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Studies of Quiescent and Bursty Radio Emission of Ultra-Cool Dwarfs with the GMRT

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INTRODUCTION

Many Ultra-Cool Dwarf (UCD) properties remain unclear, e.g.:

- Magnetic field structure
- Supply of energetic electrons to magnetosphere
- Relationship of radio properties with other properties

Observed two UCDs with the Giant Metrewave Radio Telescope (GMRT) at 1400 and 610 MHz, to determine:

1. Spectral turnover frequency of quiescent radio emission
2. Existence of low-frequency component to bursts seen at 4-8 GHz

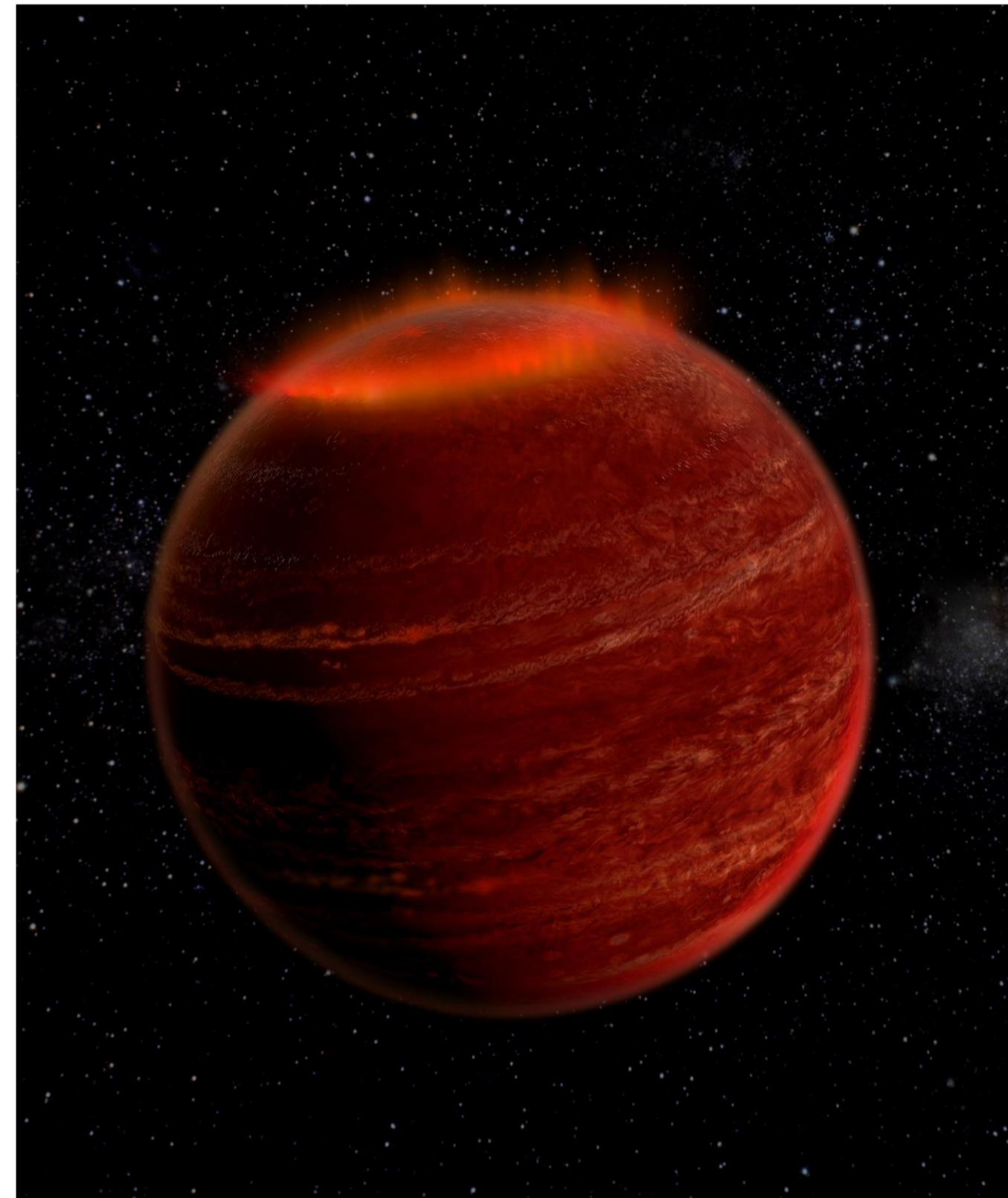


Image credit: Chuck Carter & Gregg Hallinan/Caltech

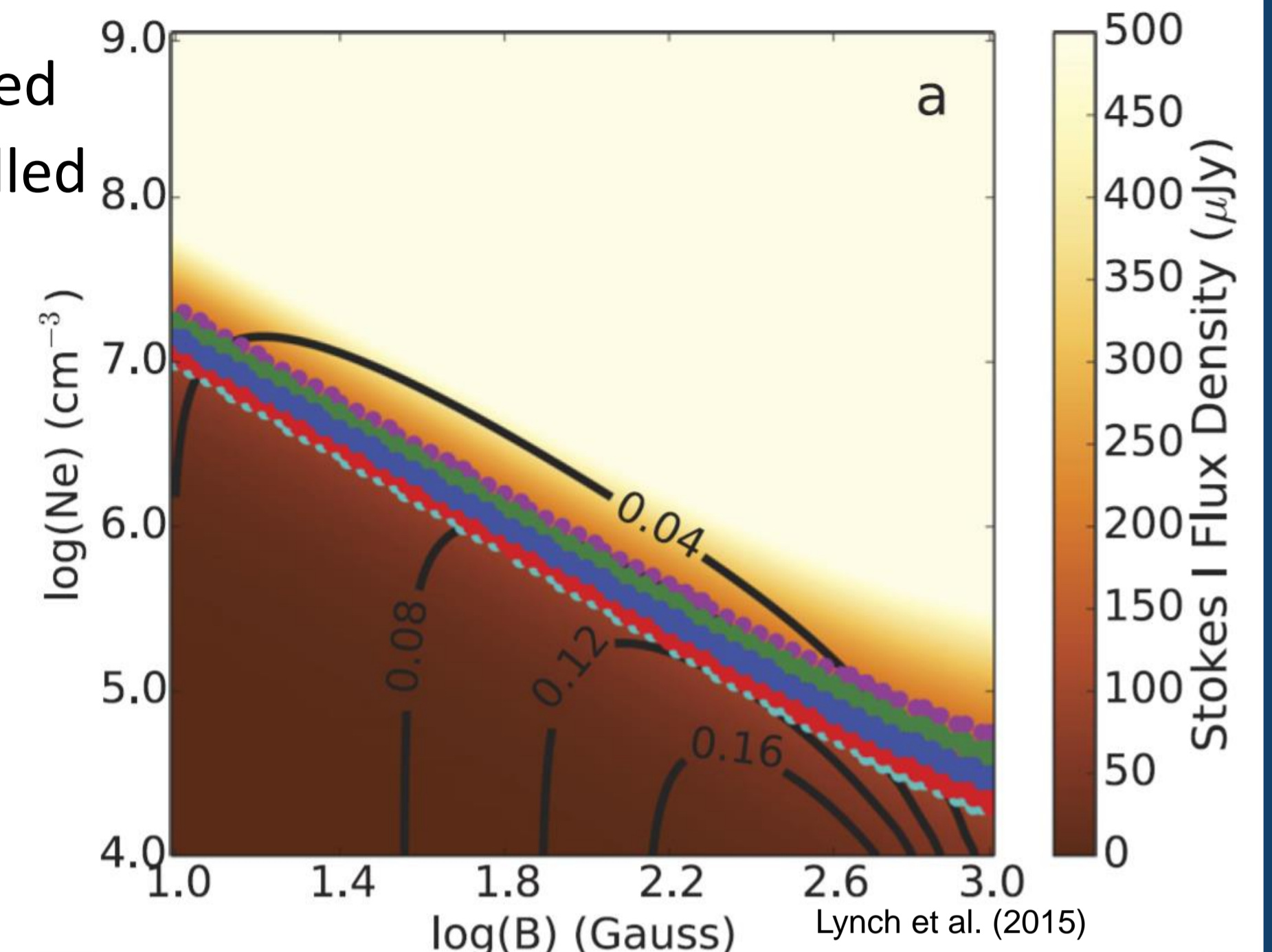
BREAKING A DEGENERACY & CONSTRAINING VOLUMES

Lynch et al. (2015): coloured lines indicate where modelled gyrosynchrotron emission consistent with measured flux density

Turnover frequency of quiescent emission breaks degeneracy:

$$\nu_{peak} \approx 10^{3.41+0.27\delta} \times (N_e L)^{0.32-0.03\delta} \times B^{0.68+0.03\delta}$$

Electron cyclotron frequency $\Omega_e = eB/cm_e \rightarrow$ constrain coronal volume suitable for radio emission



