



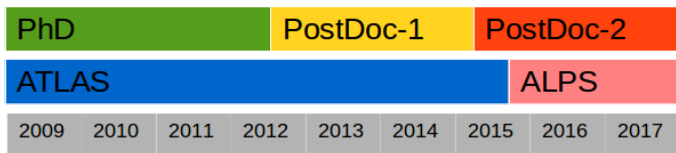
ALPS experiment

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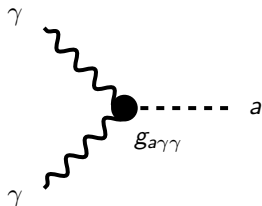
DESY Hamburg, 02.02.2016

Personal introduction



Physics behind ALPS

Axions / Axion-Like-Particles (ALPs)



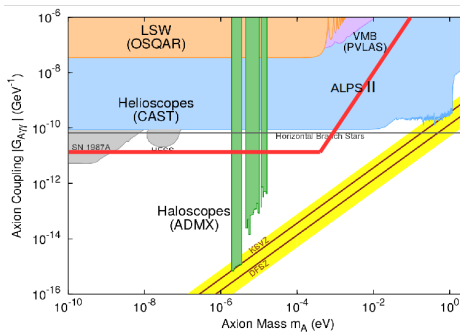
- Axion introduced to solve strong-CP problem
- ALPs arise generically in various BSM theories
- Candidates for dark matter

Hidden Photons

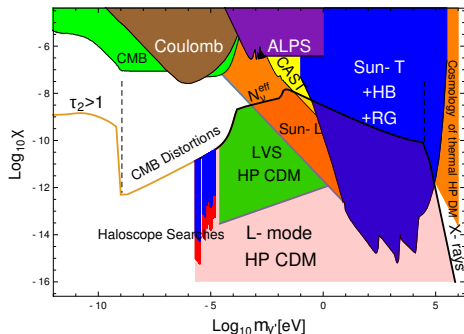


- Gauge boson of hidden local U(1) symmetry
- Kinetic Mixing with SM- γ
- Quantum fluctuations during inflation allowing HP production

Sensitivity to search WISPs



- Last update from OSQAR overlap results from ALPS-I
- ALPS-II results cover new unexploited regions.

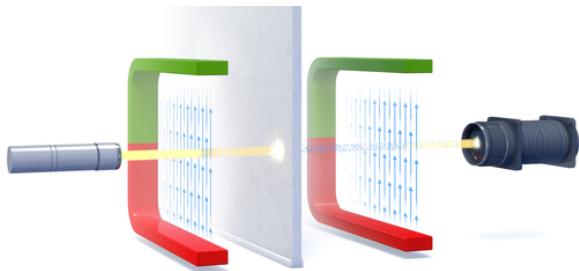


- ALPS II sensitivity:

$$\chi \gtrsim 2 \times 10^{-9}$$

$$m_{\gamma'} \gtrsim 4 \times 10^{-4} \text{ eV}$$

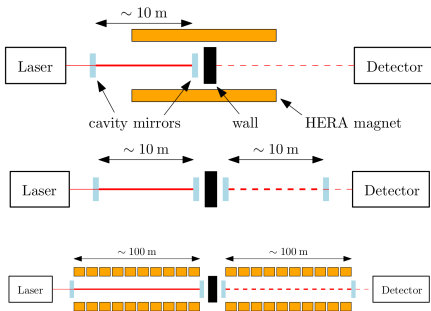
Development of ALPS



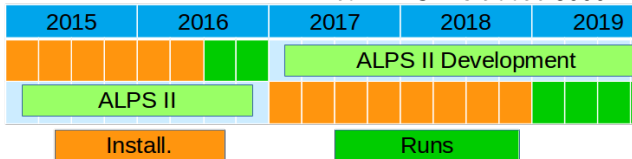
- Light is shone on a wall it cannot traverse
- Photons convert into ALPs in a magnetic field/hidden photons via kinetic mixing and pass the wall
- Behind the wall, the ALPs/hidden photons convert back to photons
- Light is detected in the detector

Development of ALPS

$$\frac{1}{S} \propto (BL)(P_{laser})^{1/4}(n_{\gamma})^{1/4}(P_{reg})^{1/4}(P_{prod})^{1/4}(D_{eff})^{1/4}(D_{noise})^{1/8}$$



