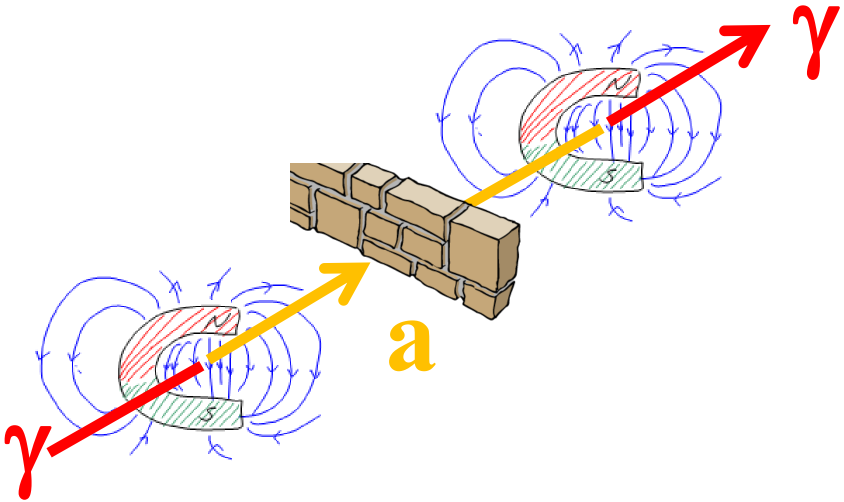
Light-shining-through-walls and ALPS II @ DESY



Axel Lindner, DESY

HELMHOLTZ SPITZENFORSCHUNG FÜR GROSSE HERAUSFORDERUNGEN

Particle Physics beyond the Standard Model ?

The standard model (SM) of particle physics is

- extremely successful, but
- does not provide answers to crucial questions (a selection):
  - How to integrate non-zero neutrino masses? } Here the SM fails!
  - What are dark matter and dark energy?
  - How to explain the baryon-antibaryon asymmetry of the universe? } Cosmology
  - Why is the Higgs so light?
  - Why is CP conserved in QCD?
  - Why is the vacuum energy so tiny? } Fine tuning

Where to look for beyond-SM-Physics?

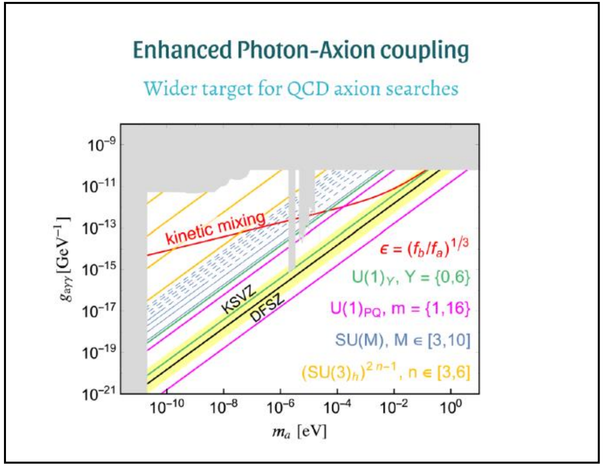
Wherever you can! An exemplary selection:	energy reach
> Laboratory experiments	
▪ Energy frontier	10 TeV (LHC)
▪ Precision frontier	10^2 TeV (BELLE II, model dependent)
▪ Rare decays	10^4 TeV (COMET)
▪ Light-through-walls	10^5 TeV (axions, model dependent)
> Astrophysics	
▪ Stellar evolutions, light propagation	10^5 TeV (axions, model dependent)
▪ Dark matter searches	10^9 TeV (axions, model dependent)
> Cosmology	
▪ CMB, gravitational waves	10^{12} TeV (inflation, model dependent)

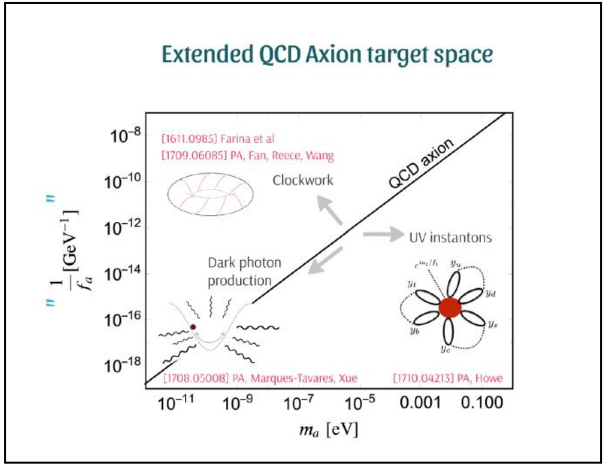
Outline

- An introduction to axions and axion-like particles
- Axions and ALPs in the sky?
- Experimental approaches
  - ALPS II at DESY in Hamburg
  - The JURA option
- Summary

The axion beyond bench-mark models

A wider parameter range?





P. Agrawal,
ESPP open symposium,
Granada, 14 May 2019
https://europeanstrategyupdate.web.cern.ch/open-symposium

The QCD axion

- might have much stronger photon coupling than in benchmark-models,
- might have a different f_a-mass relation than in benchmark models.

Axion and axion-like particles (ALPs)

More than one QCD axion

PHYSICAL REVIEW D **81**, 123530 (2010)

String axiverse

Asimina Arvanitaki,[1,2] Savas Dimopoulos,[3] Sergei Dubovsky,[3,4] Nemanja Kaloper,[5] and John March-Russell[6]
[1]*Berkeley Center for Theoretical Physics, University of California, Berkeley, California, 94720, USA*
[2]*Theoretical Physics Group, Lawrence Berkeley National Laboratory, Berkeley, California, 94720, USA*
[3]*Department of Physics, Stanford University, Stanford, California 94305, USA*
[4]*Institute for Nuclear Research of the Russian Academy of Sciences, 60th October Anniversary Prospect, 7a, 117312 Moscow, Russia*
[5]*Department of Physics, University of California, Davis, California 95616, USA*
[6]*Rudolf Peierls Centre for Theoretical Physics, University of Oxford, 1 Keble Road, Oxford, England*
(Received 22 October 2009; published 28 June 2010)

- *String theory suggests the simultaneous presence of many ultralight axions possibly populating each decade of mass down to the Hubble scale 10^{-33} eV. Conversely the presence of such a plenitude of axions (an "axiverse") would be evidence for string theory.*

JHEP Published for SISSA by Springer
Received: July 13, 2012
Accepted: September 17, 2012
Published: October 22, 2012

The type IIB string axiverse and its low-energy phenomenology

Michele Cicoli,[a,b] Mark D. Goodsell[c] and Andreas Ringwald[d]
[a]*Abdus Salam ICTP, Strada Costiera 11, Trieste 34014, Italy*
[b]*INFN — Sezione di Trieste, Trieste, Italy*
[c]*CERN, Theory Division, CH-1211 Geneva 23, Switzerland*
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E-mail: mcicoli@ictp.it, mark.goodsell@cern.ch, andreas.ringwald@desy.de

- *Moreover, we show how models can be constructed with additional light axion-like particles that could explain some intriguing astrophysical anomalies, and could be searched for in the next generation of axion helioscopes and light-shining-through-a-wall experiments.*

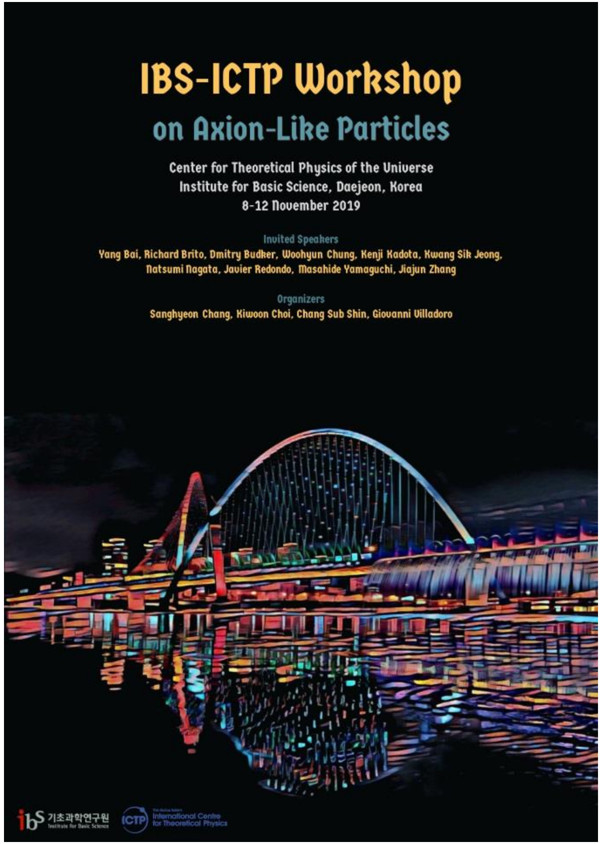
ALPs

> don’t solve the problem of CP conservation of QCD,

> have couplings ~ 1/ f_{alp} , but m_{alp} and f_{alp} are not related.

More on axion-like particles (ALPs)

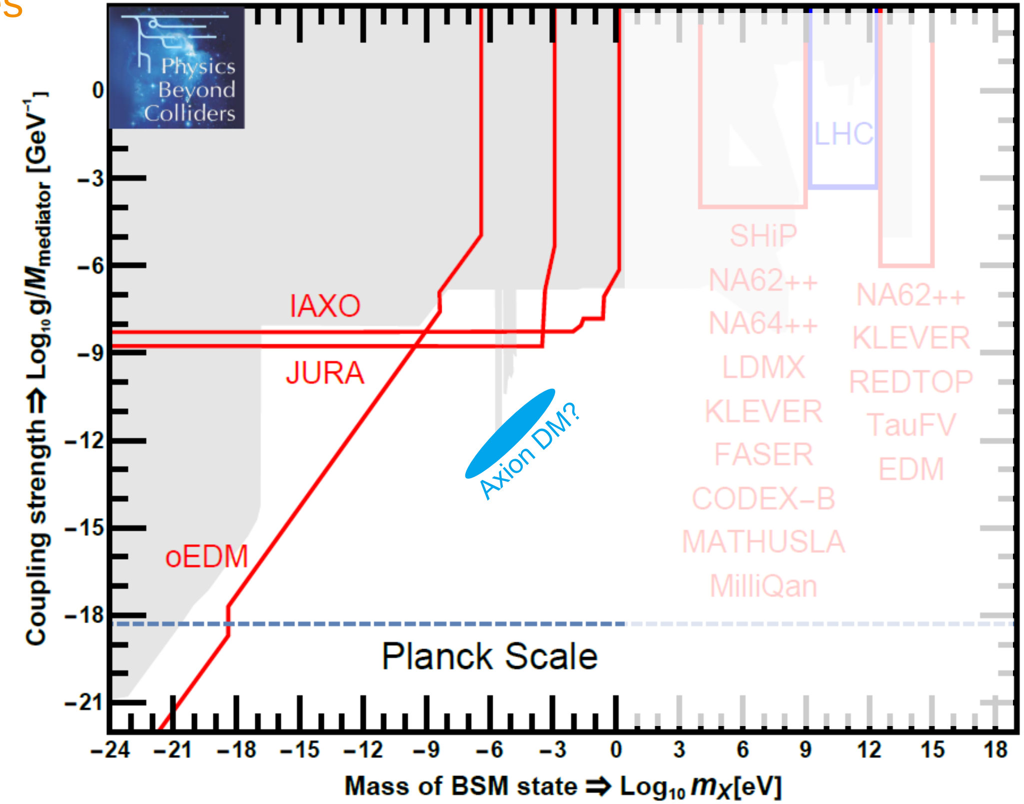
Dedicated workshop next week!



