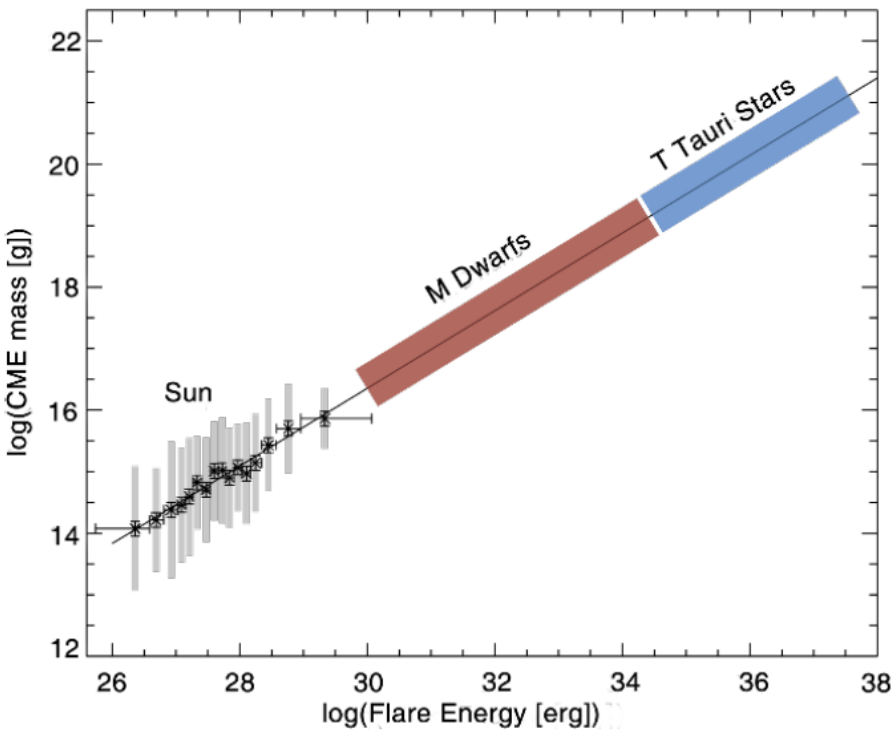
Low Frequency Radio Emission

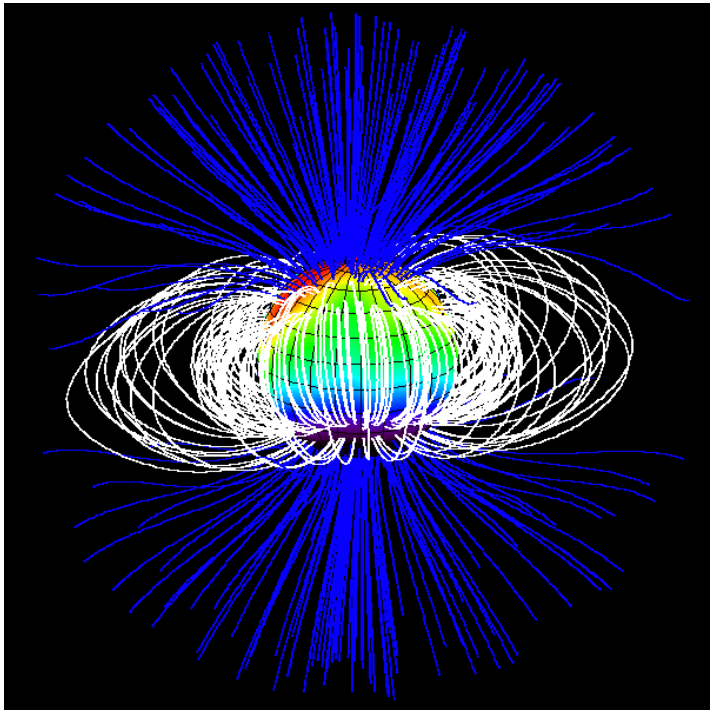
Type II radio bursts
traces density at CME shock

