

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

### LSW/Helioscopes

- ALPS [74]
- CAST [75, 76, 77]
- CROWS [78]
- OSQAR [79]
- PVLAS [80]
- SAPPHIRES [81, 82, 83]
- ALPS-II (projection) [84]
- IAXO (projection) [85]
- IAXO (Galactic SN) [86]
- WISPMI (projection) [87]

### Astro

- 21 cm power spectrum (projection) [88]
- ATHENA (projection) [89]
- Axion star explosions [90]
- Betelgeuse [91]
- BICEP/KECK [92]
- Black hole polarimetry [93]
- Breakthrough Listen (Doppler shifted radio line in MW) [94]
- Bullet Cluster (archival radio data) [95]
- Cosmic IR background (hint) [96]
- Chandra (Hydra) [97]
- Chandra (M87) [98]
- Chandra (NG7 1275) [99]
- Chandra (H1821+643) [100]
- CMB Anisotropies [101, 102]
- COBE/FIRAS+Planck spectral dist. [103]
- Diffuse gamma-rays [104]
- Diffuse SN ALPs [105] (see also [106])
- Distance ladder [107]
- Fermi-LAT (NGC 1275) [108]
- Fermi-LAT (Extragalactic SNe) [109]
- Fermi-LAT (Quasars) [110]
- FIRAS [111]
- Gamma-ray attenuation (ALP dark matter) [112]
- Gamma-ray decay [88]
- Globular clusters ( $R$  parameter) [113]
- Globular clusters ( $R_2$  parameter) [114]
- GW170817 (Fermi) [115]
- GW170817 [116]
- HAWC (TeV Blazars) [117]
- HESS (PKS 2155-304) [118]
- INTEGRAL (ALP decay) [119]
- Leo T gas temperature [120]
- M82 (NuSTAR) [121]
- MAGIC (Perseus galaxy cluster) [122]
- Magnetic white dwarfs (X-rays) [123]
- Magnetic white dwarf (polarization) [124]
- MOJAVE [125]
- Mrk 421 (ARGO-YBJ+Fermi): [126]
- Mrk 421 (ARGO-YBJ+MAGIC): [127]
- Neutron Stars (Foster et al. 2020) [128]
- Neutron Stars (Darling 2020) [129]
- Neutron Stars (Battye et al. 2021) [130]
- Neutron stars (Foster et al. 2022) [131]
- Neutron Stars (Battye et al. 2023) [132]
- NuSTAR (decaying dark matter, recast from Sterile nu) [133, 134, 135]
- NuSTAR (Sun) [136]
- Planck cosmic birefringence [137]
- POLARBEAR [138, 139]
- PPTA+QUIJOTE [140]
- Pulsar polarisation arrays (projection) [141]
- Pulsar polar cap [142]
- PSR J0437-4715 polarisation [143]
- Red supergiant [144]
- Solar neutrinos [145]
- Stellar axion background [146]
- SN1987A- $\gamma$  (ALP decay) [147, 148, 149]
- SN1987A- $\gamma$  (low mass ALP conversion) [150, 148, 151]
- SN1987A- $\gamma,\nu$  (high mass ALPs) [152, 153, 104]
- SN1987A (PVO) [154]
- Sgr A\* [155]
- Low-energy supernovae (ALP decay) [104]
- Solar basin (NuSTAR) [156]
- Solar basin (NuSTAR and SPHINX) [157]
- Super Star clusters [158]
- SPT [159]
- Telescopes (Haystack) [160]
- Telescopes (MUSE) [161] (updated from: [162])
- Telescopes (VIMOS) [163]
- Telescopes (HST) [164, 165]
- Telescopes (JWST) [166]
- Telescopes (WINERED) [167, 168]

- Telescopes (eROSITA) [169]
- Fermi galactic SN (projection) [170]
- THESEUS (projection) [171]
- eROSITA (projection) [172]
- XRISM (projection) [173]
- White dwarf initial-final mass relation [174]
- XMM-Newton (decaying DM ALPs) [175]

