

## 1 Axion-photon

### Haloscopes

- ABRACADABRA [1, 2]
- ADMX [3, 4, 5, 6]
- ADMX-Sidecar [7, 8]
- ADMX-SLIC [9]
- CAPP [10, 11, 12, 13, 14, 15]
- CAST-CAPP [16]
- BASE [17]
- GrAHal [18]
- HAYSTAC [19, 20, 21]
- ORGAN [22, 23]
- QUAX [24, 25, 26]
- RADES [27]
- RBF [28]
- SHAFT [29]
- TASEH [30]
- SuperMAG [?]
- UF [31]
- UPLOAD-DOWNLOAD [32]
- ABRACADABRA (projection) [33]
- ADBC (projection) [34]
- ADMX (projection) [35]
- aLIGO (projection) [36]
- ALPHA (projection) [37, 38]
- BRASS (projection) [39]
- BREAD (projection) [40]
- CADEX (projection) [41]
- DM-Radio (projection) [42, 43]
- DANCE (projection) [44]
- LAMPOST (projection) [45]
- MADMAX (projection) [46]
- FLASH (projection) [47, 48]
- QUAX (projection) [49]
- ORGAN (projection) [22]
- TOORAD (projection) [50]
- Twisted Anyon Cavity (projection) [51]
- WISPLC (projection) [52]
- SRF heterodyne cavity (projection) [53]

### LSW/Helioscopes

- ALPS [54]
- CAST [55, 56]
- CROWS [57]
- OSQAR [58]
- PVLAS [59]
- SAPPHIRES [60, 61]
- ALPS-II (projection) [62]
- IAXO (projection) [63]
- IAXO (Galactic SN) [64]

### Astro

- Axion star explosions [65]
- Betelgeuse [66]
- BICEP/KECK [67]
- Breakthrough Listen (Doppler shifted radio line in MW) [68]
- Breakthrough Listen (Neutron stars) [69]
- Bullet Cluster (archival radio data) [70]
- Cosmic IR background (hint) [71]
- Chandra (Hydra) [72]
- Chandra (M87) [73]
- Chandra (NGC 1275) [74]
- Chandra (H1821+643) [75]
- COBE/FIRAS+Planck spectral dist. [76]

- Diffuse gamma-rays [77]
- Diffuse SN ALPs [78] (see also [79])
- Distance ladder [80]
- Fermi-LAT (NGC 1275) [81]
- Fermi-LAT (Extragalactic SNe) [82]
- Fermi-LAT (Quasars) [83]
- Gamma-ray attenuation (ALP dark matter) [84]
- Globular clusters ( $R$  parameter) [85]
- Globular clusters ( $R_2$  parameter) [86]
- HAWC (TeV Blazars) [87]
- HESS (PKS 2155-304) [88]
- INTEGRAL (ALP decay) [89]
- Leo T gas temperature [90]
- Magnetic white dwarfs (X-rays) [91]
- Magnetic white dwarf (polarization) [92]
- MOJAVE [93]
- Mrk 421 (ARGO-YBJ+Fermi): [94]
- Mrk 421 (ARGO-YBJ+MAGIC): [95]
- Neutron Stars (Foster et al.) [96]
- Neutron Stars (Darling) [97]
- Neutron Stars (Battye et al.) [98]
- Planck cosmic birefringence [99]
- PPTA+QUIJOTE [100]
- Pulsar polarisation arrays (projection) [101]
- Pulsar polar cap [102]
- Red supergiant [103]
- Solar neutrinos [104]
- SN1987A- $\gamma$  (ALP decay) [105, 106]
- SN1987A- $\gamma$  (low mass ALP conversion) [107, 106]
- SN1987A- $\gamma, \nu$  (high mass ALPs) [108]
- Low-energy supernovae (ALP decay) [77]
- Solar basin (NuSTAR) [109]
- Star clusters [110]
- SPT [111]
- Telescopes (Haystack) [112]
- Telescopes (MUSE) [113]
- Telescopes (VIMOS) [114]
- Telescopes (HST) [115, 116]
- Fermi galactic SN (projection) [117]
- THESEUS (projection) [118]
- eROSITA (projection) [119]
- White dwarf initial-final mass relation [120]
- XMM-Newton (decaying DM ALPs) [121]

### Cosmology

- Ionisation fraction, EBL, X-rays [122]
- BBN+ $N_{\text{eff}}$  [123]
- Freeze in [124]

