
Dark matter axions

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• Program

- Axions as dark matter (reminder)
- Astrophysical and laboratory constraints
- Axion search experiments and current results
 - * Microwave cavity experiments
 - * Searches for solar axions
 - * 'Light shining through the wall' experiments

• Literature:

- P. W. Graham *et al.*, *Experimental Searches for the Axion and Axion-like Particles*, Ann. Rev. Nucl. Part. Sci. 65 (2015) 485 and arXiv:1602.00039
- G.G. Raffelt, *Astrophysical axion bounds*, Lect. Notes Phys. **741** (2008) 51
- H.V. Klapdor-Kleingrothaus and K. Zuber, *Particle Astrophysics*, IoP (2000) Chap.11
- J.E. Kim and G. Carosi, *Axions and the strong CP problem*, Rev.Mod. Phys. **82** (2010) 557
- J. Beringer *et al.* (PDG), *Axions and other similar particles*, PRD **86** (2012) 010001

• Material for lecture:

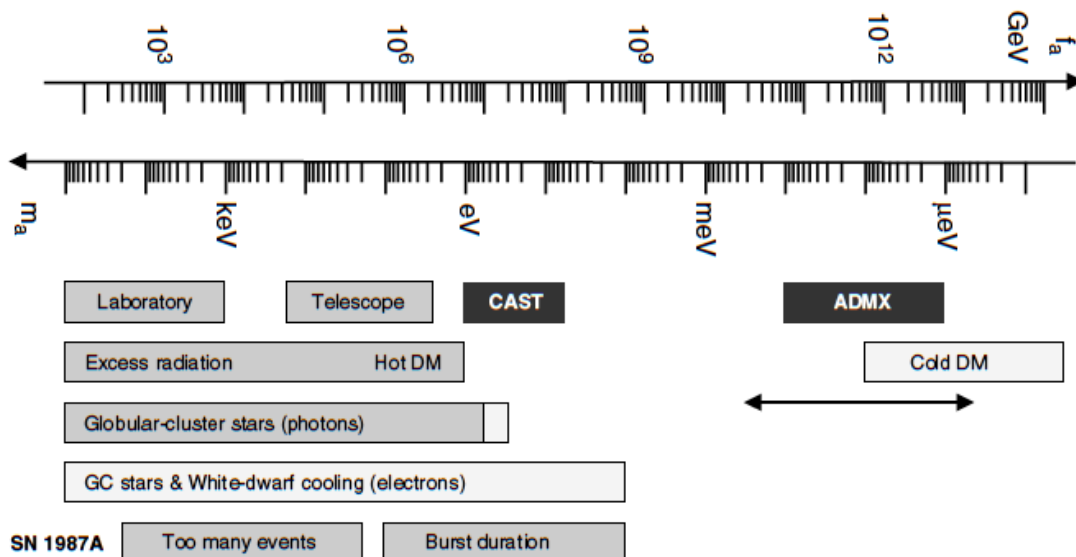


Figure 1: Summary of astrophysical and cosmological axion limits. The black sensitivity bars indicate the search ranges of the CAST solar axion search and the ADMX search for galactic dark matter axions. Light-grey exclusion bars are very model dependent. Figure from G. Raffelt, *Astrophysical axion bounds*, Lect. Notes Phys. 741 (2008) 51.