### Cosmology

- Ionisation fraction, EBL, X-rays [176]
- BBN+ $N_{\text{eff}}$  [177]
- Freeze in [178]
- Cosmic background [179]

## 2 Heavy ALP-photon coupling

- ATALS (PbPb) [180]
- BaBar [181]
- Beam dump [182, 183, 181, 184, 185]
- Belle II [186]
- BESIII [187]
- CMS (PbPb) [188]
- EuXFL [189]
- LEP [190]
- LHC (pp)[191]
- MiniBooNE [192]
- NOMAD [193]
- OPAL [191]
- PrimEx [194, 195]
- CONUS (projection) [196]
- DUNE (projection) [197]
- FASER LLP (projection) [198]

## 3 Axion-electron

- Electron g-2 [199]
- EDELWEISS [200]
- Fermionic axion interferometer [201]
- Magnon non-demolition [202]
- DarkSide-50 [203]
- GERDA [204]
- LUX [205]
- Old comagnetometers [206]
- Panda-X [207]
- Torsion pendulum (spin force) [208]
- Torsion pendulum (axion wind) [209]
- SuperCDMS [210]
- XENON1T [211, 212]
- XENONnT [213]
- XENON1T (Solar basin) [214]
- Red giants ( $\omega$ Cen) [215]
- Solar neutrinos [216]
- Electron storage ring (projection) [217]
- Axion wind multilayer (projection) [218]
- Magnons (projection) [219]
- Polaritons (projection) [220]
- DARWIN (projection) [221]
- LZ (projection) [222]
- QUAX [223, 224]
- NV Centers (projection) [225]
- Superconductors (projection) [226]
- Semiconductors (projection) [227]
- Spin-orbit coupling (projection) [228]
- Torsion pendulum (projection) [229]
- YIG (projection) [219]
- White dwarf hint [230]
- Freeze-in irreducible axions [178]
- X-rays (1-loop decay) [231]

## 4 Axion-nucleon

Note: CASPER and nEDM limits account for stochastic correction reported in [232]

- Casimir effect (fifth force) [233]
- CASPER-ZULF-Comagnetometer [234]
- CASPER-ZULF-Sidechain [235]
- ChangE [236, 237]
- Hefei Spin-based amplifiers [238]
- nEDM (ultracold neutrons and mercury) [239]
- NASDUCK [240, 241]
- PSI HgM (nEDM) [242]
- K-3He comagnetometer (fifth force) [243]

- K-3He comagnetometer (dark matter) [244]
- Mainz-Krakow comagnetometers [245]
- JEDI [246]
- Old comagnetometers [206]
- Torsion balance [247]
- Neutron star cooling [248] (corrected from [249])
- SN1987A Cooling [250, 251]
- SNO (deuterium dissasociation) [252]
- Proton storage ring (projection) [253]
- Electrostatic storage ring (projection) [217]
- DM comagnetometer (projection) [206]
- CASPER-gradient (projection) [235]
- Superfluid helium-3 HPD (projection) [254]
- MnCO3 (projection) [255]

## 5 Axion-EDM

- Axinovae [256]
- Beam EDM [257]
- BBN (dark matter) [258]
- CASPER-electric [259]
- nEDM [239]
- $\text{HfF}^+$  [260]
- $I_2^+/\text{Ca}^+$  [261]
- JEDI [246]
- Rb/Quartz [262]
- SN1987A [263]
- *Planck*+BAO thermal axion bound [264]
- CASPER-electric (projection) [265]
- Storage Ring EDM (projection) [265]
- Polarisation haloscope (projection) [266]

## 6 Axion-top

Axion-top coupling limits originally compiles in Ref. [267]

## 7 Axion mass versus $f_a$

- BBN (dark matter) [258]
- Beam EDM [257]
- Binary pulsars and Solar core constraint on  $\bar{\theta}$  [268]. I include minor numerical corrections made by [269, 270].
- GW170817 [271]
- $\text{HfF}^+$  [260]
- Rb/Quartz [262]
- JEDI [246]
- nEDM [239]
- Tritium decay [272]
- Piezoaxionic effect (projection) [273]
- *Planck*+BAO thermal axion bound [264]
- SN1987A [263]
- Neutron stars (projection) [268].
- NS-NS and NS-BH Inspirals (projection) [268].
- White dwarfs [274]
- Polarisation haloscope (projection) [266]
- Neutron star cooling [275]

