

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]
- DANCE [23]
- BASE [24]
- GrAHal [25]
- HAYSTAC [26, 27, 28, 29, 30]
- LIDA [31]
- ORGAN [32, 33, 34, 35]
- QUAX [36, 37, 38, 39]
- RADES [40, 41]
- RBF [42, 43]
- SHAFT [44]
- TASEH [45]
- SuperMAG [46, 47]
- UF [48, 49]
- UPLOAD-DOWNLOAD [50, 51]
- ABRACADABRA (projection) [52]
- ADBC (projection) [53]
- ADMX (projection) [54]
- aLIGO (projection) [55]
- ALPHA (projection) [56, 57]
- BabyIAXO-RADES (projection) [58]
- BRASS (projection) [59]
- BREAD (projection) [60]
- CADEx (projection) [61]
- DALI (projection) [62]
- DarkGEO (projection) [63]
- DM-Radio (projection) [64, 65]
- DANCE (projection) [66]
- LAMPOST (projection) [67]
- MADMAX (projection) [68]
- FLASH (projection) [69, 70]
- QUAX (projection) [71]
- ORGAN (projection) [32]
- TOORAD (projection) [72]
- Twisted Anyon Cavity (projection) [73]
- WISPLC (projection) [74]
- SRF heterodyne cavity (projection) [75]

LSW/Helioscopes

- ALPS [76]
- CAST [77, 78, 79]
- CROWS [80]
- OSQAR [81]
- PVLAS [82]
- SAPPHIRES [83, 84, 85]
- ALPS-II (projection) [86]
- IAXO (projection) [87]
- IAXO (Galactic SN) [88]
- WISPMI (projection) [89]

Astro

- 21 cm power spectrum (projection) [90]
- ATHENA (projection) [91]
- Axion star explosions [92]
- Betelgeuse [93]
- BICEP/KECK [94]
- Black hole polarimetry [95]
- Breakthrough Listen (Doppler shifted radio line in MW) [96]
- Bullet Cluster (archival radio data) [97]
- Cosmic IR background (hint) [98]
- Chandra (Hydra) [99]
- Chandra (M87) [100]
- Chandra (NG7 1275) [101]
- Chandra (H1821+643) [102]
- CMB Anisotropies [103, 104]
- COBE/FIRAS+Planck spectral dist. [105]
- Diffuse gamma-rays [106]
- Diffuse SN ALPs [107] (see also [108])
- Distance ladder [109]
- Fermi-LAT (NGC 1275) [110]
- Fermi-LAT (Extragalactic SNe) [111]
- Fermi-LAT (Quasars) [112]
- FIRAS [113]
- Gamma-ray attenuation (ALP dark matter) [114]
- Gamma-ray decay [90]
- Globular clusters (R parameter) [115]
- Globular clusters (R_2 parameter) [116]
- GW170817 (Fermi) [117]
- GW170817 [118]
- HAWC (TeV Blazars) [119]
- HESS (PKS 2155-304) [120]
- INTEGRAL (ALP decay) [121]
- Leo T gas temperature [122]
- M82 (NuSTAR) [123]
- MAGIC (Perseus galaxy cluster) [124]
- Magnetic white dwarfs (X-rays) [125]
- Magnetic white dwarf (polarization) [126]
- MOJAVE [127]
- Mrk 421 (ARGO-YBJ+Fermi): [128]
- Mrk 421 (ARGO-YBJ+MAGIC): [129]
- Neutron Stars (Foster et al. 2020) [130]
- Neutron Stars (Darling 2020) [131]
- Neutron Stars (Battye et al. 2021) [132]
- Neutron stars (Foster et al. 2022) [133]
- Neutron Stars (Battye et al. 2023) [134]
- NuSTAR (decaying dark matter, recast from Sterile nu) [135, 136, 137]
- NuSTAR (Sun) [138]
- Planck cosmic birefringence [139]
- POLARBEAR [140, 141]
- PPTA+QUIJOTE [142]
- Pulsar polarisation arrays (projection) [143]
- Pulsar polar cap [144]
- PSR J0437-4715 polarisation [145]
- Red supergiant [146]
- Solar neutrinos [147]
- Stellar axion background [148]
- SN1987A- γ (ALP decay) [149, 150, 151]
- SN1987A- γ (low mass ALP conversion) [152, 150, 153]
- SN1987A- γ, ν (high mass ALPs) [154, 155, 106]
- SN1987A (PVO) [156]
- Sgr A* [157]
- Low-energy supernovae (ALP decay) [106]
- Solar basin (NuSTAR) [158]
- Solar basin (NuSTAR and SPHINX) [159]
- Super Star clusters [160]
- SPT [161]
- Telescopes (Haystack) [162]
- Telescopes (MUSE) [163] (updated from: [164])
- Telescopes (VIMOS) [165]
- Telescopes (HST) [166, 167]
- Telescopes (JWST) [168]
- Telescopes (WINERED) [169, 170]

