

References for AxionLimits webpage

Ciaran A. J. O'Hare

ARC Centre of Excellence for Dark Matter Particle Physics
The University of Sydney, Camperdown, NSW 2006, Australia

1 Axion-photon

Haloscopes

- ABRACADABRA [1, 2]
- ADBC [3]
- ADMX [4, 5, 6, 7, 8]
- ADMX-Sidecar [9, 10]
- ADMX-SLIC [11]
- CAPP [12, 13, 14, 15, 16, 17, 18, 19, 20, 21]
- CAST-CAPP [22]
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- DANCE (projection) [67]
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- MADMAX (projection) [69]
- FLASH (projection) [70, 71]
- QUAX (projection) [72]
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- TOORAD (projection) [73]
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- SRF heterodyne cavity (projection) [76]

LSW/Helioscopes

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- CROWS [81]
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- Gamma-ray decay [91]
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- HESS (PKS 2155-304) [122]
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- Neutron Stars (Darling 2020) [133]
- Neutron Stars (Battye et al. 2021) [134]
- Neutron stars (Foster et al. 2022) [135]
- Neutron Stars (Battye et al. 2023) [136]
- NuSTAR (decaying dark matter, recast from Sterile ν) [137, 138, 139]
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- PSR J0437-4715 polarisation [147]
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- Solar neutrinos [149]
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- SN1987A- γ, ν (high mass ALPs) [156, 157, 109]
- SN1987A (PVO) [158]
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- Solar basin (NuSTAR) [160]
- Solar basin (NuSTAR and SPHINX) [161]
- Super Star clusters [162]
- SPT [163]
- Telescopes (Haystack) [164]
- Telescopes (MUSE) [165] (updated from: [166])
- Telescopes (VIMOS) [167]
- Telescopes (HST) [168, 169]
- Telescopes (JWST) [170]
- Telescopes (WINERED) [171, 172]

- Telescopes (eROSITA) [173]
- Fermi galactic SN (projection) [174]
- THESEUS (projection) [175]
- eROSITA (projection) [176]
- XRISM (projection) [177]
- White dwarf initial-final mass relation [178]
- XMM-Newton (decaying DM ALPs) [179]

Cosmology

- Ionisation fraction, EBL, X-rays [180]
- BBN+ N_{eff} [181]
- Freeze in [182]
- Cosmic background [183]

2 Heavy ALP-photon coupling

- ATALS (PbPb) [184]
- BaBar [185]
- Beam dump [186, 187, 185, 188, 189]
- Belle II [190]
- BESIII [191]
- CMS (PbPb) [192]
- EuXFL [193]
- LEP [194]
- LHC (pp)[195]
- MiniBooNE [196]
- NOMAD [197]
- OPAL [195]
- PrimEx [198, 199]
- CONUS (projection) [200]
- DUNE (projection) [201]
- FASER LLP (projection) [202]

3 Axion-electron

- Electron g-2 [203]
- EDELWEISS [204]
- Fermionic axion interferometer [205]
- Magnon non-demolition [206]
- DarkSide-50 [207]
- GERDA [208]
- LUX [209]
- Old comagnetometers [210]
- Panda-X [211]
- Torsion pendulum (spin force) [212]
- Torsion pendulum (axion wind) [213]
- SuperCDMS [214]
- XENON1T [215, 216]
- XENONnT [217]
- XENON1T (Solar basin) [218]
- Red giants (ω Cen) [219]
- Solar neutrinos [220]
- Electron storage ring (projection) [221]
- Axion wind multilayer (projection) [222]
- Magnons (projection) [223]
- Polaritons (projection) [224]
- DARWIN (projection) [225]
- LZ (projection) [226]
- QUAX [227, 228]
- NV Centers (projection) [229]
- Superconductors (projection) [230]
- Semiconductors (projection) [231]
- Spin-orbit coupling (projection) [232]
- Torsion pendulum (projection) [233]
- YIG (projection) [223]
- White dwarf hint [234]
- Freeze-in irreducible axions [182]
- X-rays (1-loop decay) [235]

4 Axion-nucleon

Note: CASPER and nEDM limits account for stochastic correction reported in [236]

- Casimir effect (fifth force) [237]
- CASPER-ZULF-Comagnetometer [238]
- CASPER-ZULF-Sidechain [239]
- ChangE [240, 241]
- Hefei Spin-based amplifiers [242]
- nEDM (ultracold neutrons and mercury) [243]
- NASDUCK [244, 245]
- PSI HgM (nEDM) [246]
- K-3He comagnetometer (fifth force) [247]

