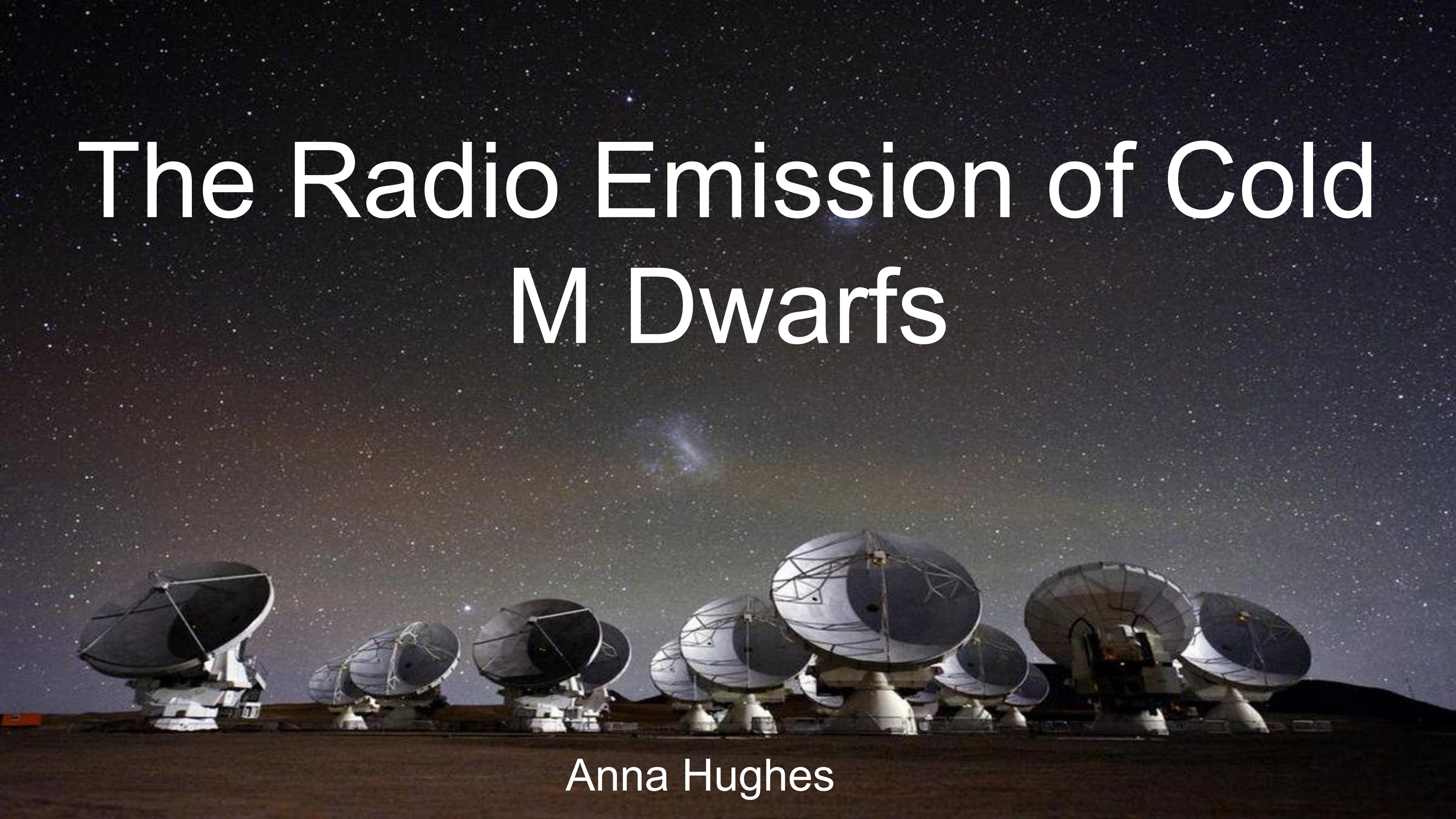