Axion and axion-like particles (ALPs)

Here: only low masses

Roughly m < 1 eV

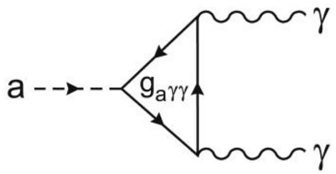


arXiv:1901.09966v1 [hep-ex]

Axions and axion-like particles (ALPs)

How to look at low masses: exploiting photon couplings

Axion decay to two photons



$$\Gamma_{A\to\gamma\gamma} = \frac{G^2_{A\gamma\gamma} m_A^3}{64\,\pi} = 1.1 \times 10^{-24}\ \mathrm{s}^{-1} \left(\frac{m_A}{\mathrm{eV}}\right)^5$$

$$m_A = \frac{z^{1/2}}{1+z}\,\frac{f_\pi m_\pi}{f_A} = \frac{0.60\ \mathrm{meV}}{f_A/10^{10}\,\mathrm{GeV}}$$

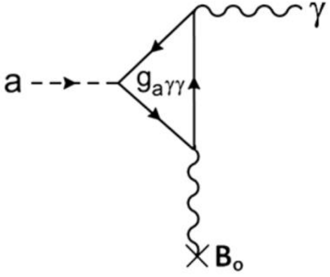
m_A [eV]	τ [$T_{universe}$]	f_A [LHC]
1	10^6	10^2
0.0001	10^{26}	10^6

http://pdg.lbl.gov/2010/reviews/rpp2010-rev-axions.pdf

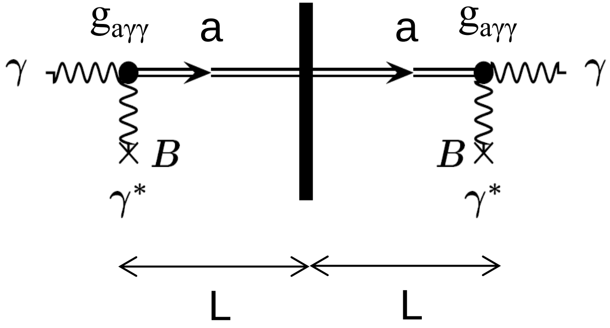
Axions and axion-like particles (ALPs)

How to look at low masses: exploiting photon couplings

Sikivie conversion



and light-shining-through-walls.



P(γ→a→γ)

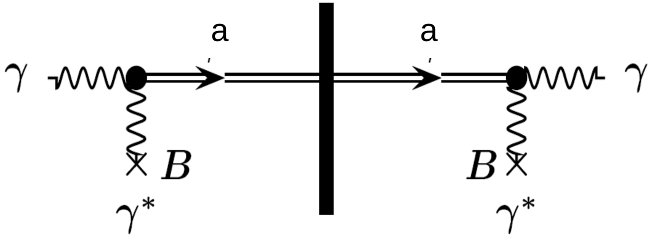
$= 6\cdot10^{-38}\cdot\ (g_{a\gamma\gamma}[10^{-10}\mathrm{GeV}^{-1}]\cdot B[1T]\cdot L[10m])^4$

$= 5\cdot10^{-34}$ (ALPS II at DESY)

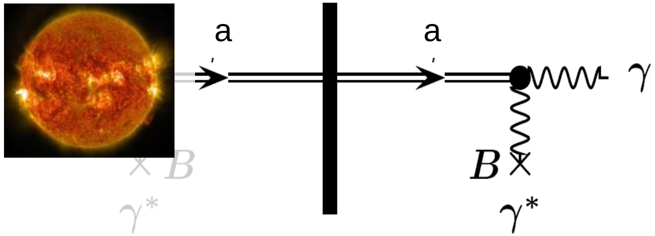
Light-Shining-through-Walls (LSW) in context

How to look: three kinds of light-shining-through-walls

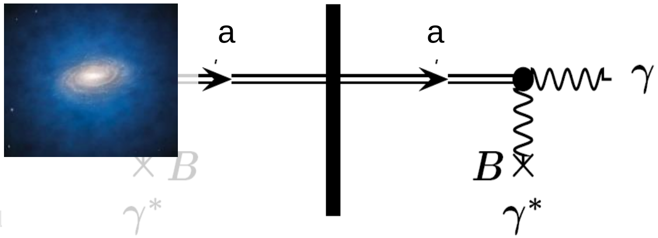
- Purely laboratory experiments
  “light-shining-through-walls”,
  optical photons



- Helioscopes
  ALPs emitted by the sun,
  X-rays,



- Haloscopes
  looking for dark matter constituents,
  microwaves.



Pros and cons for different experimental approaches

ALP parameter	LSW (laboratory)	Helioscopes	Dark matter searches
Parity and spin	yes	perhaps	yes
Coupling $g_{a\gamma\gamma}$	yes	no	no
Coupling · flux	(does not apply)	yes	yes
Mass	perhaps	perhaps	yes
Electron coupling	no	yes	no
Rely on astrophysical assumptions	no	yes	yes
QCD axion	no (?)	yes	yes

The three approaches complement each other.

Outline

> An introduction to axions and axion-like particles

> Axions and ALPs in the sky?

> Experimental approaches

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Axions and ALPs in the sky

Hints from astrophysics?

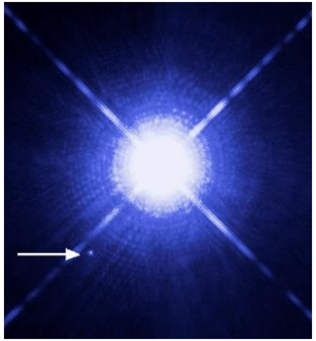
- Stellar evolutions
- Propagation of TeV photons
- Photon propagation in magnetic fields

Axions and ALPs in the sky

Stellar evolutions

- Extra energy loss beyond SM expectations
  is indicated by stellar developments.

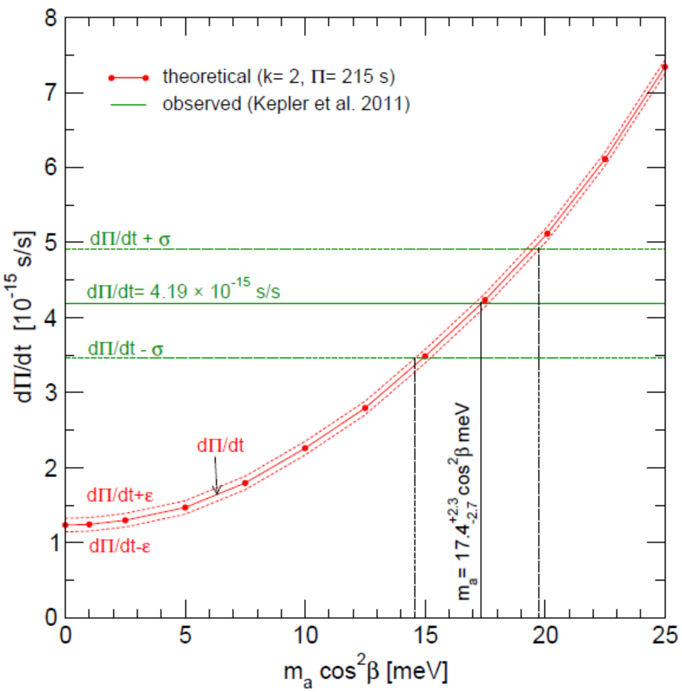
- Example:
  white dwarf stars.



The change of frequency of a pulsating DA white dwarf measures its cooling rate.

Data indicate that the white dwarf cools “too fast”.

G117−B15A

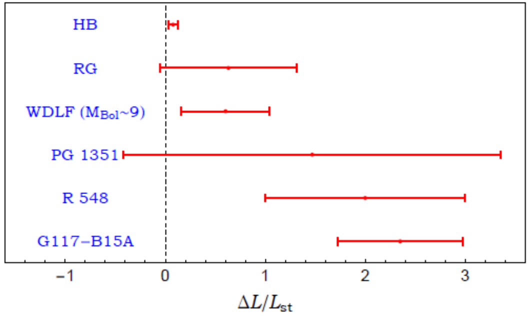


https://arxiv.org/abs/1205.6180

Axions and ALPs in the sky

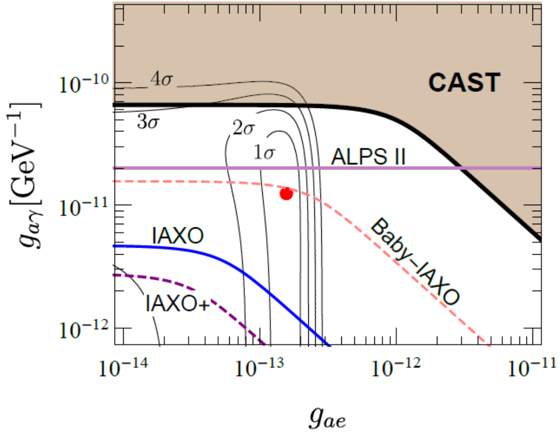
Stellar evolutions

- > Extra energy loss beyond SM expectations
  is indicated by stellar developments.
- > Such losses can be explained consistently
  by the emission of axions coupling to photons and electrons.
  Light ALPs would also work.