Auroral radio emission
measures magnetic fields

Stellar CMEs



Adapted from Aarnio et al. 2012



Donati et al. 2006

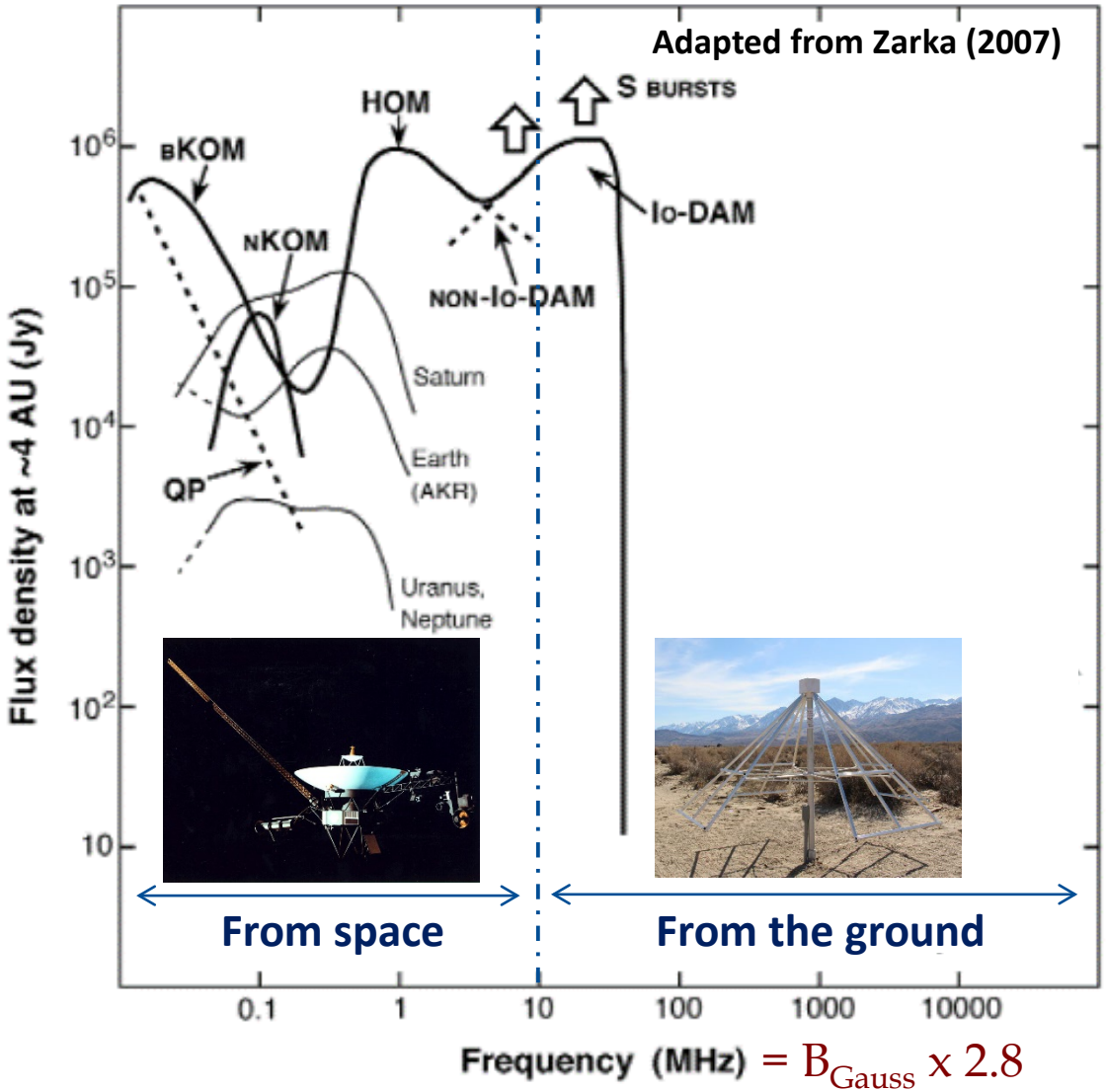
No direct evidence of CMEs on any star other than the Sun to date

Magnetic field configuration may be play an important role (Alvarado-Gómez et al. 2018)