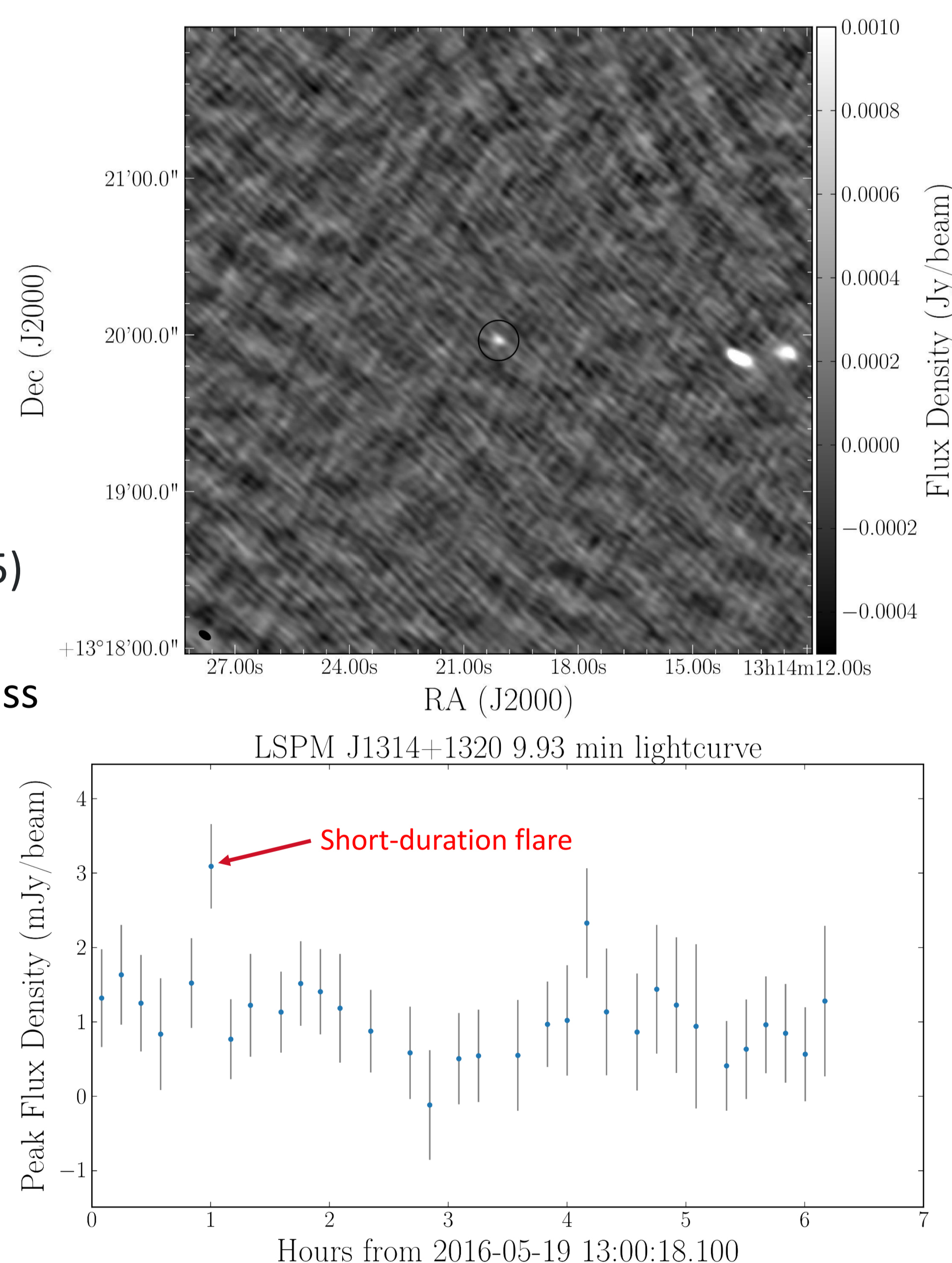
PRELIMINARY 1.4 GHz RESULTS: LSPM J1314+1320

Detect ~ 1 mJy quiescent emission, consistent with McLean et al (2011)

Variability search shows:

- Possible sinusoidal variability as reported in Williams et al. (2015)
- A short-duration (< 1 minute), high brightness temp. ($T_B \gtrsim 6 \times 10^{11}$ K) flare \rightarrow most likely coherent emission