- Telescopes (eROSITA) [171]
- Fermi galactic SN (projection) [172]
- THESEUS (projection) [173]
- eROSITA (projection) [174]
- XRISM (projection) [175]
- White dwarf initial-final mass relation [176]
- XMM-Newton (decaying DM ALPs) [177]

Cosmology

- Ionisation fraction, EBL, X-rays [178]
- BBN+ N_{eff} [179]
- Freeze in [180]
- Cosmic background [181]

2 Heavy ALP-photon coupling

- ATALS (PbPb) [182]
- BaBar [183]
- Beam dump [184, 185, 183, 186, 187]
- Belle II [188]
- BESIII [189]
- CMS (PbPb) [190]
- EuXFL [191]
- LEP [192]
- LHC (pp)[193]
- MiniBooNE [194]
- NOMAD [195]
- OPAL [193]
- PrimEx [196, 197]
- CONUS (projection) [198]
- DUNE (projection) [199]
- FASER LLP (projection) [200]

3 Axion-electron

- Electron g-2 [201]
- EDELWEISS [202]
- Fermionic axion interferometer [203]
- Magnon non-demolition [204]
- DarkSide-50 [205]
- GERDA [206]
- LUX [207]
- Old comagnetometers [208]
- Panda-X [209]
- Torsion pendulum (spin force) [210]
- Torsion pendulum (axion wind) [211]
- SuperCDMS [212]
- XENON1T [213, 214]
- XENONnT [215]
- XENON1T (Solar basin) [216]
- Red giants (ω Cen) [217]
- Solar neutrinos [218]
- Electron storage ring (projection) [219]
- Axion wind multilayer (projection) [220]
- Magnons (projection) [221]
- Polaritons (projection) [222]
- DARWIN (projection) [223]
- LZ (projection) [224]
- QUAX [225, 226]
- NV Centers (projection) [227]
- Superconductors (projection) [228]
- Semiconductors (projection) [229]
- Spin-orbit coupling (projection) [230]
- Torsion pendulum (projection) [231]
- YIG (projection) [221]
- White dwarf hint [232]
- Freeze-in irreducible axions [180]
- X-rays (1-loop decay) [233]

4 Axion-nucleon

Note: CASPER and nEDM limits account for stochastic correction reported in [234]

- Casimir effect (fifth force) [235]
- CASPER-ZULF-Comagnetometer [236]
- CASPER-ZULF-Sidechain [237]
- ChangE [238, 239]
- Hefei Spin-based amplifiers [240]
- nEDM (ultracold neutrons and mercury) [241]
- NASDUCK [242, 243]
- PSI HgM (nEDM) [244]
- K-3He comagnetometer (fifth force) [245]

- K-3He comagnetometer (dark matter) [246]
- Mainz-Krakow comagnetometers [247]
- JEDI [248]
- Old comagnetometers [208]
- Torsion balance [249]
- Neutron star cooling [250] (corrected from [251])
- SN1987A Cooling [252, 253]
- SNO (deuterium dissasociation) [254]
- Proton storage ring (projection) [255]
- Electrostatic storage ring (projection) [219]
- DM comagnetometer (projection) [208]
- CASPER-gradient (projection) [237]
- Superfluid helium-3 HPD (projection) [256]
- MnCO3 (projection) [257]

5 Axion-EDM

- Axinovae [258]
- Beam EDM [259]
- BBN (dark matter) [260]
- CASPER-electric [261]
- nEDM [241]
- HfF⁺ [262]
- I_2^+/Ca^+ [263]
- JEDI [248]
- Rb/Quartz [264]
- SN1987A [265]
- *Planck*+BAO thermal axion bound [266]
- CASPER-electric (projection) [267]
- Storage Ring EDM (projection) [267]
- Polarisation haloscope (projection) [268]

