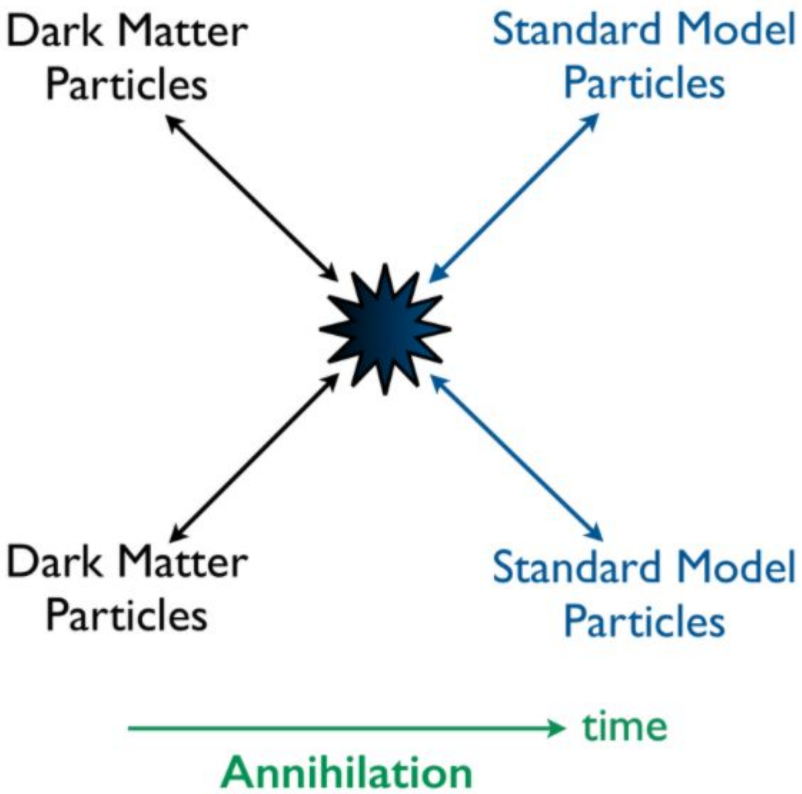
Gas-rich dwarf galaxy bounds on dark matter decay & annihilation

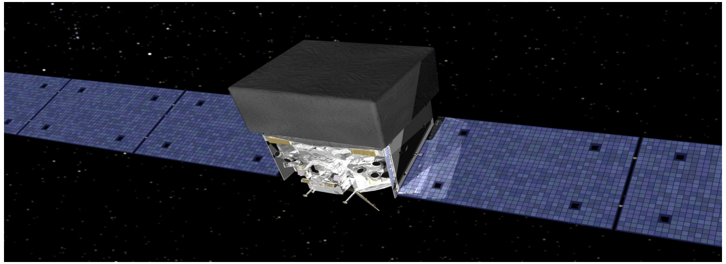
Zihui Wang (NYU)