M. Giannotti, I. Irastorza,
J. Redondo, A. Ringwald,
http://arxiv.org/abs/1512.08108

M. Giannotti, I. Irastorza,
J. Redondo, A. Ringwald, K. Saikawa
https://arxiv.org/abs/1708.02111

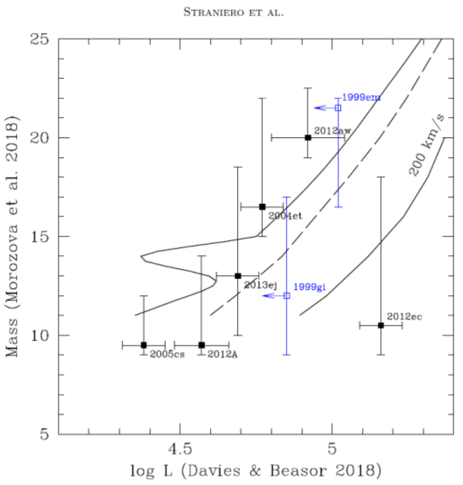


P. Di Vecchia, M. Giannotti,
M. Lattanzi, A. Lindner
https://arxiv.org/abs/1708.02111

Axions and ALPs in the sky

Supernovae

seem to be a bit too dim compared to expectations from the mass of progenitor stars:



O. Straniero et al, arXiv:1907.06367 [astro-ph.SR]

An axion / ALP with $g_{a\gamma} = 6{\cdot}10^{-11}\,\mathrm{GeV}^{-1}$ and $g_{ae} = 4{\cdot}10^{-13}$ might resolve the discrepancy.

Axions / ALPs in reach of ALPS II and IAXO might solve the problem!

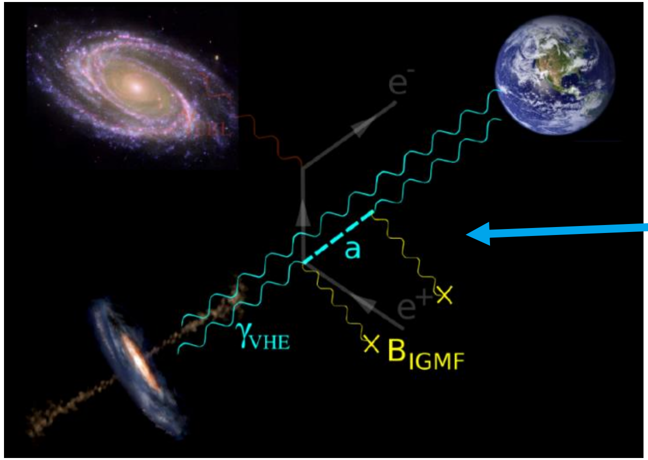
Do we understand astrophysics?

Axions and ALPs in the sky

Propagation of TeV photons

Anomalous transparency of the universe to TeV photons:

- TeV photons might not be absorbed in the intergalactic space due to $\gamma + \gamma \rightarrow e^+e^-$ scattering as predicted by QED.
- This could be explained by axion-like particles.



TeV photons in the universe

might convert in magnetic fields to ALPs via their two-photon coupling.

Such ALPs might convert back to photons in the vicinity of earth.

Axions and ALPs in the sky

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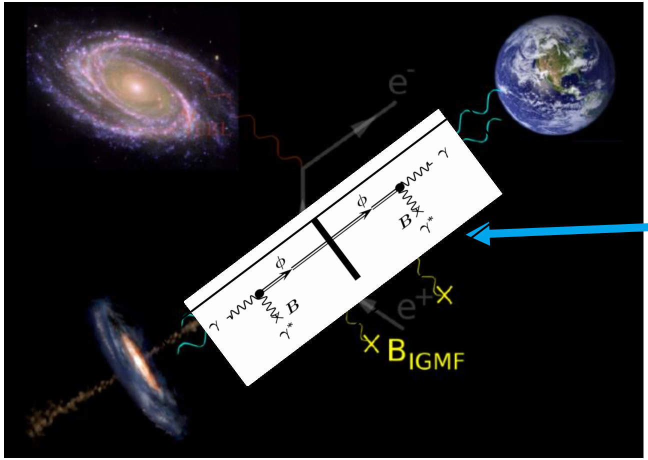

TeV photons in the universe:

"Light-shining-through-the-wall" of extragalactic background light?

Axions and ALPs in the sky

Propagation of TeV photons

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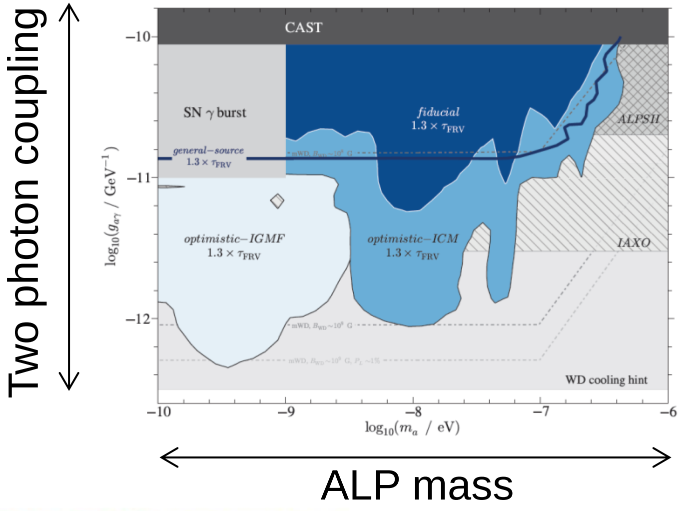


A very similar axion-photon coupling as derived from stellar developments is required!

M. Meyer, D. Horns, M. Raue,
arXiv:1302.1208 [astro-ph.HE], Phys. Rev. D 87, 035027 (2013)

S. V. Troitsky,
arXiv:1612.01864 [astro-ph.HE], JETP Lett. 105 (2017) no.1, 55

Axions and ALPs in the sky

Propagation of TeV photons

ALPs to explain an unexpected high transparency of the universe for TeV photons:

PoS PROCEEDINGS OF SCIENCE

Hints for an axion-like particle from PKS 1222+216?

https://arxiv.org/abs/1409.4401

Advantages of axion-like particles for the description of very-high-energy blazar spectra

https://arxiv.org/abs/1503.04436

PHYSICAL REVIEW D **86**, 075024 (2012)

Hardening of TeV gamma spectrum of active galactic nuclei in galaxy clusters by conversions of photons into axionlike particles

https://arxiv.org/abs/1207.0776

Journal of Cosmology and Astroparticle Physics
An IOP and SISSA journal

Sensitivity of the Cherenkov Telescope Array to the detection of axion-like particles at high gamma-ray opacities

https://arxiv.org/abs/1410.1556

PHYSICAL REVIEW D **93**, 045014 (2016)

Towards discrimination between galactic and intergalactic axion-photon mixing

https://arxiv.org/abs/1507.08640

Distance-dependent hardenings in gamma-ray blazar spectra corrected for the absorption on the extragalactic background light

https://arxiv.org/abs/1810.03443

Axion-like particles and the propagation of gamma rays over astronomical distances

https://arxiv.org/abs/1612.01864

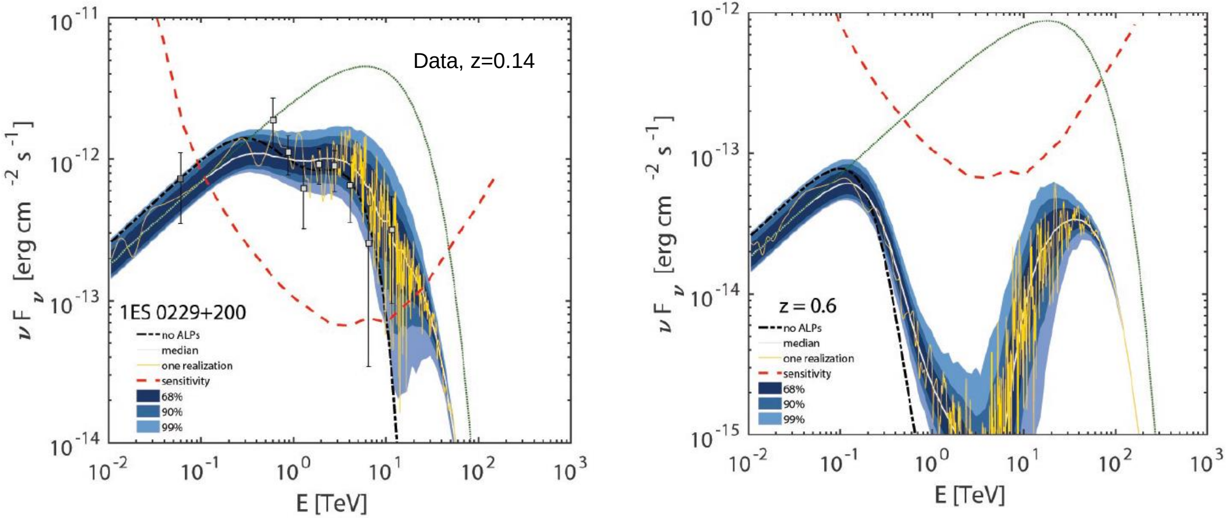
Axions and ALPs in the sky

Propagation of TeV photons

G. Galanti, F. Tavecchio, M. Roncadelli and C. Evoli, arXiv:1811.03548

Magnetic fields:

- Source
- Host galaxy
- Intergalactic space
- Milky way



Data seem to prefer an ALP with $g_{a\gamma} = O(10^{-11}\mathrm{GeV}^{-1})$ and $m_a = O(10^{-10}\mathrm{eV})$.

Even CTA might not have the sensitivity to fully settle this question.