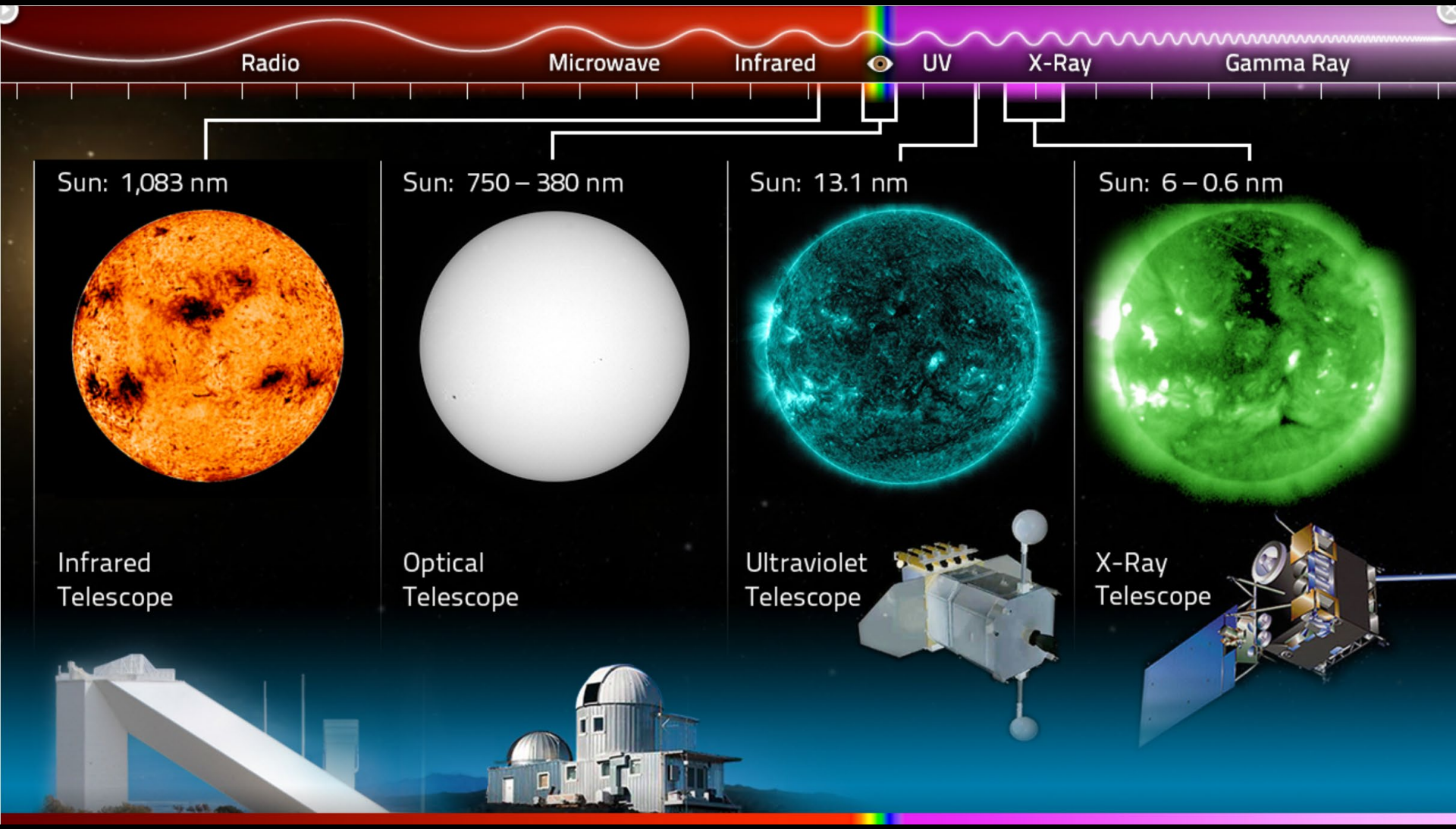
Radio Emission from Solar System Planets