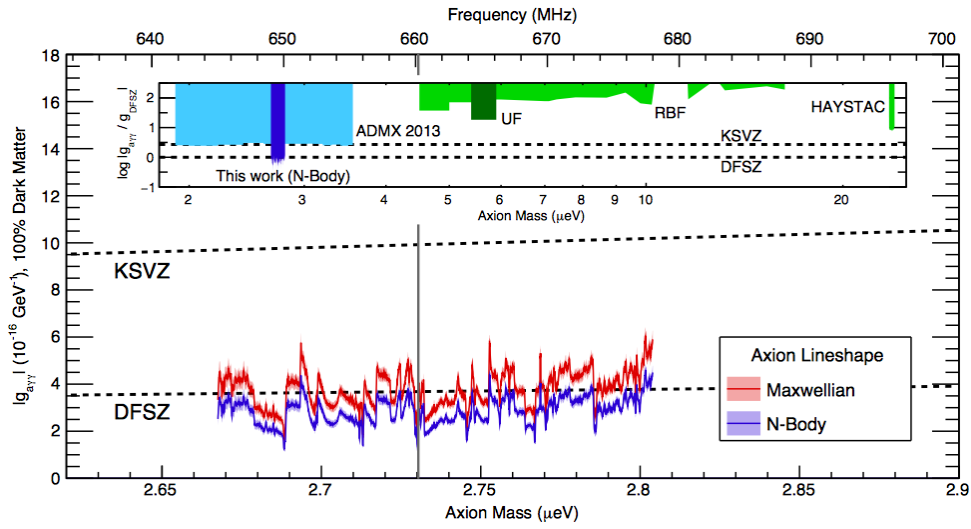


Figure 2: Exclusion limit (90% CL) for axion mass and axion coupling $g_{a\gamma\gamma}$ for two different halo models. Figure from ADMX Collaboration, PRL. 120 (2018) 151301.

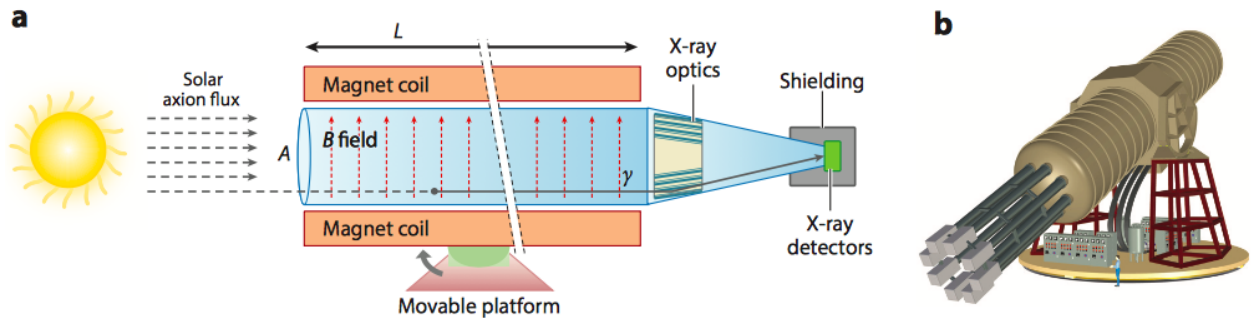


Figure 3: A) Scheme of an axion helioscope with X-ray focusing. B) Proposed design for the future IAXO experiment. Figures from Graham *et al.*, Ann. Rev. Nucl. Part. Sci. 65 (2015) 485

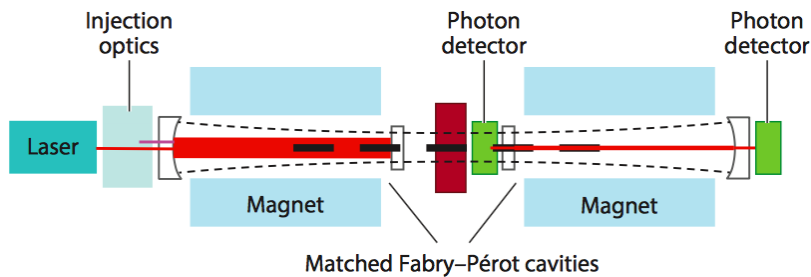


Figure 4: Principle of 'light shining through walls' experiments. Figure from Graham *et al.*, Ann. Rev. Nucl. Part. Sci. 65 (2015) 485