Axions and ALPs in the sky

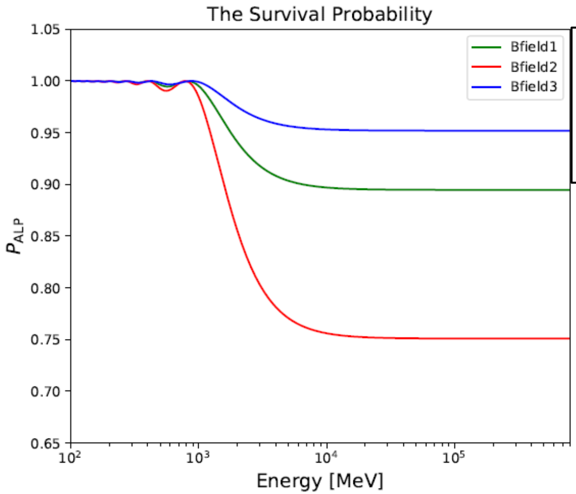
Photon propagation in magnetic fields

Photon spectra might be changed due to photon-ALP conversion in magnetic fields (10.1103/PhysRevD.97.063003, Zi-Qing Xia et al.):

$$P_{\mathrm{ALP}} = 1 - P_{\gamma\to a} = 1 - \frac{1}{1+E_c^2/E_\gamma^2}\sin^2\left[\frac{g_{a\gamma}B_{\mathrm{T}}l}{2}\sqrt{1+\frac{E_c^2}{E_\gamma^2}}\right]$$

where the characteristic energy E_c is defined as

$$E_c = \frac{|m_a^2 - w_{\mathrm{pl}}^2|}{2g_{a\gamma}B_{\mathrm{T}}},$$



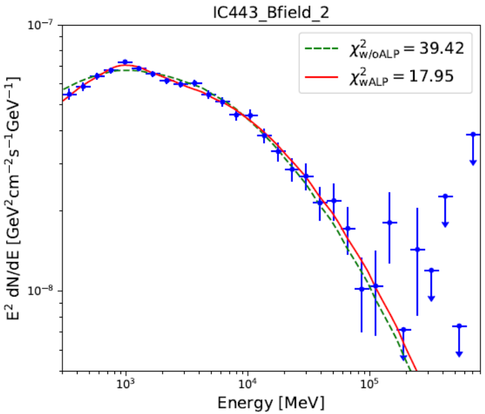
SNR IC443, 1.5 kpc
$m_a = 6.6\cdot10^{-9}$eV
$g_{a\gamma\gamma} = 1.3\cdot10^{-10}$GeV^{-1}

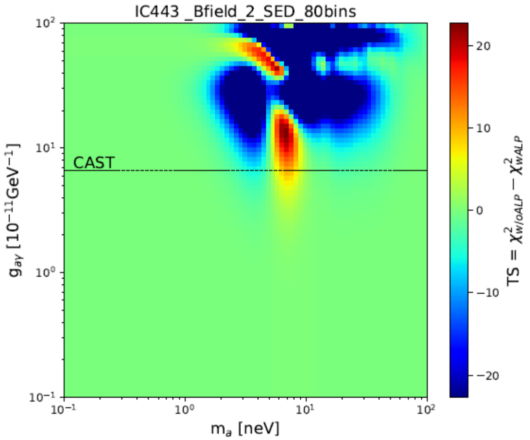
Spectral modulations might hint at the existence of ALPs!

Axions and ALPs in the sky

Photon propagation in magnetic fields: conflicting results!

Galactic SNR (10.1103/PhysRevD.97.063003, Zi-Qing Xia et al.):





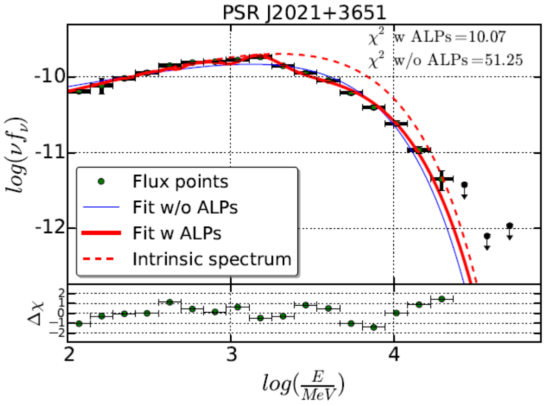
Evidence for ALPs from IC443?

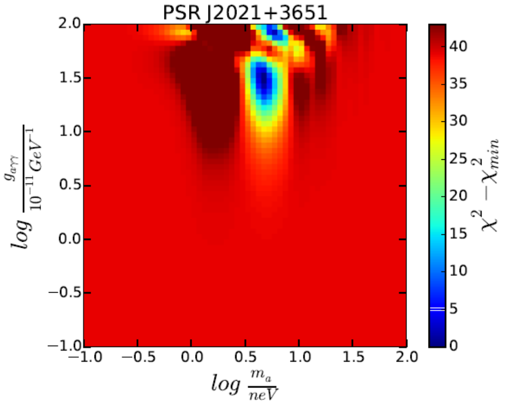
No ALPs indications from W44 and W51C, method checked with close SNRs.

Axions and ALPs in the sky

Photon propagation in magnetic fields: conflicting results!

Galactic pulsars (J. Majumdar *et al* JCAP04(2018)048):





Pulsar name	N_0 [10^{-9}MeV^{-1} cm^{-2} s^{-1}]	Γ_1	E_{cut} [GeV]	$g_{a\gamma\gamma}$ [10^{-10} GeV^{-1}]	m_a [neV]
J1420-6048	0.0016(2)	1.74(4)	5.4(6)	1.7(3)	3.6(1)
J1648-4611	0.0028(2)	0.88(3)	3.4(2)	5.3(9)	4.3(1)
J1702-4128	0.13(3)	0.9(1)	1.0(2)	4.4(2)	8.1(5)
J1718-3825	0.024(2)	1.48(4)	2.1(1)	2.4(3)	8.9(2)
J2021+3651	0.18(1)	1.45(3)	3.5(1)	3.5(3)	4.4(1)
J2240+5832	0.005(1)	1.5(1)	2.4(6)	2.1(4)	3.7(3)

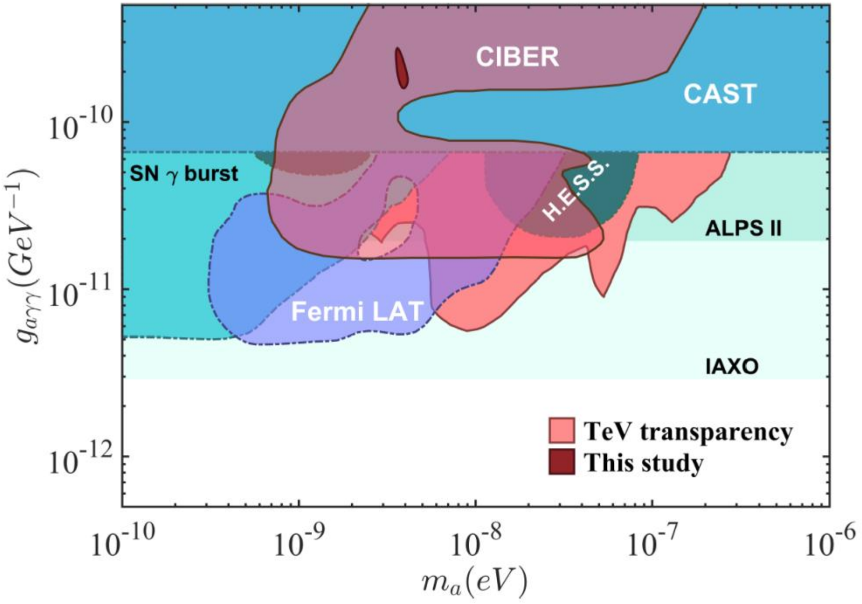
Pulsars selected according to the magnetic field strength along the line of sight.

Method checked with close pulsar.

Axions and ALPs in the sky

Photon propagation in magnetic fields: conflicting results!

Galactic pulsars (J. Majumdar *et al* JCAP04(2018)048):



Surprising agreement with SNR analyses!

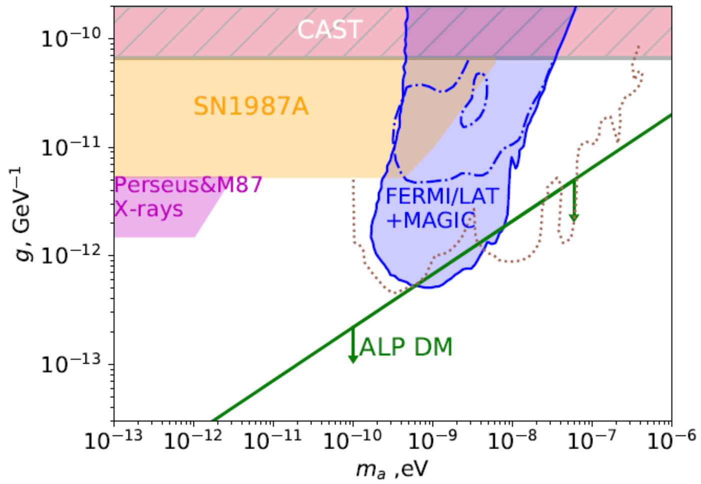
Conflict to other exclusions!

Do we understand astrophysics?

Axions and ALPs in the sky

Photon propagation in magnetic fields: conflicting results!

NGC 1275, Perseus cluster (D. Malyshev et al, arXiv:1805.04388 [astro-ph.HE]):

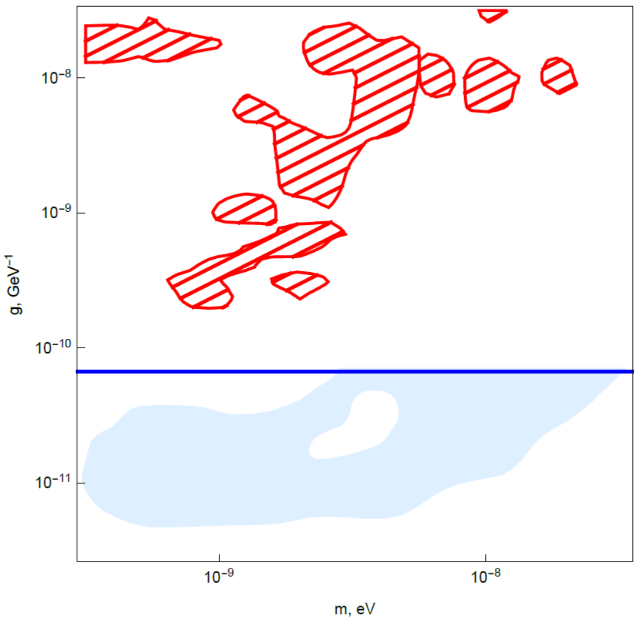


No evidence for ALPs! “Galactic hints” excluded?

Do we understand astrophysics?

Axions and ALPs in the sky

NGC 1275: different magnetic field configurations



M. Libanov and S. Troitsky, arXiv:1908.03084 [astro-ph.HE].

regular magnetic field

turbulent magnetic field

Do we understand astrophysics? Limits from NGC 1752 might be well compatible with CAST.

Axions and ALPs in the sky

Hints from astrophysics?

- Stellar evolutions
- Propagation of TeV photons
- Photon propagation in magnetic fields

Nothing conclusive yet, but lot's of interesting data hinting at $g_{a\gamma} = 10^{-11}$ to 10^{-10}GeV^{-1}.

Strive for model independent measurements: ALPS II at DESY!

