Any Light Particle Search-II review.

An Introduction to the Cornerstones of ALPS-II

Babette Döbrich for the collaboration

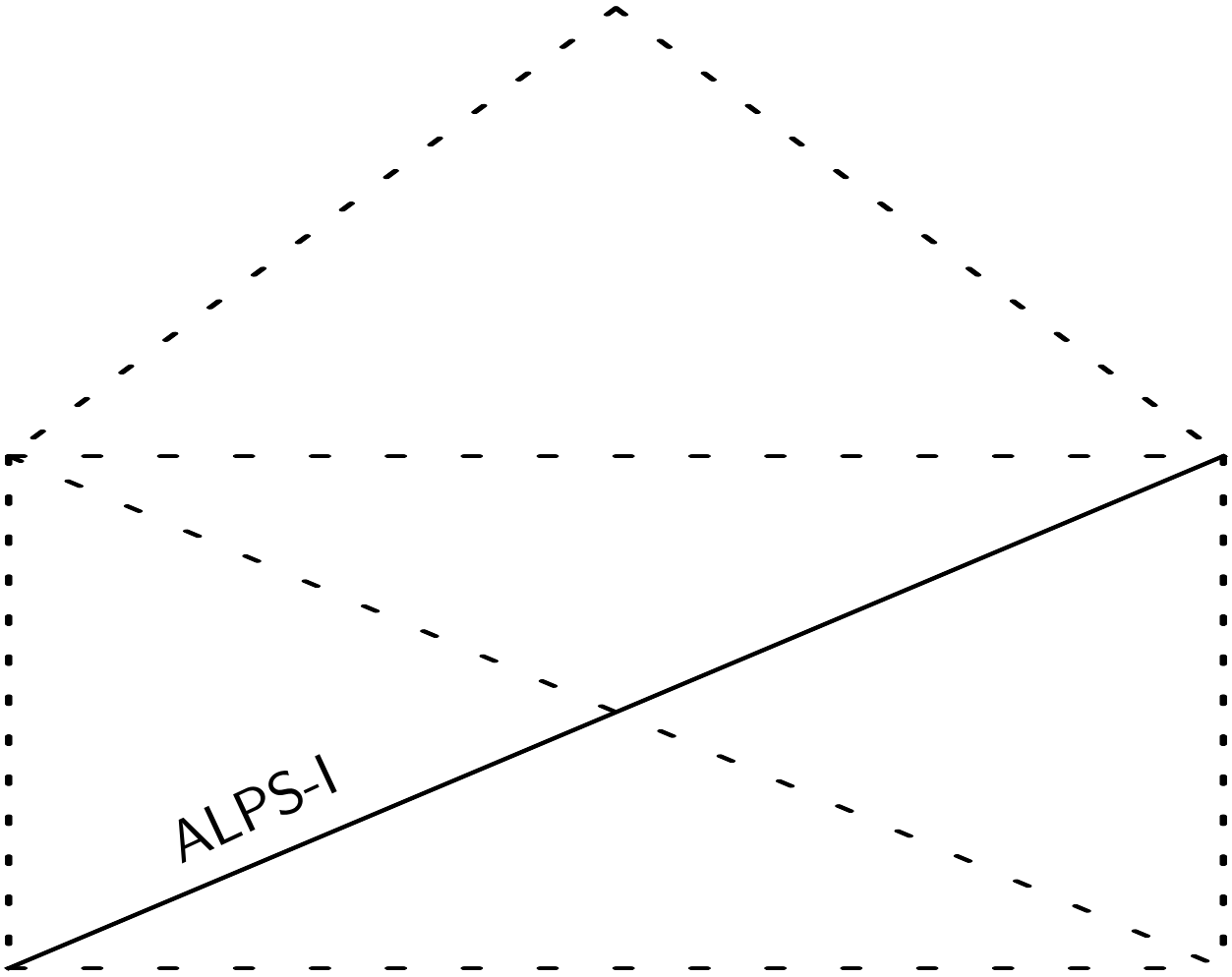
PRC ALPS-II review

DESY Zeuthen, November 7th, 2012

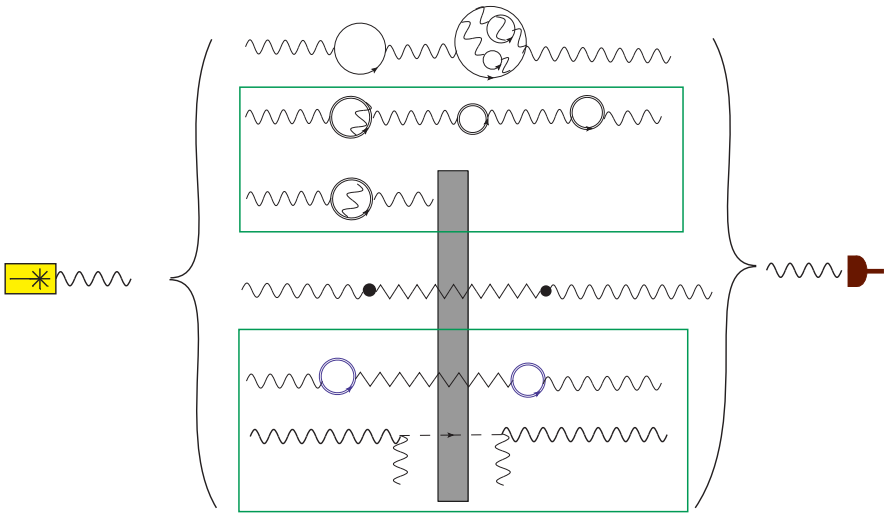
HELMHOLTZ GEMEINSCHAFT

DESY

Cornerstones of ALPS-II

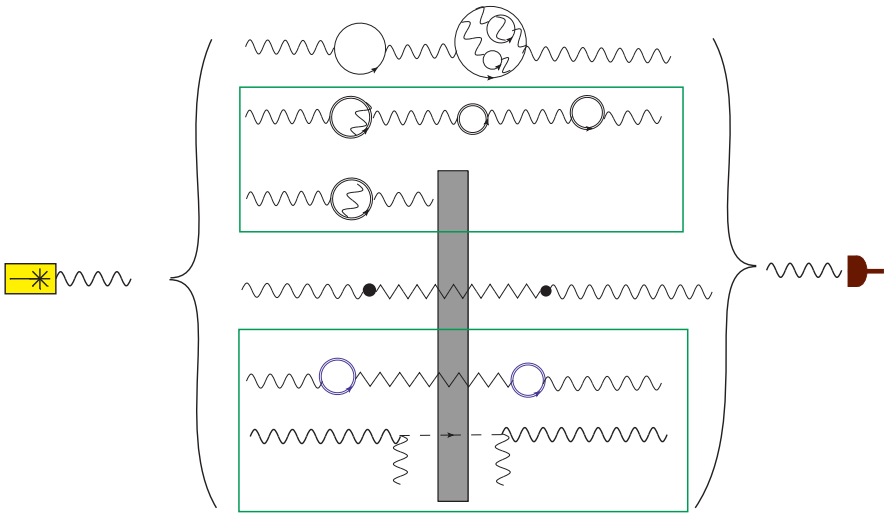


Essentials of ALPS-I

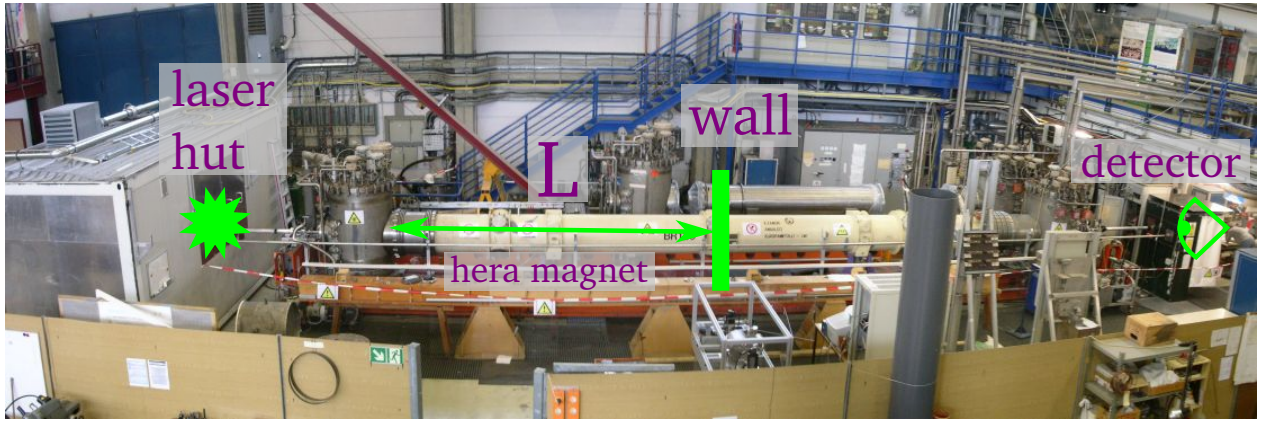


- Look for weakly interacting slim particles "WISPs" ⇒ Light-shining-through-a-wall
- Types of WISPs: w B-field: ALPs, MCPs , w/o B-field: HPs