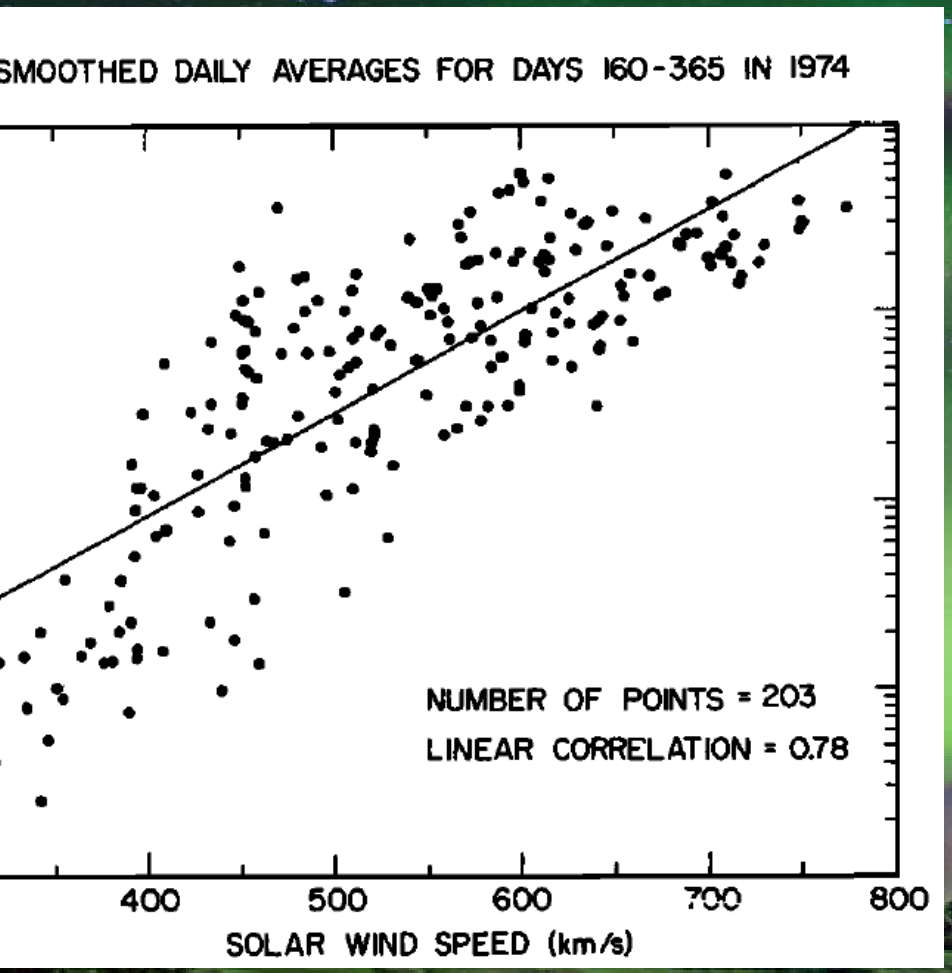
All gas giants and Earth have strong auroral radio emission

