Understanding the morphology of WINQSEs

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Motivation

Solar Coronal Heating Problem

- Surface of the sun: ~5,800K
- Coronal of the sun: 10^6 K

Hypothesis: **Parker's Nanoflare Hypothesis**

WINQSEs: Weak Impulsive Narrowband Quiet Sun Emissions
Consequence of nanoflares
First detection: Mondal et. al. 2020
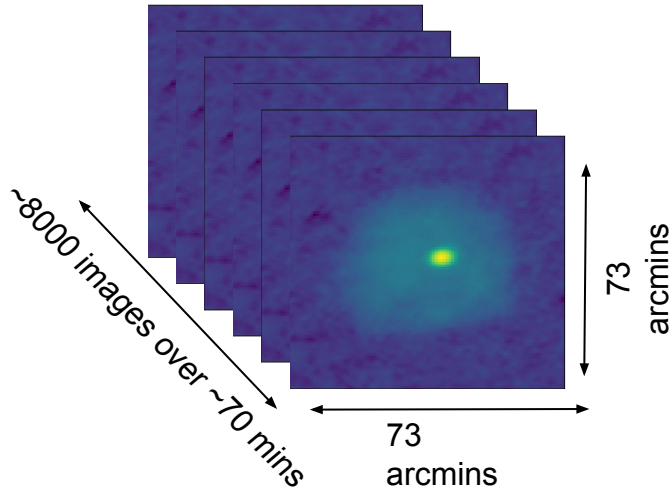
A pipeline to study shapes of WINQSEs:
Data: High quality radio frequency images available from MWA
Expected Behaviour: Random over space-time, compact, low-intensity

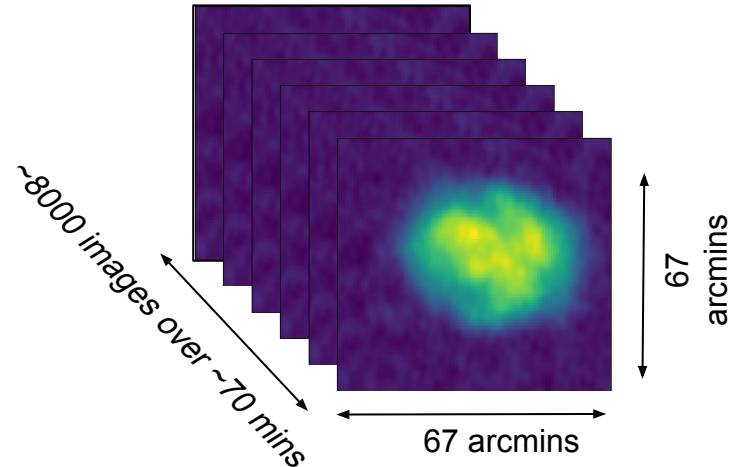# Data (MURCHISON WIDEFIELD ARRAY)