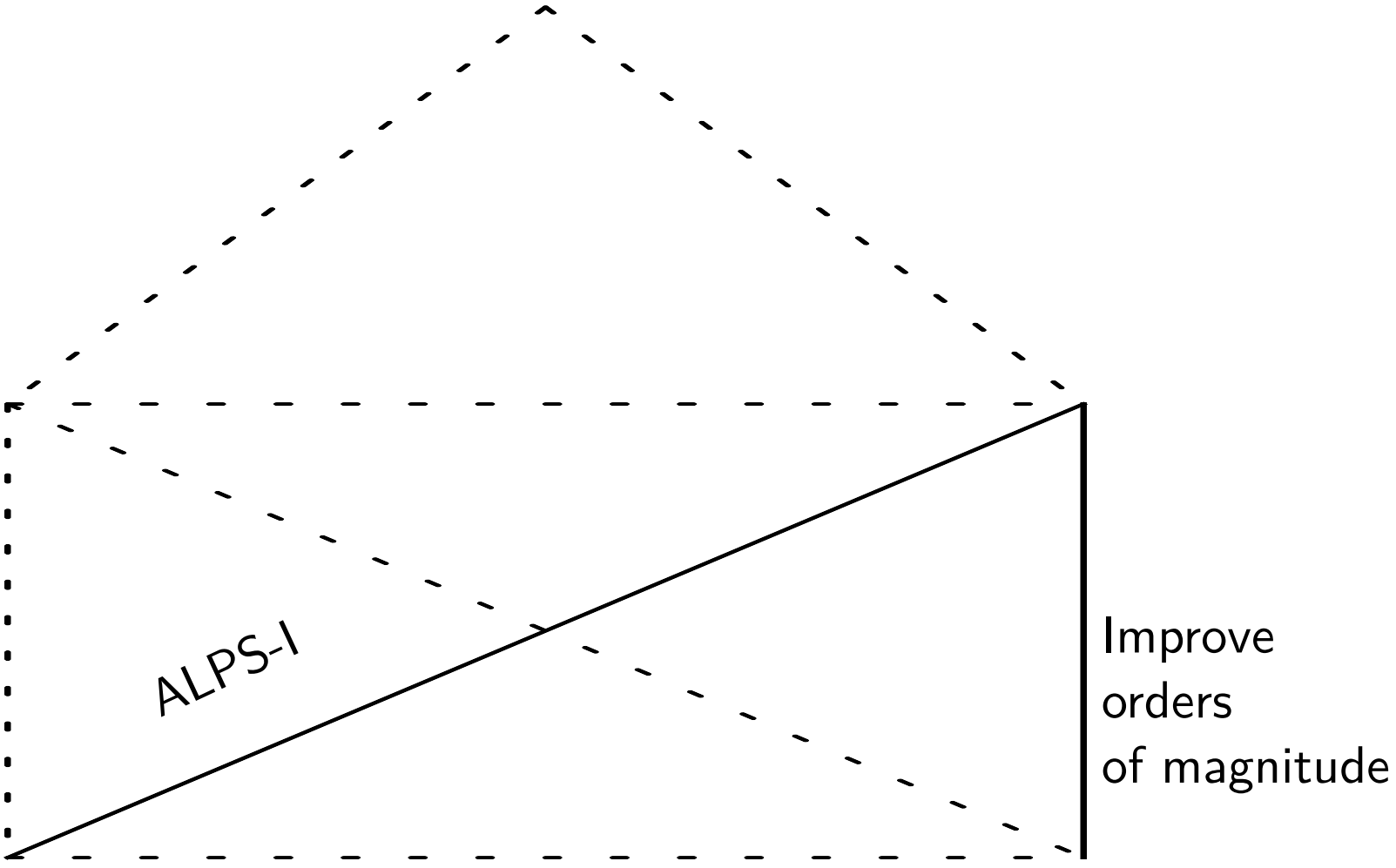
Essentials of ALPS-I



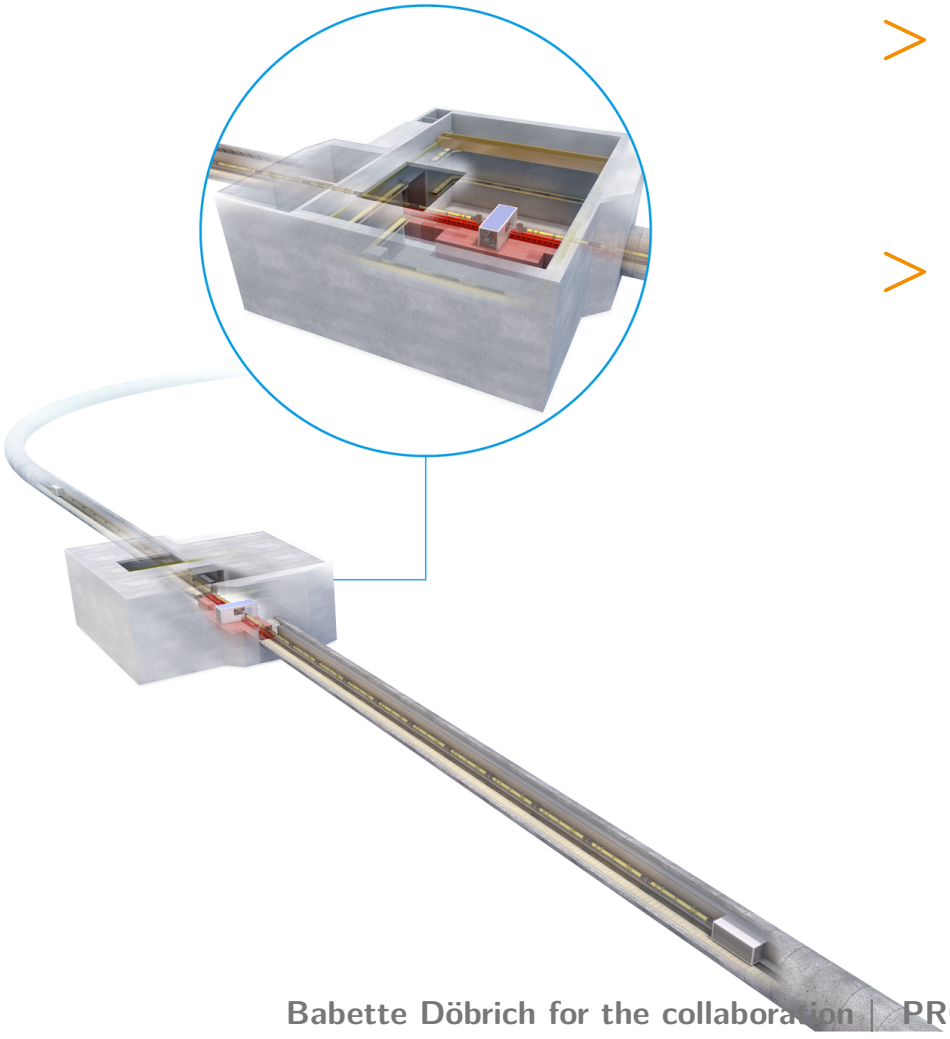
- Look for weakly interacting slim particles "WISPs" ⇒ Light-shining-through-a-wall
- Types of WISPs: w B-field: ALPs, MCPs , w/o B-field: HPs
- ALPS-I: cavity in production region, CCD detector, 1 HERA dipole; concluded in 2010, until now world-leading lab. limits



Cornerstones of ALPS-II

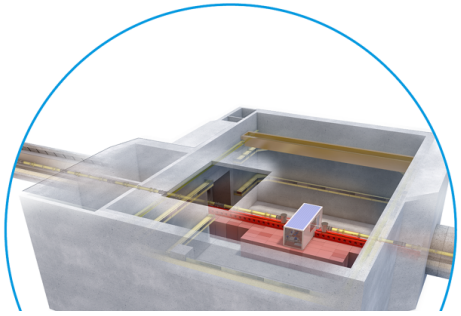


Boosting the sensitivity



- past years have narrowed down interesting parameter range
- Sensitivity increase → test motivated parameter regions for several WISPs
- essential ingredients/challenges
  - *more light*: higher power build up + cavity in regeneration region, durability, locking
  - *better detection* established: CCD, sensitivity for red → transition edge sensor
  - *greater (magnetic) length*: 10+10 HERA Dipoles, straightening

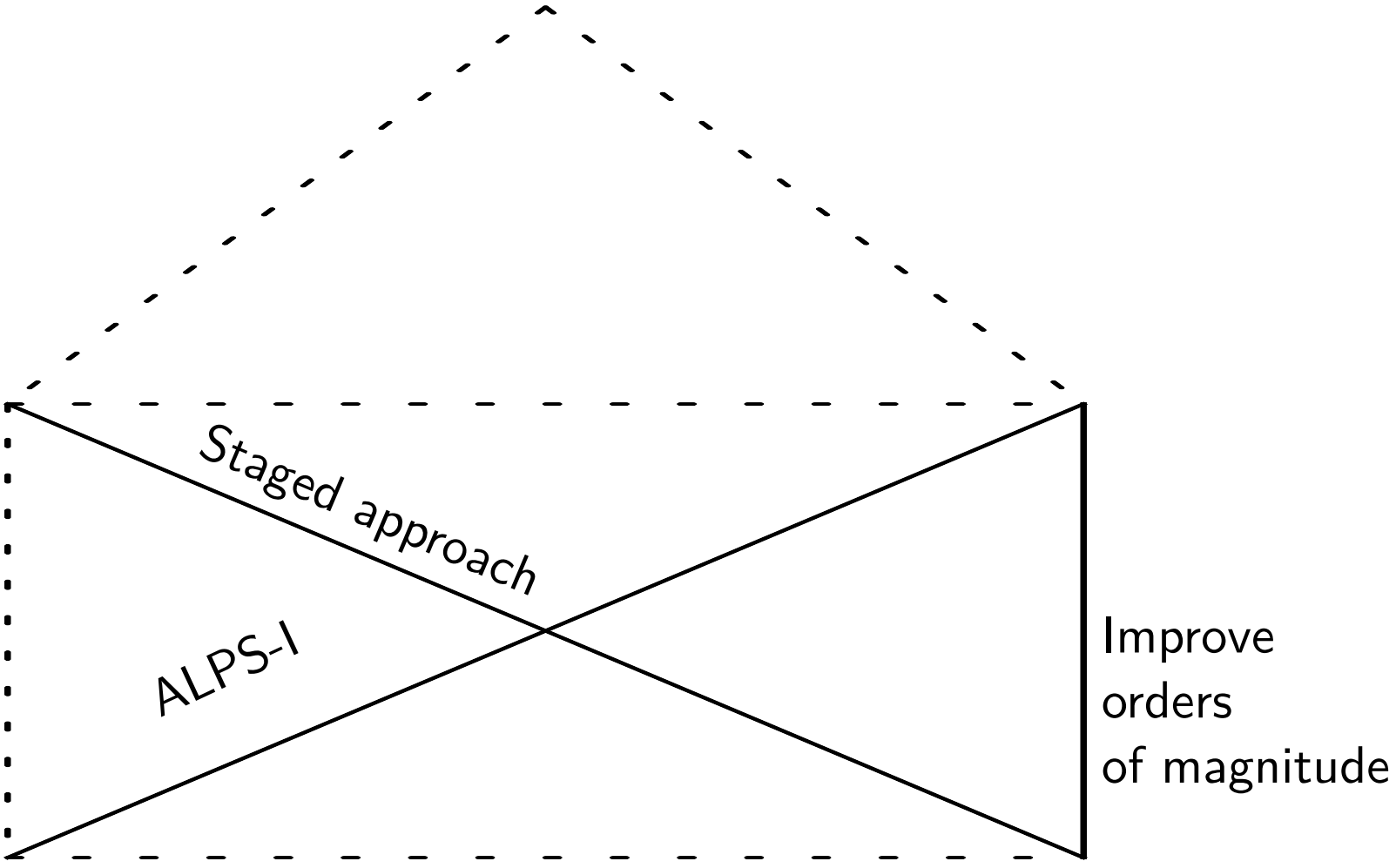
Boosting the sensitivity



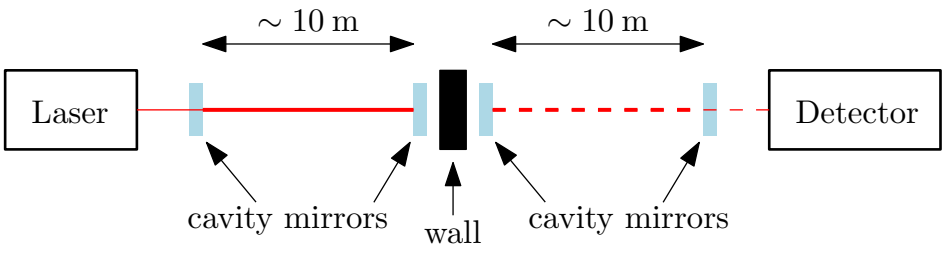
- past years have narrowed down interesting parameter range
- Sensitivity increase $\rightarrow$ test motivated parameter regions for several WISPs
- essential ingredients/challenges