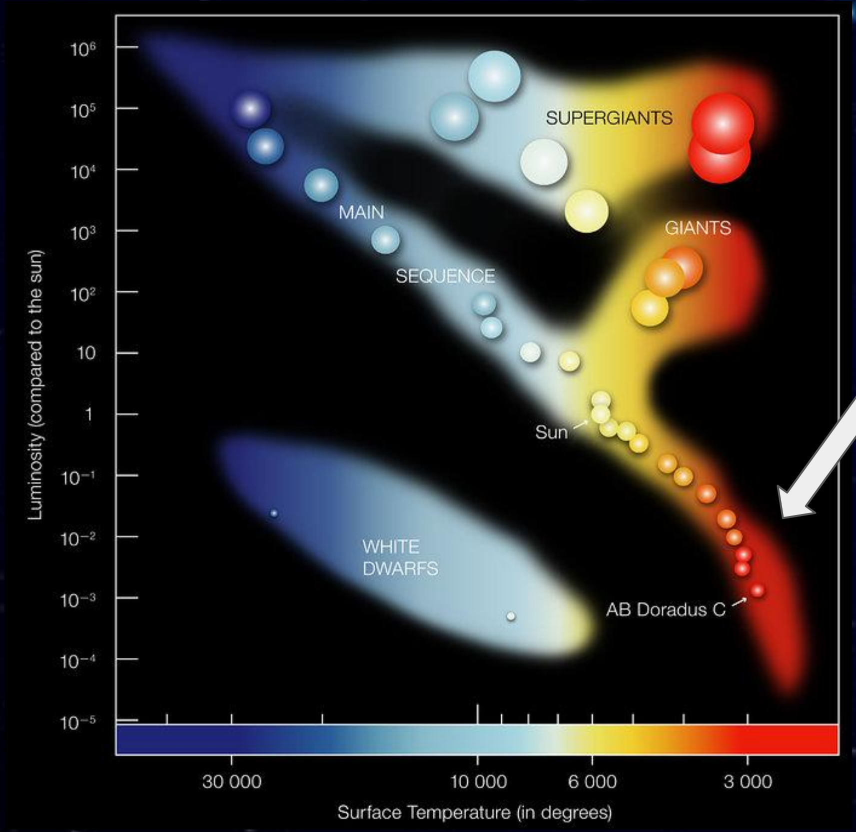