Electron cyclotron maser emission – coherent, highly circularly polarized

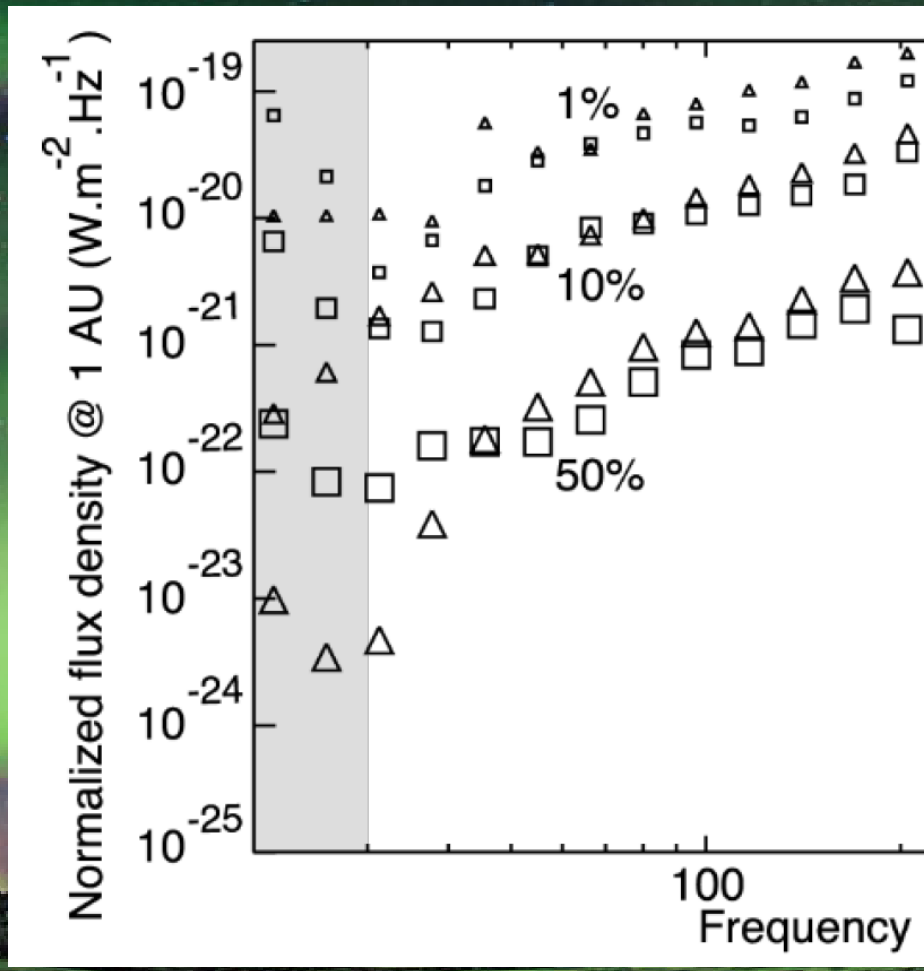


Paradigm Shift



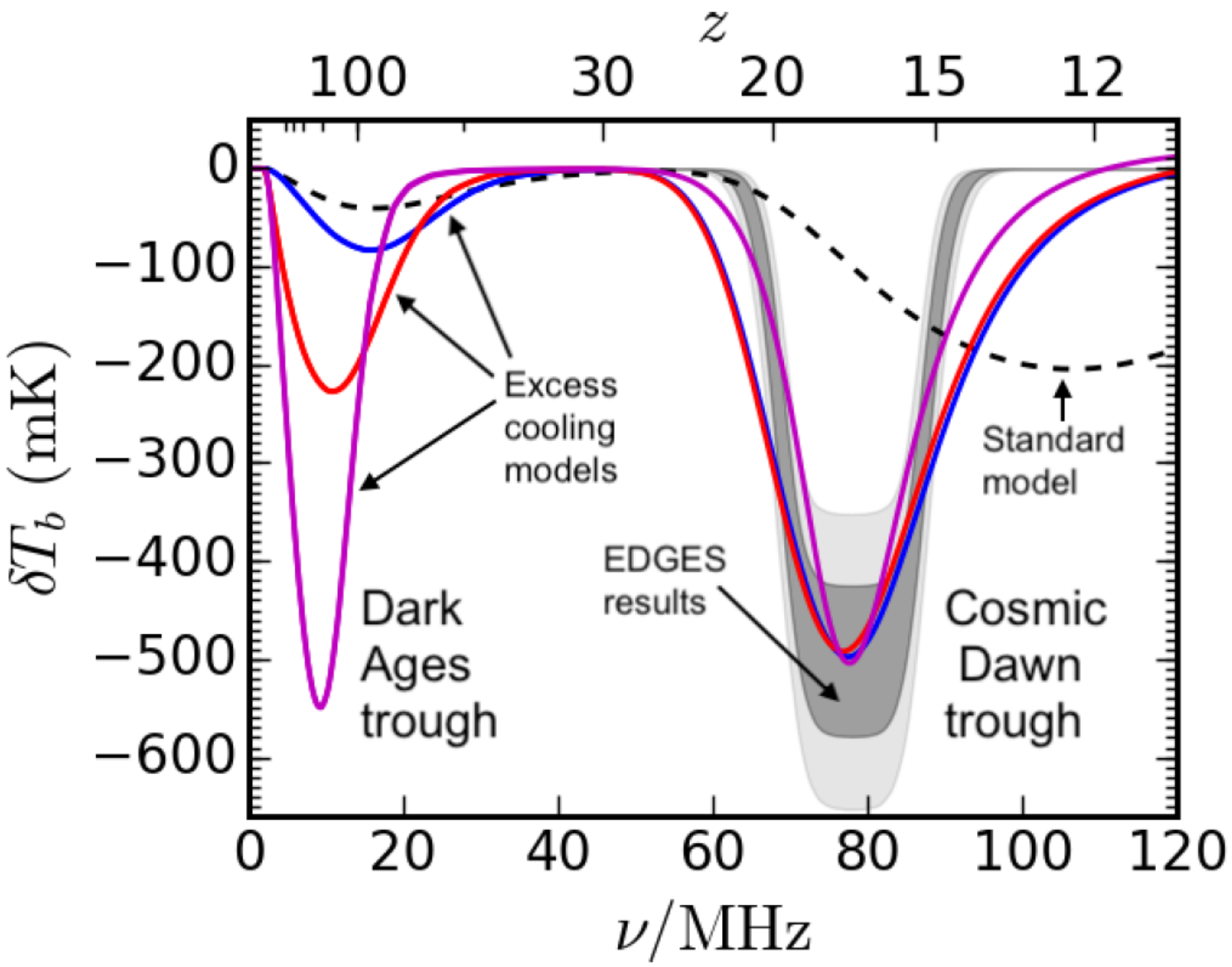


r & D'Angelo 1981