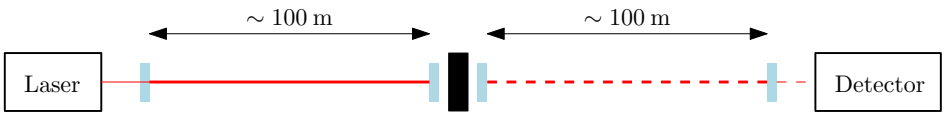
Parameter	Scaling	ALPS-I	ALPS-IIc	Sens. gain
Effective laser power P_{laser}	$g_{a\gamma} \propto P_{\text{laser}}^{-1/4}$	1 kW	150 kW	3.5
Rel. photon number flux n_γ	$g_{a\gamma} \propto n_\gamma^{-1/4}$	1 (532 nm)	2 (1064 nm)	1.2
Power built up in RC P_{RC}	$g_{a\gamma} \propto P_{reg}^{-1/4}$	1	40,000	14
BL (before& after the wall)	$g_{a\gamma} \propto (BL)^{-1}$	22 Tm	468 Tm	21
Detector efficiency QE	$g_{a\gamma} \propto QE^{-1/4}$	0.9	0.75	0.96
Detector noise DC	$g_{a\gamma} \propto DC^{1/8}$	$0.0018\,\text{s}^{-1}$	$0.000001\,\text{s}^{-1}$	2.6
Combined improvements				3082

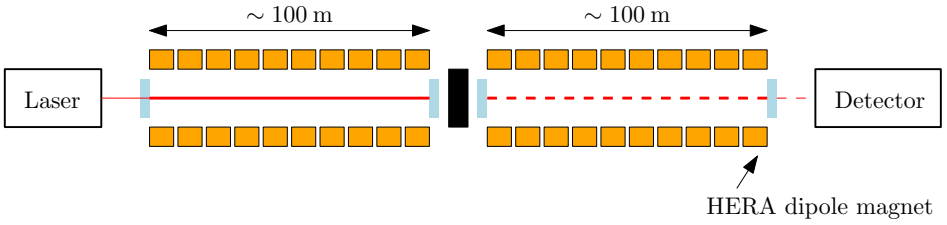
Cornerstones of ALPS-II



The three stages of ALPS-II

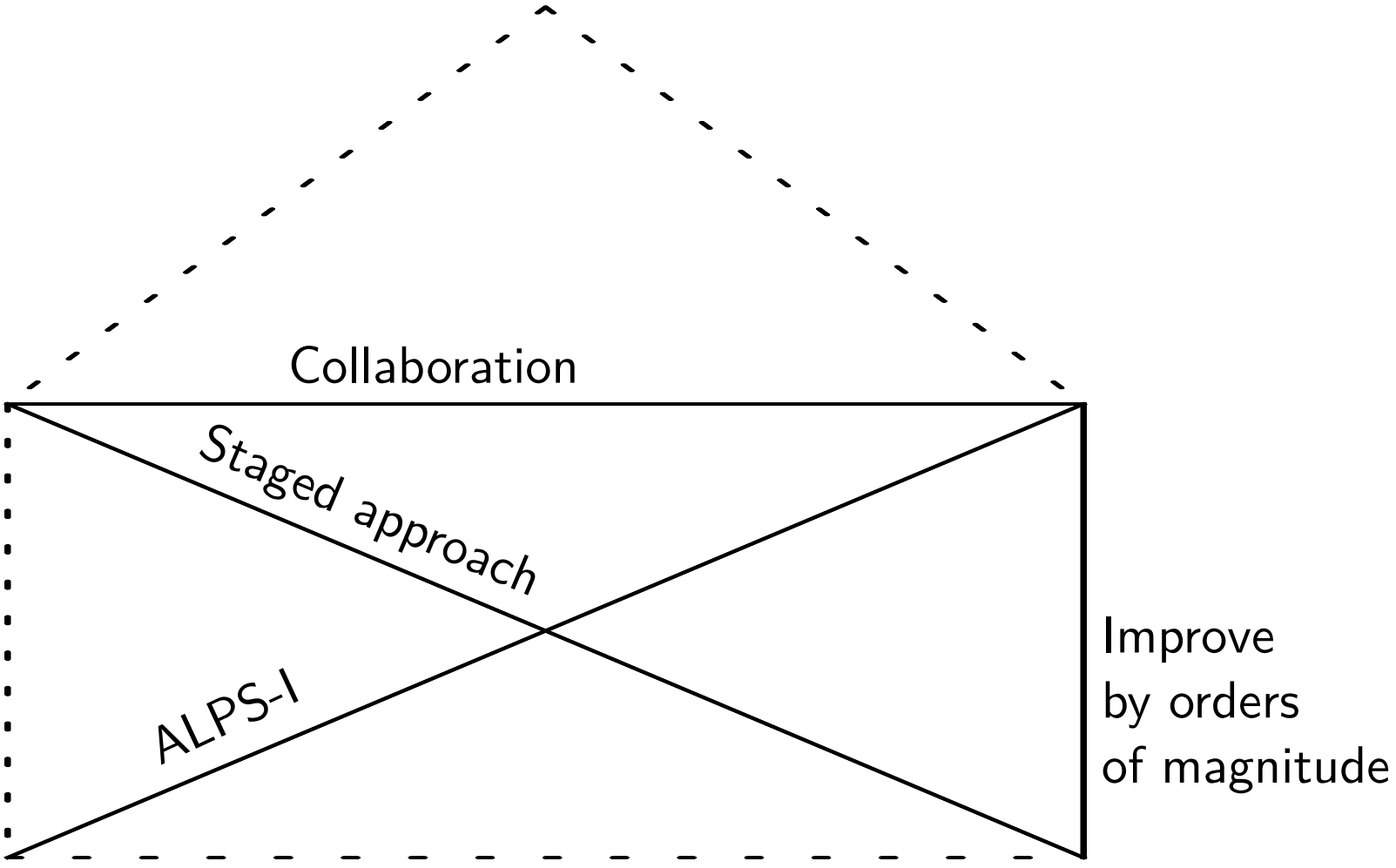






- ALPS-IIa until 2014 (without magnets) viability of optics & detector at 10m+10m setup
- ALPS-IIb until 2015 (without magnets) viability of optics & detector with enhanced length 100m+100m setup
- ALPS-IIc 2017 (with magnets) ALP measurements

Cornerstones of ALPS-II



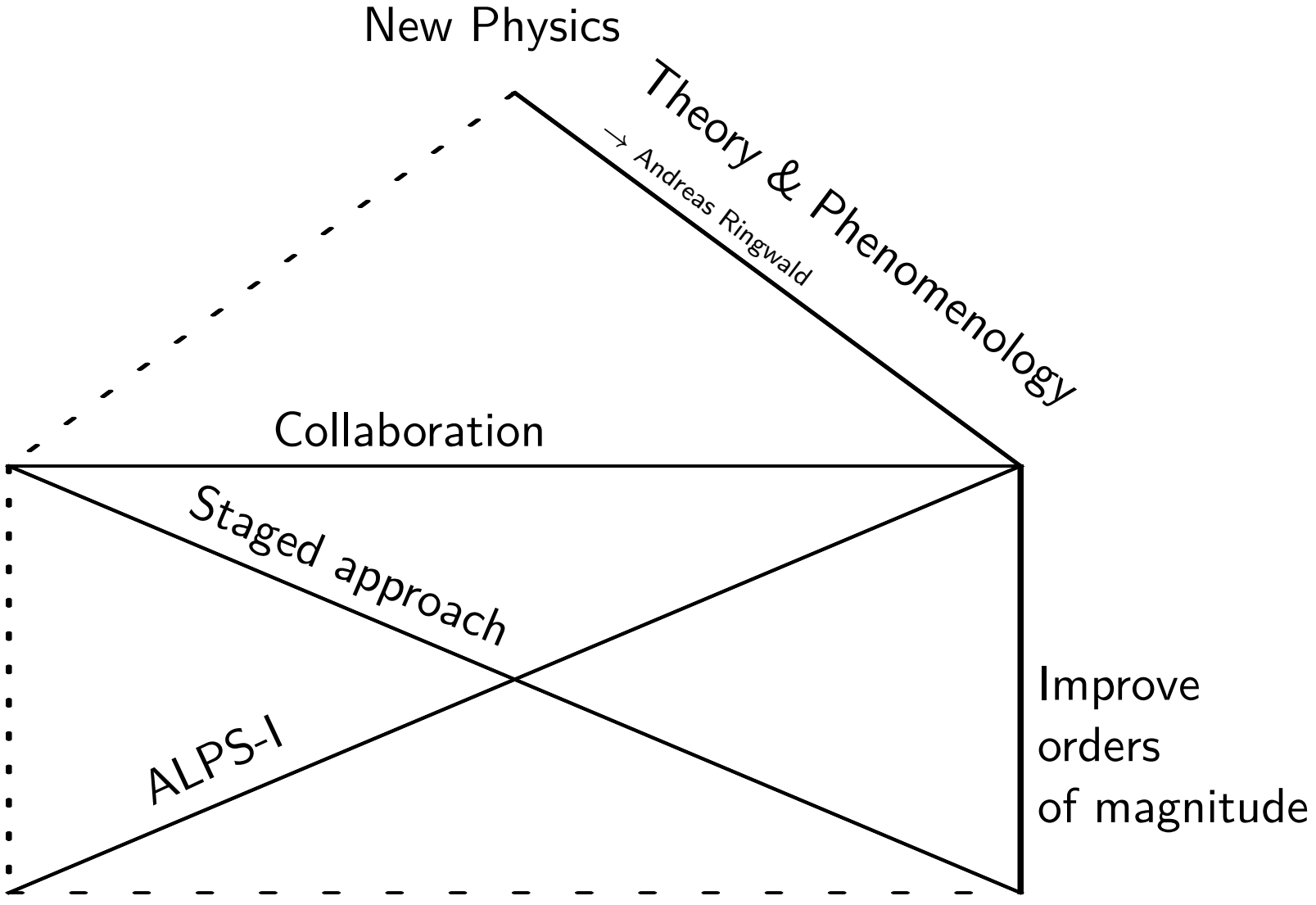
Collaboration & expertise

Institution	Physicist FTE	Postdoc FTE	Ph.D. student	Eng. FTE	Note
Albert-Einstein-Institute:					
R. Bähre			1.0		
B. Willke	0.2				
DESY:					
B. Döbrich		1.0			
J. Dreyling-Eschweiler			1.0		
S. Ghazaryan	0.2				
R. Hodajerdi			1.0		
F. Januschek		1.0			
E.-A. Knabbe	1.0				
A. Lindner	0.3				
D. Notz	0.1				
A. Ringwald	0.2				
R. Stromhagen				0.3	
D. Trines	0.5				
J. E. v. Seggern			1.0		
N. N.		0.5			laser / optics
University of Hamburg:					
D. Horns	0.2				
Sum	2.7	2.5	4.0	0.3	

