High fidelity spectroscopic imaging at low radio frequencies to estimate plasma parameters of solar coronal mass ejections at higher coronal heights

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Introduction and overview

- Modelling the gyrosynchrotron spectra of the radio emission from solar coronal mass ejections (CMEs) is a important tool to estimate plasma parameters of CMEs.
- High fidelity radio images at low frequency obtained from Murchison Widefield Array (MWA) (Mondal et al. 2019) is ideal for detecting and modelling very faint gyrosynchrotron emission from CME.

Previous studies

Only handful of studies managed to detect this faint gyrosynchrotron radio emission.

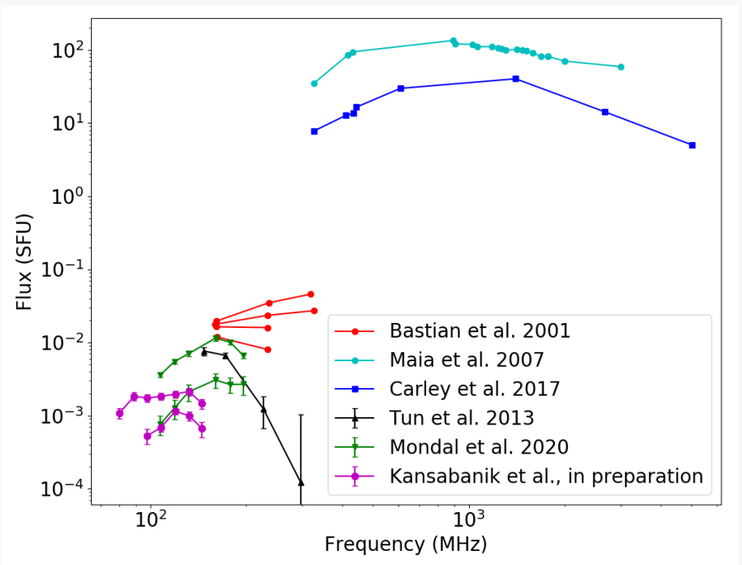

Figure: 1. Spectra for previous and present study

Detecting radio emission from CME

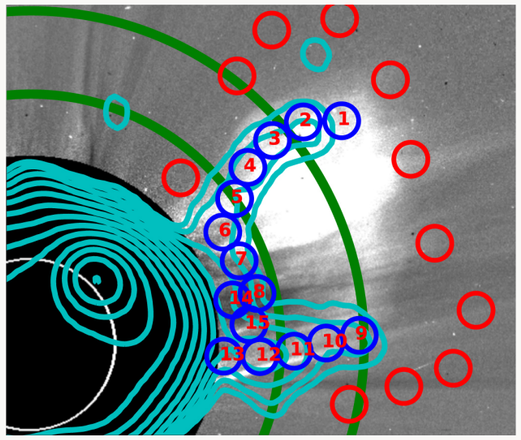

Figure: 2. Radio emission at 108−145 MHz detected upto $4.73R_{\odot}$ shown by cyan contours (Mondal et al. 2020)

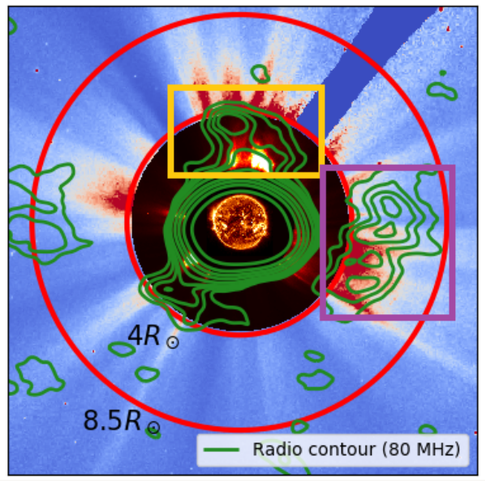

Figure: 3. Radio emissions from two CMEs are detected at 80 MHz shown by green contours. South western CME is detected at the largest heliocentric distance upto $8.3R_{\odot}$ (Kansabanik et al., in prep)

Modelling the spectra and estimated parameters

We fit gyrosychrotron model (Fleishman & Kuznetsov 2010) to the observed spectra.

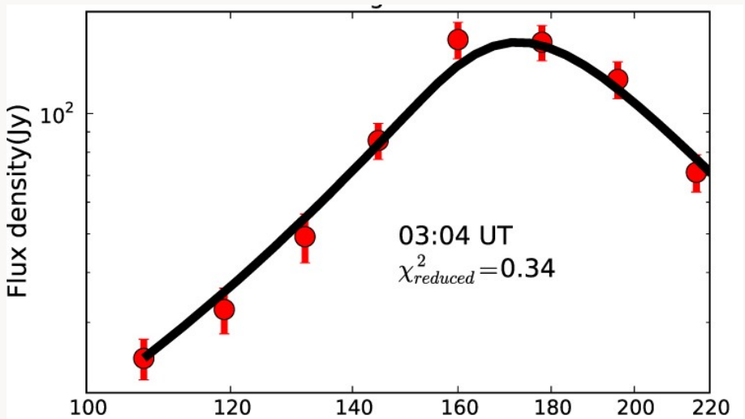

Figure: 4. Observed spectrum is shown by red points and fitted gyrosynchrotron spectrum is shown by black solid line (Mondal et al. 2020)

- Magnetic field strength, B = 1~5 G. (2.2−2.7 $R_{\odot}$)
- Non-thermal electron power-law index; δ= 2.5 ± 0.2.
- Area of emission; A = 3 ± 1 Mm^2.

Summary and conclusion

- We believe with the high fidelity low frequency radio images it is now possible to detect this faint gyrosynchrotron emission routinely at much higher coronal heights.

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MWA MURCHISON WIDEFIELD ARRAY