

Unravelling sub-stellar magnetospheres via radio observations

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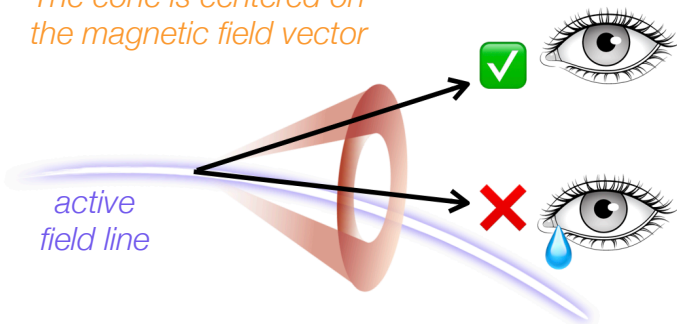
Why measure their fields?

- ★ They offer protection from energetic particles
- ★ Help prevent (or facilitate?) atmospheric stripping
- ★ Allow for satellite detection
- ★ Info about (geo)dynamo processes

Radiometric magnetometers

- ★ Measuring the Zeeman effect on sub-stellar objects is not currently feasible
- ★ Cyclotron emission provides an alternative measure of field strength ($\nu = 2.8B$ MHz)
- ★ Electrons accelerated in low-density magnetic fields can produce bright circularly polarised emission via the electron cyclotron maser (ECM) instability
- ★ ECM emission is beamed in a hollow cone, providing a unique probe of the field geometry

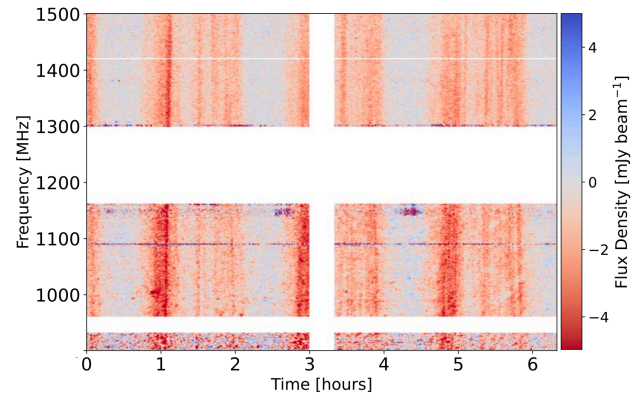
The cone is centered on the magnetic field vector



The emission is only visible at certain inclinations wrt the vector

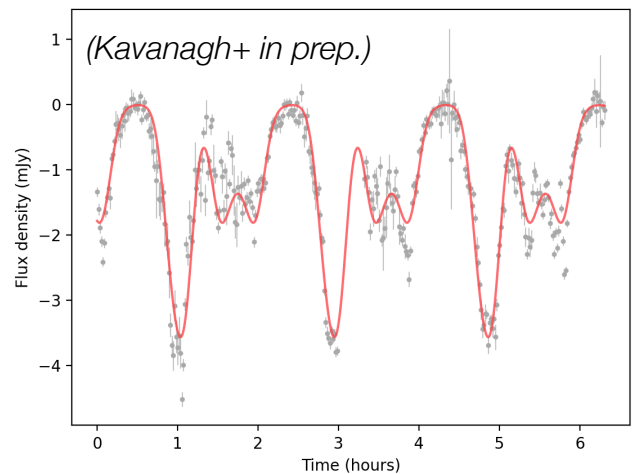
Puzzling periodic pulses

- ★ Rose+ (2023) recently detected periodic radio pulses from the nearby T8 dwarf WISE J062309.94-045624.6 using MeerKAT/ATCA
- ★ The lightcurve shows an interesting complex pattern which repeats over multiple rotations
- ★ The high circular polarisation fraction implies it is ECM emission

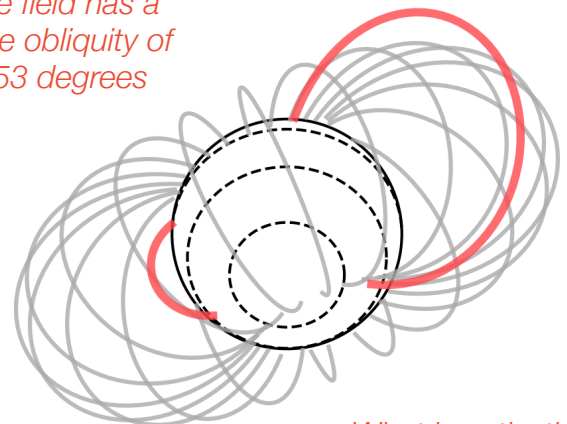


Unravelling the field

- ★ We model the radio lightcurve using a geometric model of emission beamed from active field lines
- ★ *Two active field lines* reproduce the observed pulse structure:



The field has a large obliquity of ~53 degrees



What is activating these field lines?

We are organising a splinter session at

COOL STARS 22

on Monday June 24th in San Diego titled:

"Unraveling the magnetic fields of (sub)-stellar systems"

We hope to see you there!