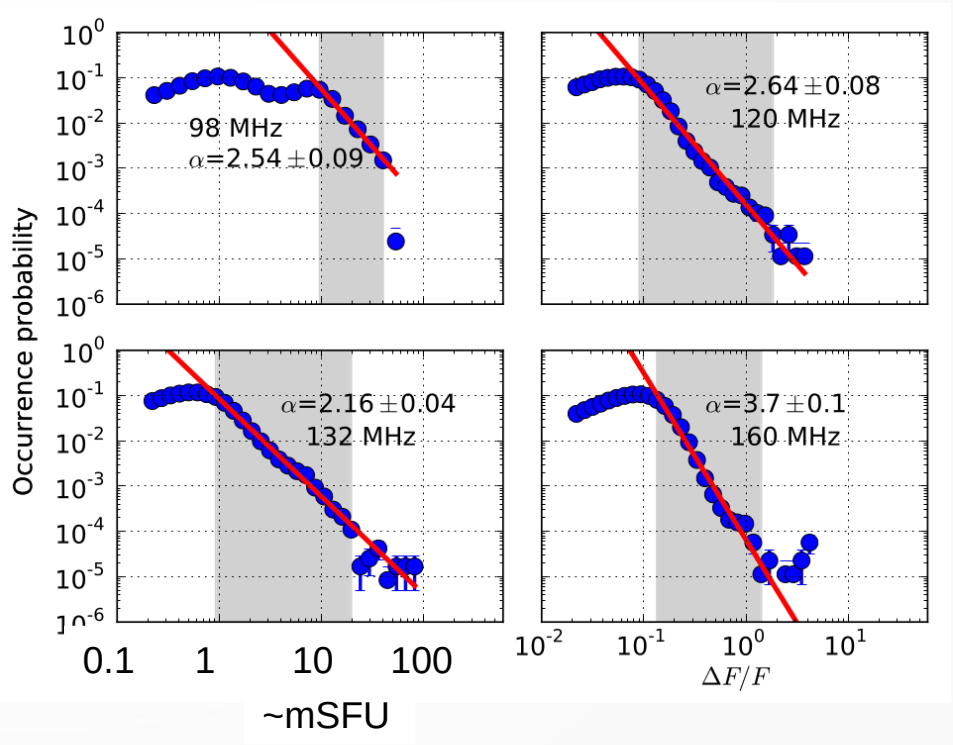
The first detection of WINQSEs

Weak Impulsive Narrowband Quiet Sun Emissions - WINQSEs



160 MHz, 0.5 s, 160 kHz

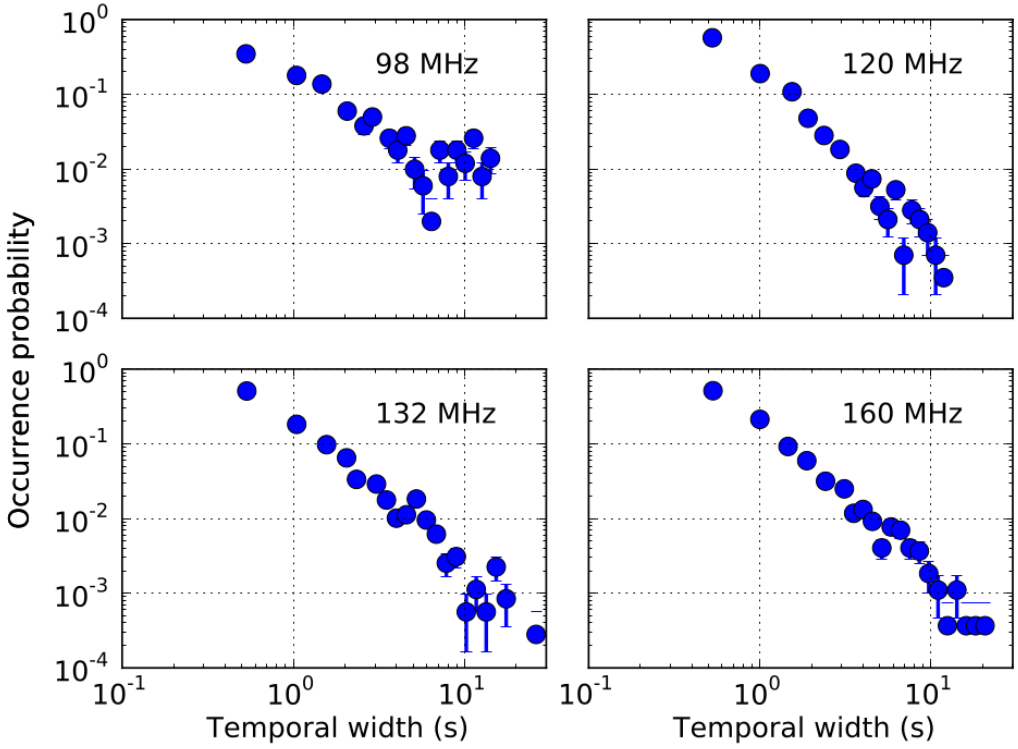
$$(\Delta F/F)_{i,t} = \frac{F_{i,t} - < F_i >}{< F_i >}$$