The Radio Emission of Cold M Dwarfs

Anna Hughes

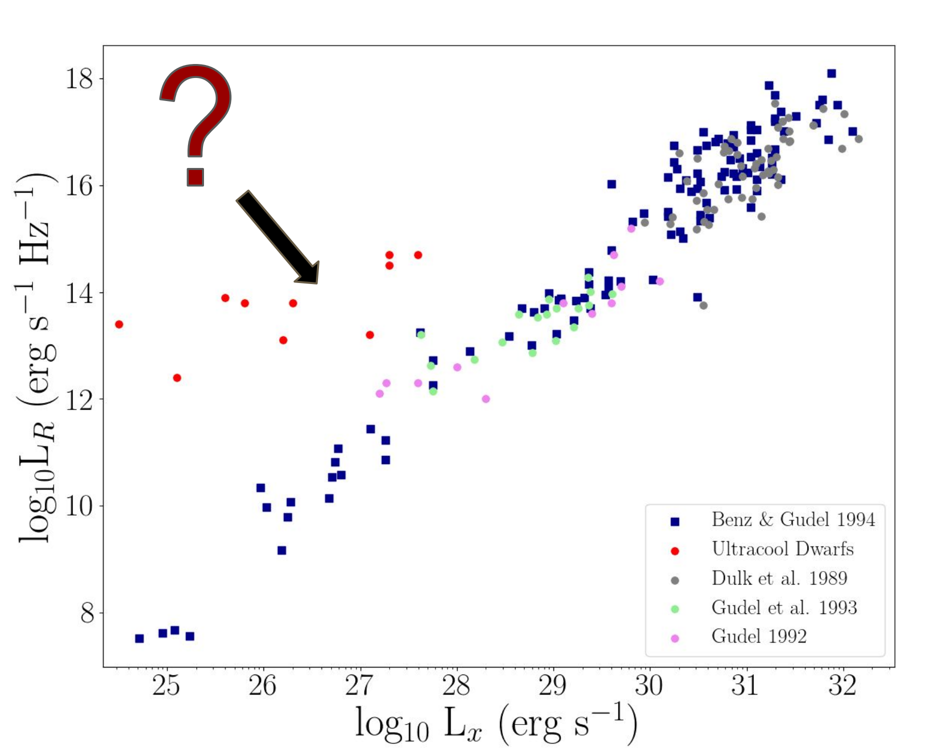
Ultracool Dwarfs



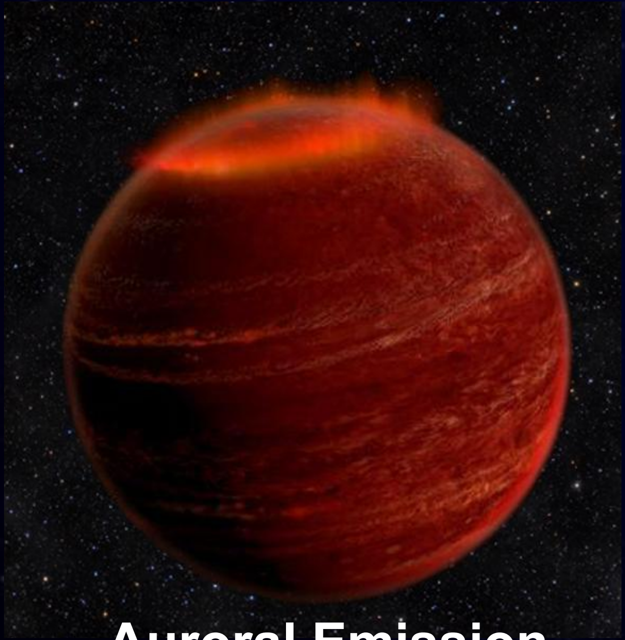
- **Large enough to fuse hydrogen**
- **Too small for convective and radiative layers**
- **$0.075M_\odot$ - $0.14M_\odot$**
- **$0.08R_\odot$ - $0.2R_\odot$**
- **T_{eff}: 2300K - 2800K ($T_\odot$ = 5800K)**

The Güdel-Benz Relation

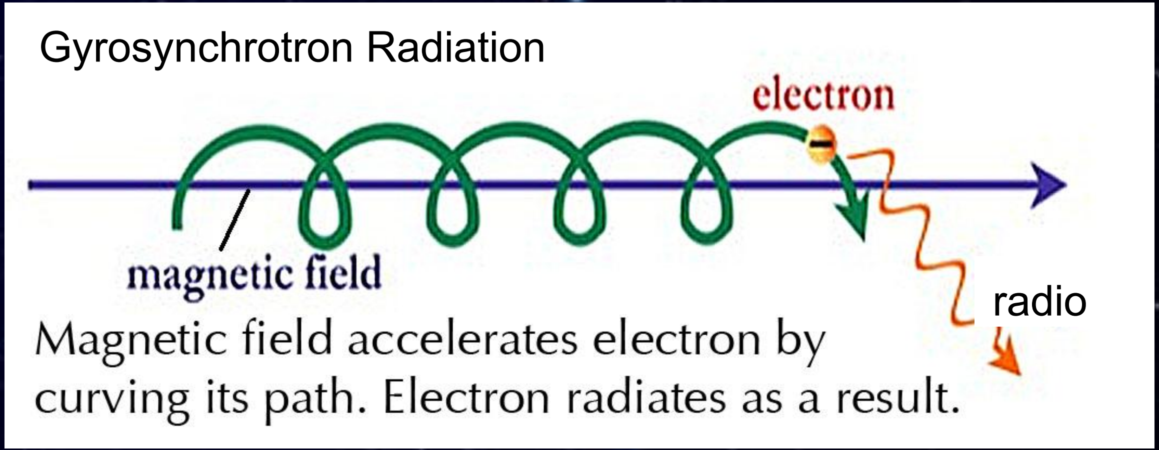
- Empirical relationship between X-ray and radio luminosity
- Holds well for F ~ early-M stars
- Drastically underpredicts radio luminosity (or overpredicts X-ray luminosity) of some UCDs