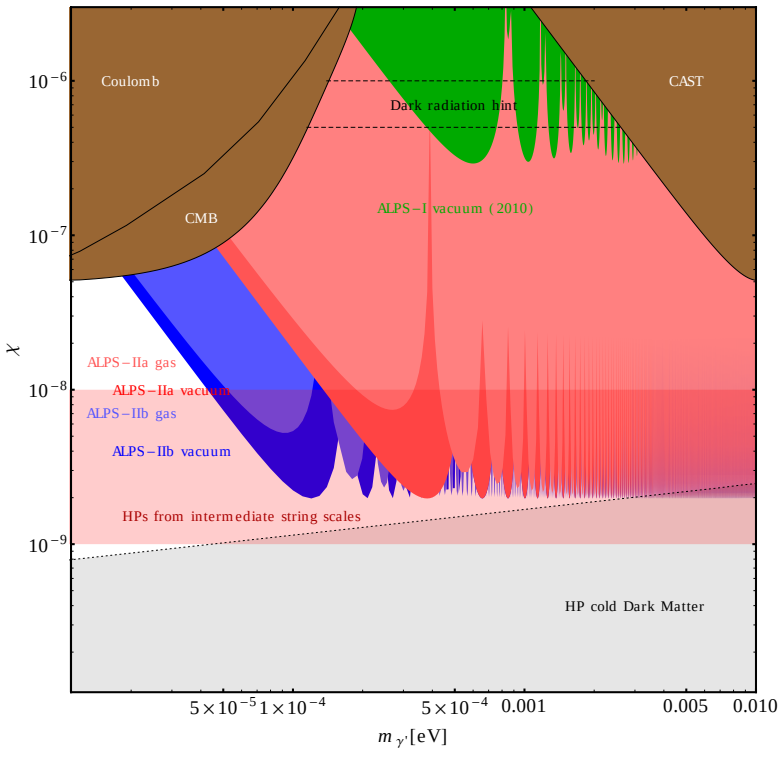
Table 5.1: The ALPS collaboration as of August 2012.

- expertise:
  - AEI Hannover → optics
  - DESY → magnet, infrastructure, organization, theory, detector
  - Univ. Hamburg → detector, data
- 8 people joined since ALPS-I
- 6 full-time PhD & Postdocs

Cornerstones of ALPS-II

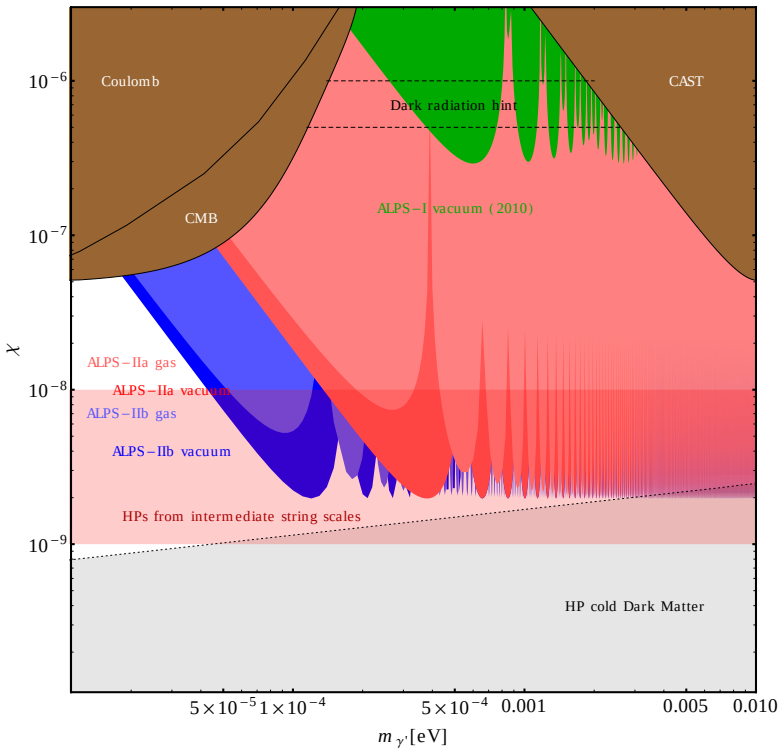


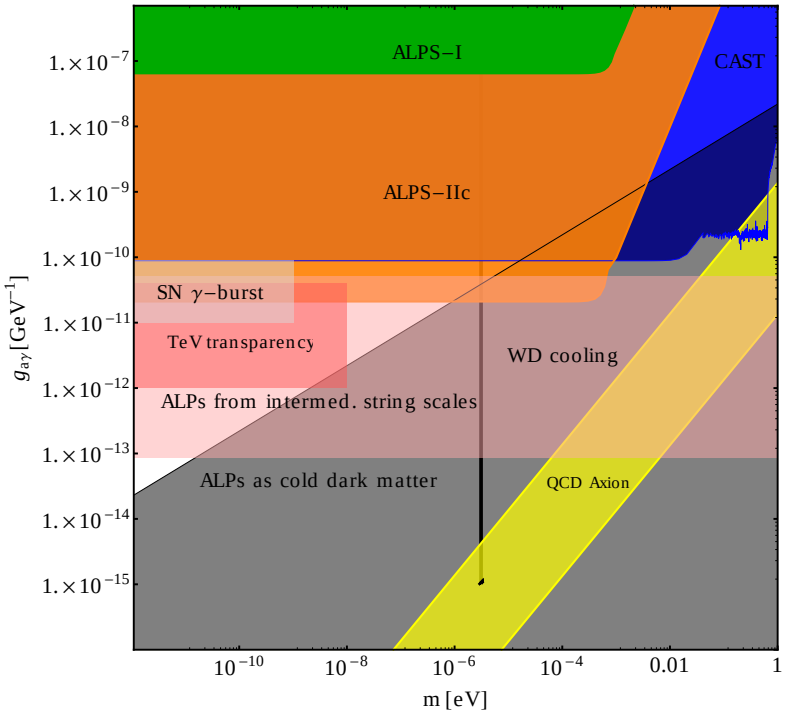
Favored parameter regions from Theory & Pheno



> HPs: ALPS-IIa/b String & Field, Dark Radiation, Dark Matter

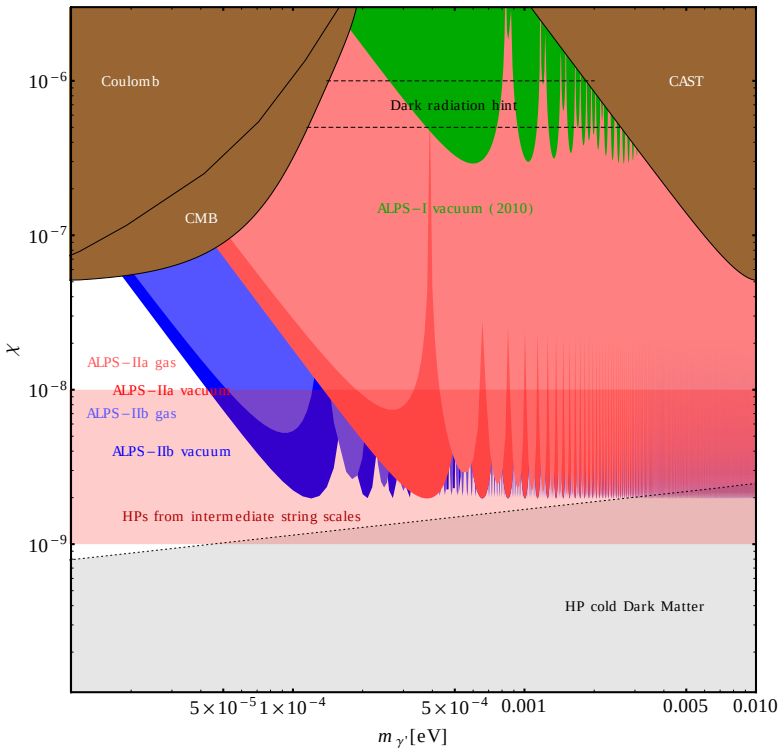
Favored parameter regions from Theory & Pheno

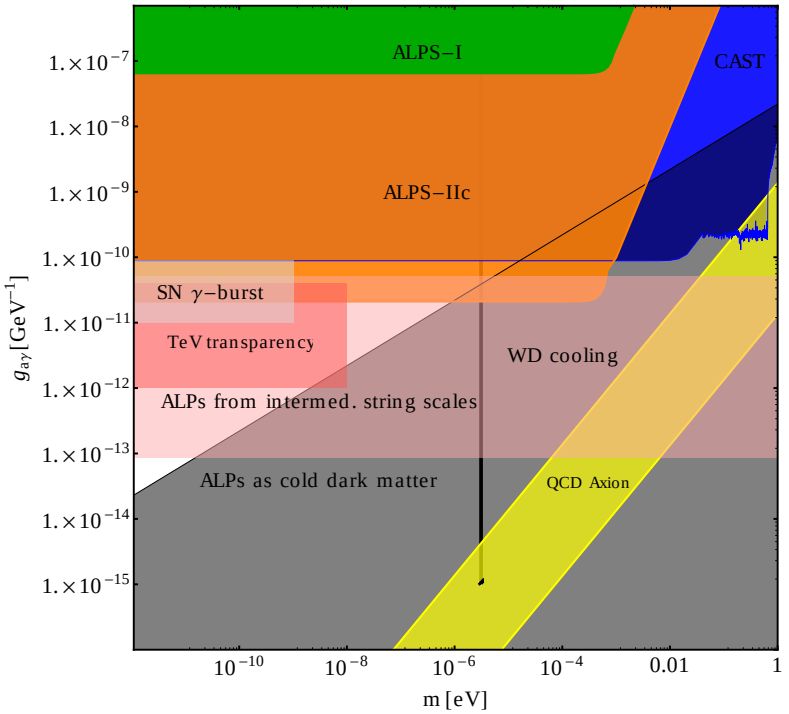




- HPs: ALPS-IIa/b String & Field, Dark Radiation, Dark Matter
- ALPs: ALPS-IIc Intermediate String Scales, Dark Matter, anomalous White Dwarf cooling, TeV transparency