- K-3He comagnetometer (dark matter) [248]
- Mainz-Krakow comagnetometers [249]
- JEDI [250]
- Old comagnetometers [210]
- Torsion balance [251]
- Neutron star cooling [252] (corrected from [253])
- SN1987A Cooling [254, 255]
- SNO (deuterium dissasociation) [256]
- Proton storage ring (projection) [257]
- Electrostatic storage ring (projection) [221]
- DM comagnetometer (projection) [210]
- CASPER-gradient (projection) [239]
- Superfluid helium-3 HPD (projection) [258]
- MnCO3 (projection) [259]

5 Axion-EDM

- Axinovae [260]
- Beam EDM [261]
- BBN (dark matter) [262]
- CASPER-electric [263]
- nEDM [243]
- HfF⁺ [264]
- I_2^+/Ca^+ [265]
- JEDI [250]
- Rb/Quartz [266]
- SN1987A [267]
- *Planck*+BAO thermal axion bound [268]
- CASPER-electric (projection) [269]
- Storage Ring EDM (projection) [269]
- Polarisation haloscope (projection) [270]

6 Axion-top

Axion-top coupling limits originally compiles in Ref. [271]

7 Axion mass versus f_a

- BBN (dark matter) [262]
- Beam EDM [261]
- Binary pulsars and Solar core constraint on $\bar{\theta}$ [272]. I include minor numerical corrections made by [273, 274].
- GW170817 [275]
- HfF⁺ [264]
- Rb/Quartz [266]
- JEDI [250]
- nEDM [243]
- Tritium decay [276]
- Piezoaxionic effect (projection) [277]
- *Planck*+BAO thermal axion bound [268]
- SN1987A [267]
- Neutron stars (projection) [272].
- NS-NS and NS-BH Inspirals (projection) [272].
- White dwarfs [278]
- Polarisation haloscope (projection) [270]
- Neutron star cooling [279]

7.1 Black hole superradiance

- Baryakhtar et al. [280] (just Stellar mass BHs)
- Mehta et al. [280] (Stellar mass and SMBHs)
- Stott [281]
- Ünal et al. [282] (Quasars)
- Hoof et al. [283]
- Cardoso et al. [284] (dark photon)

8 Axion theory predictions

8.1 Post-inflation QCD axion

- Ballesteros et al. [285]
- Buschmann et al. 2020 [286]
- Buschmann et al. 2021 [287]
- Bonati et al. [288]
- Borsanyi et al. [289]
- Berkowitz et al. [290]
- Dine et al. [291]
- Petreczky et al. [292]
- Fleury & Moore [293]
- Klaer & Moore [294]
- Gorghetto et al. [295]
- Saikawa et al. (2019) [88]

- Saikawa et al. (2024) [296]
- Beyer et al. (2023) [297]
- Kim et al. (2024) [298]

8.2 Other dark matter predictions

- ALP Cogenesis [299]
- Early matter domination [300]
- Post-inflation ALP misalignment [301, 302]
- Trapped misalignment (\mathcal{Z}_N axion) [273]

9 CP-violating couplings

Combined constraints [303]

Scalar-nucleon

- Red giants [304]
- MICROSCOPE [305].
- Eot-Wash [306, 307, 308]
- Irvine [309]. Corrected to 2σ limit by [310]
- HUST [311, 312, 313, 314].
- Stanford [315]
- IUPUI [316].
- Wuhan [310]

Pseudoscalar-electron

- Red giants [304]
- Eot-wash [317]
- e^+e^- Penning trap [318]
- NIST [319]
- SMILE [320]
- Perihelion shift [321]
- QUAX [322, 323, 324]
- Washington [212, 325].
- XENON1T [326]
- ACME (projection) [327]
- Magnon (projection) [224]
- QUAX (projection) [322].

Pseudoscalar-nucleon

- Neutron star cooling [252]
- Hefei (Earth) [328]
- Hefei (mm) [329]
- Washington [330]. Limit taken from [331].
- SMILE [320].
- Mainz [332]
- Moon/Sun [333]
- Yb trap (projection) [327]
- ARIADNE (projection) [334]
- CASPER-wind (projection) [269]
- DM comagnetometer (projection) [210]
- Fifth force Ne-Rb-K comagnetometer (projection) [335]