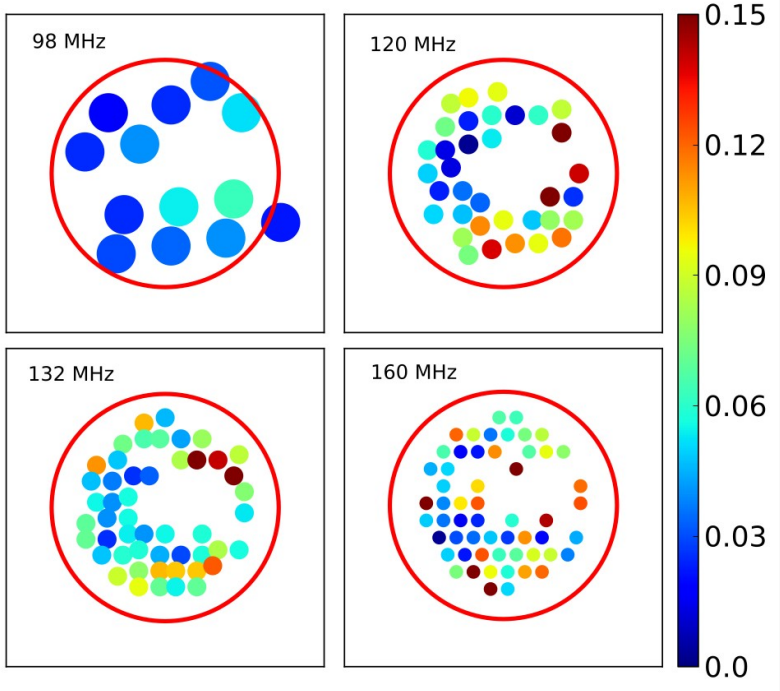


70 min; 4 spectral channels; ~33,000 images
82,000 features (most at 132 MHz – 33,500)

Mondal et al. (2020)