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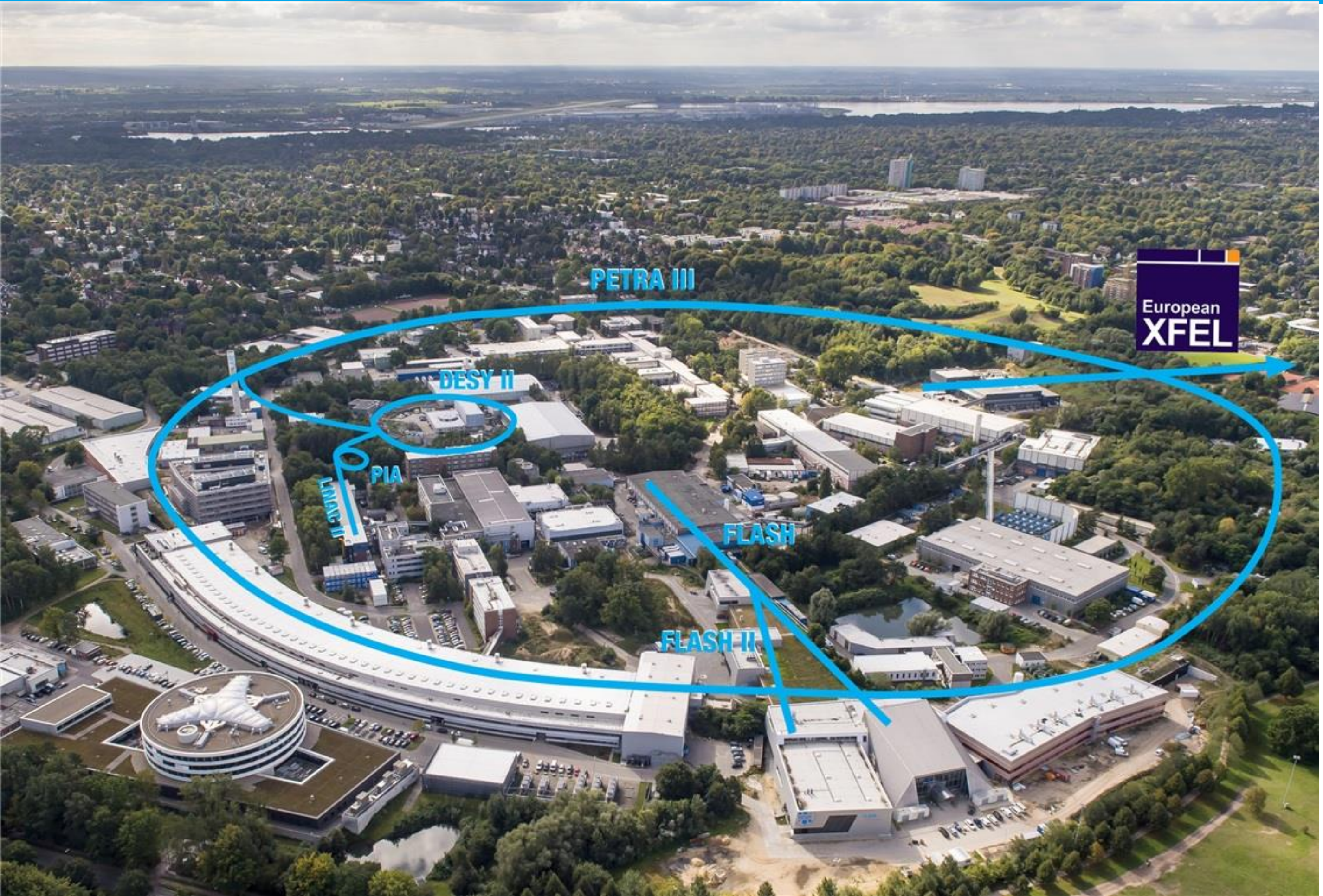
DESY in Hamburg



Axion physics:

Opportunity to have particle physics experiments on-site complementing participation in remote experiments (ATLAS, CMS, BELLE II).

ALPS II: aiming for start-up in 2020 @ DESY in HH

Collaboration

ALPS II main contributions				
Partner	**Magnets**	**Optics**	**Detectors**	**Infrastructure**
DESY	X	X	X	X
AEI Hannover		X		
U. Cardiff		X		
U. Florida		X	X	X
U. Mainz			X	

DESY

Albert Einstein Institute Hannover

UF UNIVERSITY of FLORIDA

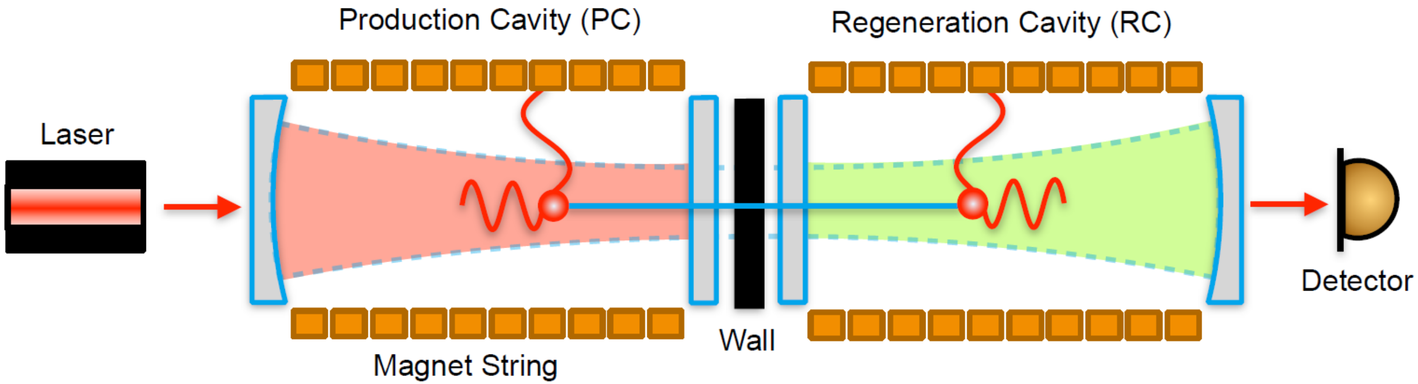
JG|U JOHANNES GUTENBERG UNIVERSITÄT MAINZ

CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD

Significant funding support also by the

HEISING-SIMONS FOUNDATION

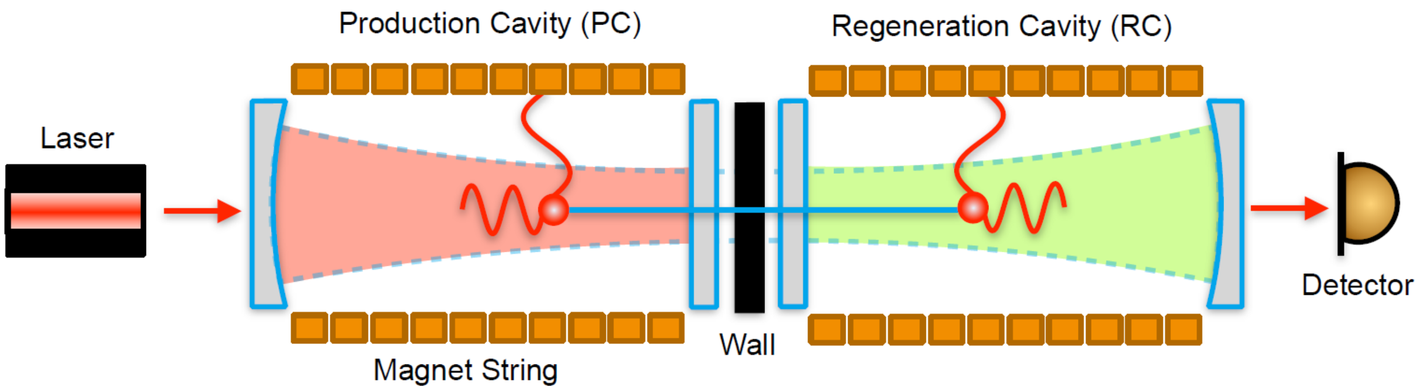
ALPS II @ DESY in Hamburg: concept update Feb. 2019



12+12 dipole magnets from the HERA proton accelerator

Production cavity and regeneration cavity, mode matched

ALPS II @ DESY in Hamburg: concept



$$P_{\gamma\to\phi\to\gamma} = \frac{1}{16} \cdot \mathcal{F}_{PC}\mathcal{F}_{RC} \cdot (g_{a\gamma\gamma} B l)^4 = 6 \cdot 10^{-38} \cdot \mathcal{F}_{PC}\mathcal{F}_{RC} \cdot \left(\frac{g_{a\gamma\gamma}}{10^{-10} GeV^{-1}} \frac{B}{1\,T} \frac{l}{10m} \right)^4$$

= 10^{-25}

5.000 40.000 0.2 5.3 10.56

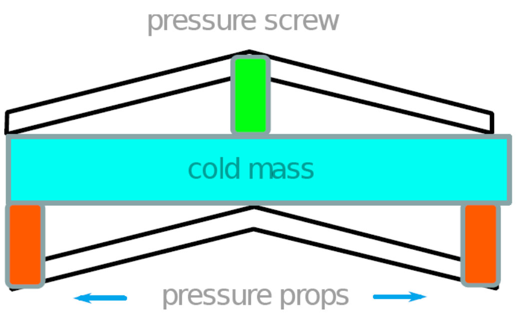
30 W cw laser at 1064 nm: $3 \cdot 10^{-5}$ photon/s ($5 \cdot 10^{-24}$ W).

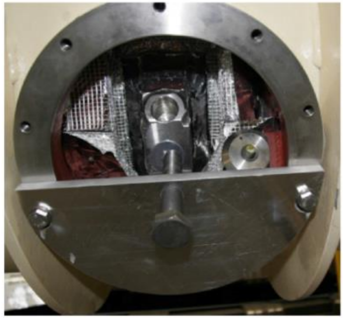
ALPS II site: a straight section of the HERA tunnel

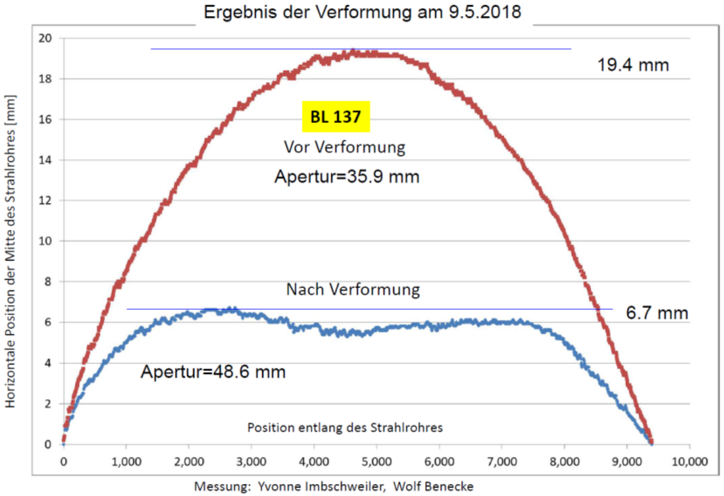
- The HERA tunnel was cleared in2018.