Lowest-frequency and shortest burst detected from this UCD to date

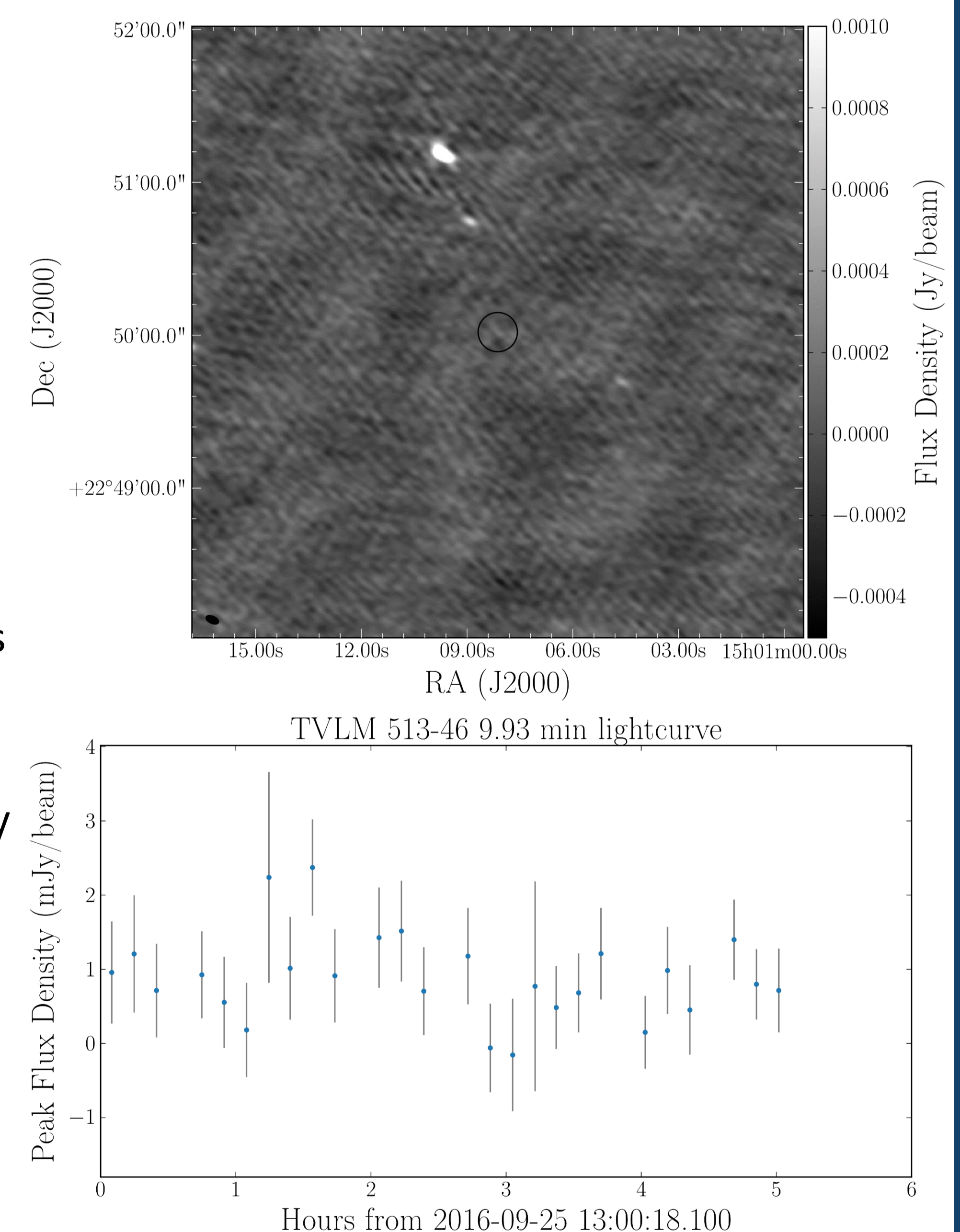


PRELIMINARY 1.4 GHz RESULTS: TVLM 513-46

No emission detected: 3σ upper limit: $236 \mu\text{Jy}$, consistent with Osten et al. (2006)

No variability detected on any timescale

Image sensitivity is less than expected for GMRT specifications \rightarrow Next step is to apply self-calibration



CONCLUSIONS

After reducing 1.4 GHz observations, we have found:

- LSPM J1314+1320 exhibits ~ 1 mJy quiescent emission and a bright (~ 5 mJy) short-duration flare
 - No detections of TVLM 513-46 – 3σ upper limit on quiescent emission: $236 \mu\text{Jy}$
- Analysis of the observations are ongoing

REFERENCES

- Lynch, C., Mutel, R. L., & Güdel, M. 2015, ApJ, 802, 106
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 Osten, R. A., Hawley, S. L., Bastian, T. S., & Reid, I. N. 2006, ApJ, 637, 518
 Williams, P. K. G., Berger, E., Irwin, J., Berta-Thompson, Z. K., & Charbonneau, D. 2015, ApJ, 799, 192