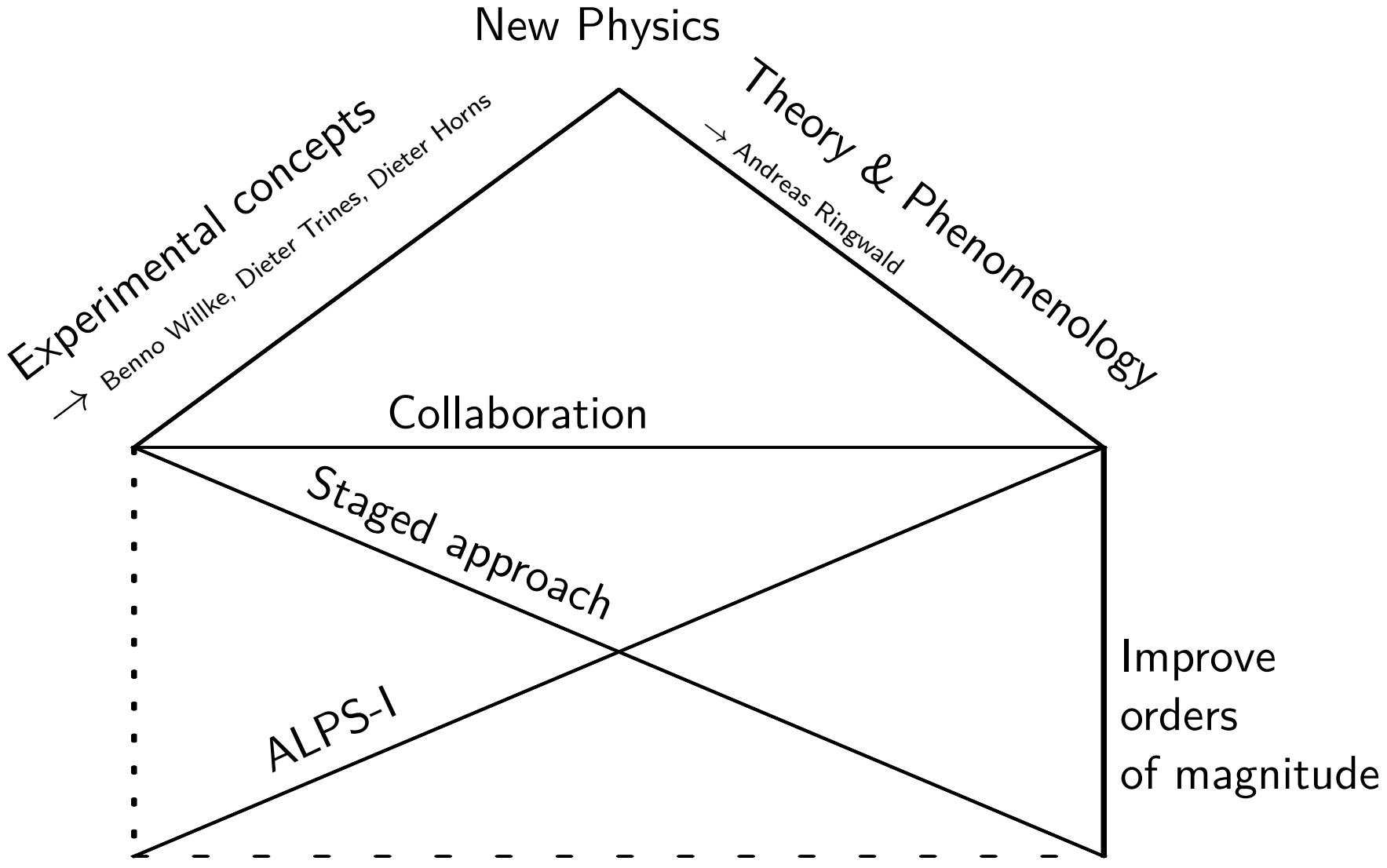
Favored parameter regions from Theory & Pheno



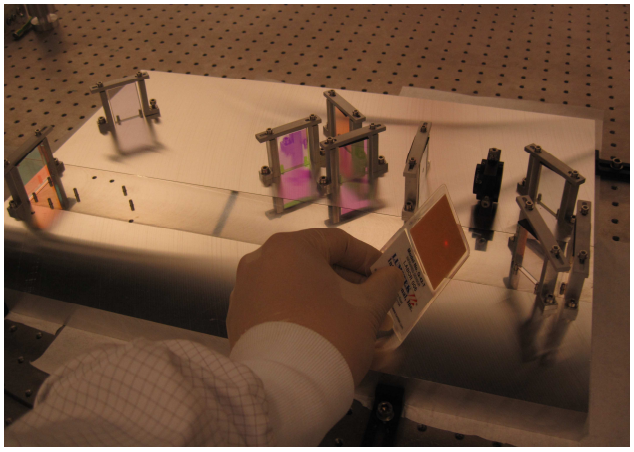


- HPs: ALPS-IIa/b String & Field, Dark Radiation, Dark Matter
- ALPs: ALPS-IIc Intermediate String Scales, Dark Matter, anomalous White Dwarf cooling, TeV transparency
- In addition: MCPs & massive gravity models

Cornerstones of ALPS-II

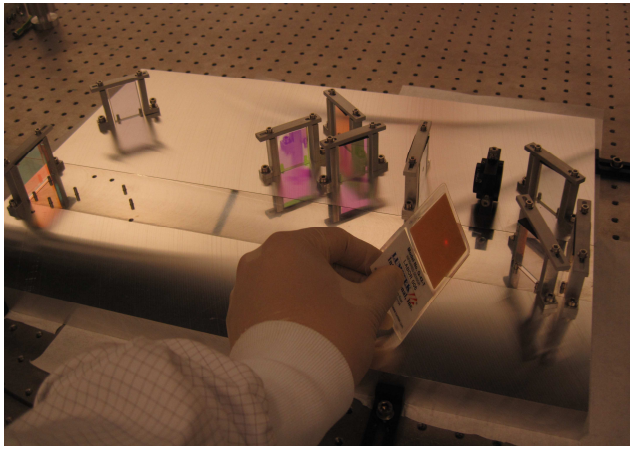


Status of experimental concepts

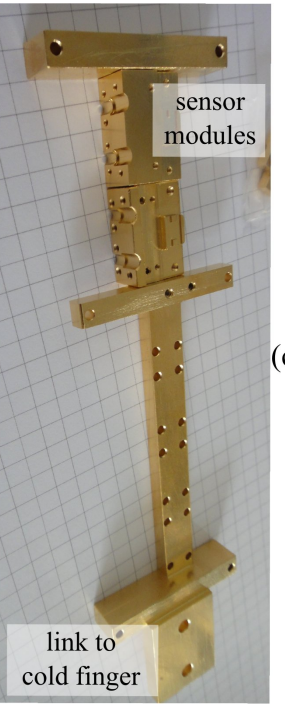


- test production cavity (Hamburg)
  & regeneration cavity (Hannover)

Status of experimental concepts



- test production cavity (Hamburg) & regeneration cavity (Hannover)
- CCD ready, transition edge sensor setup under way



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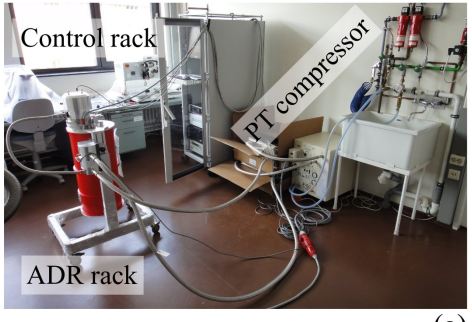
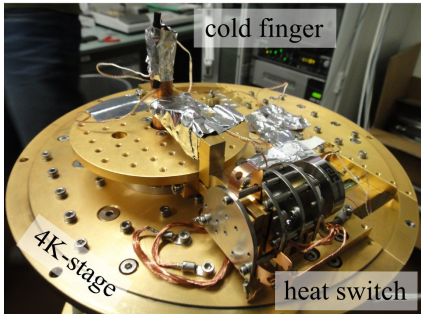
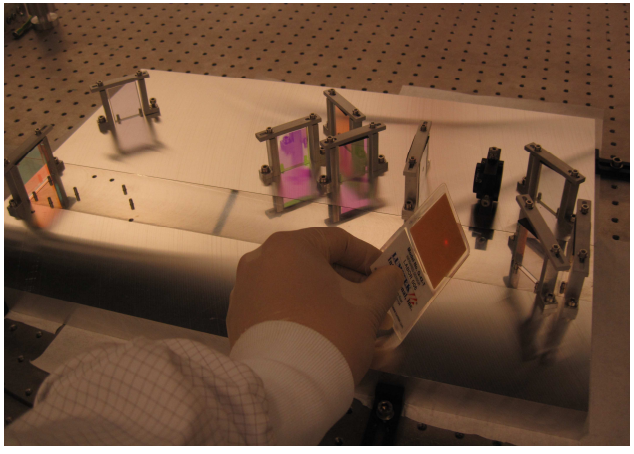


(a)

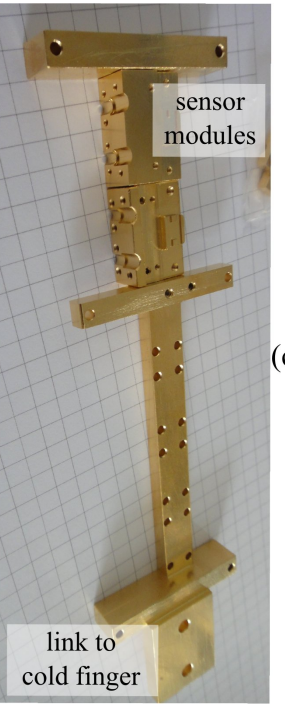


(b)

Status of experimental concepts



- test production cavity (Hamburg) & regeneration cavity (Hannover)
- CCD ready, transition edge sensor setup under way
- straightening of ALPS-I magnet succeeded (aperture!)