Lamy et al. 2010

The Dark Ages



Requirements

Need many km^2 of collecting area…

in space…

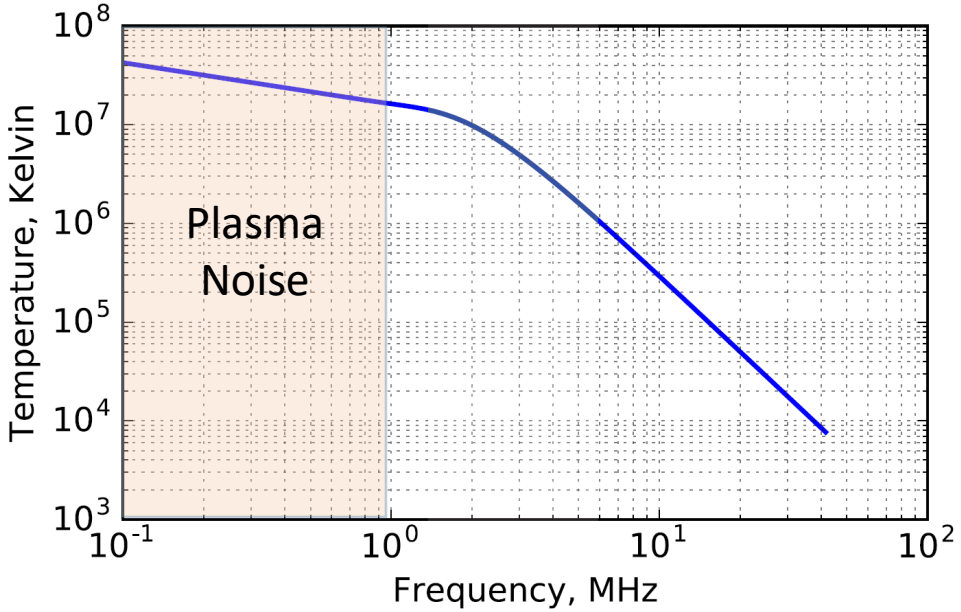
that can monitor 1000s of stellar systems simultaneously

EASY!

