

# References for AxionLimits webpage

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## 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) [?]

- YIG (projection) [249]
- White dwarf hint [259]
- Freeze-in irreducible axions [202]
- X-rays (1-loop decay) [260]

## 4 Axion-nucleon

Note: CASPER and nEDM limits account for stochastic correction reported in [261]

- Casimir effect (fifth force) [262]
- CASPER-gradient [263]
- CASPER-ZULF-Comagnetometer [264]
- CASPER-ZULF-Sidechain [265]
- ChangE [266, 267]
- Hefei Spin-based amplifiers [268]
- nEDM (ultracold neutrons and mercury) [269]
- NASDUCK [270, 271]
- PSI HgM (nEDM) [272]
- K-3He comagnetometer (fifth force) [273]
- K-3He comagnetometer (dark matter) [274]
- Mainz-Krakow comagnetometers [275]
- JEDI [276]
- Old comagnetometers [233]
- Torsion balance [277]
- Neutron star cooling [278] (corrected from [279])
- SN1987A Cooling [280, 281]
- Super-Kamiokande diffuse supernova ALPs [282]
- SNO (deuterium dissasociation) [283]
- Xe-129 fifth force [284]
- Proton storage ring (projection) [285]
- Electrostatic storage ring (projection) [246]
- DM comagnetometer (projection) [233]
- CASPER-gradient (projection) [265]
- Superfluid helium-3 HPD (projection) [286]
- MnCO3 (projection) [287]

## 5 Axion-EDM

- Axinovae [288]
- Beam EDM [289]
- BBN (dark matter) [290]
- CASPER-electric [291]
- nEDM [269]
- HfF<sup>+</sup> [292]
- $I_2^+/\text{Ca}^+$  [293]
- JEDI [276]
- ONIX [294]
- Rb/Quartz [295]
- SN1987A [296, 297]
- *Planck*+BAO thermal axion bound [298]
- CASPER-electric (projection) [299]
- Storage Ring EDM (projection) [299]
- Polarisation haloscope (projection) [300]

## 6 Axion-top

Axion-top coupling limits originally compiled in Ref. [301, 302]

## 7 Axion mass versus $f_a$

- BBN (dark matter) [290]
- Beam EDM [289]
- Binary pulsars and Solar core constraint on  $\bar{\theta}$  [303]. I include minor numerical corrections made by [304, 305].
- GW170817 [306]
- HfF<sup>+</sup> [292]
- MICROSCOPE [307]
- Rb/Quartz [295]
- JEDI [276]
- nEDM [269]
- Tritium decay [308]
- 40K decay [309]
- Yb+ E3/E2 [310]
- Piezoaxionic effect (projection) [311]
- *Planck*+BAO thermal axion bound [298]
- SN1987A [296, 297]
- Neutron stars (projection) [303].
- NS-NS and NS-BH Inspirals (projection) [303].
- White dwarfs [312]
- Polarisation haloscope (projection) [300]

- Neutron star cooling (Gomez-Banon et al. [313], Kumamoto et al. [314])

## 7.1 Black hole superradiance

- Baryakhtar et al. [315] (just Stellar mass BHs)
- Mehta et al. [315] (Stellar mass and SMBHs)
- Stott [316]
- Ünal et al. [317] (Quasars)
- Hoof et al. [318]
- Witte and Mummery [319]
- Cardoso et al. [320] (dark photon)

## 8 Axion theory predictions

### 8.1 Post-inflation QCD axion

- Ballesteros et al. [321]
- Buschmann et al. 2020 [322]
- Buschmann et al. 2021 [323]
- Benabou et al. 2024 [324]
- Bonati et al. [325]
- Borsanyi et al. [326]
- Berkowitz et al. [327]
- Dine et al. [328]
- Petreczky et al. [329]
- Fleury & Moore [330]
- Klaer & Moore [331]
- Gorghetto et al. [332]
- Saikawa et al. (2019) [96]
- Saikawa et al. (2024) [333]
- Beyer et al. (2023) [334]
- Kim et al. (2024) [335]

### 8.2 Other dark matter predictions

- ALP Cogenesis [336]
- Early matter domination [337]
- Post-inflation ALP misalignment [338, 339]
- Trapped misalignment ( $\mathcal{Z}_N$  axion) [304]

## 9 CP-violating couplings

Combined constraints [340]

### Scalar-nucleon

- Red giants [341]
- MICROSCOPE [342].
- Eot-Wash [343, 344, 345]
- Irvine [346]. Corrected to  $2\sigma$  limit by [347]
- HUST [348, 349, 350, 351].
- Stanford [352]
- IUPUI [353].
- Wuhan [347]

### Pseudoscalar-electron

- Red giants [341]
- Eot-wash [354]
- $e^+e^-$  Penning trap [355]
- NIST [356]
- SMILE [357]
- Perihelion shift [358]
- QUAX [359, 360, 361]
- Washington [237, 362].
- XENON1T [363]
- ACME (projection) [364]
- Magnon (projection) [250]
- QUAX (projection) [359].