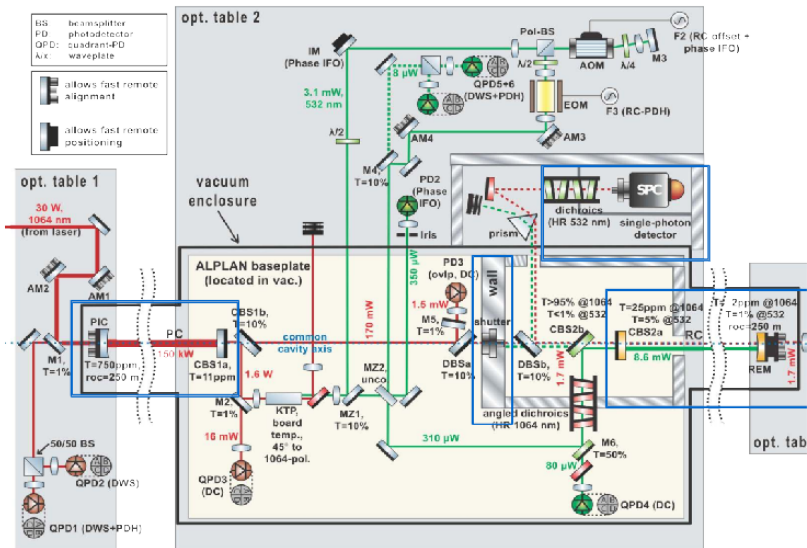
- ALPS-I (2006-2010). 10m cavity ($P_{prod} \sim 300$) with 1 HERA magnet. Laser: 4.6W@532nm, Detector: PIXIS CCD
- ALPS-II-Development (dedicated for hidden-photon search). Laser: 35W@1064nm, $P_{prod} \sim 5000$, second cavity ($P_{reg} \sim 40000$). Detector: TES/Heterodyne
- ALPS-II. Using long string of 20 HERA magnets. Total sensitivity gain compared to ALPS-I is about 3000.



ALPS-II overview

- Two stage experiment:
 - ▶ Development (ongoing) - Hidden photon search, development of the cavities and detector.
 - ▶ ALPs-search using 20 HERA magnets.
- Project structure:
 - ▶ ALPS-Machine: Optics, Detector, Magnets, Vacuum
 - ▶ Run management system
 - ▶ Integration
 - ▶ Site activation
 - ▶ Scientific analysis
 - ▶ Personal safety
 - ▶ Miscellaneous: project management, technical documentation, operation, outreach, information management, ...

ALPS-II machine



Site activation, Integration

- Setup of clean rooms and optical tables
 - ▶ Have to be done twice for each stage
- Preparation of HERA tunnel
 - ▶ Tunnel cleaning
 - ▶ Installation of magnets and infrastructure
- Supply on site (could compete with other DESY projects)
 - ▶ Electricity supply
 - ▶ Climate system
 - ▶ Cryogenic supply
- Site integration

Collaboration work

- Currently ALPS collaboration consists of: DESY, University of Hamburg, University of Hannover (AEI), University of Florida, University of Mainz
 - ▶ The ALPS-II installation is located at DESY
 - ▶ Part of the ALPS-II optics are developing at Hannover and Florida sites
- Several institutes outside of ALPS collaboration supporting us: PTB, NIST, AIST, Magnicon, Entropy
- Two groups: Detector and Optics are formed within ALPS collaboration. Each have regular dedicated meetings to discuss current activities. Current ALPS questions are discussed at regular ALPS meeting.



Scientific analysis

- Current stage: preparation for data analysis
 - ▶ Efficiency measurement
 - ▶ Noise measurement
 - ▶ Studies of the background
 - ▶ Event simulation
- Optics commissioning (cavities, feed-back control system, auto-alignment)
- Seismic data are measured and analysed. Design of the seismic isolation system is studied.
- ALPS results are not only particle search, but also includes detector and cavities commissioning
- Vacuum birefringence measurement may extend physics program of ALPS experiment

Summary

- ALPS is already well established experiment with long history.
- Several universities are working together to perform ALPS search.
- First physics-results are expected end-of-this year