

# 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, 9]
- ADMX-Sidecar [10, 11]
- ADMX-SLIC [12]
- CAPP [13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23]
- CAST-CAPP [24]
- DANCE [25]
- BASE [26]
- GigaBREAD [27]
- GrAHal [28]
- HAYSTAC [29, 30, 31, 32, 33]
- LIDA [34]
- MADMAX [35]
- ORGAN [36, 37, 38, 39]
- QUAX [40, 41, 42, 43, 44]
- RADES [45, 46]
- RBF [47, 48]
- SHAFT [49]
- TASEH [50]
- SuperMAG [51, 52]
- Eskdalemuir [53]
- UF [54, 55]
- UPLOAD-DOWNLOAD [56, 57]
- ABRACADABRA (projection) [58]
- ADBC (projection) [59]
- ADMX (projection) [60]
- aLIGO (projection) [61]
- ALPHA (projection) [62, 63]
- BabyIAXO (projection) [64]
- BabyIAXO-RADES (projection) [65]
- BRASS (projection) [66]
- BREAD (projection) [67]
- CADEX (projection) [68]
- DALI (projection) [69]
- DarkGEO (projection) [70]
- DM-Radio (projection) [71, 72]
- DANCE (projection) [73]
- EQC (projection) [74]
- LAMPOST (projection) [75]
- MADMAX (projection) [76]
- FLASH (projection) [77, 78]
- QUAX (projection) [79]
- ORGAN (projection) [36]
- TOORAD (projection) [80], 2025 update [81]
- Twisted Anyon Cavity (projection) [82]
- WISPLC (projection) [83]
- SRF heterodyne cavity (projection) [84]

### LSW/Helioscopes

- ALPS [85]
- CAST [86, 87, 88]
- CROWS [89]
- OSQAR [90]
- PVLAS [91]
- SAPPHIRES [92, 93, 94]
- ALPS-II (projection) [95]
- IAXO (projection) [96]
- IAXO (Galactic SN) [97]
- WISPEI (projection) [98]

### Astro

- 21 cm power spectrum (projection) [99]
- ATHENA (projection) [100]
- Axion star explosions [101]
- Betelgeuse [102]
- BICEP/KECK [103]
- Black hole polarimetry [104]
- Breakthrough Listen (Doppler shifted radio line in MW) [105]
- Bullet Cluster (archival radio data) [106]
- Cosmic IR background (hint) [107]
- Chandra (Hydra) [108]
- Chandra (M87) [109]
- Chandra (NG7 1275) [110]
- Chandra (H1821+643) [111]
- CMB Anisotropies [112, 113]
- CMB Patchy screening [114, 115]
- COBE/FIRAS+Planck spectral dist. axion decay [116]
- COBE/FIRAS - low mass axion-photon conversion [117]
- Diffuse gamma-rays [118]
- Diffuse SN ALPs [119] (see also [120])
- Distance ladder [121]
- EPTA [122]
- Fermi-LAT (NGC 1275) [123]
- Fermi-LAT (Extragalactic SNe) [124]
- Fermi-LAT (Quasars) [125]
- Gamma-ray attenuation (ALP dark matter) [126]
- Gamma-ray decay [99]
- Globular clusters ( $R$  parameter) [127]
- Globular clusters ( $R_2$  parameter) [128]
- GW170817 (Fermi) [129]
- GW170817 [130]
- HAWC (TeV Blazars) [131]
- HESS (PKS 2155-304) [132]
- INTEGRAL (ALP decay) [133]
- Leo T gas temperature [134]
- M82 (NuSTAR) [135]
- M82 (NuSTAR - axion decay) [136]
- MAGIC (Perseus galaxy cluster) [137]
- Magnetic white dwarfs (X-rays) [138]
- Magnetic white dwarf (polarization) [139]
- Magnetic white dwarf (polarization - Keck/Lick observations) [140]
- MOJAVE [141]
- Mrk 421 (ARGO-YBJ+Fermi): [142]
- Mrk 421 (ARGO-YBJ+MAGIC): [143]
- Mrk 421 (Fermi+HAWC): [144]
- Neutron Stars (Foster et al. 2020) [145]
- Neutron Stars (Darling 2020) [146]
- Neutron Stars (Battye et al. 2021) [147]
- Neutron stars (Foster et al. 2022) [148]
- Neutron Stars (Battye et al. 2023) [149]
- NuSTAR (decaying dark matter, recast from Sterile nu) [150, 151, 152]
- NuSTAR (Sun) [153]
- Planck cosmic birefringence [154]
- POLARBEAR [155, 156]
- PPTA+QUIJOTE [157]
- Pulsar polarisation arrays (projection) [158]
- Pulsar polarisation arrays (PPTA analysis) [159]
- Pulsar polar cap [160]
- PSR J0437-4715 polarisation [161]
- Red supergiant [162]
- Solar neutrinos [163]
- Stellar axion background [164]
- SN1987A- $\gamma$  (ALP decay) [165, 166, 167]
- SN1987A- $\gamma$  (low mass ALP conversion) [168, 166, 169]
- SN1987A- $\gamma, \nu$  (high mass ALPs) [170, 171, 118]
- SN1987A (PVO) [172]
- Sgr A\* [173]
- Low-energy supernovae (ALP decay) [118]
- Low-energy supernovae (ALP decay) - Fiorillo et al. 2025 update [174]
- Solar basin (NuSTAR) [175]