ALPS II main components: magnets from HERA

- 12+12 dipoles from HERA,
  each 5.3 T on 8.8 m.
- To be straightened to achieve
  $\approx$ 50 mm aperture
  from 35 mm (600 m bending radius)

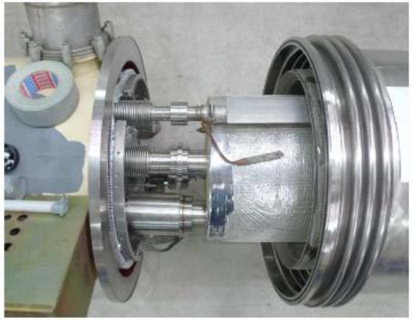




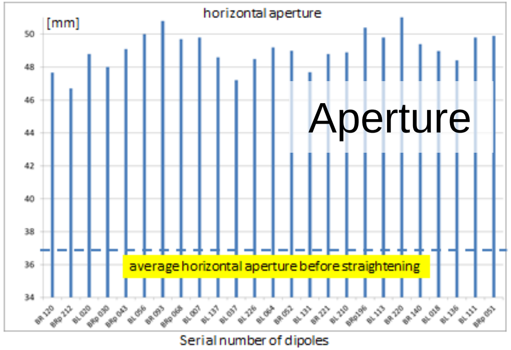


ALPS II main components: magnets from HERA

- 12+12 dipoles from HERA, each 5.3 T on 8.8 m.
- To be straightened to achieve ≈ 50 mm aperture.
- 25 magnets modified successfully (out of 26).
- Test string assembled successfully

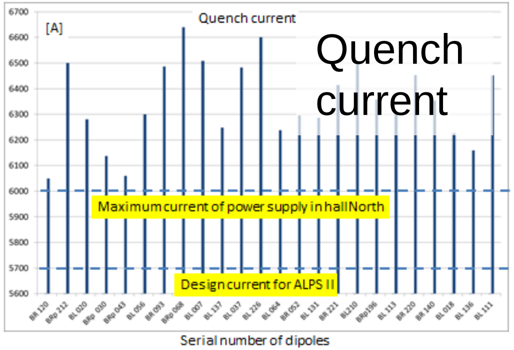


25 dipoles were straightened up to now
Including the original ALPS I dipole (BR 120) which will be kept as a spare.



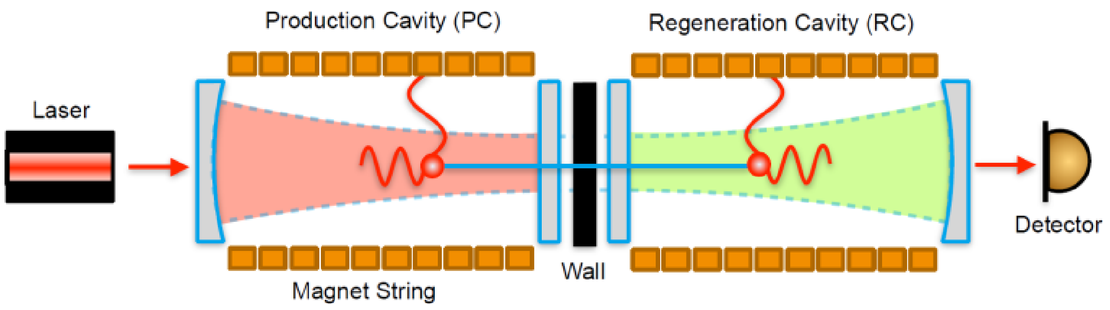
Inner diameter of beam pipe 55.3 mm

Each dipole was powered up to the quench current and operated continuously at 5700 A for ~8 hours on the test bench.
Last dipole needed has been **tested today: 6256 A**



Dieter Trines

ALPS II main components: optics adapted from LIGO

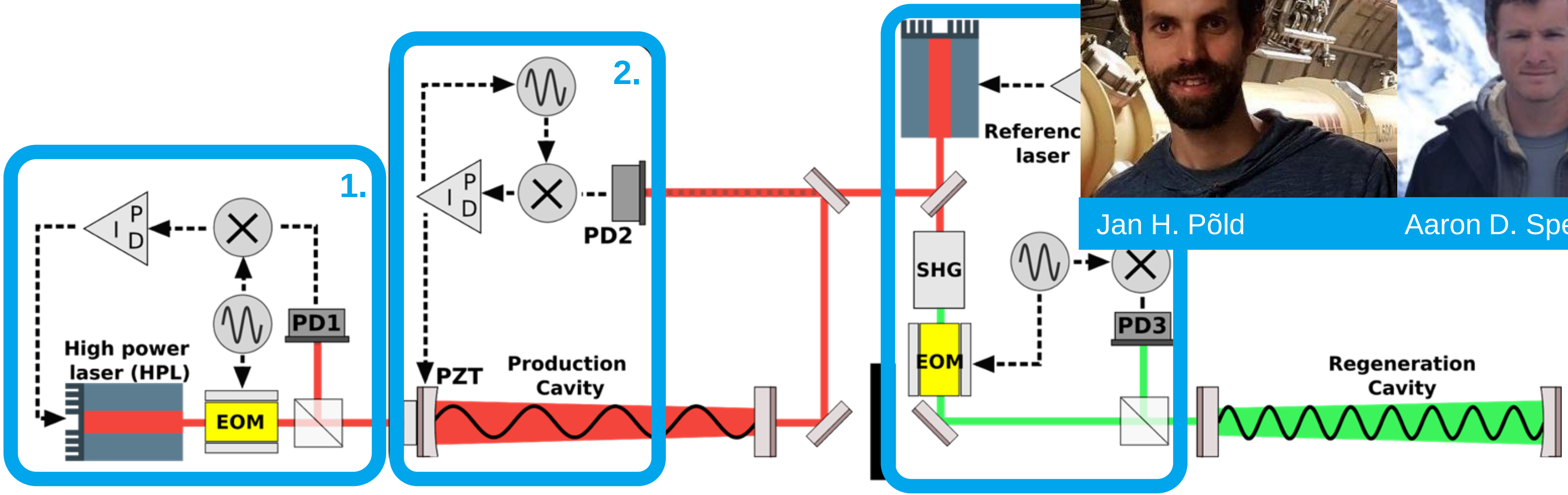


- Mode-matched optical resonators before (“PC”) and behind (“RC”) the wall. ✓
- Relative angle between PC and RC less than 0.5 µrad. ✓
- Each about 120 m long, need to compensate seismic noise. ✓
- Power built-up PC: 5,000: 150 kW circulating power. ✓
- Power built-up RC: 40,000. ✓
- PC and RC relative length stabilized to 0.5 pm. ✓

ALPS II control scheme (TES)

Jan H. Põld

Aaron D. Spector



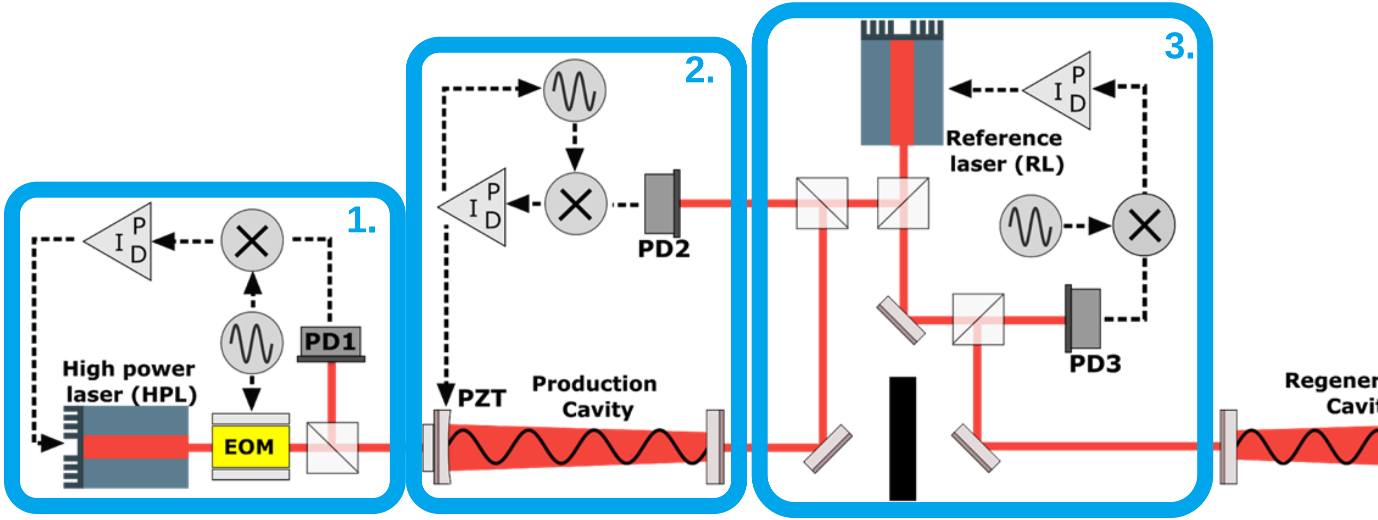
HPL Laser Frequency → **PC Length** → **RL Laser Frequency** → **RC Length**

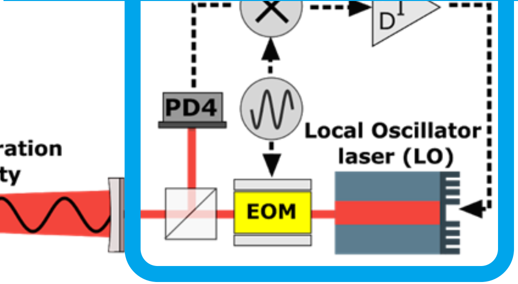
1.
PC PDH Loop

2.
PLL with Length Actuation

3.
PDH using SHG green light

ALPS II control scheme (HET)





HPL Laser Frequency → PC Length → RL Laser Frequency → LO Laser Frequency → RC Length