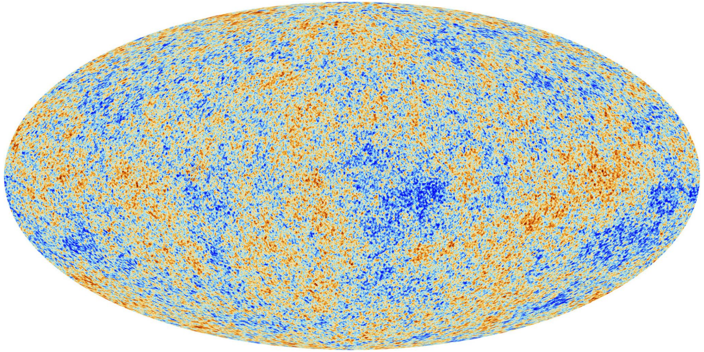
Brookhaven forum 2021

Based on 2111.xxxxx with Jay Wadekar

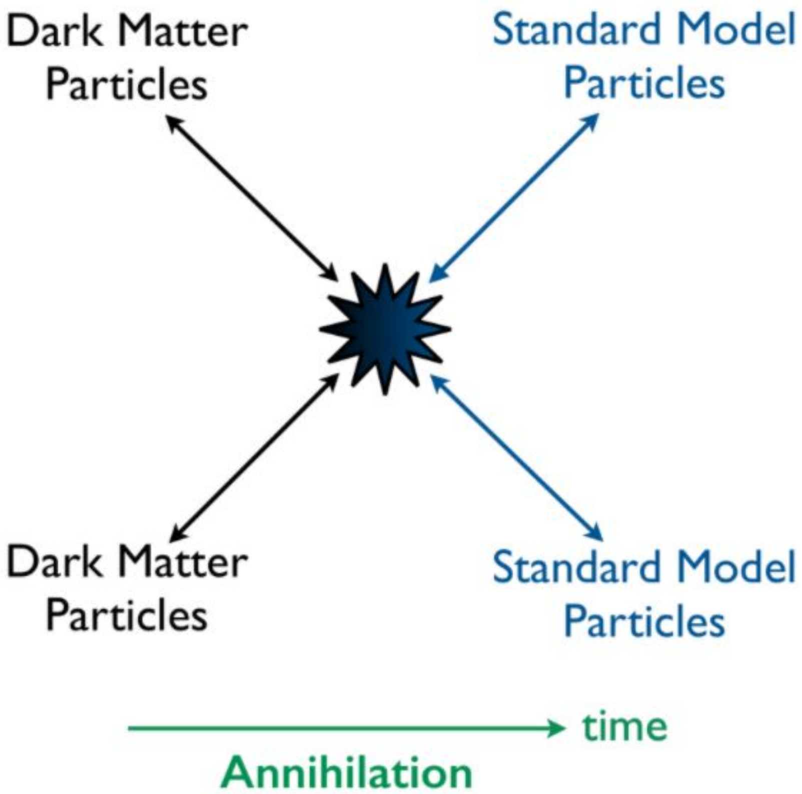
Dark matter indirect detection

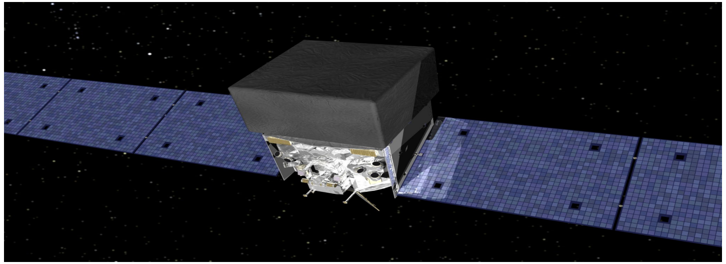


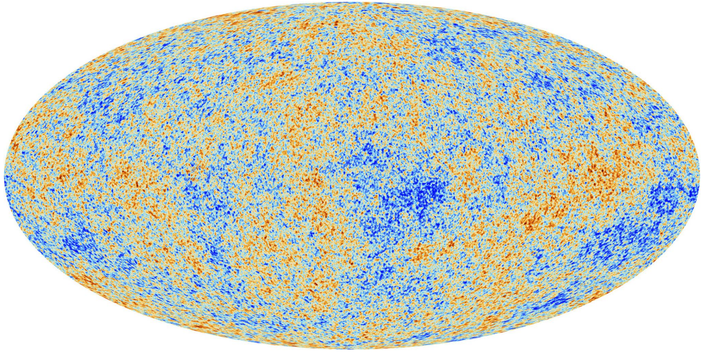




Dark matter indirect detection

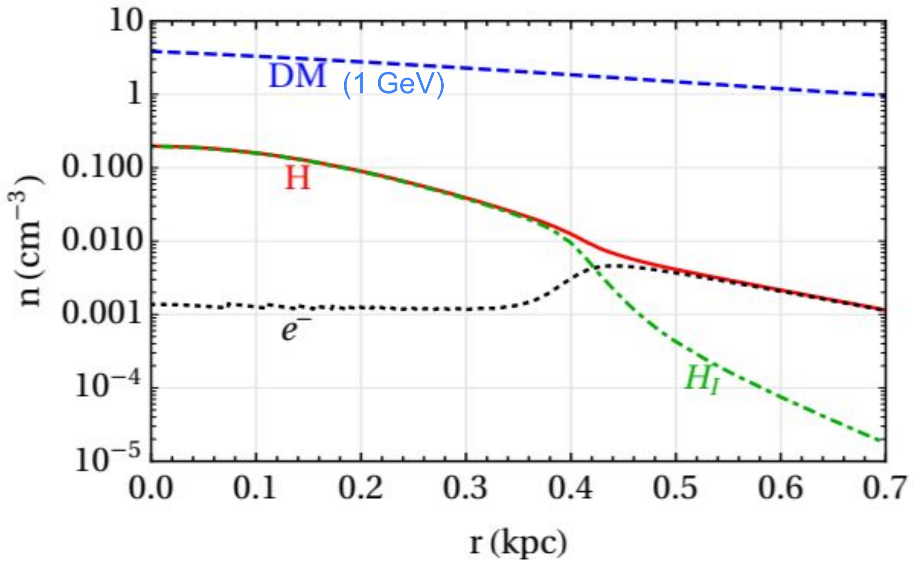






This talk: Gas-rich dwarf galaxy as detector!