Properties of WINQSEs



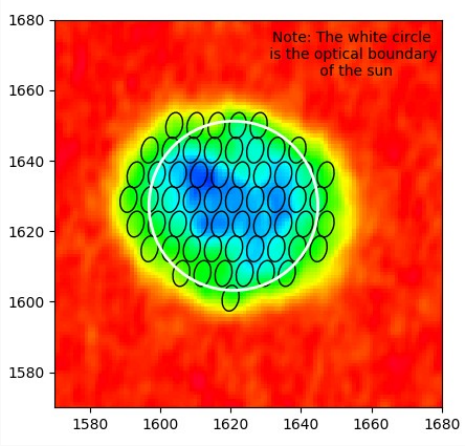


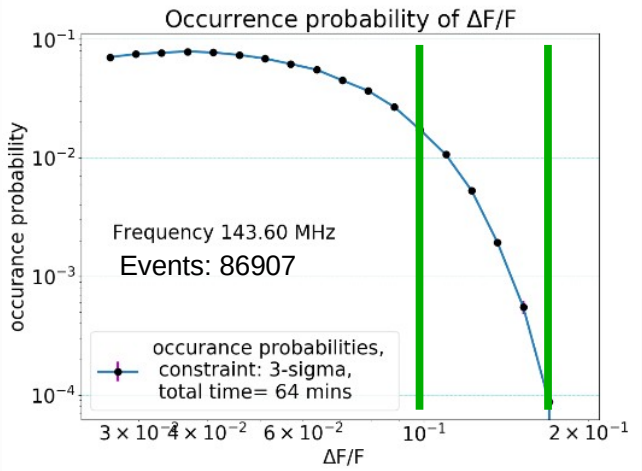
Most of the WINQSEs unresolved in time

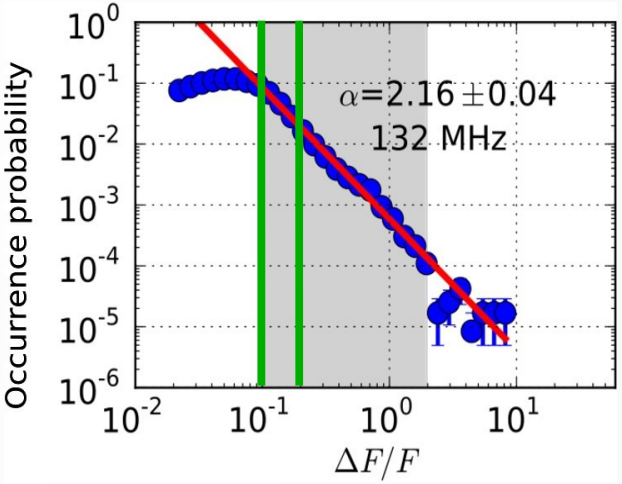
Ubiquitous over the quiet Sun

Mondal et al. (2020)

Very quiet solar conditions



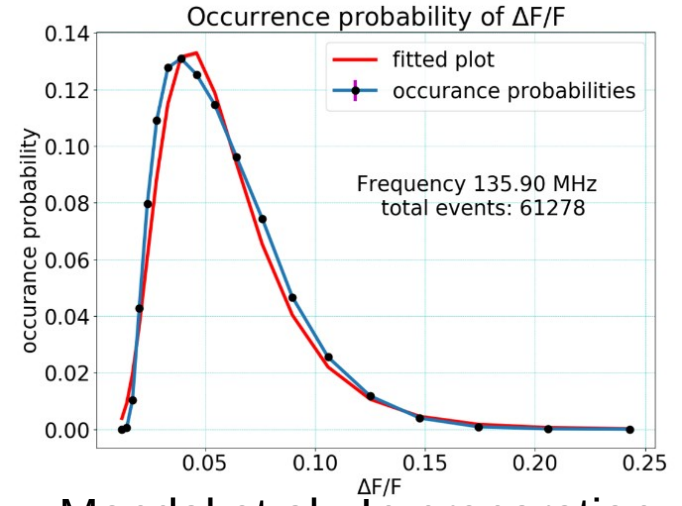




- A much larger number of weaker features are seen
- Ubiquitous over the quiet Sun
- The brightest WINQSEs are missing!

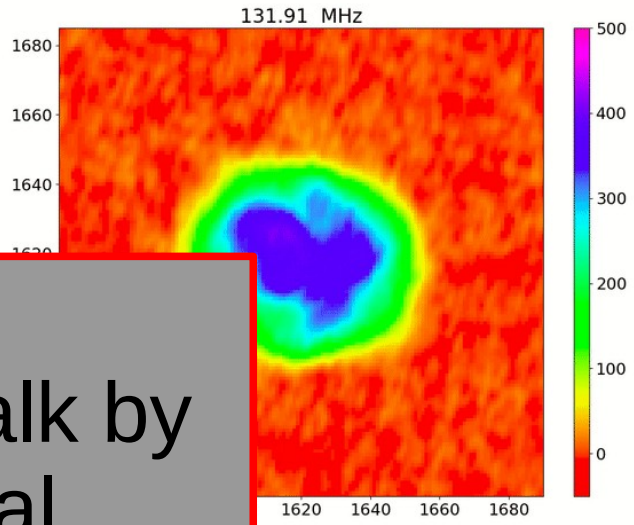
- All of the more energetic WINQSEs come from the vicinity of the lone active region!