### Pseudoscalar-nucleon

- Neutron star cooling [278]
- Hefei (Earth) [365]
- Hefei (mm) [366]
- Washington [367]. Limit taken from [368].
- SMILE [357].
- Mainz [369]
- Moon/Sun [370]
- Yb trap (projection) [364]
- ARIADNE (projection) [371]
- CASPER-wind (projection) [299]
- DM comagnetometer (projection) [233]
- Fifth force Ne-Rb-K comagnetometer (projection) [372]

## 10 Scalars

### Scalar-photon

- Globular clusters [128]
- Eot-Wash (EP) [373]
- Fifth force [374, 375, 376, 377]
- MICROSCOPE [342]
- AURIGA [378]
- BACON [379]
- Cs/Cav [380]
- DAMNED [381]
- Dy/Dy [382]
- Dy/Quartz [295]
- Dynamic Decoupling [383]
- GEO600 [384]
- LIGO O3 [385], see also [386]
- Holometer [387]
- H/Quartz/Sapphire [388]
- PTB (Yb+, Sr clock) [389]
- I<sub>2</sub> [390]
- Rb/Cs [391]
- Sr/Si [392]
- QSNET [393]
- QSNET (projection) [394]
- AEDGE (projection) [395]
- AION (projection) [395]
- DUAL (projection) [396]
- MAGIS (projection) [397]
- Nuclear clock (projection) [398]
- Mechanical Resonators (projection) [399]

### Scalar-electron

- Red giants [341]
- White dwarfs [400]
- Eot-Wash (EP) [373]
- Fifth force [374, 375, 376, 377]
- MICROSCOPE [342]
- AURIGA [378]
- Cavities [401]
- Cs/Cav [380]
- DAMNED [381]
- GEO600 [384]
- Holometer [387]
- H/Quartz/Sapphire [388]
- LIGO O3 [385], see also [386]
- I<sub>2</sub> [390]
- H/Si [392]
- Rb/Quartz [295]
- Yb/Cs [402]
- NANOGrav 15-year PTA [403]
- FOCOS (nuclear clock projection) [404]
- AEDGE (projection) [395]
- AION (projection) [395]
- DUAL (projection) [396]
- HELIOS (projection) [405]
- QSNET (projection) [394]
- Optical microwave clock (projection) [406]
- Optical cavities [407]
- SrOH [408]
- Mechanical Resonators (projection) [399]
- IPTA (mock data) [409]

- MAGIS (projection) [397]
- Optomechanical membranes (projection) [426]
- SKA (projection) [427]
- Torsion balance (projection) [427]
- STE-QUEST (projection) [428]

## 11 Vectors

### B-L coupling

- Casimir [410, 411, 412]
- Eot-Wash (EP) [413]
- Eot-Wash (ISL) [414]
- MICROSCOPE [415]
- DM stability [416]
- Horizontal branch [417]
- Red giant [417]
- Sun [417]
- Eot-Wash (DM) [418]
- KAGRA (DM) [419]
- LIGO (O1) [420]
- LIGO/VIRGO [420]
- LISA Pathfinder [421, 422]
- PPTA [423]
- POLONAISE [424]
- Asteroids (projection) [425]
- HELIOS (projection) [405]
- LISA (projection) [425]

## 12 Dark photons

Combined constraints [429]

### SM photon-DP transitions

- Coulomb [430, 431, 432, 433, 434],
- Plimpton & Lawton's experiment [435, 434]
- Atomic spectroscopy [436]
- Atomic force microscopy (AFM) [434]
- Static magnetic field of the Earth [437, 438, 439]
- Static magnetic field of Jupiter [440, 439].
- Jupiter B-field/Juno mission [441]
- ALPs [85]
- ALPS-II (projection) [442]
- SPring-8 [443]
- UWA-LSW [444, 445]
- ADMX-LSW [446]
- CROWS [89].
- DarkSRF [447]
- DarkSRF (projection) [448]
- TEXONO [449]
- Crab nebula [450]
- COBE and FIRAS [451]
- STAX (projection) [452]

### Production in stars

- CAST [453]
- SHIPS [454]
- HINODE [455]
- IAXO (modified for longitudinal mode) [456]
- New globular cluster bound [457]
- Old stellar bounds: Solar-L, HB and RG stars [417] (see also [458])
- Neutron stars [459]
- Solar neutrinos [460]
- XENON1T [461]

### Dark matter cosmology/astro

- Blazars [462]
- Dark matter, Arias et al. [338]
- Dark matter, Witte et al. [463, 464]
- COBE/FIRAS, Caputo et al. [465, 451]
- COBE/FIRAS with Spectral distortions [466, 467]
- Lyman-alpha [468]
- ISM [469],
- Leo T dwarf [470]
- Gas clouds [470, 471]
- JWST [472]
- Parker Solar Probe [473]
- Planck + unWISE [474]
- INTEGRAL [475, 476]

### Dark matter experiments

- Reinterpreted axion limits [429]
- APEX [477]
- ALPHA [63]
- AMAILS [478]
- BRASS-p [479]
- BREAD (projection) [67]
- Dandelion (projection) [480]
- DarkSide-50 [230]
- DAMIC [481]
- Dark E-field Radio [482, 483]
- DM Pathfinder [484]
- DOSUE-RR [485, 486]
- FAST Radio antenna [487]
- FUNK [488]
- GigaBREAD [489]
- Hefei haloscope [490]
- MADMAX [491]
- LAMPOST [492]
- LOFAR (solar corona) [493]
- MuDHI [494]
- ORGAN [495, 39]
- ORPHEUS [496]
- QUALIPHIDE [497]
- Quantum cyclotron [498]
- SENSEI [499]
- SHUKET [500]
- SuperCDMS [501]
- SuperMAG [502, 503, 52]

- SQuAD [504],
- SQMS [505],
- SUPAX [506]
- SRF scanning [507]
- Tokyo dish antennae experiments [508, 509, 510]
- WISPDMM [511]
- XENON(100,1T,nT) [512, 363, 513, 514, 461, 515].



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