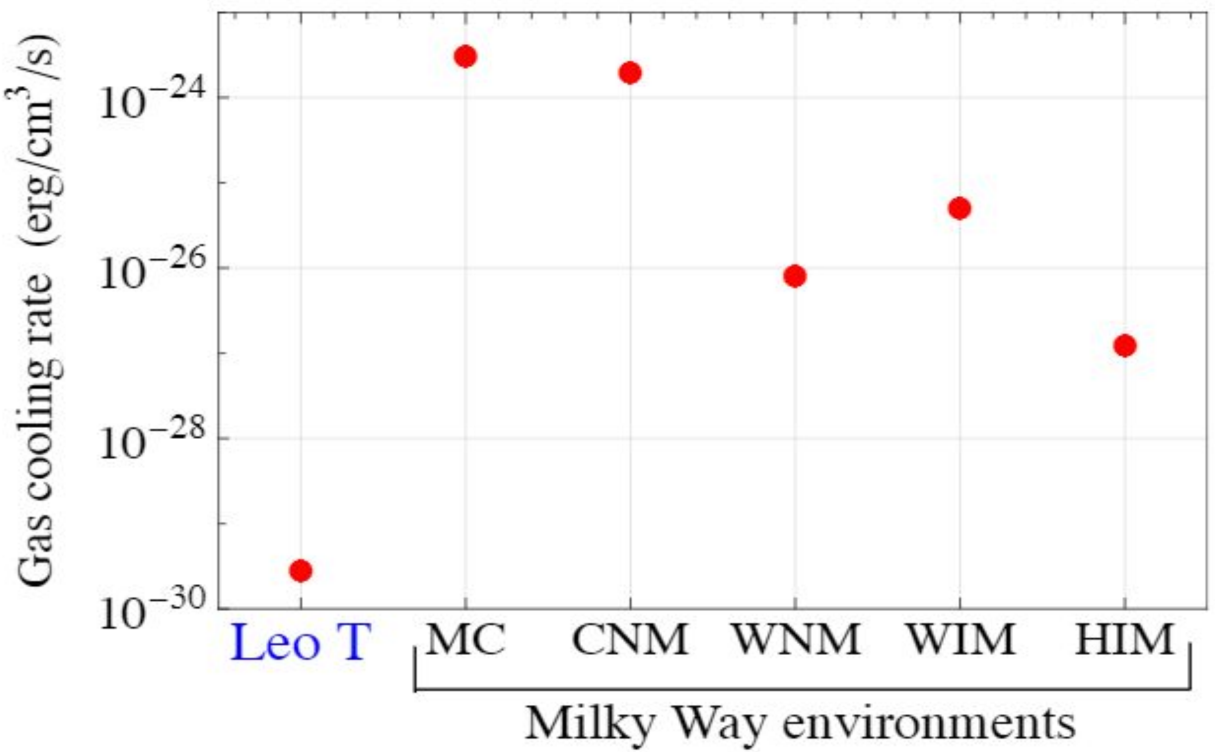
Gas-rich dwarf galaxy: Leo T



- Neutral for r < 0.35 kpc
- Low cooling rate (low metalicity, cool~6000 K)
- Sensitive to energy injection from DM!