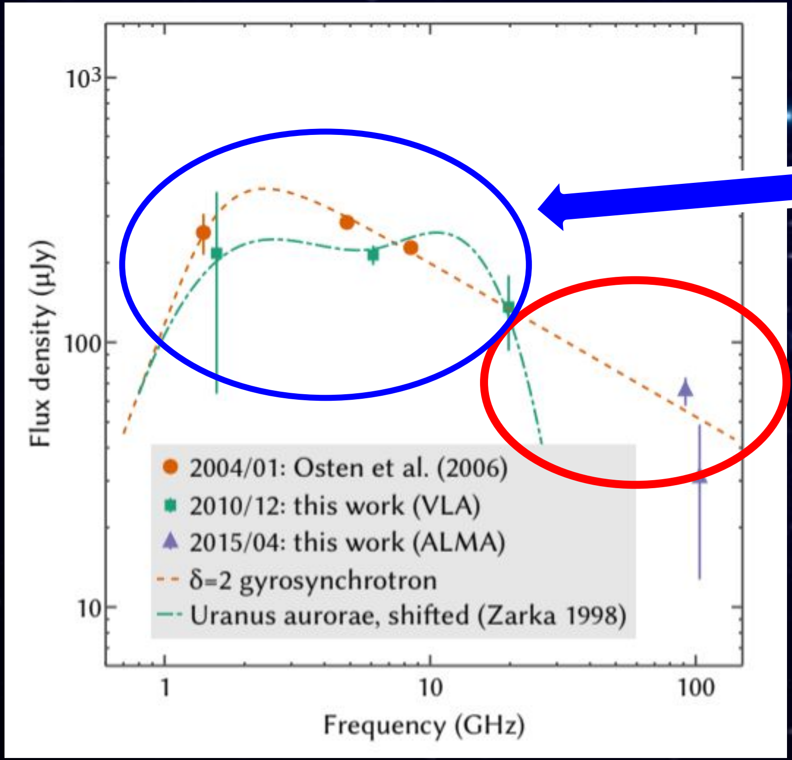
What causes radio emission in ultracool M dwarfs?



Auroral Emission



How can you distinguish between the two mechanisms?

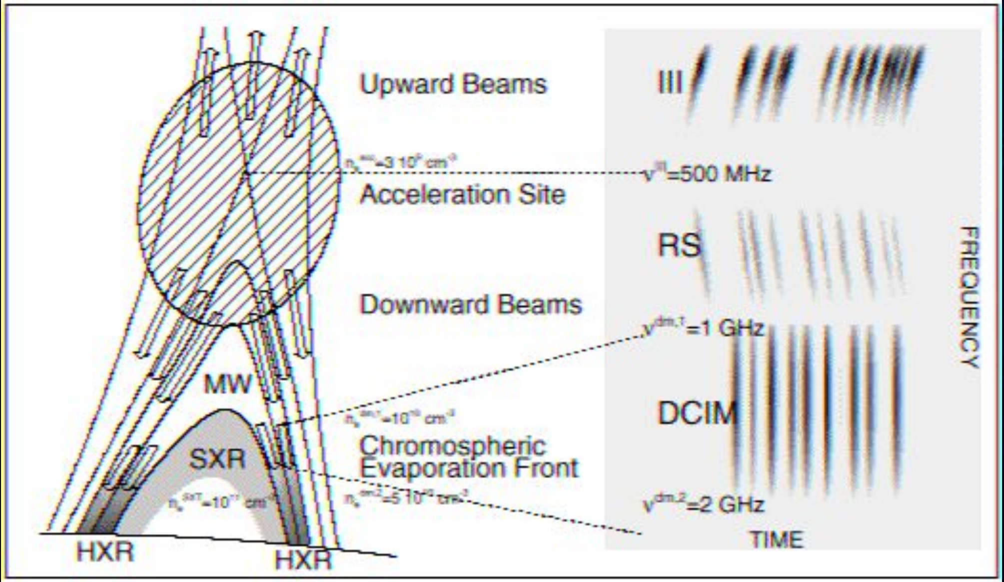


Can't look here

Look here!