1. PC PDH Loop

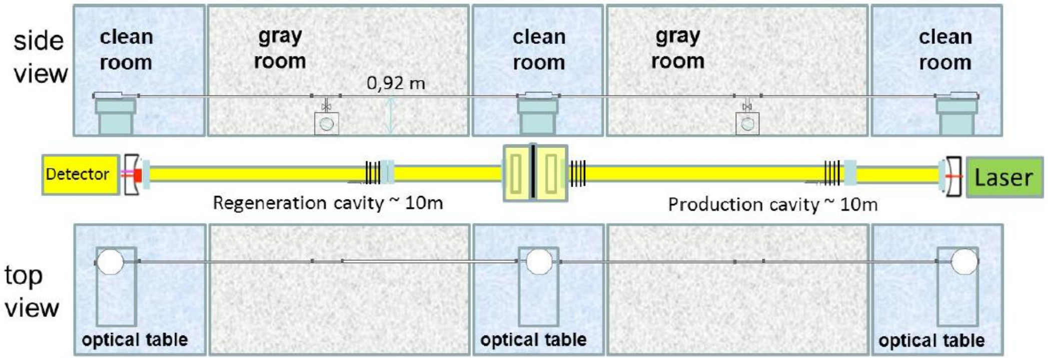
2. PLL with Length Actuation

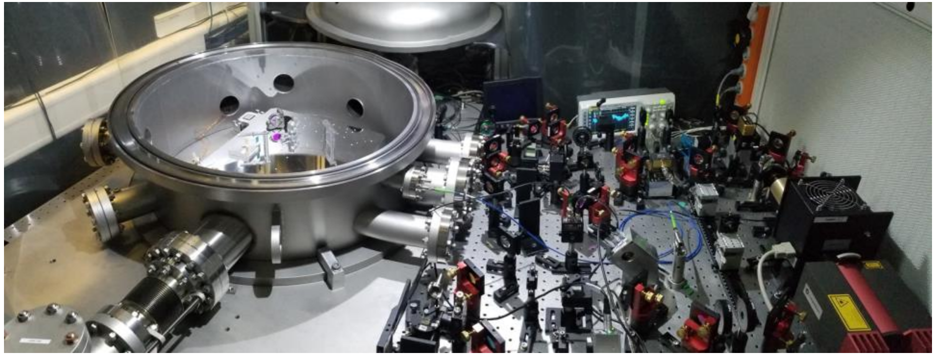
3. PLL with Frequency Actuation

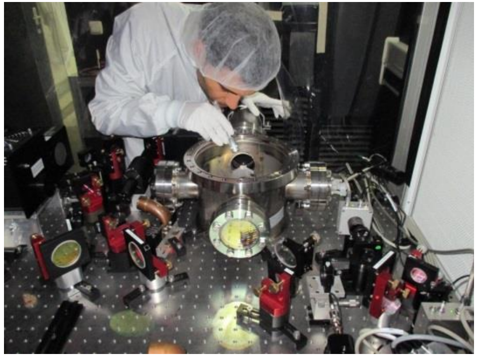
4. RC PDH Loop

ALPS II mockup: optics

The optics is probed in a 20 m long dedicated lab “ALPS IIa“.



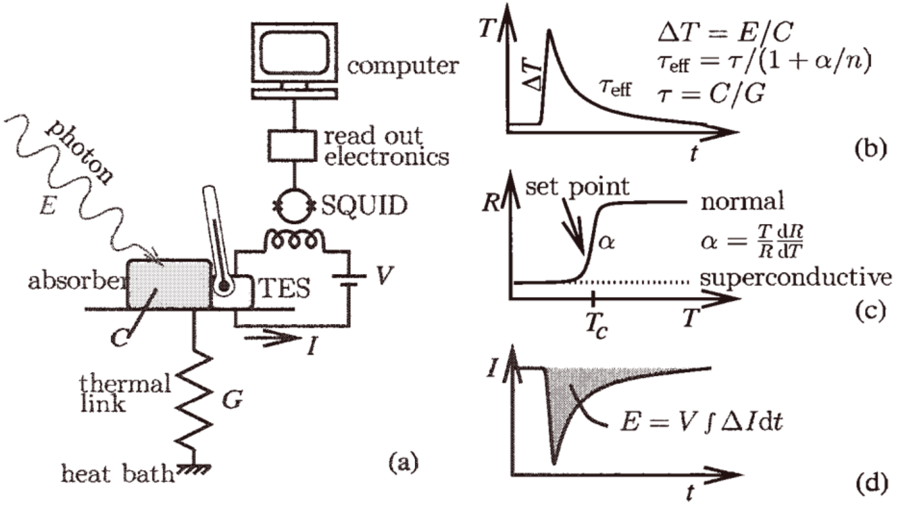




ALPS II main components: detectors

DESY:

- Transition edge sensor (TES) operated at 80 mK.



$\Delta T \approx 100\ \mu K$

$\Delta R \approx 1\ \Omega$

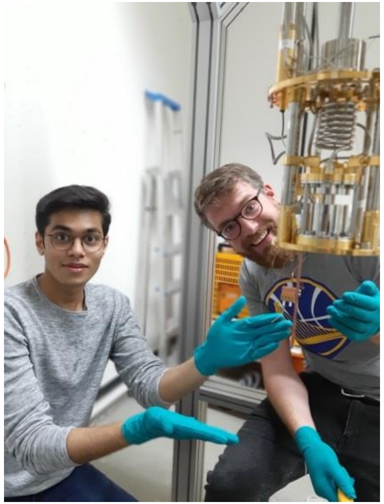
$\Delta I \approx 70\ nA$

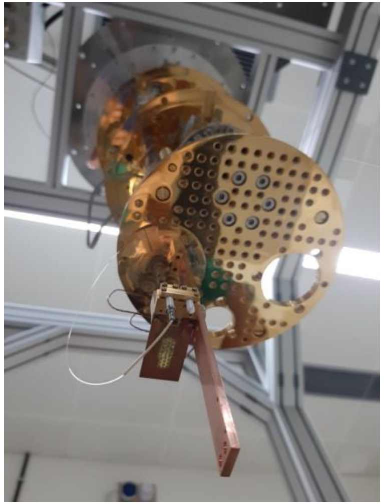
Friederike Januschek

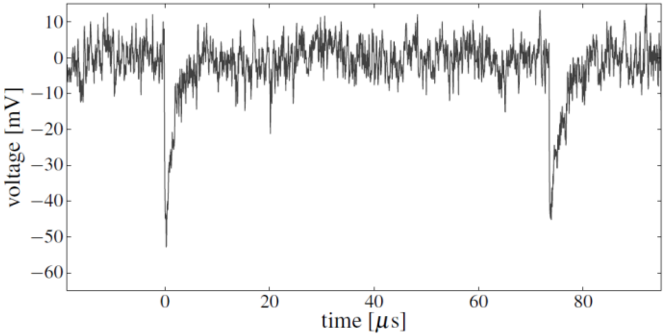
ALPS II main components: detectors

DESY:

- Transition edge sensor (TES) operated at 80 mK (NIST, PTB)
- Single 1064 nm photon detection demonstrated:
  - 5% energy resolution
  - 10^{-4} counts/s intrinsic background
- R&D has resumed with a new cryostat in summer 2018.







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- Transition edge sensor (TES) operated at 80 mK.
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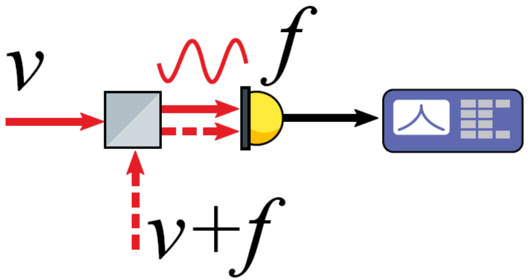
University of Florida:

- Heterodyne detection scheme.



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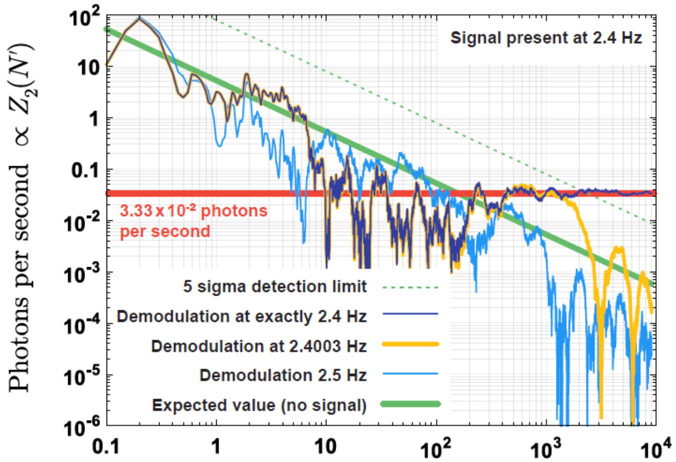
University of Florida:

- Heterodyne detection scheme.
- 0.03 photons/s demonstrated.



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J Low Temp Phys (2016) 184:88–90
DOI 10.1007/s10909-015-1408-5

CrossMark

Quantum Efficiency Characterization and Optimization of a Tungsten Transition-Edge Sensor for ALPS II

Noëmie Bastidon[1] · Dieter Horns[1] ·
Axel Lindner[2]

Coherent Detection of Ultra-weak Electromagnetic Fields

Zachary R. Bush[1], Simon Barke[1], Harold Hollis[1], Aaron D. Spector[2],
Ayman Hallal[1], Giuseppe Messineo[1], D.B. Tanner [1], Guido Mueller[1]
[1] *Department of Physics, University of Florida, PO Box 118440, Gainesville, Florida, 32611, USA*
[2] *Deutsches Elektronen-Synchrotron (DESY), Notkestrae 85, D-22607 Hamburg, Germany*
(Dated: November 22, 2018)

https://arxiv.org/abs/1710.04209

First Magnet Fest 28 October 2019

First Magnet Fest 28 October 2019

Pilot:
Christina Krywka, DESY

Model:
David Reuther, DESY

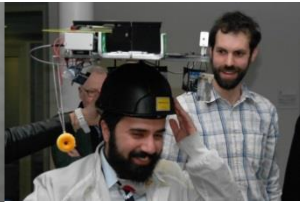
ALPS II @ DESY in Hamburg

Results and schedule

Results:

- Axions and ALPs:
  none (no data run yet …)
- Publications:
  5 on optics and detector developments;
  several conference contributions.
- People (since 2012):
  8 Ph.D. theses completed,
  about 6 to come,
  5 postdocs left for a next career step.

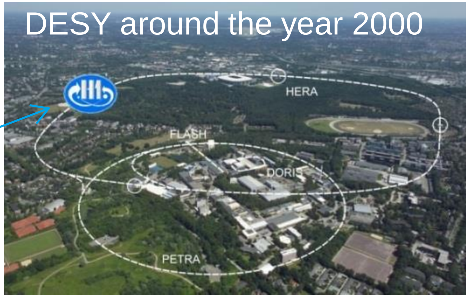
Jan Dreyling-Eschweiler



Reza Hodajerdi

Schedule and site:

- First data in (late) 2021, depends on time for commissioning.