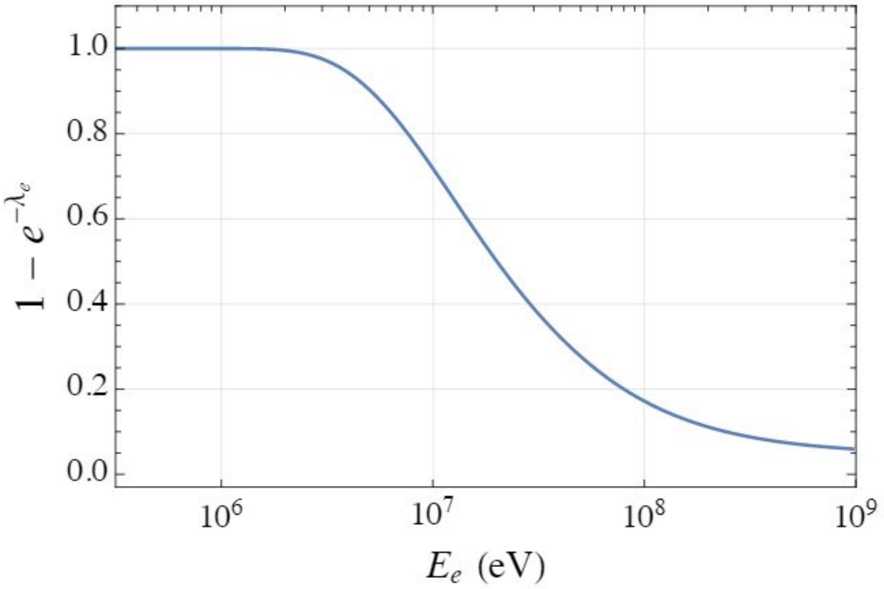
  (1903.12190, Wadekar & Farrar)
- Decay and annihilation DM -> e+ e-, DM -> γγ