### 7.1 Black hole superradiance

- Baryakhtar et al. [276] (just Stellar mass BHs)
- Mehta et al. [276] (Stellar mass and SMBHs)
- Stott [277]
- Ünal et al. [278] (Quasars)
- Hoof et al. [279]
- Cardoso et al. [280] (dark photon)

## 8 Axion theory predictions

### 8.1 Post-inflation QCD axion

- Ballesteros et al. [281]
- Buschmann et al. 2020 [282]
- Buschmann et al. 2021 [283]
- Bonati et al. [284]
- Borsanyi et al. [285]
- Berkowitz et al. [286]
- Dine et al. [287]
- Petreczky et al. [288]
- Fleury & Moore [289]
- Klaer & Moore [290]
- Gorghetto et al. [291]
- Saikawa et al. (2019) [85]

- Saikawa et al. (2024) [292]
- Beyer et al. (2023) [293]
- Kim et al. (2024) [294]

## 8.2 Other dark matter predictions

- ALP Cogenesis [295]
- Early matter domination [296]
- Post-inflation ALP misalignment [297, 298]
- Trapped misalignment ( $\mathcal{Z}_N$  axion) [269]

## 9 CP-violating couplings

Combined constraints [299]

### Scalar-nucleon

- Red giants [300]
- MICROSCOPE [301].
- Eot-Wash [302, 303, 304]
- Irvine [305]. Corrected to  $2\sigma$  limit by [306]
- HUST [307, 308, 309, 310].
- Stanford [311]
- IUPUI [312].
- Wuhan [306]

### Pseudoscalar-electron

- Red giants [300]
- Eot-wash [313]
- $e^+e^-$  Penning trap [314]
- NIST [315]
- SMILE [316]
- Perihelion shift [317]
- QUAX [318, 319, 320]
- Washington [208, 321].
- XENON1T [322]
- ACME (projection) [323]
- Magnon (projection) [220]
- QUAX (projection) [318].

### Pseudoscalar-nucleon

- Neutron star cooling [248]
- Hefei (Earth) [324]
- Hefei (mm) [325]
- Washington [326]. Limit taken from [327].
- SMILE [316].
- Mainz [328]
- Moon/Sun [329]
- Yb trap (projection) [323]
- ARIADNE (projection) [330]
- CASPER-wind (projection) [265]
- DM comagnetometer (projection) [206]
- Fifth force Ne-Rb-K comagnetometer (projection) [331]

## 10 Scalars

### Scalar-photon

- Globular clusters [114]
- Eot-Wash (EP) [332]
- Fifth force [333, 334, 335, 336]
- MICROSCOPE [301]
- AURIGA [337]
- BACON [338]
- Cs/Cav [339]
- DAMNED [340]
- Dy/Dy [341]
- Dy/Quartz [262]
- Dynamic Decoupling [342]
- GEO600 [343]
- LIGO O3 [344], see also [345]
- Holometer [346]
- H/Quartz/Sapphire [347]
- PTB (Yb+, Sr clock) [348]
- I<sub>2</sub> [349]
- Rb/Cs [350]
- Sr/Si [351]
- Yb/Sr [352]
- AEDGE (projection) [353]
- AION (projection) [353]
- DUAL (projection) [354]
- MAGIS (projection) [355]
- Nuclear clock (projection) [356]
- Mechanical Resonators (projection) [357]