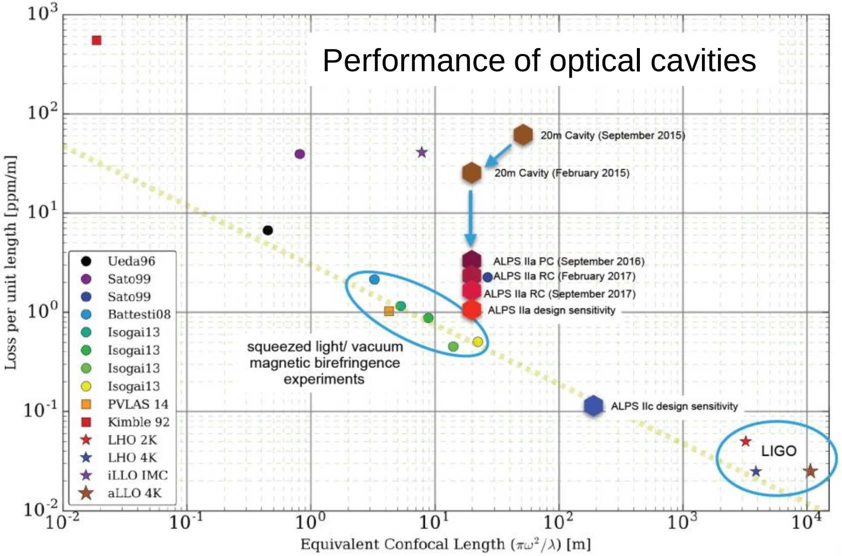


HERA hall North
(former H1 experiment at HERA)

Beyond ALPS II: the JURA option

Future LSW

- ALPS II optics and detectors will be “state of the art”.



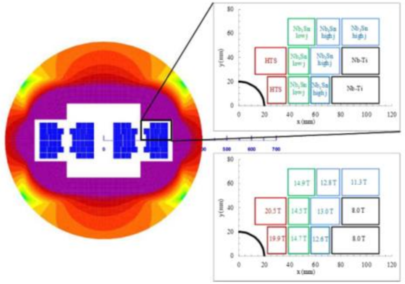
plot from LIGO T-1400226-v6

Beyond ALPS II: the JURA option

Future LSW

- ALPS II optics and detectors will be “state of the art”.
- The HERA dipole magnets are limited in field strength and aperture (limiting the length).

Dipole	Aperture [mm]	Field strength [T]	LSW experiment	Number of used dipoles
HERA (straightened)	50	5.3	ALPS II (DESY)	24
LHC	40	9.0	OSQAR (CERN)	2
“FCC”	100	13	JURA	



For the “FCC” dipole parameters see for example:

- Bottura L, de Rijk G, Rossi L, Todesco E., IEEE Trans. Appl. Supercond. 22:4002008 (2012), http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6656892
- Todesco E, Bottura L, de Rijk G, Rossi L., IEEE Trans. Appl. Supercond. 24:4004306 (2014), http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6172724

Beyond ALPS II: the JURA option

Future LSW

- ALPS II optics and detectors will be “state of the art”.
- The HERA dipole magnets are limited in field strength and aperture (limiting the length).
- JURA (Joint Undertaking in Research on ALPs) could combine ALPS II optics and detector developments with modern magnets being developed for future hadron colliders.

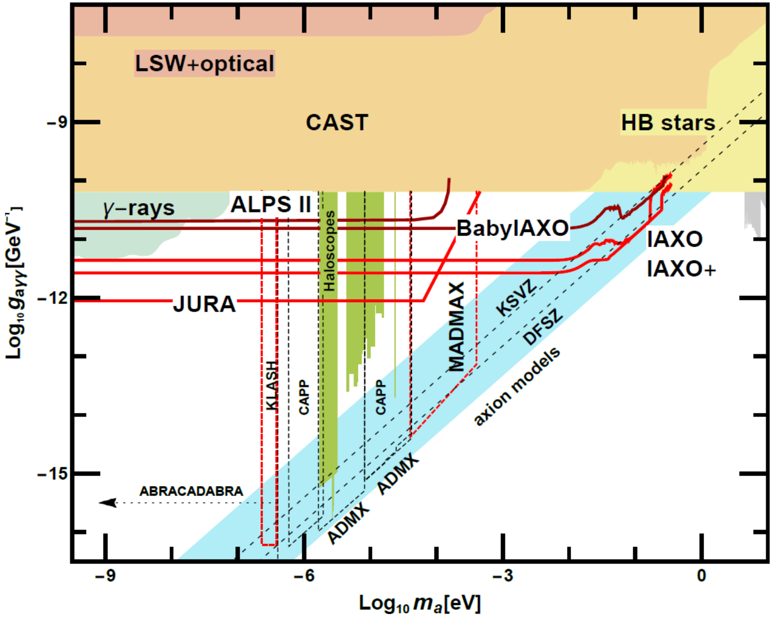
A physics case for a prototype series of Nb_3SN dipoles?

Beyond ALPS II: the JURA option

JURA

- Magnetic field strength: 13 T
- Magnetic length: 426 m
- Light wavelength: 1064 nm
- Circulating light power: 2.5 MW
- Power built-up behind the wall: 10^5
- Detector sensitivity: 10^{-4} s^{-1}

(Magnetic field strength and magnetic length: 10 · ALPS II)



JURA could allow to probe for very lightweight ALPs in the laboratory even beyond the IAXO reach.
It would be a (costly) about 1km long apparatus.

If ALPS II fulfills expectations, JURA should be feasible. Dipole magnet R&D is essential.

Context: an international axion strategy

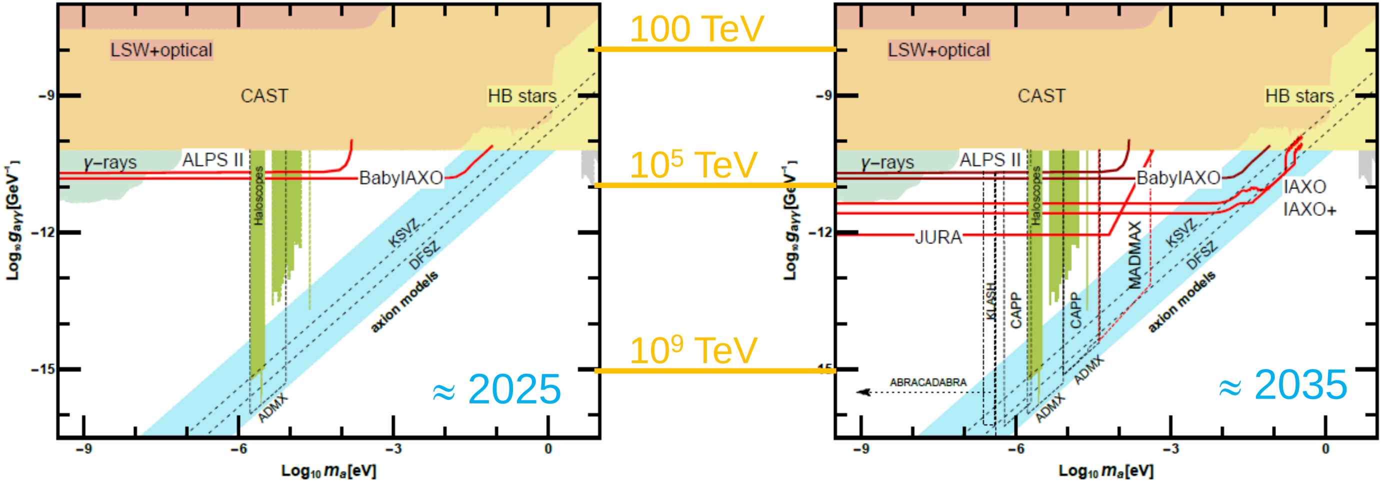
Input for the update process of the European strategy on particle physics ESPP

A European Strategy Towards Finding Axions and Other WISPs

K. Desch[1], *B. Döbrich*[2], *I. Irastorza*[3], *J. Jaeckel*[4], *A. Lindner*[5], *B. Majorovits*[6], *A. Ringwald*[5],
[1]Physikalisches Institut, Uni. Bonn, Nußallee 12, D-53115 Bonn, Germany
[2]CERN, 1 Esplanade des Particules, CH-1211 Geneva 23, Switzerland
[3]Departamento de Fisica Teorica, Uni. de Zaragoza, Pedro Cerbuna 12, E-50009, Zaragoza, Spain
[4]Institut für Theoretische Physik, Uni. Heidelberg, Philosophenweg 16, D-69120 Heidelberg, Germany
[5]DESY, Notkestraße 85, D-22607 Hamburg, Germany
[6]Max-Planck-Institut für Physik, Föhringer Ring 6, D-80805 Munich, Germany

https://indico.cern.ch/event/765096/contributions/3295758/

Supported by 142 physicists



Summary (1)

Axion-like particle physics

- is very well motivated by theory, cosmology and astrophysics,
- complements accelerator based searches for BSM physics.

Experiments searching for axions and ALPs

- are small to moderate scale compared to accelerator experiments,
- combine technical expertise from different communities,
- are always looking for new collaborators!

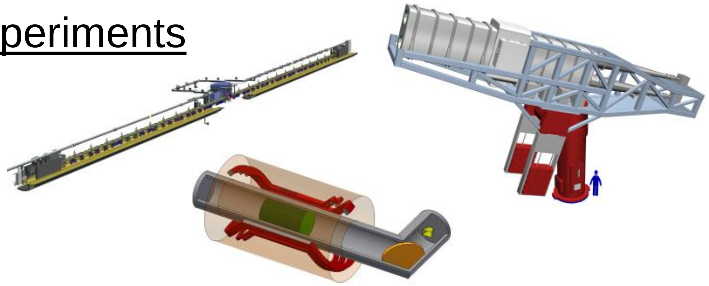
ALPS II being independent on astrophysical/cosmological assumptions

- has started construction to be ready for data taking in 2021,
- will be the first experiment probing the astrophysics hints on ALPs,
- might see JURA as a LSW-successor.

Summary (2)

DESY might become a center for axion/WISP experiments

- constructing ALPS II,
- preparing for (Baby)IAXO and MADMAX.



Infrastructure for more experiments:

- DESY is converting the HERA North hall into a “cryo-platform” offering 4k He (few kW).
- Discussions are starting on options exploiting the ALPS II magnet string / area after finishing ALPS II data taking.