Low cooling rate in Leo T



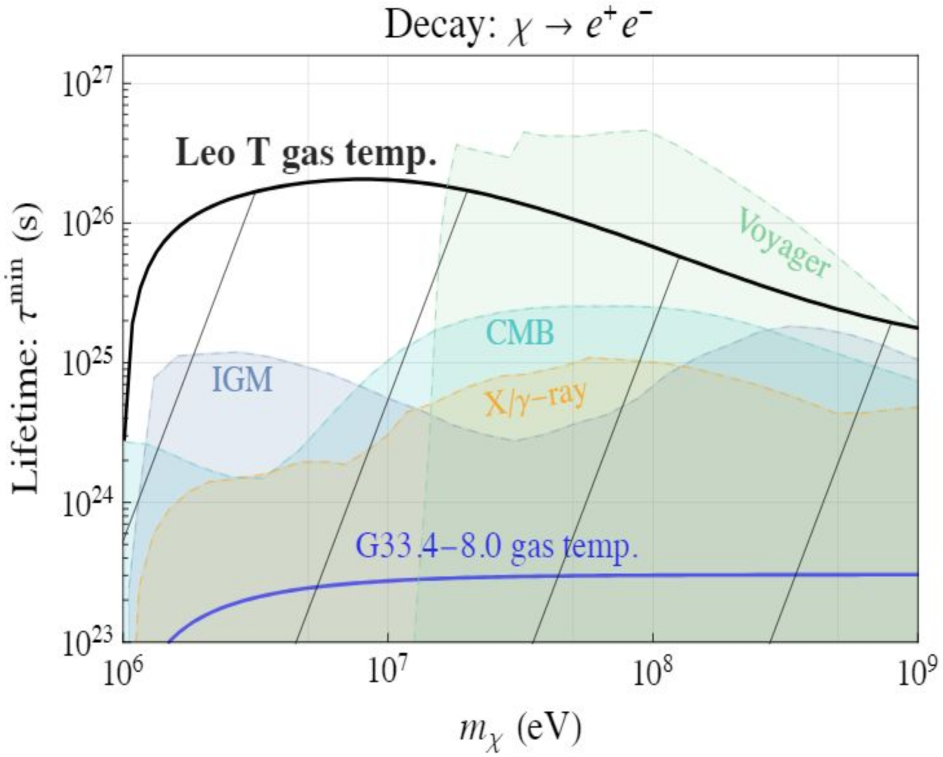
Fate of electron/positrons

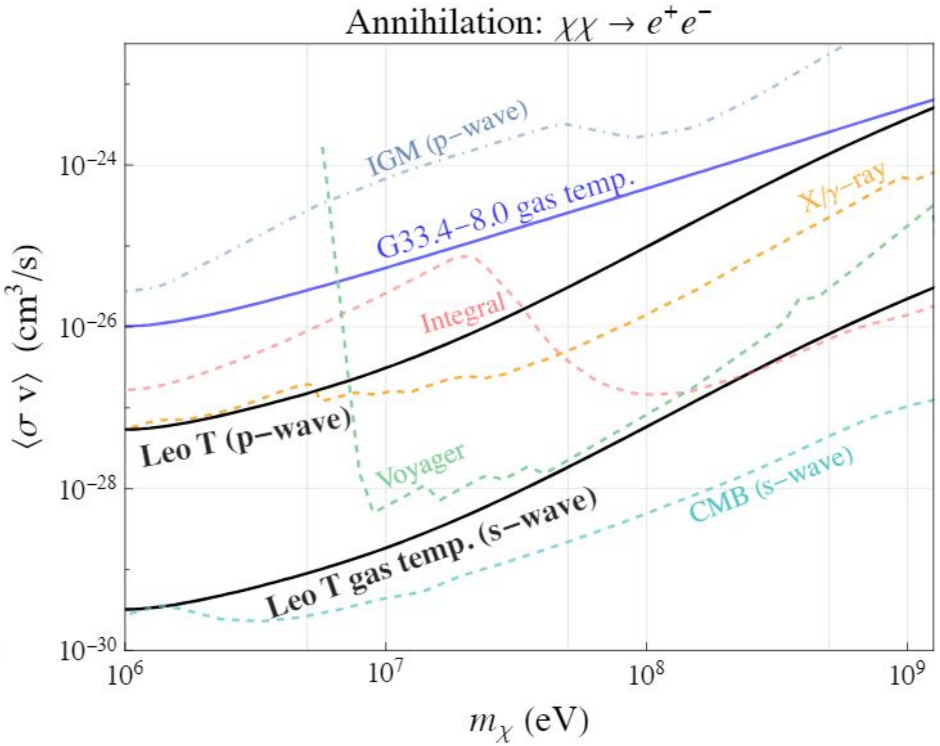
- Escape the galaxy (no heating). Low energy e bound by magnetic fields
- **Collide with free electrons (injects heat)** ~ 40%
- Heating rate < cooling rate sets bounds on decay and annihilation



- Opaque for <10 MeV. Hard for direct searches.
- Advantage for Leo T, strong interaction -> more efficient heating!