- Distribution well described by a log-normal function (Pauluhn and Solanki, 2007)



Mondal et al., In preparation

The morphology of WINQSEs

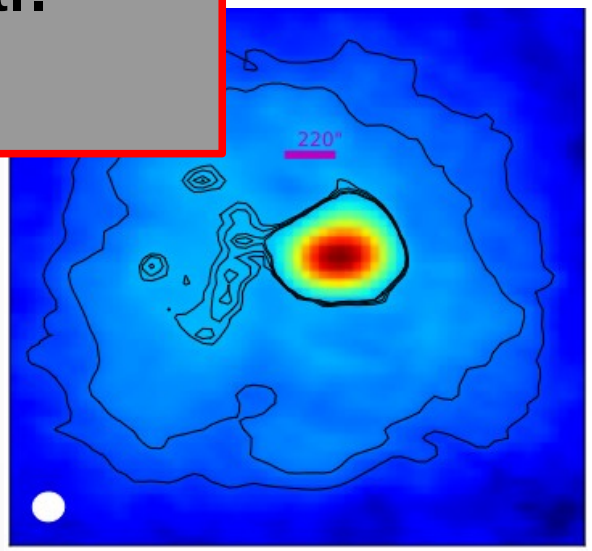


These reconnecti
spatial scales.

Intrinsic shapes c
compact, though

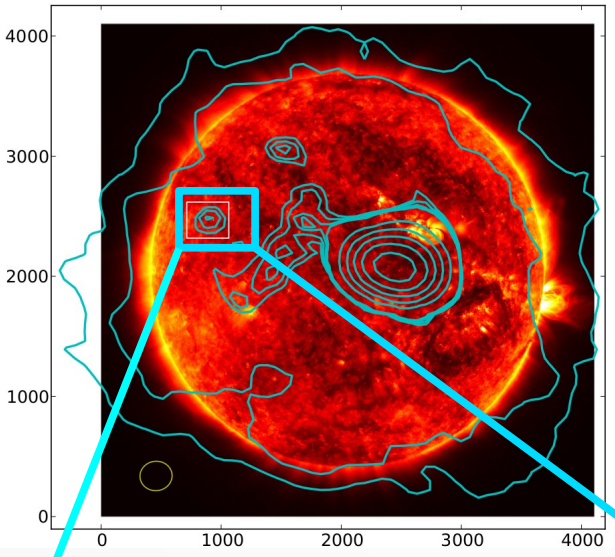
Very large number of features to characaterize → use of AI/ML driven techniques.

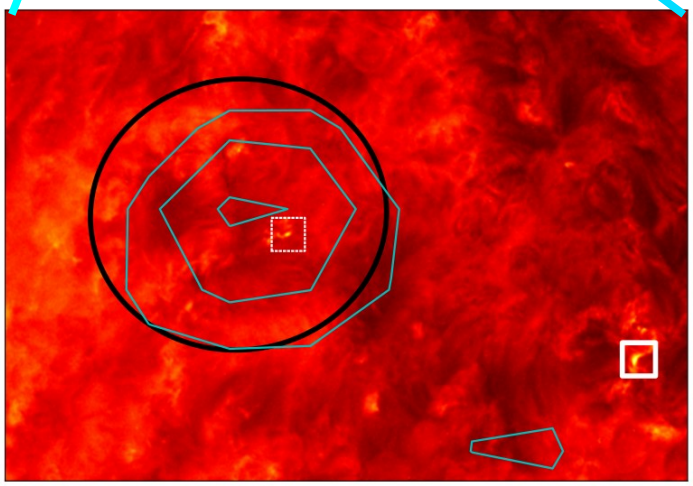
Subject of the next talk by Shabbir Bawaji et al.

