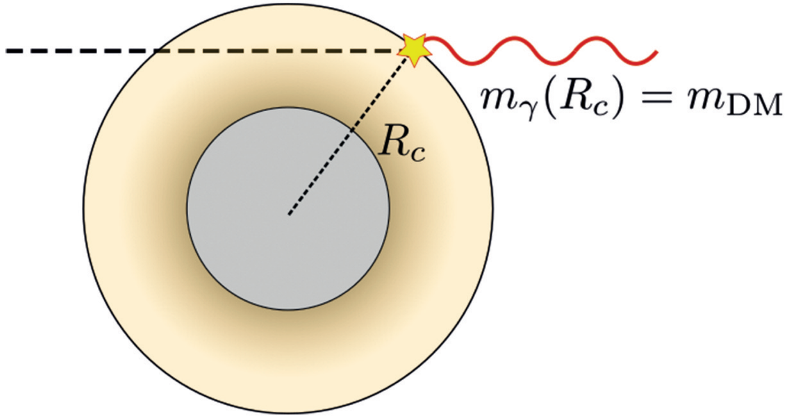
Low-frequency radio telescopes sensitivity to light dark matter

Dark Matter (DM) radio conversion

Light DM can convert into radio waves
in astrophysical plasmas



Typical plasmas for Solar System
objects naturally open a radio window for DM conversion

$\hbar\omega_{\rm pl} \sim 10^{-10} - 10^{-6}\,{\rm eV} \qquad \nu_{\rm DM} \sim 10\,{\rm kHz} - 100\,{\rm MHz}$

Radio telescopes can detect Dark Matter!

Radio signal

$$F_\nu^{\rm DM} \propto \underbrace{\rho_{\rm DM}\, v_{\rm DM}}_{\rm DM} \times \underbrace{P_{{\rm DM}\to\gamma}}_{\rm conversion} \times \underbrace{\left(\frac{R_c}{d}\right)^2}_{\rm geometry} \times \underbrace{\delta(\nu - \nu_{\rm DM})}_{\rm spectrum}$$

Focus on three Solar System targets:
the Sun, Jupiter, and the Earth

Main goal

Assess the sensitivity reach and discovery potential of current and future space-based radio antennas to light DM

The **detectability** of the DM-induced line
is set by the SEFD via the radiometer equation

$$\frac{1}{\Delta\nu}\int_{\Delta\nu} F_\nu^{\rm DM}\, {\rm d}\nu \geq \frac{\rm SNR}{\sqrt{\Delta\nu\, t_{\rm int}}}\,{\rm SEFD}$$