132 MHz

~8000 images, each with 0.5s integration. Prominent bright spot on Sun from an active region; harder to detect WINQSEs in vicinity.
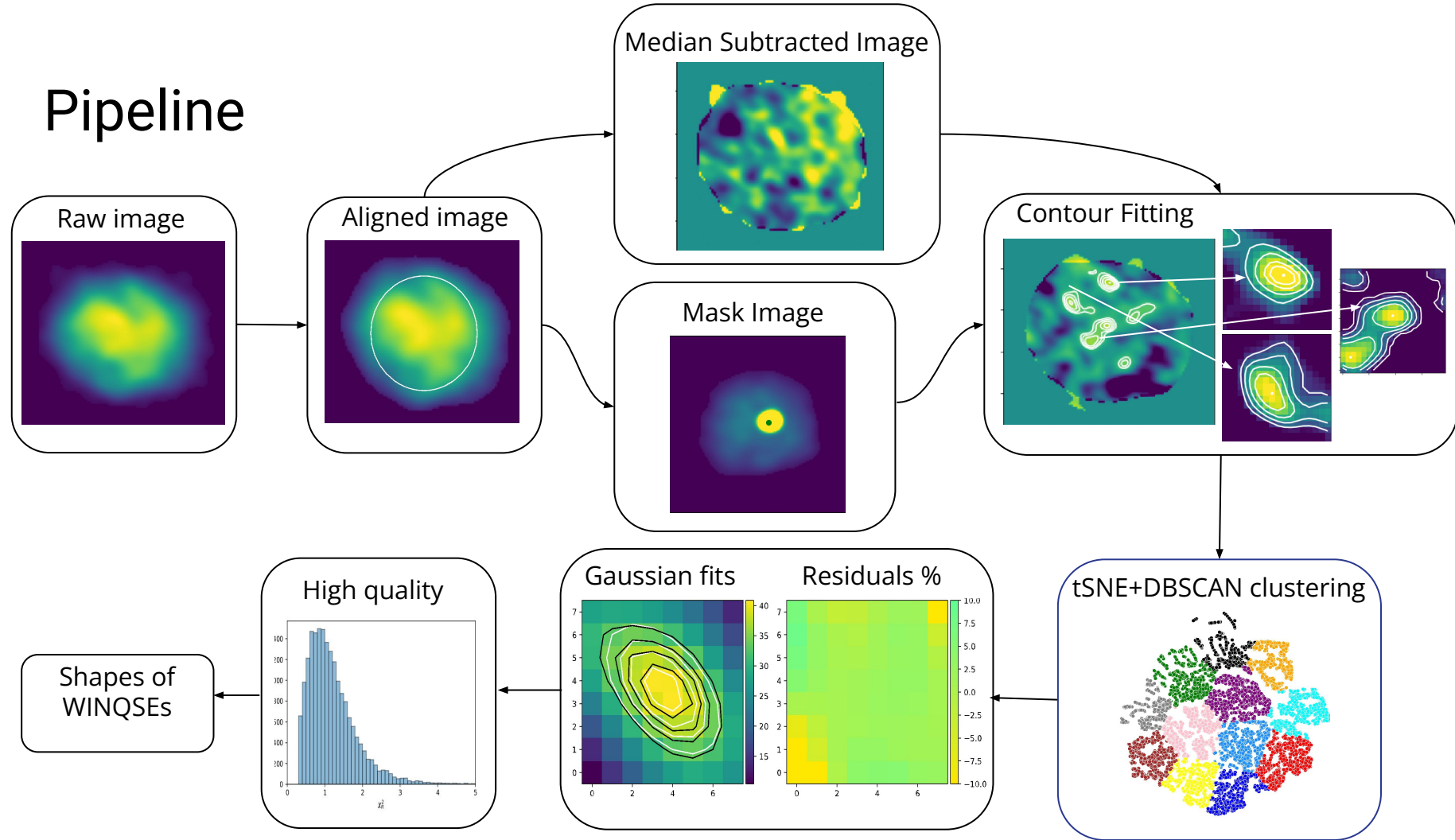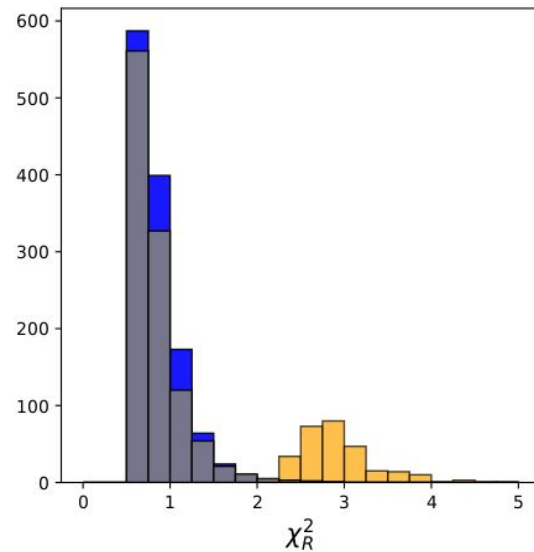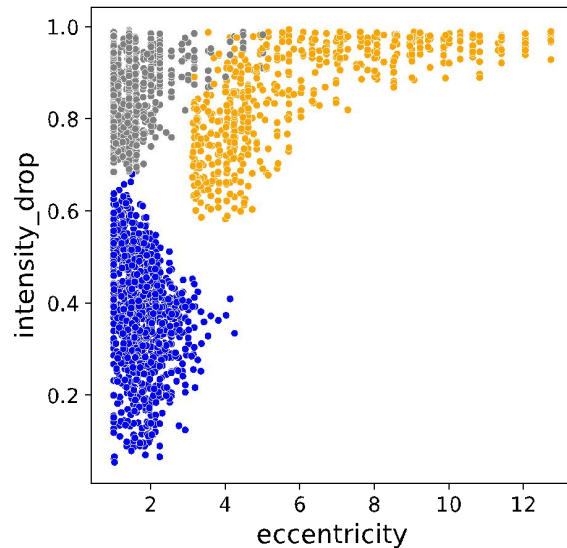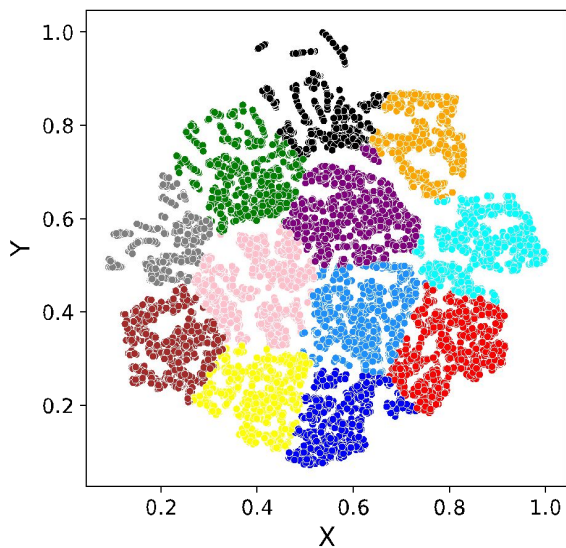
120.5, 128.2, 135.9, 143.6 MHz