### Scalar-electron

- Red giants [300]
- White dwarfs [358]
- Eot-Wash (EP) [332]
- Fifth force [333, 334, 335, 336]
- MICROSCOPE [301]
- AURIGA [337]
- Cavities [359]
- Cs/Cav [339]
- DAMNED [340]
- GEO600 [343]
- Holometer [346]
- H/Quartz/Sapphire [347]
- LIGO O3 [344], see also [345]
- I<sub>2</sub> [349]
- H/Si [351]
- Rb/Quartz [262]
- Yb/Cs [360]
- NANOGrav 15-year PTA [361]
- FOCOS (nuclear clock projection) [362]
- AEDGE (projection) [353]
- AION (projection) [353]
- DUAL (projection) [354]
- HELIOS (projection) [363]
- Optical microwave clock (projection) [364]
- Optical cavities [365]
- SrOH [366]
- Mechanical Resonators (projection) [357]
- IPTA (mock data) [367]

- Torsion balance (projection) [384]
- STE-QUEST (projection) [385]

## 11 Vectors

### B-L coupling

- Casimir [368, 369, 370]
- Eot-Wash (EP) [371]
- Eot-Wash (ISL) [372]
- MICROSCOPE [373]
- DM stability [374]
- Horizontal branch [375]
- Red giant [375]
- Sun [375]
- Eot-Wash (DM) [376]
- LIGO (O1) [377]
- LIGO/VIRGO [377]
- LISA Pathfinder [378, 379]
- PPTA [380]
- POLONAISE [381]
- Asteroids (projection) [382]
- HELIOS (projection) [363]
- LISA (projection) [382]
- MAGIS (projection) [355]
- Optomechanical membranes (projection) [383]
- SKA (projection) [384]

## 12 Dark photons

Combined constraints [386]

### SM photon-DP transitions

- Coulomb [387, 388, 389, 390, 391],
- Plimpton & Lawton's experiment [392, 391]
- Atomic spectroscopy [393]
- Atomic force microscopy (AFM) [391]
- Static magnetic field of the Earth [394, 395, 396]
- Static magnetic field of Jupiter [397, 396].
- Jupiter B-field/Juno mission [398]
- ALPs [74]
- ALPS-II (projection) [399]
- SPring-8 [400]
- UWA-LSW [401, 402]
- ADMX-LSW [403]
- CROWS [78].
- DarkSRF [404]
- DarkSRF (projection) [405]
- TEXONO [406]
- Crab nebula [407]
- COBE and FIRAS [408]
- STAX (projection) [409]

### Production in stars

- CAST [410]
- SHIPS [411]
- HINODE [412]
- IAXO (modified for longitudinal mode) [413]
- New globular cluster bound [414]
- Old stellar bounds: Solar-L, HB and RG stars [375] (see also [415])
- Neutron stars [416]
- Solar neutrinos [417]
- XENON1T [418]

### Dark matter cosmology/astro

- Arias et al. [297]
- Witte et al. [419, 420]
- Caputo et al. [421, 408],
- ISM [422],
- Leo T dwarf [423]
- Gas clouds [423, 424]
- JWST [425]
- Parker Solar Probe [426]
- Planck + unWISE [427]
- INTEGRAL [428]

### Dark matter experiments

- Reinterpreted axion limits [386]
- APEX [429]
- ALPHA [55]
- AMAILS [430]
- BRASS-p [431]
- BREAD (projection) [58]
- Dandelion (projection) [432]
- DarkSide-50 [203]
- DAMIC [433]
- Dark E-field Radio [434, 435]
- DM Pathfinder [436]
- DOSUE-RR [437, 438]
- FAST Radio antenna [439]
- FUNK [440]
- GigaBREAD [441]
- MADMAX [442]
- LAMPOST [443]
- LOFAR (solar corona) [444]
- MuDHI [445]
- ORGAN [446, 33]
- ORPHEUS [447]
- QUALIPHIDE [448]
- Quantum cyclotron [449]
- SENSEI [450]
- SHUKET [451]
- SuperCDMS [452]
- SuperMAG [453, 454, 45]

- SQuAD [455],
- SQMS [456],
- SUPAX [457]
- SRF scanning [458]
- Tokyo dish antennae experiments [459, 460, 461]
- WISPDMM [462]
- XENON(100,1T,nT) [463, 322, 464, 465, 418, 466].

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