- Solar basin (NuSTAR and SPHINX) [176]
- Super Star clusters [177]
- SPT [178]
- Telescopes (DESI) [179]
- Telescopes (Haystack) [180]
- Telescopes (MUSE) [181] (updated from: [182])
- Telescopes (VIMOS) [183]
- Telescopes (HST) [184, 185]
- Telescopes (HST-dwarfs) [186]
- Telescopes (JWST - Janish 2023) [187]
- Telescopes (JWST - Pinetti 2025) [188]
- Telescopes (JWST - Saha 2025) [189]
- Telescopes (WINERED) [190, 191]
- Telescopes (eROSITA) [192]
- Telescopes (XRISM) [193]
- Fermi galactic SN (projection) [194]
- THESEUS (projection) [195]
- eROSITA (projection) [196]
- XRISM (projection) [197]
- White dwarf initial-final mass relation [198]
- XMM-Newton (decaying DM ALPs) [199]

### Cosmology

- Ionisation fraction, EBL, X-rays [200]
- BBN+ $N_{\text{eff}}$  [201]
- Freeze in [202]
- Cosmic background [203]

## 2 Heavy ALP-photon coupling

- ATALS (PbPb) [204]
- BaBar [205]
- Beam dump [206, 207, 205, 208, 209]
- Belle II [210]
- BESIII [211, 212]
- CMS (PbPb) [213]
- EuXFL [214]
- FASER (limit) [215]
- LEP [216]
- LHC (pp)[217]
- MiniBooNE [218]
- NOMAD [219]
- OPAL [217]
- PrimEx [220, 221]
- GlueX [222]
- CONUS (projection) [223]
- DUNE (projection) [224]
- FASER LLP (projection) [225]

## 3 Axion-electron

- Electron g-2 [226]
- EDELWEISS [227]
- Fermionic axion interferometer [228]
- Magnon non-demolition [229]
- DarkSide-50 [230]
- GERDA [231]
- LUX [232]
- Old comagnetometers [233]
- Panda-X [234, 235, 236]
- Torsion pendulum (spin force) [237]
- Torsion pendulum (axion wind) [238]
- SuperCDMS [239]
- XENON1T [240, 241]
- XENONnT [242]
- XENON1T (Solar basin) [243]
- Red giants ( $\omega$ Cen) [244]
- Solar neutrinos [245]
- Electron storage ring (projection) [246]
- Axion wind multilayer (projection) [247]
- MOSAIC (projection) [248]
- Magnons (projection) [249]
- Polaritons (projection) [250]
- DARWIN (projection) [251]
- LZ (projection) [252]
- QUAX [253, 254]
- NV Centers (projection) [255]
- Superconductors (projection) [256]
- Semiconductors (projection) [257]
- Spin-orbit coupling (projection) [258]
- Torsion pendulum (projection) [259]

- YIG (projection) [249]
- White dwarf hint [260]
- Freeze-in irreducible axions [202]
- X-rays (1-loop decay) [261]

## 4 Axion-nucleon

Note: CASPER and nEDM limits account for stochastic correction reported in [262]

- Casimir effect (fifth force) [263]
- CASPER-gradient [264]
- CASPER-ZULF-Comagnetometer [265]
- CASPER-ZULF-Sidechain [266]
- ChangE [267, 268]
- Hefei Spin-based amplifiers [269]
- nEDM (ultracold neutrons and mercury) [270]
- NASDUCK [271, 272]
- PSI HgM (nEDM) [273]
- K-3He comagnetometer (fifth force) [274]
- K-3He comagnetometer (dark matter) [275]
- Mainz-Krakow comagnetometers [276]
- JEDI [277]
- Old comagnetometers [233]
- Torsion balance [278]
- Neutron star cooling [279] (corrected from [280])
- SN1987A Cooling [281, 282]
- Super-Kamiokande diffuse supernova ALPs [283]
- SNO (deuterium dissasociation) [284]
- Xe-129 fifth force [285]
- Proton storage ring (projection) [286]
- Electrostatic storage ring (projection) [246]
- DM comagnetometer (projection) [233]
- CASPER-gradient (projection) [266]
- Superfluid helium-3 HPD (projection) [287]
- MnCO3 (projection) [288]