~8000 images, each with 0.5s integration, at each frequency. No active region present on the Sun; easier to identify WINQSEs occurring all over the sun.
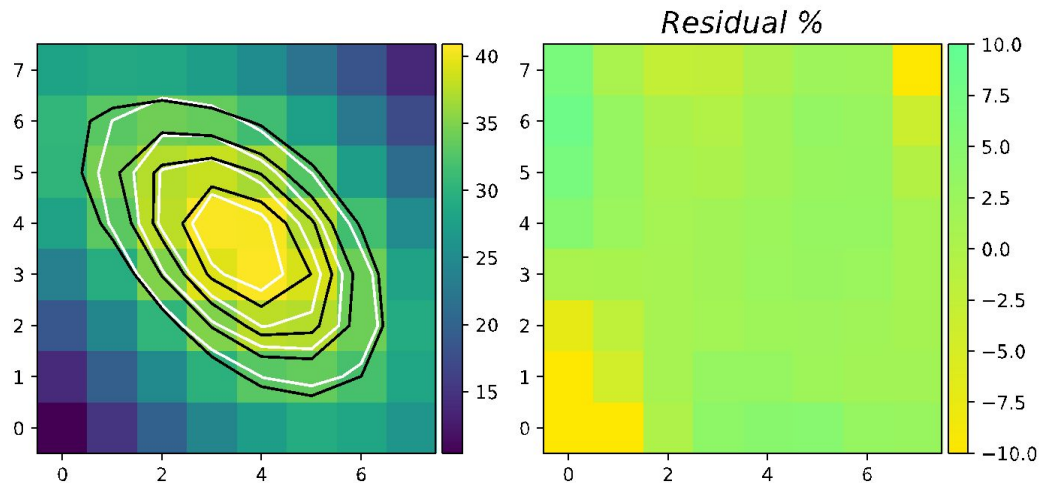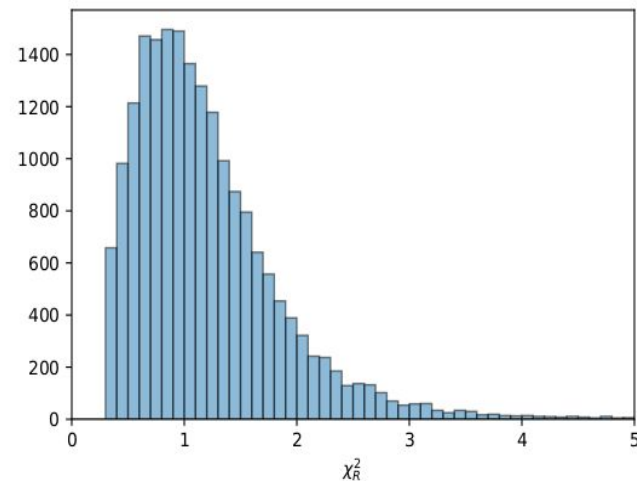
Pipeline