Gyrosynchrotron Radiation

Indicative of accelerated electrons & high-energy particles incident on the surrounding planets



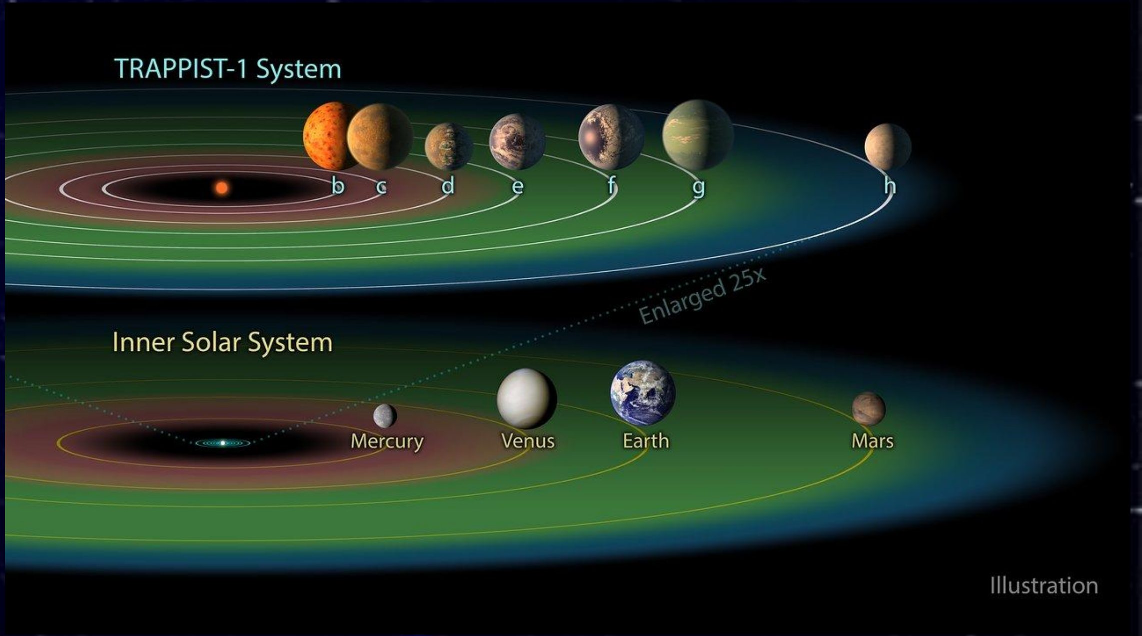
- **High-energy particles most harmful to atmospheres of surrounding planets**
- **Bad news for potential life!**

Implications for Habitability

- **Most terrestrial planets orbit M-dwarf stars**
- **High flare rates, strong flares, and magnetic activity can impact the surrounding planets**
- **Strong magnetic fields could potentially strip planets of their atmospheres**
- **High-energy particles can more efficiently erode ozone**
- **Gyrosynchrotron emission ‘signature’ of high-energy particles**