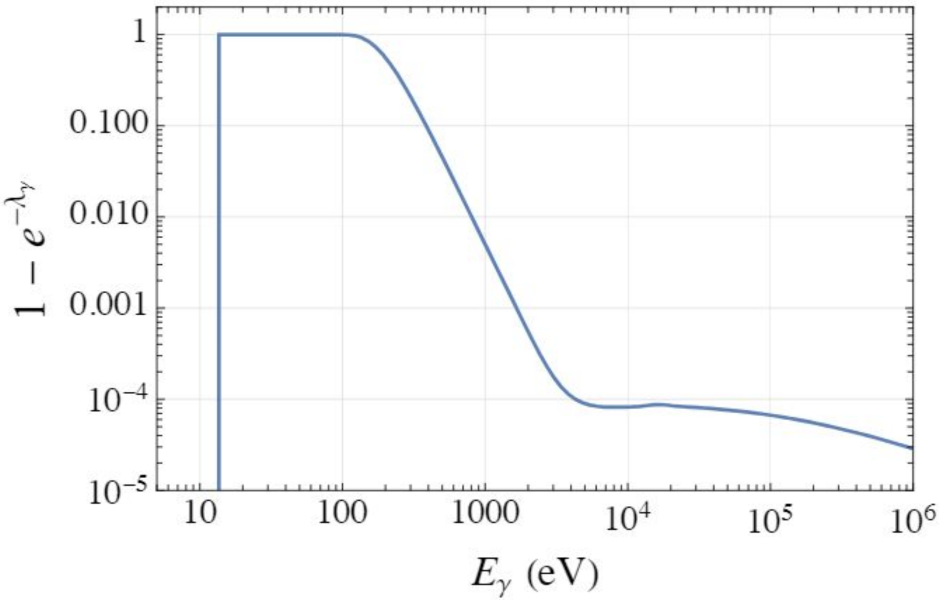
Constraints on decay and annihilation





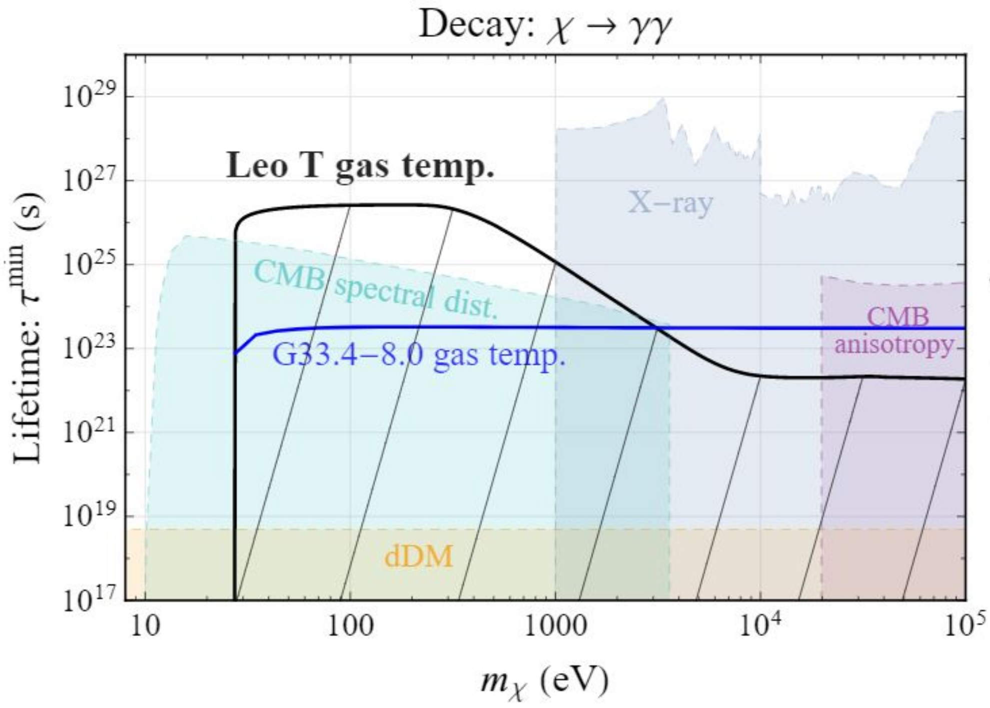
Fate of photons

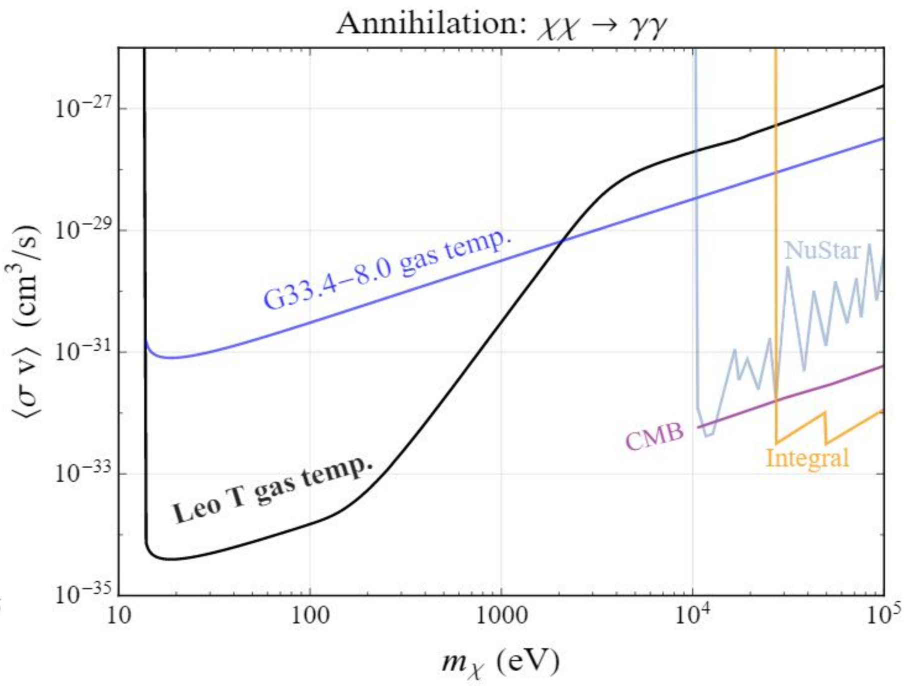
- Escapes the galaxy (no heating)
- Produce electrons via photoelectric effect (injects heat by electrons)