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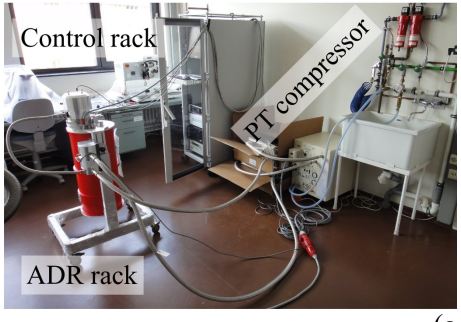

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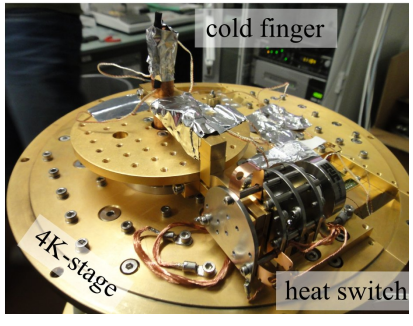
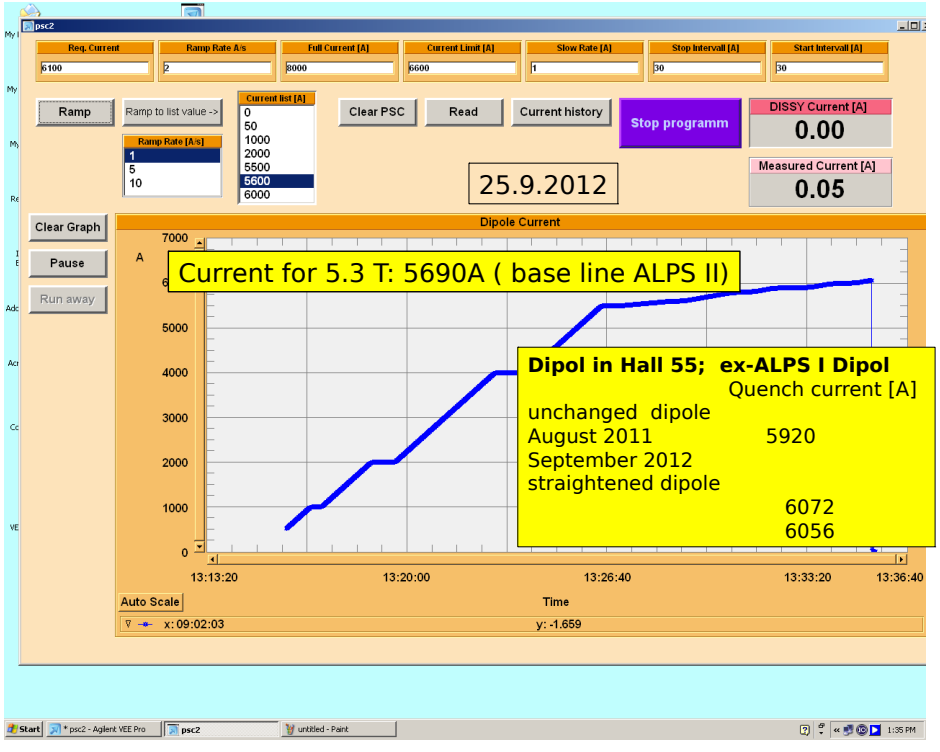
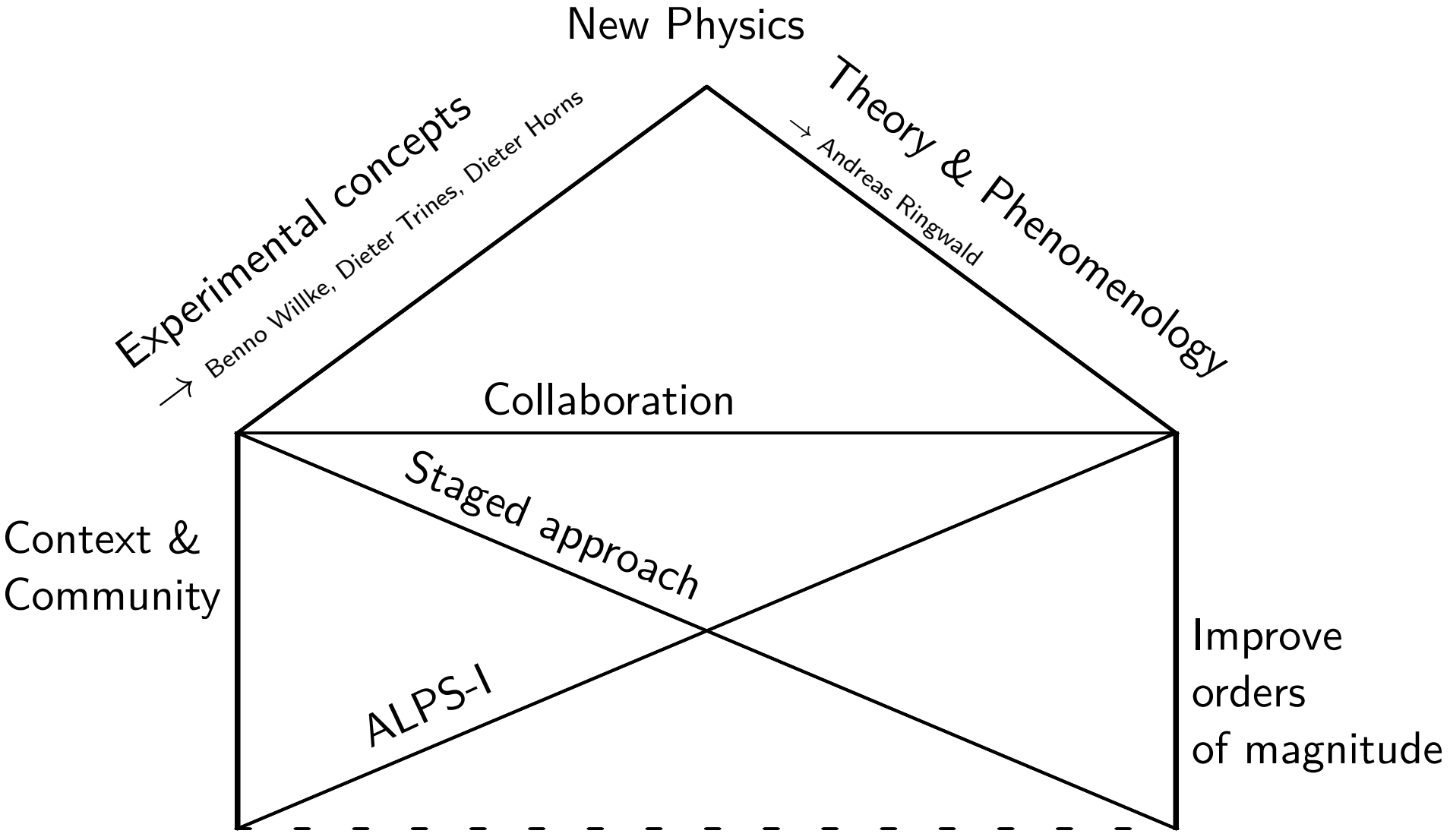


(b)



Cornerstones of ALPS-II



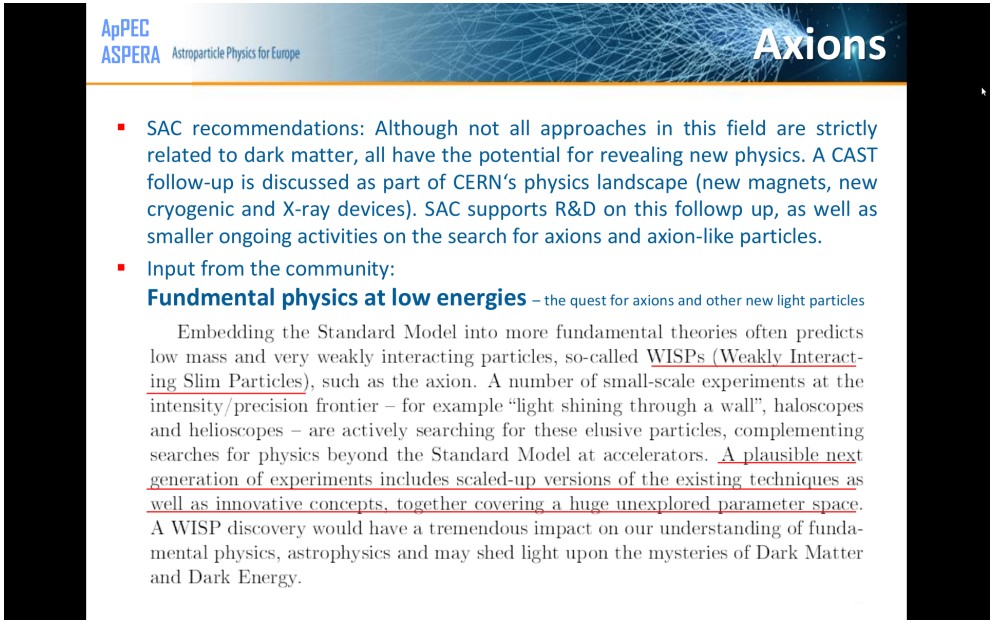
Context, Community & Momentum

Fundamental physics at low energies

The quest for axions and other new light particles

Input to the European Strategy on Particle Physics

Working group: K. Baker[1], G. Cantatore[2], S. A. Cetin[3], M. Davenport[4], K. Desch[5], B. Döbrich[6,#], H. Gies[7], D. Hoffmann[8], I. Irastorza[9], J. Jaeckel[10], A. Lindner[6], T. Papaevangelou[11], M. Pivovaroff[12], G. Raffelt[13], J. Redondo[13], A. Ringwald[6], Y. Semertzidis[14], A. Siemko[15], M. Sulc[15], A. Upadhye[16], J. C. Vallet[17], and K. Zioutas[18]



> International effort for input to Open Symposium for European Particle Physics Strategy in Cracow