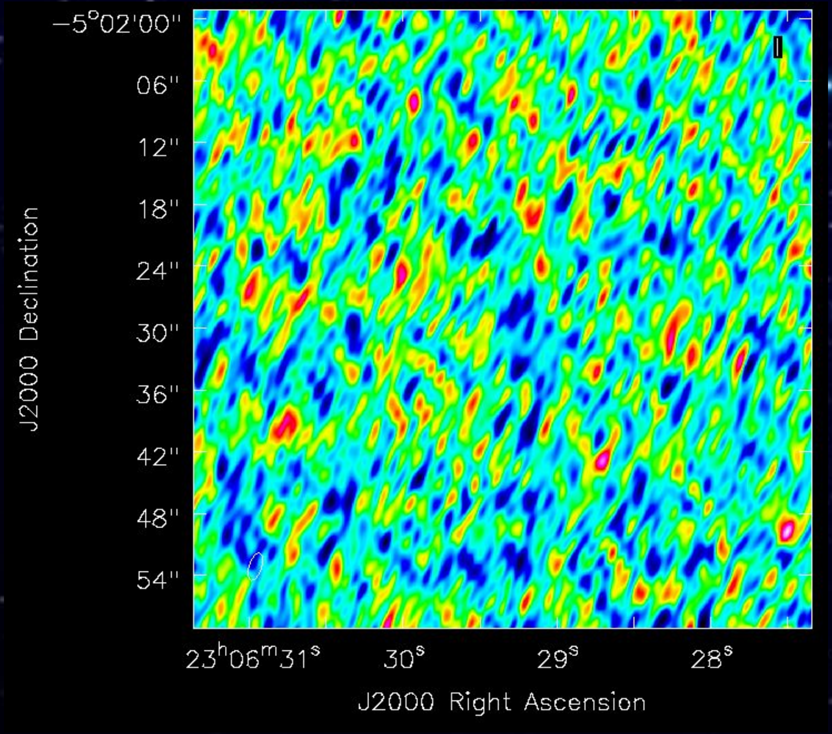
TRAPPIST-1 System

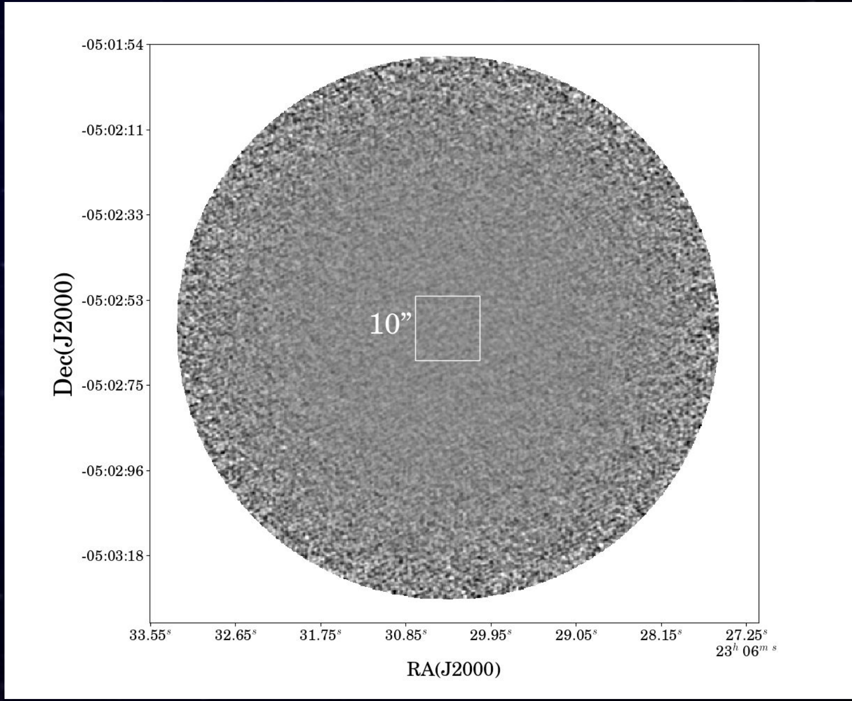
- **7 Earth-like planets**
- **3 in the habitable zone**
  - **region capable of supporting liquid water**
- **High-interest system**
  - **discovery paper cited 421 times**



My Observations

- ALMA observations at 95.7 GHz and VLA observations at 45 GHz both non-detections
- Conclusion: TRAPPIST-1 planets not overtly threatened





Radio survey of ultracool dwarfs

>100 ultracool M dwarfs observed and unpublished!

- **At 30-100 GHz, gyrosynchrotron emission dominates**
- **Out of ~200 cold dwarfs observed at radio frequencies (8GHz), only 25 have been detected**
- **Only 1 detection of a cold dwarf at >30 GHz (out of two observed stars)**


Questions?