Raw image

Aligned image

Median Subtracted Image

Contour Fitting

Mask Image

tSNE+DBSCAN clustering

Gaussian fits   Residuals %

High quality

Shapes of WINQSEs

Clustering similar features
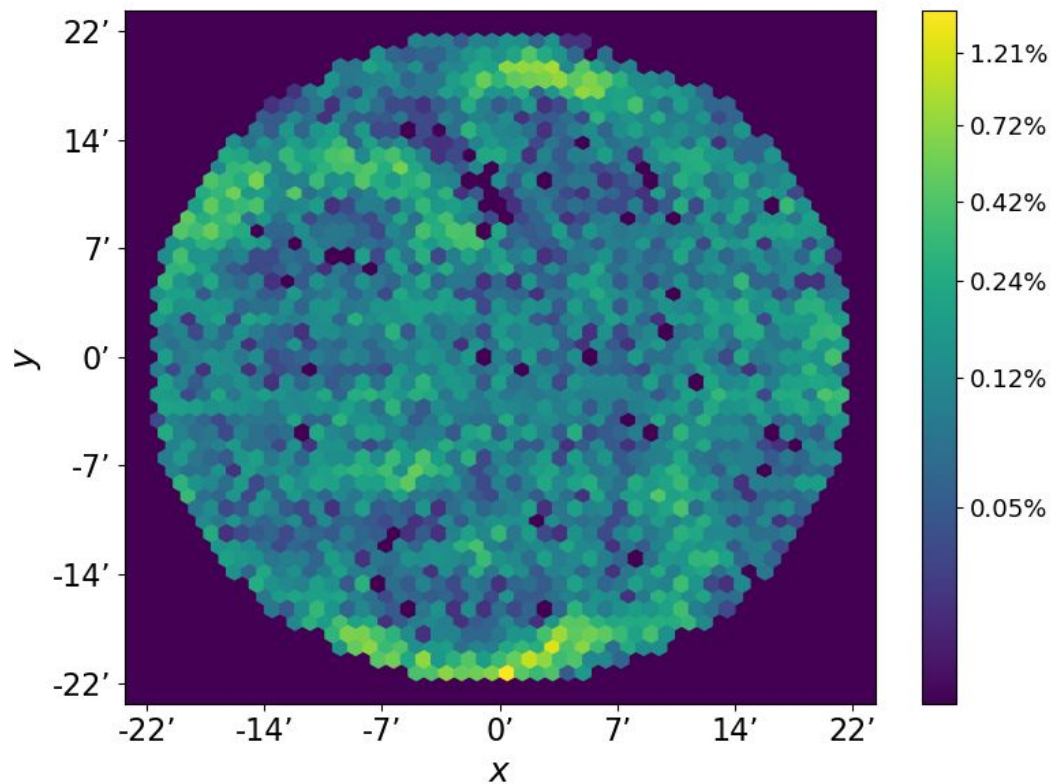
GAUSSIAN FIT TO FEATURES