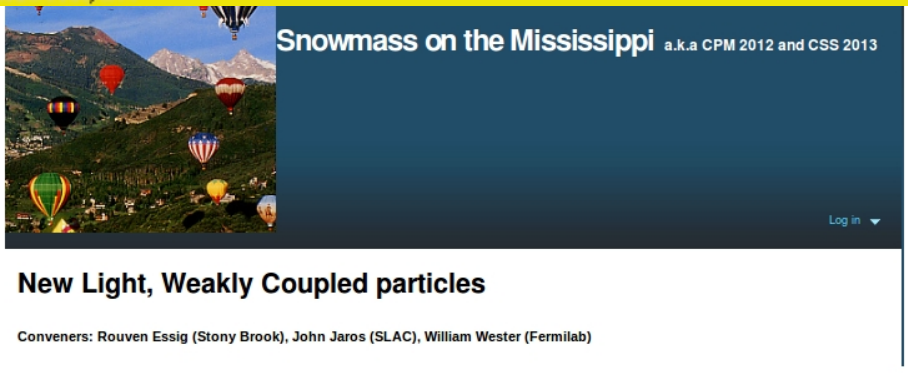
Context, Community & Momentum

FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

U.S. Department of Energy

Office of Science
Office of High Energy Physics

Second Generation Dark Matter Experiments



Vistas in Axion Physics: A Roadmap for Theoretical and Experimental Axion Physics through 2025

April 23-26, 2012

- International effort for input to Open Symposium for European Particle Physics Strategy in Cracow
- Increasing interest in the U.S. (Workshops, funding and planned experiments)

Context, Community & Momentum

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- International Patras workshop series; 2013: Mainz, 2014: CERN

Context, Community & Momentum

	Conference / Seminar	Location	Titel	Date	presented by
1	Seminar IPPP Durham	Durham, UK	The low energy frontier: searches for ultra-light particles beyond the standard model	24 January	Axel Lindner
2	Seminar CERN	Geneva, Switzerland	The low energy frontier: searches for ultra-light particles beyond the standard model	2 February	Axel Lindner
3	VFFD Hauptversammlung	Hamburg	Auf der Suche nach fehlenden elementaren Bausteinen unserer Welt	13 February	Axel Lindner
4	**WISP Theory Day**	**Hamburg**	**WISPs -- Basics and Tools**	13 February	Andreas Ringwald
5	**SFB Block Meeting**	**Hamburg**	**Towards a Hamburg Haloscope**	24 February	
6	**Haloscope Meeting**	**Hamburg**	**Scientific Scope of WISPDMX**	6 March	Andreas Ringwald
7	Kick-Off meeting „Astroparticle Physics with Multiple Messengers"	Hamburg	Detecting light behind a wall!?	8/9 March	Jan Dreyling-Eschweiler
8	Implications of the early LHC for cosmology	Hamburg	Axion Cosmology	18-20 April	Andreas Ringwald
9	Vistas in Axion Physics	Seattle, USA	Working Group Report on Resonant Photon Regeneration	23-26 April	Axel Lindner
10	Vistas in Axion Physics	Seattle, USA	Theory Working Group Report	23-26 April	Andreas Ringwald
11	Vistas in Axion Physics	Seattle, USA	Optical design of 'shining light through wall' experiments	23-26 April	Benno Willke
12	Seminar SLAC	Stanford, USA	The low energy frontier: searches for ultra-light particles beyond the standard model	1 May	Axel Lindner
13	Physikalisches Kolloquium	Duisburg	Die Suche nach ultraleichten Teilchen jenseits des Standardmodells	9 May	Andreas Ringwald
14	PASCOS 2012	Merida, Mexico	Searching for axions and ALPs from string theory	3-8 June	Andreas Ringwald
15	Seminar Bonn University	Bonn	The low energy frontier: searches for ultra-light particles beyond the standard model	24 May	Axel Lindner
16	JuSPARC Colloquium, FZ Jülich	Jülich	The low energy frontier: searches for ultra-light particles beyond the standard model	18 June	Axel Lindner
17	Theorietreffen	Berlin	Particle Cosmology	18 June	Andreas Ringwald
18	Seminaire SPP	Saclay, France	The low energy frontier: searches for ultra-light particles beyond the standard model	25 June	Axel Lindner
19	Particle Physics Blackbord Seminar	Perimeter Inst., CAN	The motivation for ALPS and its relatives	13 July	Babette Doebrich
20	8th PATRAS Workshop	Chicago, USA	Tree-level photon interaction for ALPS-II and beyond	19 July	Babette Doebrich
21	Theory Journal Club		The type IIB string axiverse and its low-energy phenomenology	9 August	Andreas Ringwald
22	Beschleuniger-Ideenmarkt	Hamburg	Staus von ALPS-II	18 September	Dieter Trines
23	Astroteilchenphysik in Deutschland: Status und Perspektiven	Zeuthen	Axions and other ultra-light particles beyond the standard model	21 September	Axel Lindner
24	IRTG PhD days 2012	Hamburg	On the road to ALPS-II – an experimental (detector) update	9/10 October	Jan Dreyling-Eschweiler
25	Lexi Cluster meeting	Hamburg	The ALPS-II proposal	11 October	Babette Doebrich
26	JuSPARC mini-workshop	Jülich	WISP theory overview	24 October	Andreas Ringwald
27	JuSPARC mini-workshop	Jülich	State-of-the-art WISP searches and prospects	24 October	Babette Doebrich

- International effort for input to Open Symposium for European Particle Physics Strategy in Cracow
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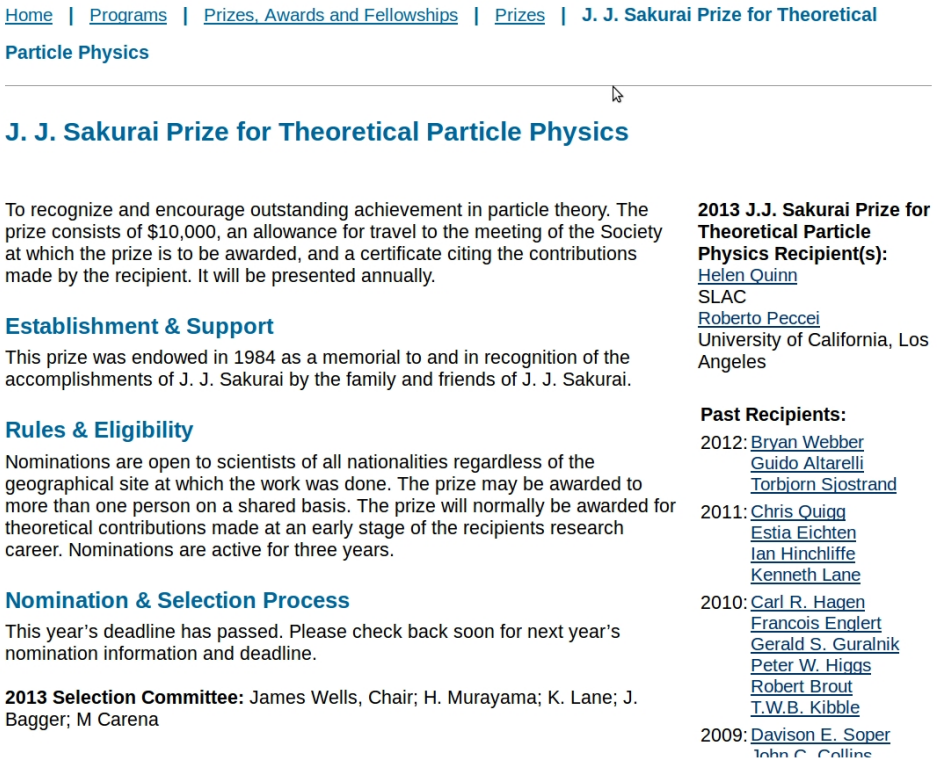
- already 27 ALPS-related talks of collaborators 2012

Context, Community & Momentum



Home | Programs | Prizes, Awards and Fellowships | Prizes | J. J. Sakurai Prize for Theoretical Particle Physics

J. J. Sakurai Prize for Theoretical Particle Physics

To recognize and encourage outstanding achievement in particle theory. The prize consists of $10,000, an allowance for travel to the meeting of the Society at which the prize is to be awarded, and a certificate citing the contributions made by the recipient. It will be presented annually.

Establishment & Support

This prize was endowed in 1984 as a memorial to and in recognition of the accomplishments of J. J. Sakurai by the family and friends of J. J. Sakurai.

Rules & Eligibility

Nominations are open to scientists of all nationalities regardless of the geographical site at which the work was done. The prize may be awarded to more than one person on a shared basis. The prize will normally be awarded for theoretical contributions made at an early stage of the recipients research career. Nominations are active for three years.

Nomination & Selection Process

This year's deadline has passed. Please check back soon for next year's nomination information and deadline.

2013 Selection Committee: James Wells, Chair; H. Murayama; K. Lane; J. Bagger; M Carena

2013 J.J. Sakurai Prize for Theoretical Particle Physics Recipient(s):
Helen Quinn
SLAC
Roberto Peccei
University of California, Los Angeles

Past Recipients:

2012: Bryan Webber, Guido Altarelli, Torbjorn Sjostrand
2011: Chris Quigg, Estia Eichten, Ian Hinchliffe, Kenneth Lane
2010: Carl R. Hagen, Francois Englert, Gerald S. Guralnik, Peter W. Higgs, Robert Brout, T.W.B. Kibble
2009: Davison E. Soper, John C. Collins