## 2 Heavy ALP-photon coupling

- ATALS (PbPb) [125]
- BaBar [126]
- Beam dump [127, 128, 126, 129, 130]
- Belle II [131]
- BESIII [132]
- CMS (PbPb) [133]
- LEP [134]
- LHC (pp)[135]
- NOMAD [136]
- OPAL [135]
- PrimEx [137, 138]
- CONUS (projection) [139]
- DUNE (projection) [140]
- FASER LLP (projection) [141]

## 3 Axion-electron

- EDELWEISS [142]
- Magnon non-demolition [143]
- GERDA [144]
- LUX [145]
- Panda-X [146]
- SuperCDMS [147]
- XENON1T [148, 149]
- XENONnT [150]
- XENON1T (Solar basin) [151]
- Red giants ( $\omega$ Cen) [152]
- NV Centers (projection) [153]
- Solar neutrinos [154]
- Magnons (projection) [155]
- Polaritons (projection) [156]
- DARWIN (projection) [157]
- LZ (projection) [158]
- QUAX [159, 160]
- Semiconductors (projection) [161]
- White dwarf hint [162]
- Freeze-in irreducible axions [124]
- X-rays (1-loop decay) [163]

## 4 Axion-nucleon

Note: CASPER and nEDM limits account for stochastic correction reported in [164]

- Casimir effect (fifth force) [165]
- CASPER-ZULF-Comagnetometer [166]
- CASPER-ZULF-Sidechain [167]
- nEDM (ultracold neutrons and mercury) [168]
- NASDUCK [169, 170]
- PSI HgM (nEDM) [171]
- K-3He comagnetometer (fifth force) [172]
- K-3He comagnetometer (dark matter) [173]
- JEDI [174]
- Old comagnetometers [175]
- Torsion balance [176]
- Neutron star cooling [177] (corrected from [178])
- SN1987A Cooling [179]
- SNO (deuterium dissocation) [180]
- Proton storage ring (projection) [181]
- DM comagnetometer (projection) [175]
- CASPER-gradient (projection) [167]
- Superfluid helium-3 HPD (projection) [182]

## 5 Axion-EDM

- Beam EDM [183]
- BBN (dark matter) [184]
- CASPER-electric [185]
- nEDM [168]
- HfF<sup>+</sup> [186]
- JEDI [174]
- Rb/Quartz [187]
- SN1987A [188]
- *Planck*+BAO thermal axion bound [189]
- CASPER-electric (projection) [190]
- Storage Ring EDM (projection) [190]

## 6 Axion mass versus $f_a$

- BBN (dark matter) [184]
- Beam EDM [183]
- Binary pulsars and Solar core constraint on  $\bar{\theta}$  [191]. I include minor numerical corrections made by [192, 193].
- GW170817 [194]
- HfF<sup>+</sup> [186]
- Rb/Quartz [187]
- JEDI [174]
- nEDM [168]
- Piezoaxionic effect (projection) [195]
- *Planck*+BAO thermal axion bound [189]
- SN1987A [188]
- Neutron stars (projection) [191].
- NS-NS and NS-BH Inspirals (projection) [191].
- White dwarfs [196]

### 6.1 Black hole superradiance

- Baryakhtar et al. [197] (just Stellar mass BHs)
- Mehta et al. [197] (Stellar mass and SMBHs)
- Stott [198]
- Ünal et al. [199] (Quasars)
- Cardoso et al. [200] (dark photon)

## 7 Axion theory predictions

### 7.1 Post-inflation QCD axion

- Ballesteros et al. [201]
- Buschmann et al. 2020 [202]
- Buschmann et al. 2021 [203]
- Bonati et al. [204]
- Borsanyi et al. [205]
- Berkowitz et al. [206]
- Dine et al. [207]
- Petreczky et al. [208]
- Fleury & Moore [209]
- Klaer & Moore [210]

### 7.2 Other dark matter predictions

- ALP Cogenesis [211]
- Early matter domination [212]
- Post-inflation ALP misalignment [213, 214]
- Trapped misalignment ( $\mathcal{Z}_N$  axion) [192]

## 8 CP-violating couplings

Combined constraints [215]

### Scalar-nucleon

- Red giants [216]
- MICROSCOPE [217].
- Eot-Wash [218, 219, 220]
- Irvine [221]. Corrected to  $2\sigma$  limit by [222]
- HUST [223, 224, 225, 226].
- Stanford [227]
- IUPUI [228].
- Wuhan [222]

### Pseudoscalar-electron

- Red giants [216]
- Eot-wash [229]
- NIST [230]
- SMILE [231].
- QUAX [232, 233]
- Washington [234, 235].
- XENONIT [236]
- Magnon (projection) [156]
- QUAX (projection) [232].