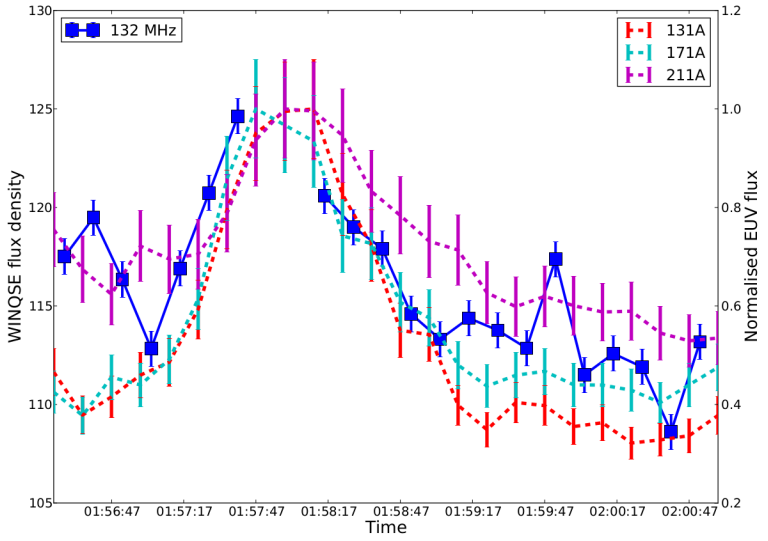


Bawaji et al., in preparation

EUV counterparts of WINQSEs

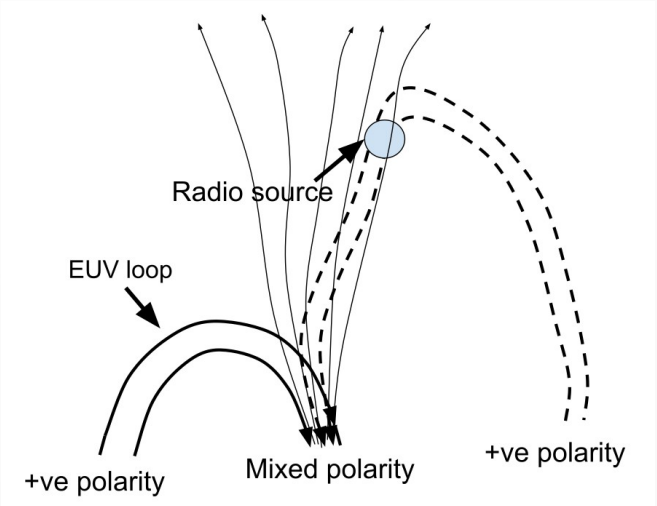






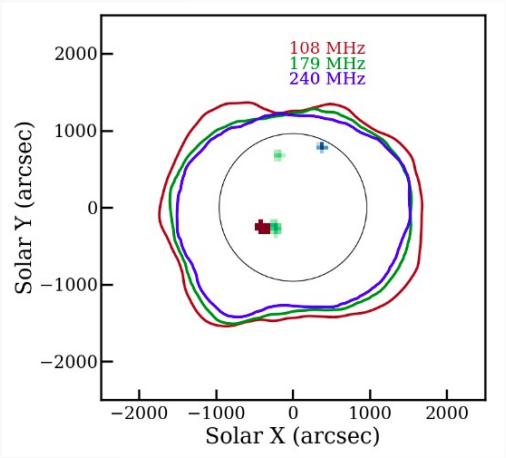
S_{peak} ~2 mSFU

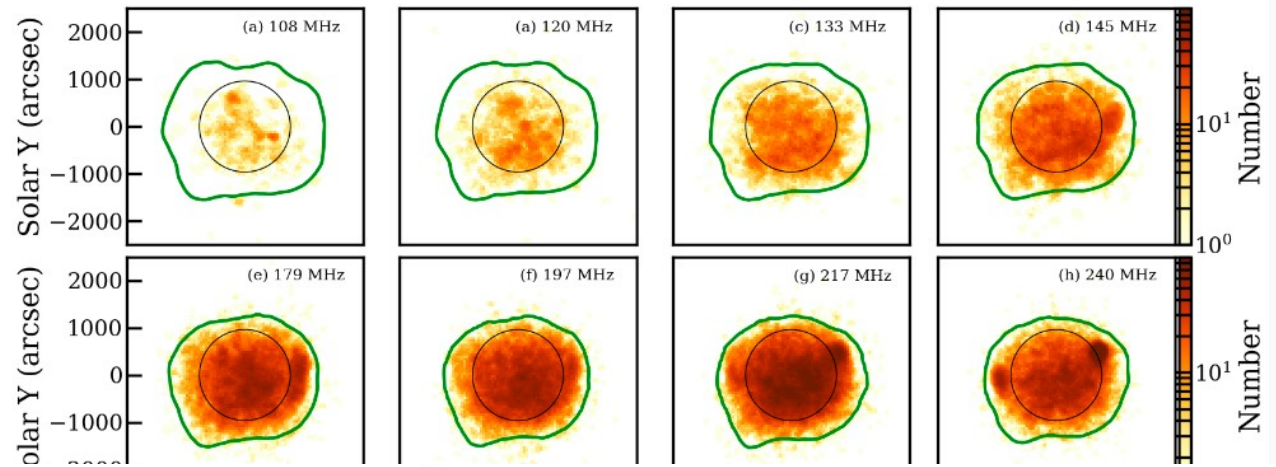
Energy deposited in corona (DEM analysis) ~10^{25} ergs