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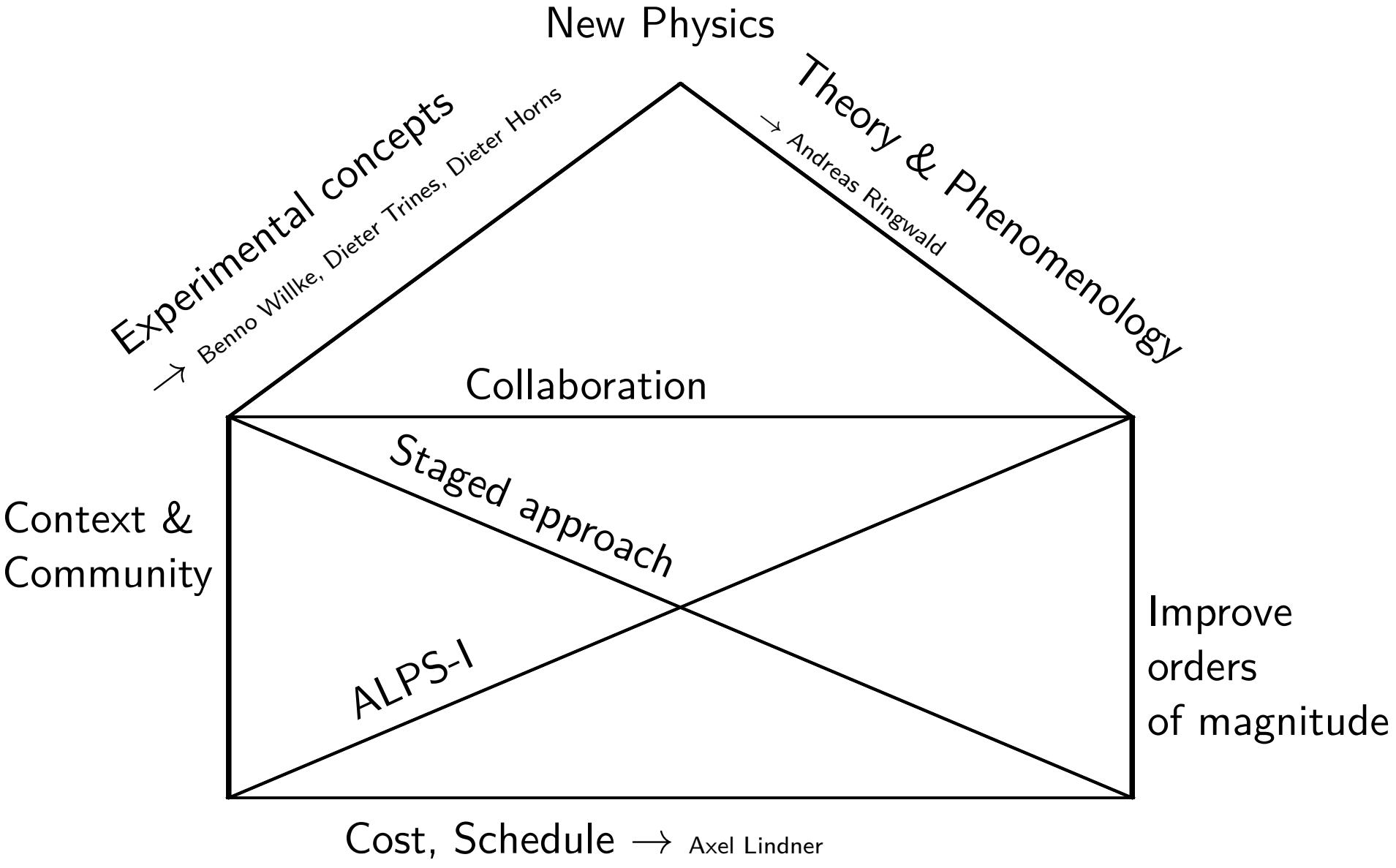
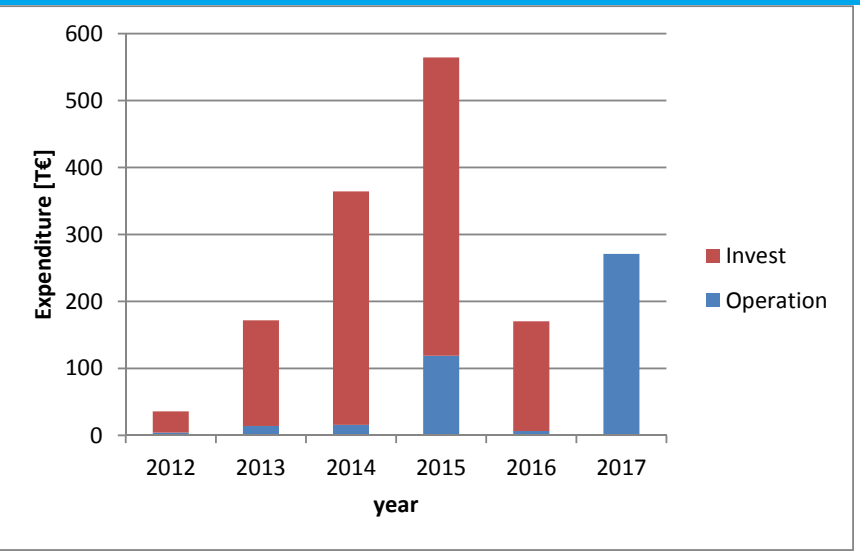
- Sakurai Prize 2013 to R. Peccei and H. Quinn

Cornerstones of ALPS-II



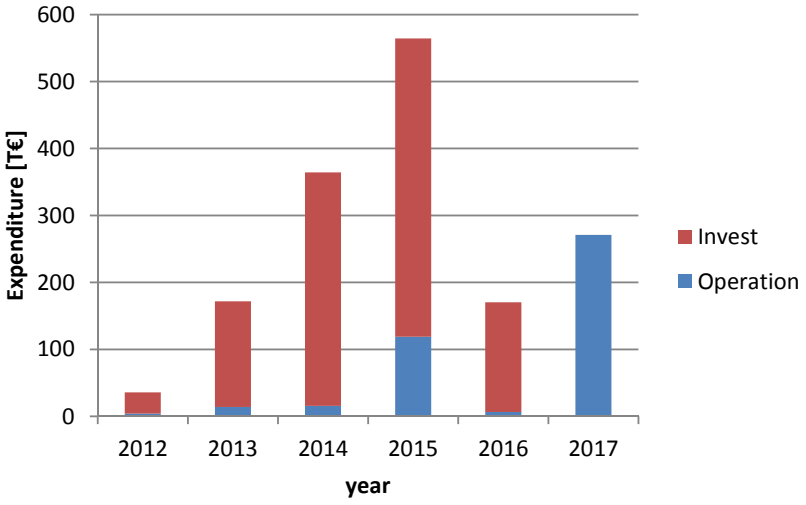
Cost & Schedule in a nutshell



Costs summary

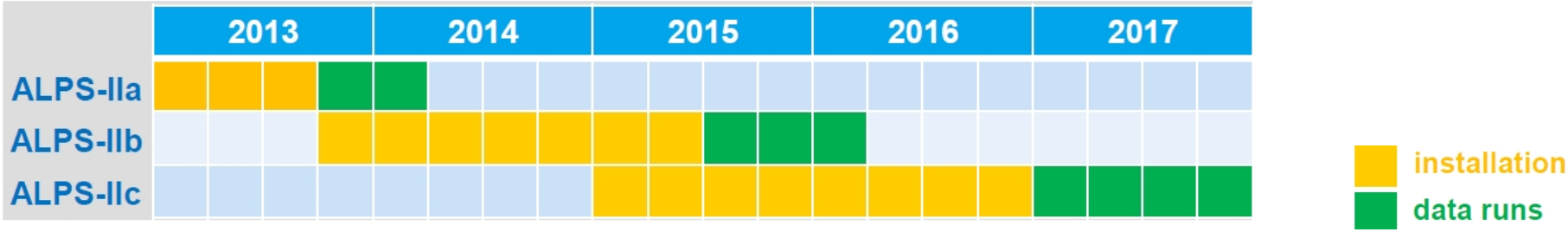
- investments: 1.9 Mio € for 5 years (thereof 743 k€ already covered)
- operation: 426 k€

Cost & Schedule in a nutshell



Costs summary

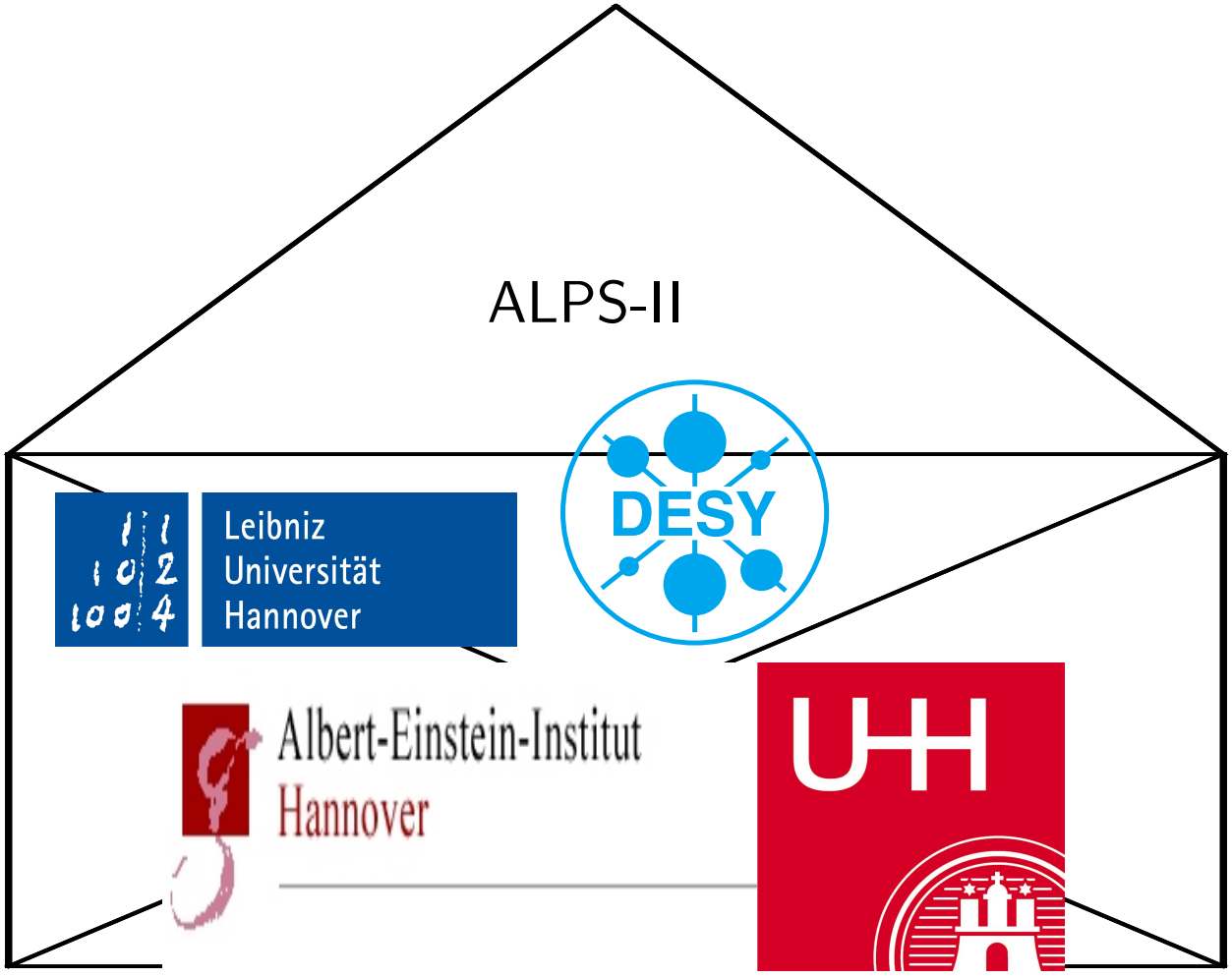
- investments: 1.9 Mio € for 5 years (thereof 743 k€ already covered)
- operation: 426 k€



Schedule, Milestones

- Detector: to be spent: 26k€, TES milestone: ALPS-IIa
- Optics: to be spent: 205 k€, milestone: stages
- Magnet, Infrastructure & Vakuum: invest. 924 k€, operation 430 k€, milestone: bending ✓ → timely go-ahead required

Thank you!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