### Pseudoscalar-nucleon

- Neutron star cooling [178]
- Washington [237]. Limit taken from [238].
- SMILE [231].
- Mainz [239]
- ARIADNE (projection) [240]
- CASPER-wind (projection) [190]
- DM comagnetometer (projection) [175]

## 9 Scalars

### Scalar-photon

- Globular clusters [86]
- Eot-Wash (EP) [241]
- Fifth force [242]
- MICROSCOPE [217]
- AURIGA [243]
- BACON [244]
- Cs/Cav [245]
- DAMNED [246]
- Dy/Dy [247]
- Dy/Quartz [187]
- Dynamic Decoupling [248]
- GEO600 [249]
- Holometer [250]
- H/Quartz/Sapphire [251]
- PTB (Yb+, Sr clock) [252]
- I<sub>2</sub> [253]
- Rb/Cs [254]
- Sr/Si [255]
- AEDGE (projection) [256]
- AION (projection) [256]
- DUAL (projection) [242]
- MAGIS (projection) [257]
- Nuclear clock (projection) [258]
- Mechanical Resonators (projection) [259]

### Scalar-electron

- Red giants [216]
- White dwarfs [260]
- Eot-Wash (EP) [241]
- Fifth force [242]
- MICROSCOPE [217]
- AURIGA [243]
- Cs/Cav [245]
- DAMNED [246]
- GEO600 [249]
- Holometer [250]
- H/Quartz/Sapphire [251]
- I<sub>2</sub> [253]
- H/Si [255]
- Rb/Quartz [187]
- AEDGE (projection) [256]
- AION (projection) [256]
- DUAL (projection) [242]
- Optical microwave clock (projection) [242]
- Optical cavities [261]
- SrOH [262]
- Mechanical Resonators (projection) [259]
- IPTA (mock data) [263]

## 10 Vectors

### B-L coupling

- Casimir [264, 265, 266]
- Eot-Wash (EP) [267]
- Eot-Wash (ISL) [268]
- MICROSCOPE [269]
- DM stability [270]
- Horizontal branch [216]
- Sun [216]
- Eot-Wash (DM) [271]
- LIGO (O1) [272]
- LIGO/VIRGO [272]
- Asteroids (projection) [273]
- LISA (projection) [273]
- MAGIS (projection) [257]
- Optomechanical membranes (projection) [274]
- SKA (projection) [275]
- Torsion balance (projection) [275]

## 11 Dark photons

Combined constraints [276]

### SM photon-DP transitions

- Coulomb [277, 278, 279, 280, 281],
- Plimpton & Lawton's experiment [282, 281]
- Atomic spectroscopy [283]
- Atomic force microscopy (AFM) [281]
- Static magnetic field of the Earth [284, 285, 286]
- Static magnetic field of Jupiter [287, 286].
- ALPs [54]
- SPring-8 [288]
- UWA-LSW [289, 290]
- ADMX-LSW [291]
- CROWS [57].
- DarkSRF [292]
- TEXONO [293]
- Crab nebula [294]
- COBE and FIRAS [295]

### Production in stars

- CAST [296]
- SHIP [297]
- HINODE [298]
- HB and RG stars [299]
- Neutron stars [300]
- Solar neutrinos [301]
- XENON1T [302]

### Dark matter cosmology/astro

- Arias et al. [213]
- Witte et al. [303, 304]
- Caputo et al. [305, 295],
- IGM [306],
- Leo T dwarf [307]
- Gas clouds [308]

### Dark matter experiments

- Reinterpreted axion limits [276]
- BREAD (projection) [40]
- DAMIC [309]
- Dark E-field Radio [310]
- DM Pathfinder [311]
- DOSUE-RR [312]
- FAST Radio antenna [313]
- FUNK [314]
- LAMPOST [315]
- LOFAR (solar corona) [316]
- MuDHI [317]
- ORGAN [318]
- ORPHEUS [319]
- QUALIPHIDE [320]
- Quantum cyclotron [321]
- SENSEI [322]
- SHUKET [323]
- SuperCDMS [324]
- SuperMAG [325, 326]
- SQuAD [327],
- SQMS [328],
- Tokyo dish antennae experiments [329, 330, 331]
- WISPDMS [332]
- XENON(100,1T,nT) [161, 236, 333, 334, 302, 335].

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