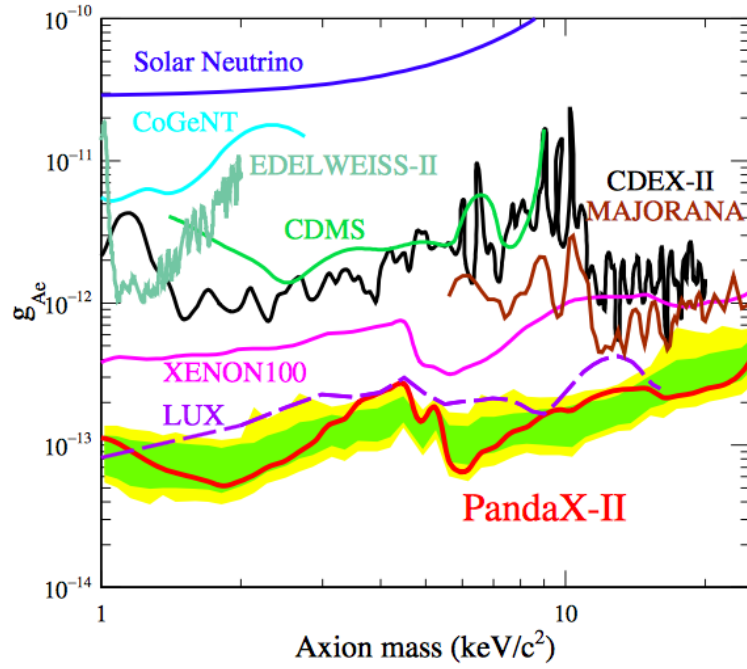


Figure 5: Constrains (90% CL) on axion mass and axion coupling g_{aee} from the PandaX experiment (red line) compared to other existing experimental results. Figure PandaX Collaboration, PRL 119 (2017) 181806.

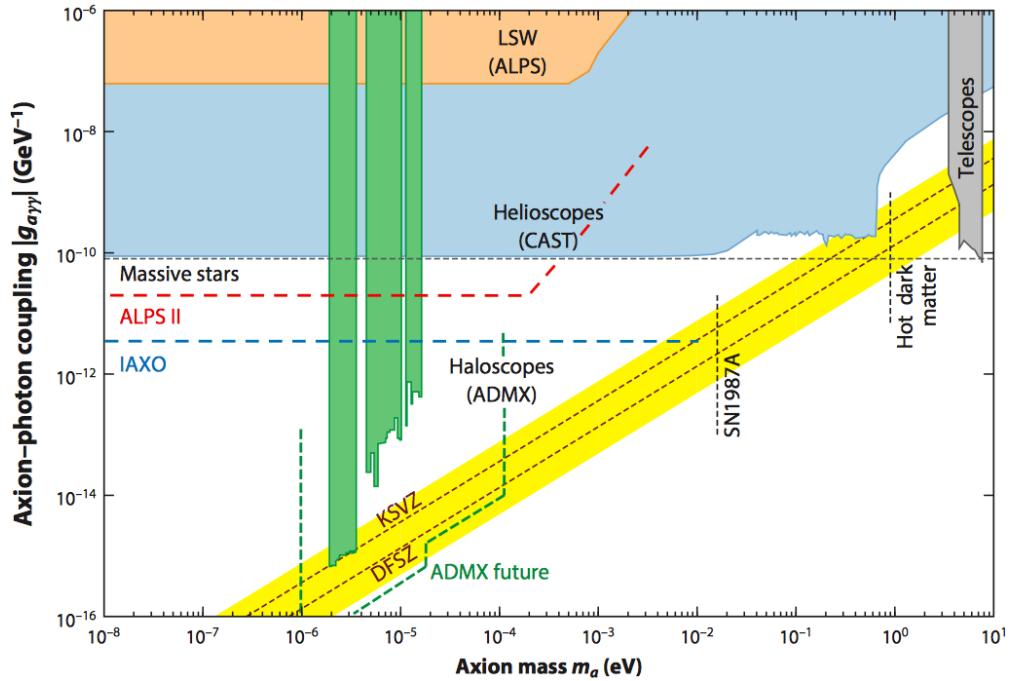


Figure 6: Constrains of axion/axion-like particles (ALPs) coupling to photons and the projected sensitivity of future devices as function of mass. Figure from Graham *et al.*, Ann. Rev. Nucl. Part. Sci. 65 (2015) 485