Fit to individual features
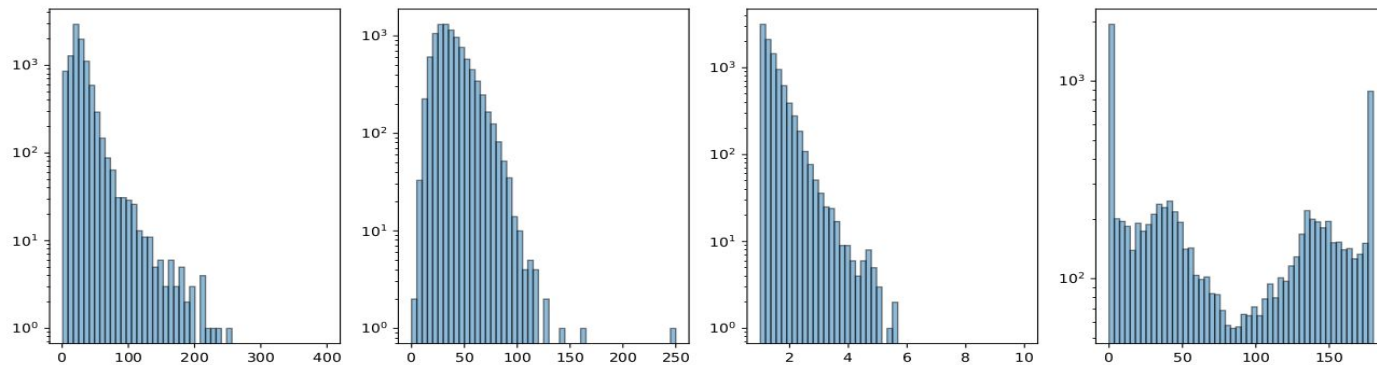
Distribution of $\square^2$

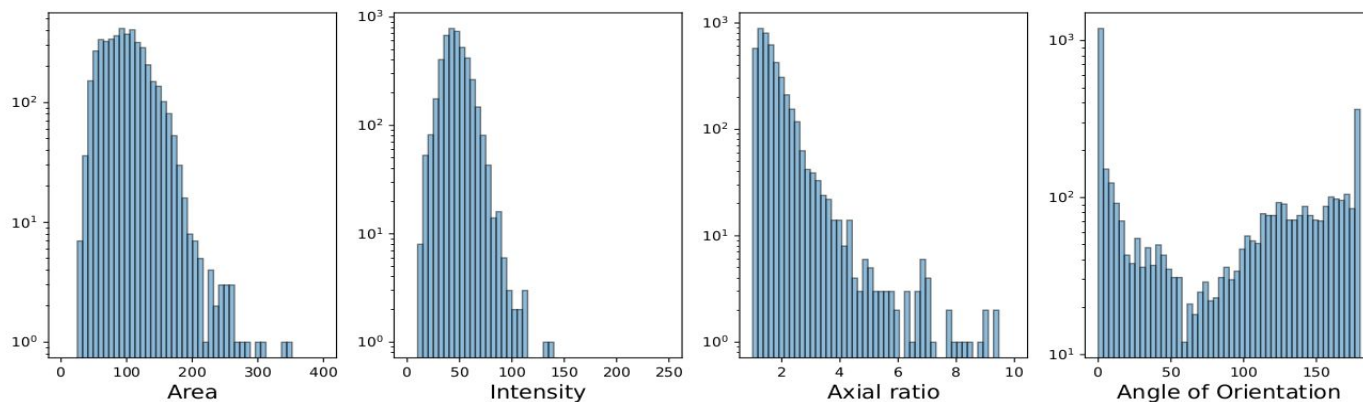Residual %

Distribution of Peaks over the surface of the sun

Distribution of fitted characteristics

Quiet Sun (120.52 MHz)

Sun with Active region (132 MHz)

Conclusion

- WINQSEs $\xrightarrow{\text{Possible radio counterparts}}$ Nanoflares

  Compact, ubiquitous in position & time   Hypothesis for coronal heating

- Significant progress over Mondal(2020) in studying WINQSEs properties for multiple datasets.
- A novel probe of coronal scattering

  Areas and axial ratio larger than PSF → scattering in apparent morphologies
- Future work:
  - Use of similar pipeline on other such images taken in other spectrums
  - Extending to study the features from spatial to spatio-temporal

Thank You

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