10 Scalars

Scalar-photon

- Globular clusters [118]
- Eot-Wash (EP) [336]
- Fifth force [337, 338, 339, 340]
- MICROSCOPE [305]
- AURIGA [341]
- BACON [342]
- Cs/Cav [343]
- DAMNED [344]
- Dy/Dy [345]
- Dy/Quartz [266]
- Dynamic Decoupling [346]
- GEO600 [347]
- LIGO O3 [348], see also [349]
- Holometer [350]
- H/Quartz/Sapphire [351]
- PTB (Yb+, Sr clock) [352]
- I₂ [353]
- Rb/Cs [354]
- Sr/Si [355]
- Yb/Sr [356]
- AEDGE (projection) [357]
- AION (projection) [357]
- DUAL (projection) [358]
- MAGIS (projection) [359]
- Nuclear clock (projection) [360]
- Mechanical Resonators (projection) [361]

Scalar-electron

- Red giants [304]
- White dwarfs [362]
- Eot-Wash (EP) [336]
- Fifth force [337, 338, 339, 340]
- MICROSCOPE [305]
- AURIGA [341]
- Cavities [363]
- Cs/Cav [343]
- DAMNED [344]
- GEO600 [347]
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- H/Quartz/Sapphire [351]
- LIGO O3 [348], see also [349]
- I₂ [353]
- H/Si [355]
- Rb/Quartz [266]
- Yb/Cs [364]
- NANOGrav 15-year PTA [365]
- FOCOS (nuclear clock projection) [366]
- AEDGE (projection) [357]
- AION (projection) [357]
- DUAL (projection) [358]
- HELIOS (projection) [367]
- Optical microwave clock (projection) [368]
- Optical cavities [369]
- SrOH [370]
- Mechanical Resonators (projection) [361]
- IPTA (mock data) [371]

- Torsion balance (projection) [388]
- STE-QUEST (projection) [389]

11 Vectors

B-L coupling

- Casimir [372, 373, 374]
- Eot-Wash (EP) [375]
- Eot-Wash (ISL) [376]
- MICROSCOPE [377]
- DM stability [378]
- Horizontal branch [379]
- Red giant [379]
- Sun [379]
- Eot-Wash (DM) [380]
- LIGO (O1) [381]
- LIGO/VIRGO [381]
- LISA Pathfinder [382, 383]
- PPTA [384]
- POLONAISE [385]
- Asteroids (projection) [386]
- HELIOS (projection) [367]
- LISA (projection) [386]
- MAGIS (projection) [359]
- Optomechanical membranes (projection) [387]
- SKA (projection) [388]

12 Dark photons

Combined constraints [390]

SM photon-DP transitions

- Coulomb [391, 392, 393, 394, 395],
- Plimpton & Lawton's experiment [396, 395]
- Atomic spectroscopy [397]
- Atomic force microscopy (AFM) [395]
- Static magnetic field of the Earth [398, 399, 400]
- Static magnetic field of Jupiter [401, 400].
- Jupiter B-field/Juno mission [402]
- ALPs [77]
- ALPS-II (projection) [403]
- SPring-8 [404]
- UWA-LSW [405, 406]
- ADMX-LSW [407]
- CROWS [81].
- DarkSRF [408]
- DarkSRF (projection) [409]
- TEXONO [410]
- Crab nebula [411]
- COBE and FIRAS [412]
- STAX (projection) [413]

Production in stars

- CAST [414]
- SHIPS [415]
- HINODE [416]
- IAXO (modified for longitudinal mode) [417]
- New globular cluster bound [418]
- Old stellar bounds: Solar-L, HB and RG stars [379] (see also [419])
- Neutron stars [420]
- Solar neutrinos [421]
- XENON1T [422]

Dark matter cosmology/astro

- Dark matter, Arias et al. [301]
- Dark matter, Witte et al. [423, 424]
- COBE/FIRAS, Caputo et al. [425, 412]
- COBE/FIRAS with Spectral distortions [426, 427]
- ISM [428],
- Leo T dwarf [429]
- Gas clouds [429, 430]
- JWST [431]
- Parker Solar Probe [432]
- Planck + unWISE [433]
- INTEGRAL [434]

Dark matter experiments

- Reinterpreted axion limits [390]
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- AMAILS [436]
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- Dandelion (projection) [438]
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- DOSUE-RR [443, 444]
- FAST Radio antenna [445]
- FUNK [446]
- GigaBREAD [447]
- MADMAX [448]
- LAMPOST [449]
- LOFAR (solar corona) [450]
- MuDHI [451]
- ORGAN [452, 36]
- ORPHEUS [453]
- QUALIPHIDE [454]
- Quantum cyclotron [455]
- SENSEI [456]
- SHUKET [457]
- SuperCDMS [458]
- SuperMAG [459, 460, 48]

- SQuAD [461],
- SQMS [462],
- SUPAX [463]
- SRF scanning [464]
- Tokyo dish antennae experiments [465, 466, 467]
- WISPDMM [468]
- XENON(100,1T,nT) [469, 326, 470, 471, 422, 472].

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