Mondal (2021) Sol Phys 296, 131

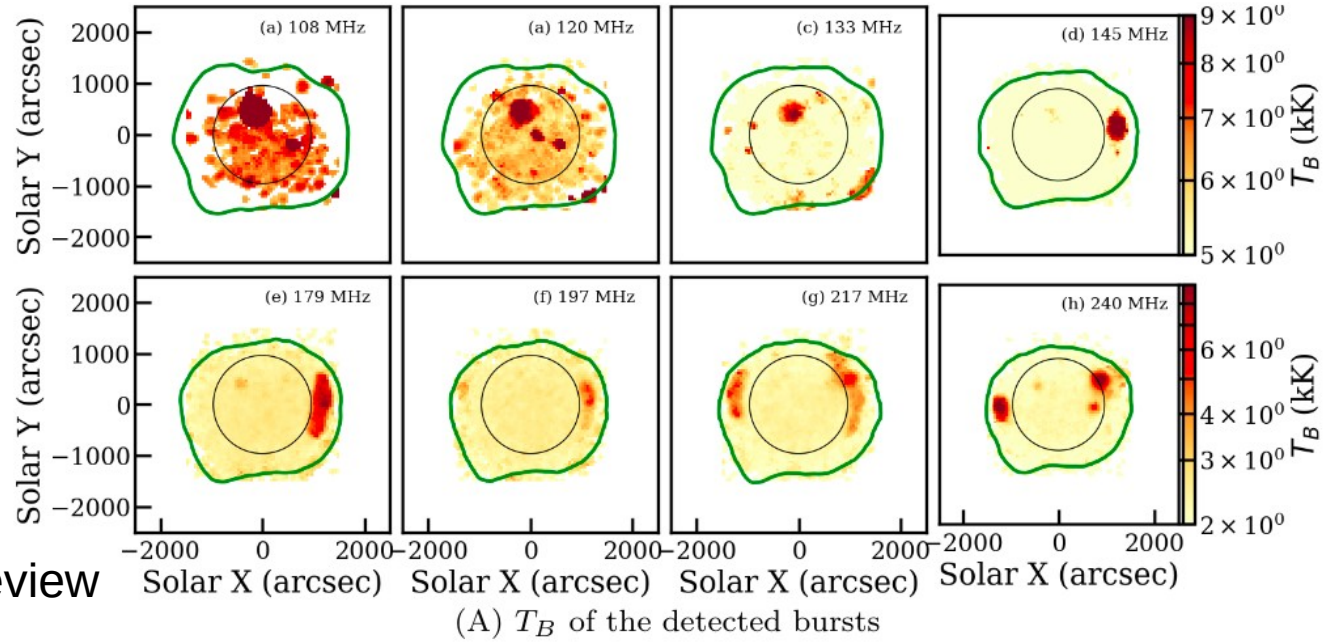
An independent detection technique





Using “residual visibilities” to image only the rapidly time varying part of solar emission.

Similar, in principle, to running difference images, only done in Fourier domain.



(A) T_B of the detected bursts

Sharma et al., Under review

Summary

- Convincing detection of Weak Impulsive Narrowband Quiet Sun Emissions – WINQSEs – using multiple datasets and independent techniques
- Probe much lower energies than are typically possible to probe with EUV and X-rays
- Meet all the requirements for being relevant for coronal heating

Thank You