6 Axion-top

Axion-top coupling limits originally compiles in Ref. [269]

7 Axion mass versus f_a

- BBN (dark matter) [260]
- Beam EDM [259]
- Binary pulsars and Solar core constraint on $\bar{\theta}$ [270]. I include minor numerical corrections made by [271, 272].
- GW170817 [273]
- HfF⁺ [262]
- Rb/Quartz [264]
- JEDI [248]
- nEDM [241]
- Tritium decay [274]
- Piezoaxionic effect (projection) [275]
- *Planck*+BAO thermal axion bound [266]
- SN1987A [265]
- Neutron stars (projection) [270].
- NS-NS and NS-BH Inspirals (projection) [270].
- White dwarfs [276]
- Polarisation haloscope (projection) [268]
- Neutron star cooling [277]

7.1 Black hole superradiance

- Baryakhtar et al. [278] (just Stellar mass BHs)
- Mehta et al. [278] (Stellar mass and SMBHs)
- Stott [279]
- Ünal et al. [280] (Quasars)
- Hoof et al. [281]
- Cardoso et al. [282] (dark photon)

8 Axion theory predictions

8.1 Post-inflation QCD axion

- Ballesteros et al. [283]
- Buschmann et al. 2020 [284]
- Buschmann et al. 2021 [285]
- Bonati et al. [286]
- Borsanyi et al. [287]
- Berkowitz et al. [288]
- Dine et al. [289]
- Petreczky et al. [290]
- Fleury & Moore [291]
- Klaer & Moore [292]
- Gorghetto et al. [293]
- Saikawa et al. (2019) [87]

- Saikawa et al. (2024) [294]
- Beyer et al. (2023) [295]
- Kim et al. (2024) [296]

8.2 Other dark matter predictions

- ALP Cogenesis [297]
- Early matter domination [298]
- Post-inflation ALP misalignment [299, 300]
- Trapped misalignment (\mathcal{Z}_N axion) [271]

9 CP-violating couplings

Combined constraints [301]

Scalar-nucleon

- Red giants [302]
- MICROSCOPE [303].
- Eot-Wash [304, 305, 306]
- Irvine [307]. Corrected to 2σ limit by [308]
- HUST [309, 310, 311, 312].
- Stanford [313]
- IUPUI [314].
- Wuhan [308]

Pseudoscalar-electron

- Red giants [302]
- Eot-wash [315]
- e^+e^- Penning trap [316]
- NIST [317]
- SMILE [318]
- Perihelion shift [319]
- QUAX [320, 321, 322]
- Washington [210, 323].
- XENON1T [324]
- ACME (projection) [325]
- Magnon (projection) [222]
- QUAX (projection) [320].

Pseudoscalar-nucleon

- Neutron star cooling [250]
- Hefei (Earth) [326]
- Hefei (mm) [327]
- Washington [328]. Limit taken from [329].
- SMILE [318].
- Mainz [330]
- Moon/Sun [331]
- Yb trap (projection) [325]
- ARIADNE (projection) [332]
- CASPER-wind (projection) [267]
- DM comagnetometer (projection) [208]
- Fifth force Ne-Rb-K comagnetometer (projection) [333]

10 Scalars

Scalar-photon

- Globular clusters [116]
- Eot-Wash (EP) [334]
- Fifth force [335, 336, 337, 338]
- MICROSCOPE [303]
- AURIGA [339]
- BACON [340]
- Cs/Cav [341]
- DAMNED [342]
- Dy/Dy [343]
- Dy/Quartz [264]
- Dynamic Decoupling [344]
- GEO600 [345]
- LIGO O3 [346], see also [347]
- Holometer [348]
- H/Quartz/Sapphire [349]
- PTB (Yb+, Sr clock) [350]
- I₂ [351]
- Rb/Cs [352]
- Sr/Si [353]
- Yb/Sr [354]
- AEDGE (projection) [355]
- AION (projection) [355]
- DUAL (projection) [356]
- MAGIS (projection) [357]
- Nuclear clock (projection) [358]
- Mechanical Resonators (projection) [359]