## 5 Axion-EDM

- Axinovae [289]
- Beam EDM [290]
- BBN (dark matter) [291]
- CASPER-electric [292]
- nEDM [270]
- HfF<sup>+</sup> [293]
- $I_2^+/\text{Ca}^+$  [294]
- JEDI [277]
- ONIX [295]
- Rb/Quartz [296]
- SN1987A [297, 298]
- *Planck*+BAO thermal axion bound [299]
- CASPER-electric (projection) [300]
- Storage Ring EDM (projection) [300]
- Polarisation haloscope (projection) [301]

## 6 Axion-top

Axion-top coupling limits originally compiled in Ref. [302, 303]

## 7 Axion mass versus $f_a$

- BBN (dark matter) [291]
- Beam EDM [290]
- Binary pulsars and Solar core constraint on  $\bar{\theta}$  [304]. I include minor numerical corrections made by [305, 306].
- GW170817 [307]
- HfF<sup>+</sup> [293]
- MICROSCOPE [308]
- Rb/Quartz [296]
- JEDI [277]
- nEDM [270]
- Tritium decay [309]
- 40K decay [310]
- Yb+ E3/E2 [311]
- Piezoaxionic effect (projection) [312]
- *Planck*+BAO thermal axion bound [299]
- SN1987A [297, 298]
- Neutron stars (projection) [304].
- NS-NS and NS-BH Inspirals (projection) [304].
- White dwarfs [313]
- Polarisation haloscope (projection) [301]

- Neutron star cooling (Gomez-Banon et al. [314], Kumamoto et al. [315])

## 7.1 Black hole superradiance

- Baryakhtar et al. [316] (just Stellar mass BHs)
- Mehta et al. [316] (Stellar mass and SMBHs)
- Stott [317]
- Ünal et al. [318] (Quasars)
- Hoof et al. [319]
- Witte and Mummery [320]
- Cardoso et al. [321] (dark photon)

## 8 Axion theory predictions

### 8.1 Post-inflation QCD axion

- Ballesteros et al. [322]
- Buschmann et al. 2020 [323]
- Buschmann et al. 2021 [324]
- Benabou et al. 2024 [325]
- Bonati et al. [326]
- Borsanyi et al. [327]
- Berkowitz et al. [328]
- Dine et al. [329]
- Petreczky et al. [330]
- Fleury & Moore [331]
- Klaer & Moore [332]
- Gorghetto et al. [333]
- Saikawa et al. (2019) [96]
- Saikawa et al. (2024) [334]
- Beyer et al. (2023) [335]
- Kim et al. (2024) [336]

### 8.2 Other dark matter predictions

- ALP Cogenesis [337]
- Early matter domination [338]
- Post-inflation ALP misalignment [339, 340]
- Trapped misalignment ( $\mathcal{Z}_N$  axion) [305]

## 9 CP-violating couplings

Combined constraints [341]

### Scalar-nucleon

- Red giants [342]
- MICROSCOPE [343].
- Eot-Wash [344, 345, 346]
- Irvine [347]. Corrected to  $2\sigma$  limit by [348]
- HUST [349, 350, 351, 352].
- Stanford [353]
- IUPUI [354].
- Wuhan [348]

### Pseudoscalar-electron

- Red giants [342]
- Eot-wash [355]
- $e^+e^-$  Penning trap [356]
- NIST [357]
- SMILE [358]
- Perihelion shift [359]
- QUAX [360, 361, 362]
- Washington [237, 363].
- XENON1T [364]
- ACME (projection) [365]
- Magnon (projection) [250]
- QUAX (projection) [360].

### Pseudoscalar-nucleon

- Neutron star cooling [279]
- Hefei (Earth) [366]
- Hefei (mm) [367]
- Washington [368]. Limit taken from [369].
- SMILE [358].
- Mainz [370]
- Moon/Sun [371]
- Yb trap (projection) [365]
- ARIADNE (projection) [372]
- CASPER-wind (projection) [300]
- DM comagnetometer (projection) [233]
- Fifth force Ne-Rb-K comagnetometer (projection) [373]

## 10 Scalars

### Scalar-photon

- Globular clusters [128]
- Eot-Wash (EP) [374]
- Fifth force [375, 376, 377, 378]
- MICROSCOPE [343]
- AURIGA [379]
- BACON [380]
- Cs/Cav [381]
- DAMNED [382]
- Dy/Dy [383]
- Dy/Quartz [296]
- Dynamic Decoupling [384]
- GEO600 [385]
- LIGO O3 [386], see also [387]
- Holometer [388]
- H/Quartz/Sapphire [389]
- PTB (Yb+, Sr clock) [390]
- I<sub>2</sub> [391]
- Rb/Cs [392]
- Sr/Si [393]
- QSNET [394]
- QSNET (projection) [395]
- AEDGE (projection) [396]
- AION (projection) [396]
- DUAL (projection) [397]
- MAGIS (projection) [398]
- Nuclear clock (projection) [399]
- Mechanical Resonators (projection) [400]

