Potential Radio Emission of Exoplanets

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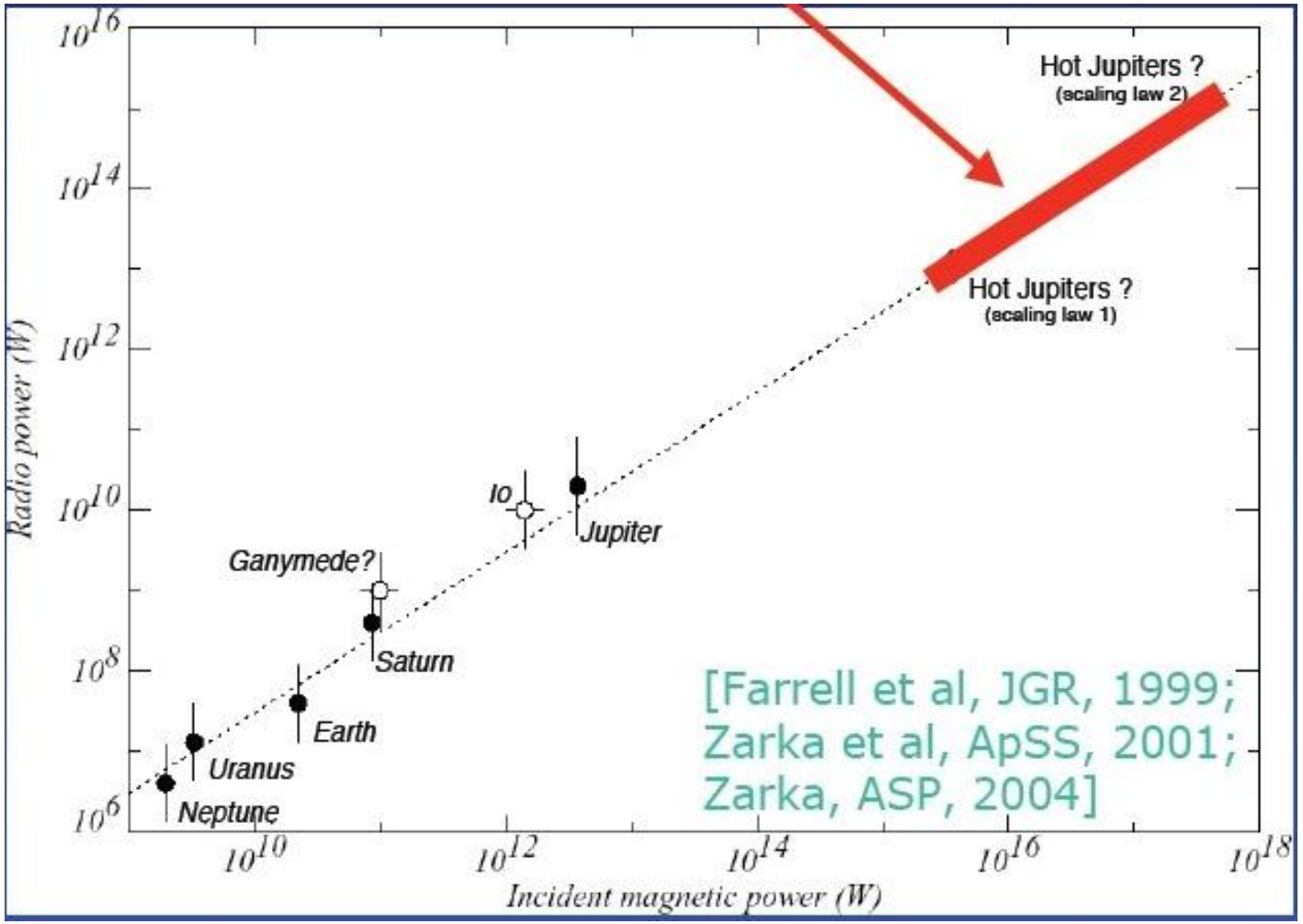
November 10, 2014

Predictions of exoplanet radio-emission

- **Hot Jupiters are the best candidates for observation (e.g. Tau Bootes b)**



Cyclotron Maser Instability (CMI)

- CMI = generation mechanism of radio emission
- Unstable electron distribution in the (exo)planetary magnetosphere
- Necessary condition for the CMI to work: ambient plasma density must be small compared with cyclotron frequency

$$\omega_{pe} << \omega_{ce} \qquad f_{pe} << f_{ce}$$

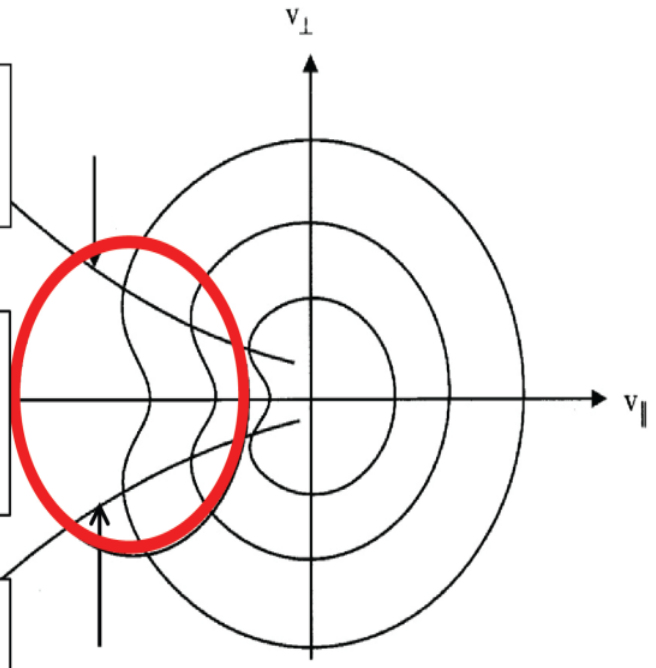
- Free energy in electron distribution exceeds threshold and is converted to, e.g., radio emission
- Loss cone distribution: direct conversion to electromagnetic waves