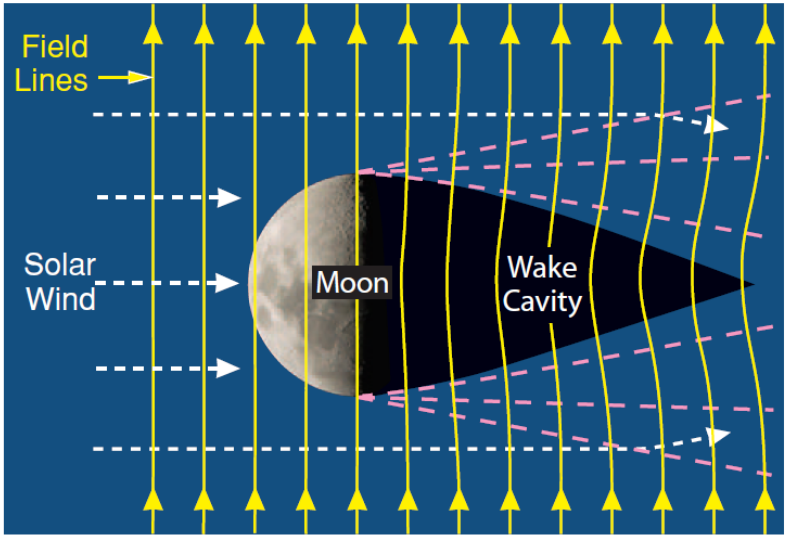
The Lunar Farside

Sensitivity of a dipole ∝ collecting area / system temperature

$\propto \lambda^2$ $\propto \lambda^{-2.6}$



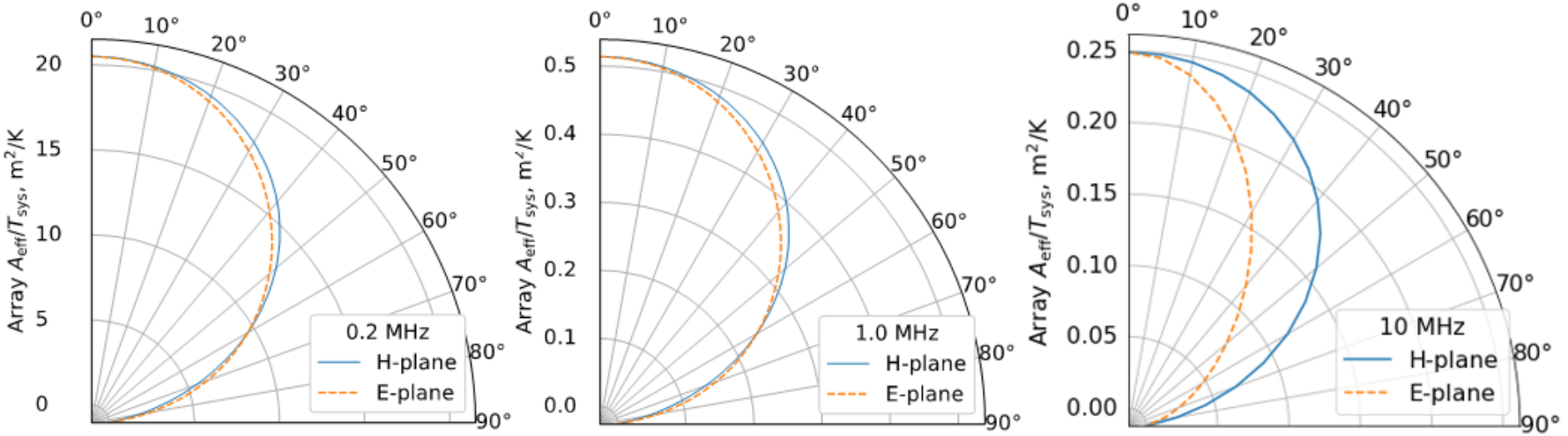
Credit: Andres Romero-Wolf



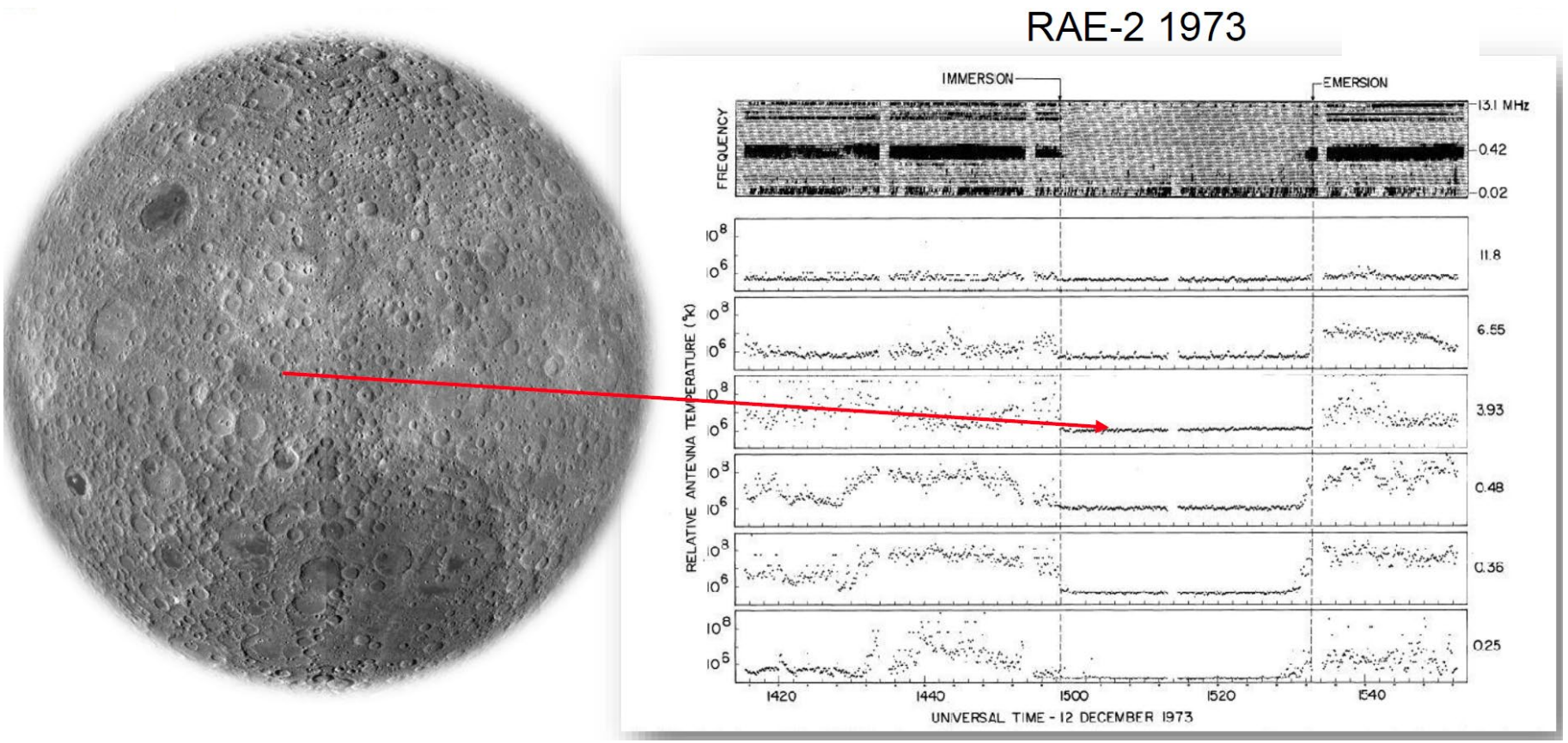
Credit: Steve Bartlett

A dipole of a few meters length on the moon has a collecting area of ~0.3 km² at 300 kHz

A dipole at 300 kHz is 20x more sensitive than at 30 MHz


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
Array A_{eff}/T_{sys}, m^2/K
0
5
10
15
20
0.2 MHz
H-plane
E-plane
Array A_{eff}/T_{sys}, m^2/K
0.0
0.1
0.2
0.3
0.4
0.5
1.0 MHz
H-plane
E-plane
Array A_{eff}/T_{sys}, m^2/K
0.00
0.05
0.10
0.15
0.20
0.25
10 MHz
H-plane
E-plane

Radio-frequency Environment of the Lunar Far-side



RAE-2 occultation of Earth in 1972

FARSIDE Probe Study

- Science Drivers:
  - The Magnetospheres and Space Environments of Candidate Habitable Exoplanets
  - The Dark Ages and our Cosmic Dawn

- Assumptions:
  - i) Lunar Gateway in operation (available as a communication relay)
  - ii) $1 billion cost cap and 500 kg mass cap [for deployed hardware]

- Timeline:
  - Nov 2018: Directed probe study commenced
  - Mar 2019: Overall architecture selected [Team X]
  - Apr 2019: Follow up mission and instrument studies planned
  - Jun 2019: Initial report completed
  - Sep 2019: Engineering Concept Definition Package