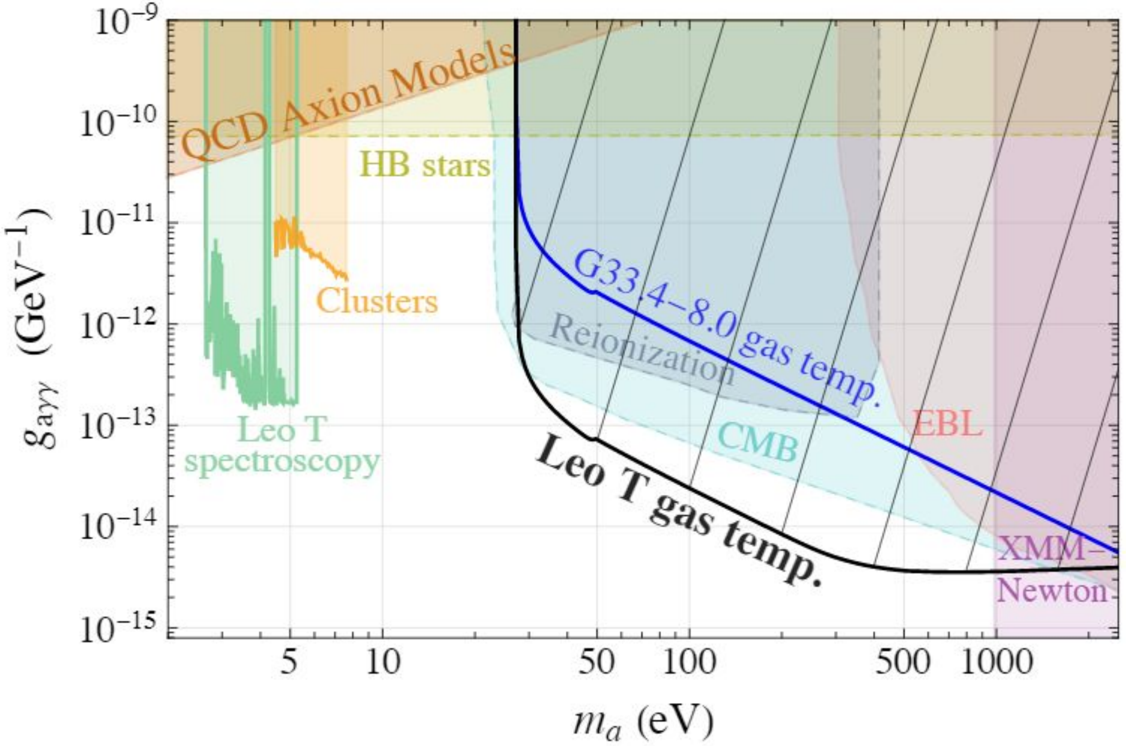
- Opaque for <300 eV. Hard for direct searches.
- Advantage for Leo T, strong interaction -> more efficient heating!