### Scalar-electron

- Red giants [342]
- White dwarfs [401]
- Eot-Wash (EP) [374]
- Fifth force [375, 376, 377, 378]
- MICROSCOPE [343]
- AURIGA [379]
- Cavities [402]
- Cs/Cav [381]
- DAMNED [382]
- GEO600 [385]
- Holometer [388]
- H/Quartz/Sapphire [389]
- LIGO O3 [386], see also [387]
- I<sub>2</sub> [391]
- H/Si [393]
- Rb/Quartz [296]
- Yb/Cs [403]
- NANOGrav 15-year PTA [404]
- FOCOS (nuclear clock projection) [405]
- AEDGE (projection) [396]
- AION (projection) [396]
- DUAL (projection) [397]
- HELIOS (projection) [406]
- QSNET (projection) [395]
- Optical microwave clock (projection) [407]
- Optical cavities [408]
- SrOH [409]
- Mechanical Resonators (projection) [400]
- IPTA (mock data) [410]

- MAGIS (projection) [398]
- Optomechanical membranes (projection) [427]
- SKA (projection) [428]
- Torsion balance (projection) [428]
- STE-QUEST (projection) [429]

## 11 Vectors

### B-L coupling

- Casimir [411, 412, 413]
- Eot-Wash (EP) [414]
- Eot-Wash (ISL) [415]
- MICROSCOPE [416]
- DM stability [417]
- Horizontal branch [418]
- Red giant [418]
- Sun [418]
- Eot-Wash (DM) [419]
- KAGRA (DM) [420]
- LIGO (O1) [421]
- LIGO/VIRGO [421]
- LISA Pathfinder [422, 423]
- PPTA [424]
- POLONAISE [425]
- Asteroids (projection) [426]
- HELIOS (projection) [406]
- LISA (projection) [426]

## 12 Dark photons

Combined constraints [430]

### SM photon-DP transitions

- Coulomb [431, 432, 433, 434, 435],
- Plimpton & Lawton's experiment [436, 435]
- Atomic spectroscopy [437]
- Atomic force microscopy (AFM) [435]
- Static magnetic field of the Earth [438, 439, 440]
- Static magnetic field of Jupiter [441, 440].
- Jupiter B-field/Juno mission [442]
- ALPs [85]
- ALPS-II (projection) [443]
- SPring-8 [444]
- UWA-LSW [445, 446]
- ADMX-LSW [447]
- CROWS [89].
- DarkSRF [448]
- DarkSRF (projection) [449]
- TEXONO [450]
- Crab nebula [451]
- COBE and FIRAS [452]
- STAX (projection) [453]

### Production in stars

- CAST [454]
- SHIPS [455]
- HINODE [456]
- IAXO (modified for longitudinal mode) [457]
- New globular cluster bound [458]
- Old stellar bounds: Solar-L, HB and RG stars [418] (see also [459])
- Neutron stars [460]
- Solar neutrinos [461]
- XENON1T [462]

### Dark matter cosmology/astro

- Blazars [463]
- Dark matter, Arias et al. [339]
- Dark matter, Witte et al. [464, 465]
- COBE/FIRAS, Caputo et al. [466, 452]
- COBE/FIRAS with Spectral distortions [467, 468]
- Lyman-alpha [469]
- ISM [470],
- Leo T dwarf [471]
- Gas clouds [471, 472]
- JWST [473]
- Parker Solar Probe [474]
- Planck + unWISE [475]
- INTEGRAL [476, 477]

### Dark matter experiments

- Reinterpreted axion limits [430]
- APEX [478]
- ALPHA [63]
- AMAILS [479]
- BRASS-p [480]
- BREAD (projection) [67]
- Dandelion (projection) [481]
- DarkSide-50 [230]
- DAMIC [482]
- Dark E-field Radio [483, 484]
- DM Pathfinder [485]
- DOSUE-RR [486, 487]
- FAST Radio antenna [488]
- FUNK [489]
- GigaBREAD [490]
- Hefei haloscope [491]
- MADMAX [492]
- LAMPOST [493]
- LOFAR (solar corona) [494]
- MuDHI [495]
- ORGAN [496, 39]
- ORPHEUS [497]
- QUALIPHIDE [498]
- Quantum cyclotron [499]
- SENSEI [500]
- SHUKET [501]
- SuperCDMS [502]
- SuperMAG [503, 504, 52]

- SQuAD [505],
- SQMS [506],
- SUPAX [507]
- SRF scanning [508]
- Tokyo dish antennae experiments [509, 510, 511]
- WISPDMM [512]
- XENON(100,1T,nT) [513, 364, 514, 515, 462, 516].



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