$$\mathrm{Im}(\omega) \propto \int_{-\infty}^{\infty} dv_{\parallel} \int_{-\infty}^{\infty} dv_{\perp} v_{\perp}^{\,2} \frac{\partial F_e}{dv_{\perp}} \delta(\omega_r - \omega_{ce}/\gamma - k_{\parallel} v_{\parallel})$$

F_e distribution function of the suprathermal electrons

$$\frac{\partial F_e}{dv_{\perp}} > 0$$

Resonance condition: $\omega_r - \omega_{ce}/\gamma - k_{\parallel} v_{\parallel} = 0$



Different scenarios for high efficiency of the CMI

- Moon around a Jovian exoplanet (Io-Jupiter system) (Nichols (2011, 2012)) (detection also possible for larger orbits)
- Hot Jupiter systems (0.015 - 0.5 AU orbital distance) (Jupiter: 5.2 AU)
- In general: larger magnetic field strength, high planetary rotation rates and high stellar XUV luminosity lead to stronger emission

Detecting radio emission of exoplanets: Why is it important?

- Status of 3rd of November 2014: 1849 planets
- Direct detection method
- Frequency of radio emission gives estimate of magnetic field strength $$f_{ce} = \frac{1}{2\pi}\frac{eB}{m_e}$$
- Possibility of detecting exoplanetary magnetospheres
- Determine orbital parameters like inclination
- Determine orbital and rotational period from modulation of radio emission
- Existence of exomoons

- Radio emission of exoplanets has not been detected yet
- Future detection from the ground expected with

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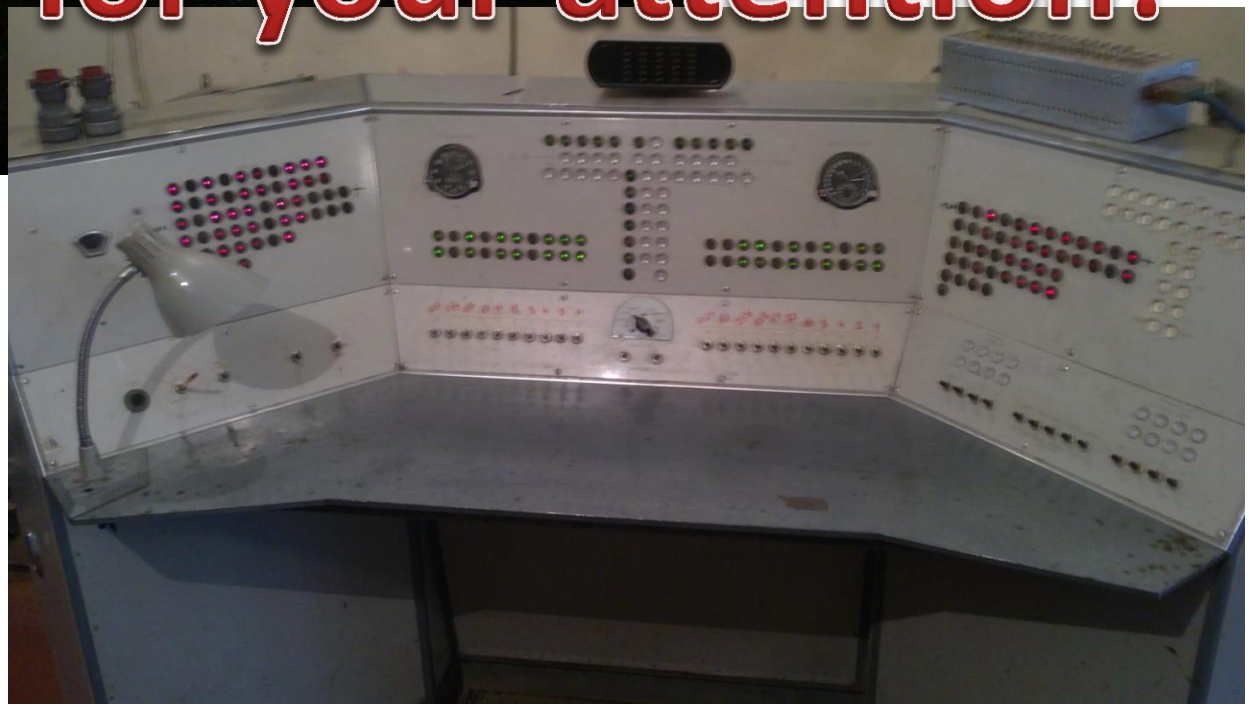
Thanks for your attention!



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