Constraints on decay and annihilation

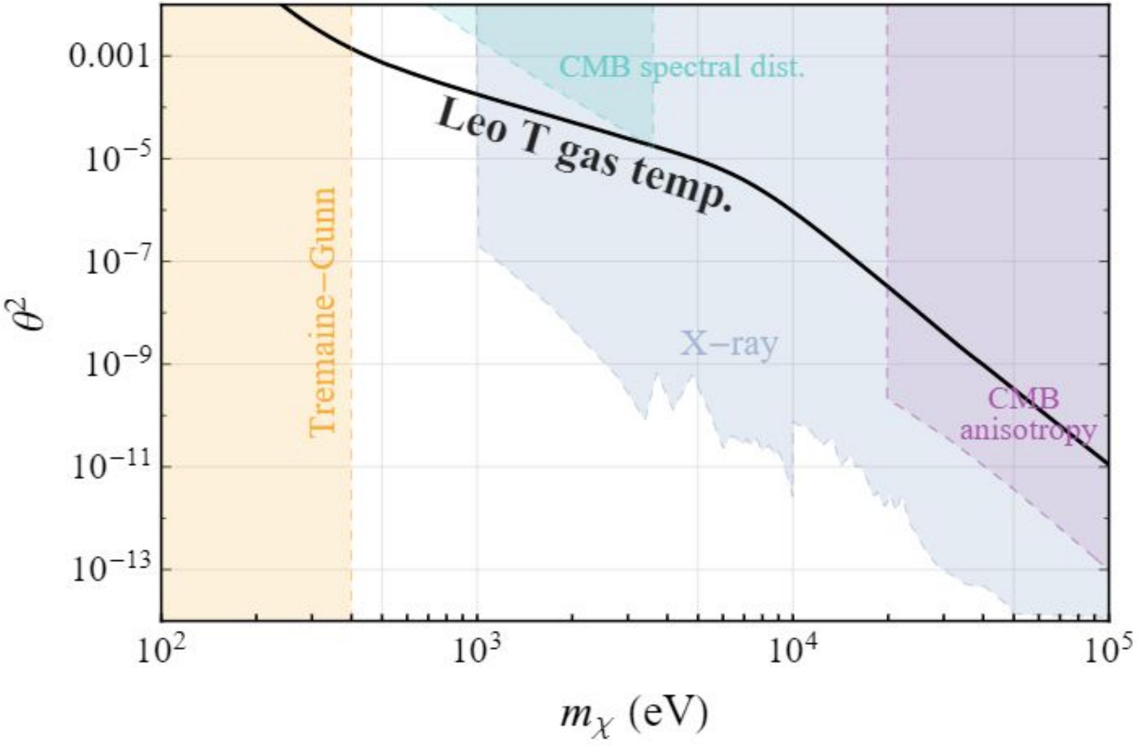




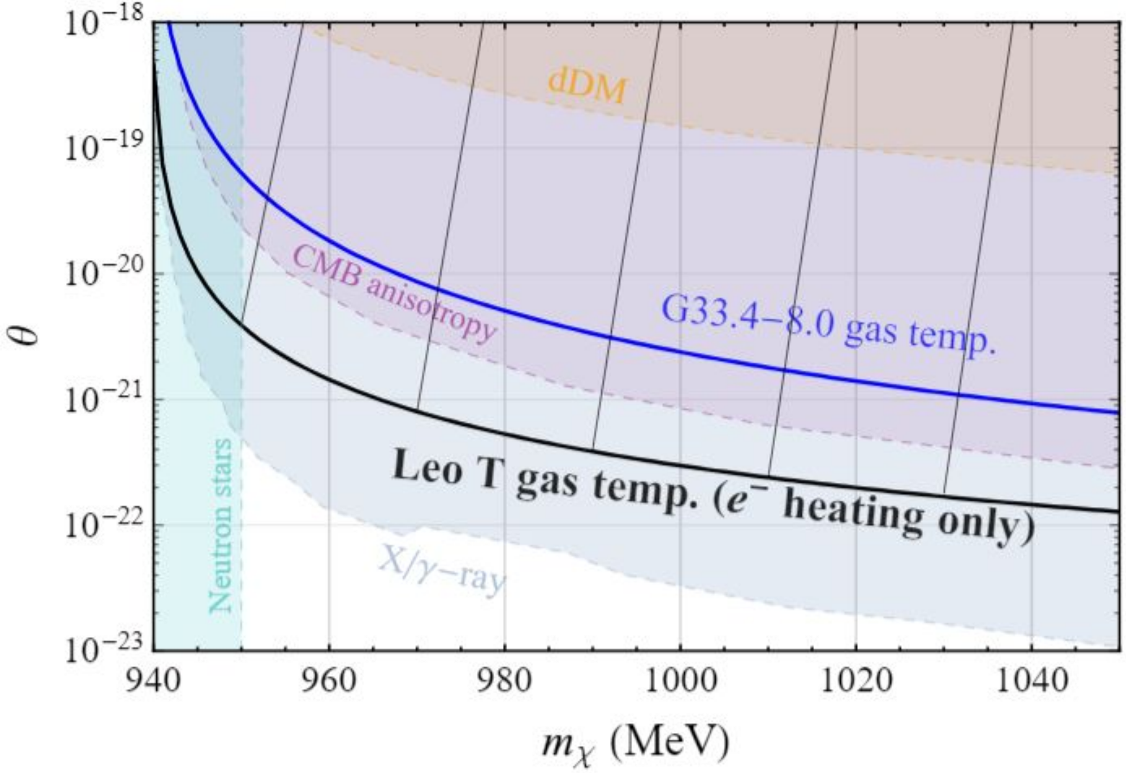
Axion like particles: $a \rightarrow \gamma\gamma$



Sterile neutrinos: $\chi \to \nu\gamma$



Dark neutrons: $\chi \to n\gamma$ & $n \to pe\nu$



Conclusions

- Photons below 300 eV and electrons below 10 MeV are hard to detect by traditional searches because of absorption & scattering
- This disadvantage can become advantage: Efficient heat injection to gas-rich dwarf galaxies
- Strong bounds for DM decay/annihilation to ee and $\gamma\gamma$, in particular ALPs
- Other ideas welcome!

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