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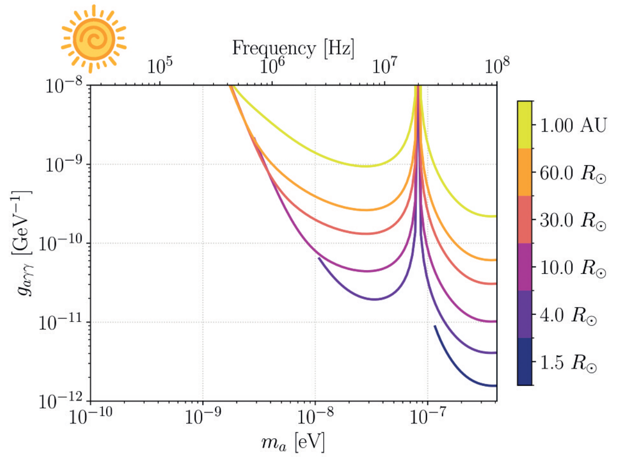
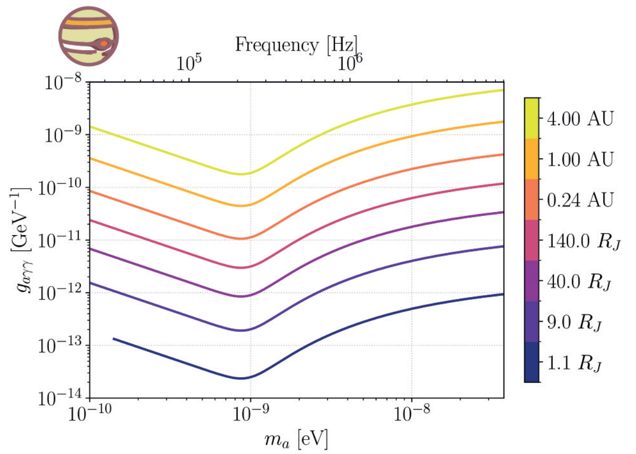
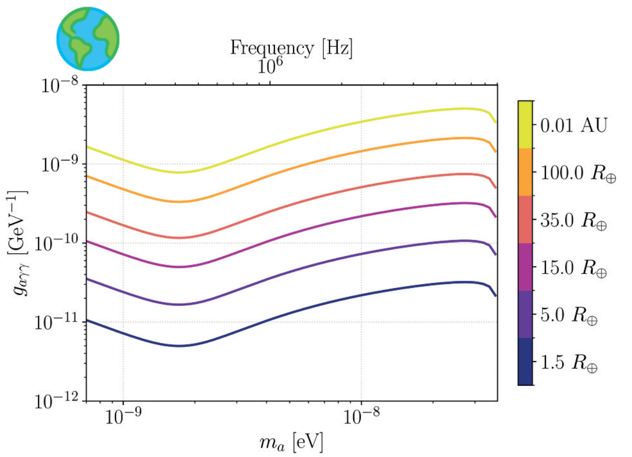
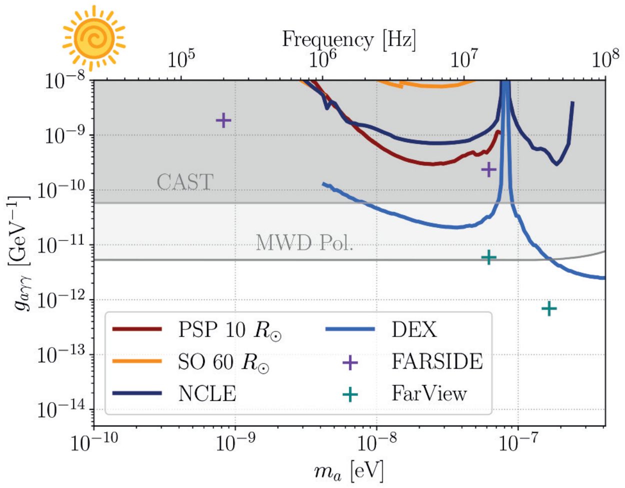
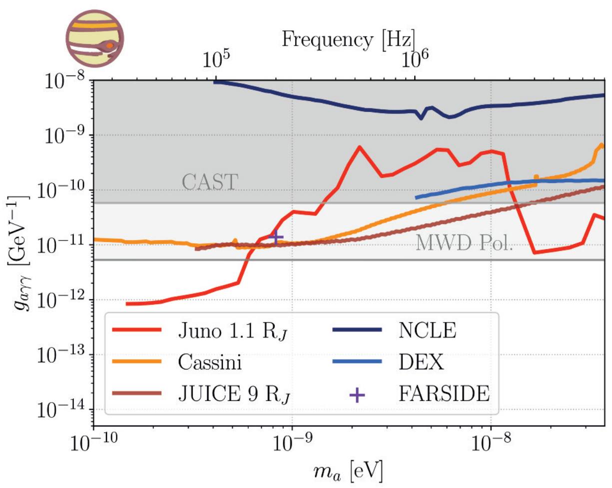


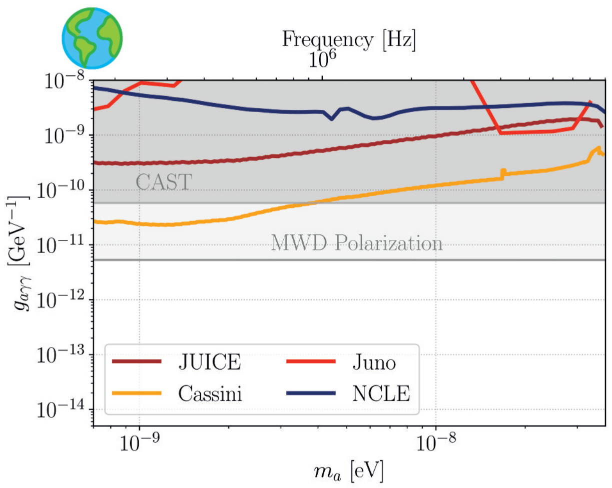




Diffuse Galactic synchroton emission + local quasi-thermal noise (QTN) set an environmental SEFD







Radio telescopes can provide detection reach competitive with the most aggressive bounds in the literature!