Scalar-electron

- Red giants [302]
- White dwarfs [360]
- Eot-Wash (EP) [334]
- Fifth force [335, 336, 337, 338]
- MICROSCOPE [303]
- AURIGA [339]
- Cavities [361]
- Cs/Cav [341]
- DAMNED [342]
- GEO600 [345]
- Holometer [348]
- H/Quartz/Sapphire [349]
- LIGO O3 [346], see also [347]
- I₂ [351]
- H/Si [353]
- Rb/Quartz [264]
- Yb/Cs [362]
- NANOGrav 15-year PTA [363]
- FOCOS (nuclear clock projection) [364]
- AEDGE (projection) [355]
- AION (projection) [355]
- DUAL (projection) [356]
- HELIOS (projection) [365]
- Optical microwave clock (projection) [366]
- Optical cavities [367]
- SrOH [368]
- Mechanical Resonators (projection) [359]
- IPTA (mock data) [369]

- Torsion balance (projection) [386]
- STE-QUEST (projection) [387]

11 Vectors

B-L coupling

- Casimir [370, 371, 372]
- Eot-Wash (EP) [373]
- Eot-Wash (ISL) [374]
- MICROSCOPE [375]
- DM stability [376]
- Horizontal branch [377]
- Red giant [377]
- Sun [377]
- Eot-Wash (DM) [378]
- LIGO (O1) [379]
- LIGO/VIRGO [379]
- LISA Pathfinder [380, 381]
- PPTA [382]
- POLONAISE [383]
- Asteroids (projection) [384]
- HELIOS (projection) [365]
- LISA (projection) [384]
- MAGIS (projection) [357]
- Optomechanical membranes (projection) [385]
- SKA (projection) [386]

12 Dark photons

Combined constraints [388]

SM photon-DP transitions

- Coulomb [389, 390, 391, 392, 393],
- Plimpton & Lawton's experiment [394, 393]
- Atomic spectroscopy [395]
- Atomic force microscopy (AFM) [393]
- Static magnetic field of the Earth [396, 397, 398]
- Static magnetic field of Jupiter [399, 398].
- Jupiter B-field/Juno mission [400]
- ALPs [76]
- ALPS-II (projection) [401]
- SPring-8 [402]
- UWA-LSW [403, 404]
- ADMX-LSW [405]
- CROWS [80].
- DarkSRF [406]
- DarkSRF (projection) [407]
- TEXONO [408]
- Crab nebula [409]
- COBE and FIRAS [410]
- STAX (projection) [411]

Production in stars

- CAST [412]
- SHIPS [413]
- HINODE [414]
- IAXO (modified for longitudinal mode) [415]
- New globular cluster bound [416]
- Old stellar bounds: Solar-L, HB and RG stars [377] (see also [417])
- Neutron stars [418]
- Solar neutrinos [419]
- XENON1T [420]

Dark matter cosmology/astro

- Arias et al. [299]
- Witte et al. [421, 422]
- Caputo et al. [423, 410],
- ISM [424],
- Leo T dwarf [425]
- Gas clouds [425, 426]
- JWST [427]
- Parker Solar Probe [428]
- Planck + unWISE [429]
- INTEGRAL [430]

Dark matter experiments

- Reinterpreted axion limits [388]
- APEX [431]
- ALPHA [57]
- AMAILS [432]
- BRASS-p [433]
- BREAD (projection) [60]
- Dandelion (projection) [434]
- DarkSide-50 [205]
- DAMIC [435]
- Dark E-field Radio [436, 437]
- DM Pathfinder [438]
- DOSUE-RR [439, 440]
- FAST Radio antenna [441]
- FUNK [442]
- GigaBREAD [443]
- MADMAX [444]
- LAMPOST [445]
- LOFAR (solar corona) [446]
- MuDHI [447]
- ORGAN [448, 35]
- ORPHEUS [449]
- QUALIPHIDE [450]
- Quantum cyclotron [451]
- SENSEI [452]
- SHUKET [453]
- SuperCDMS [454]
- SuperMAG [455, 456, 47]

- SQuAD [457],
- SQMS [458],
- SUPAX [459]
- SRF scanning [460]
- Tokyo dish antennae experiments [461, 462, 463]
- WISPDMM [464]
- XENON(100,1T,nT) [465, 324, 466, 467, 420, 468].

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