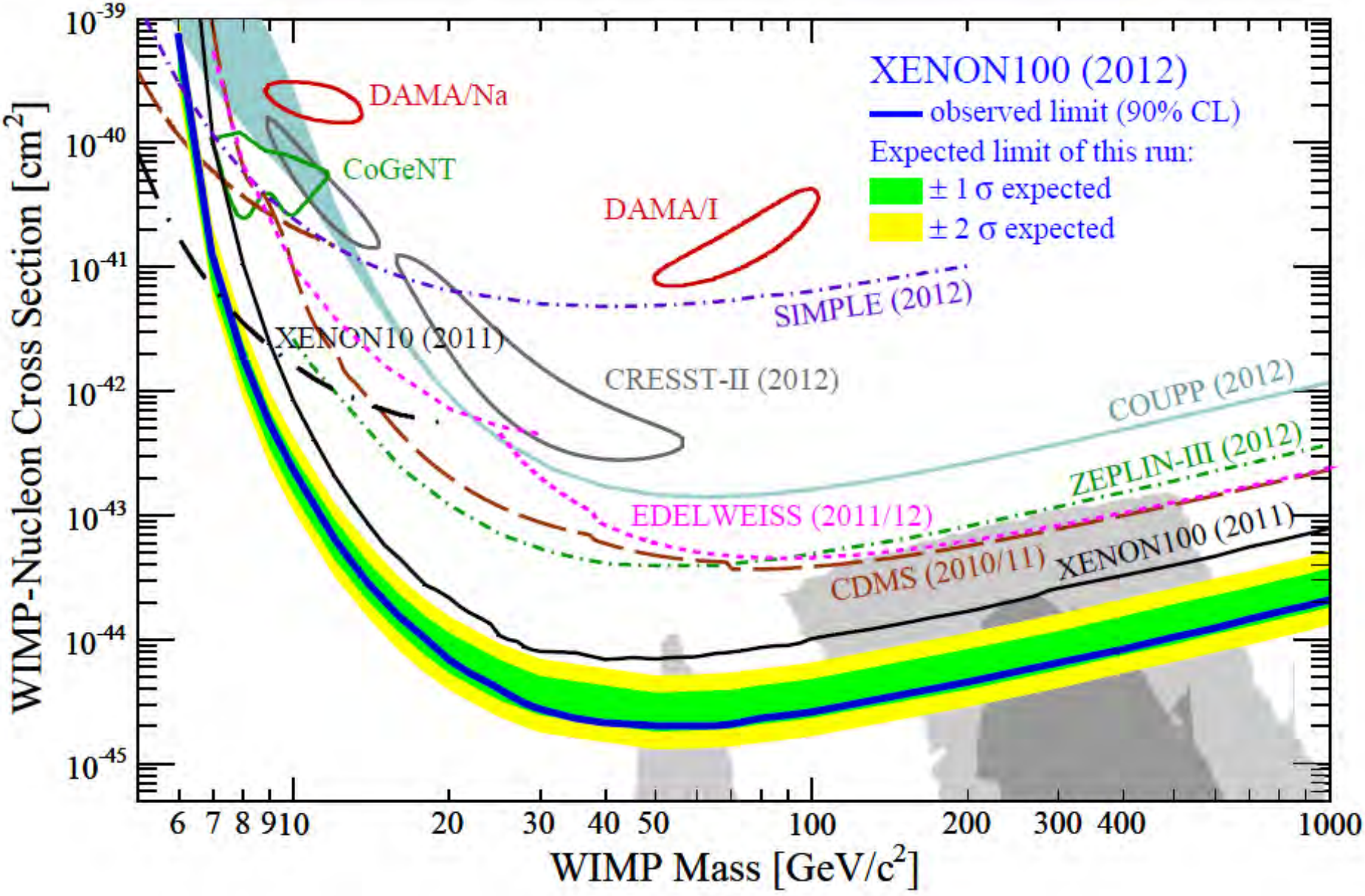
Bericht des KAT

Christian Spiering

KET Jahrestreffen
Bad Honnef, 17.11.

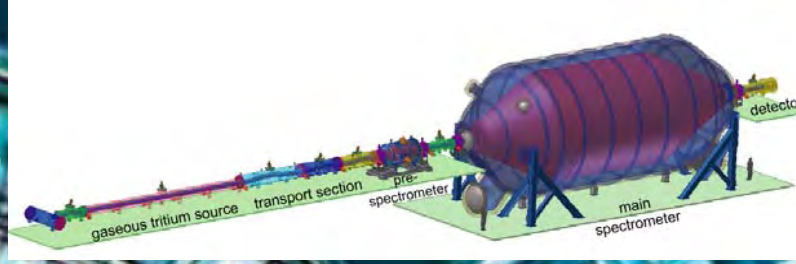
EINIGE SCHLAGLICHTER 2011/12

13


XENON100 (2012)
observed limit (90% CL)
Expected limit of this run:
± 1 σ expected
± 2 σ expected
DAMA/Na
CoGeNT
DAMA/I
SIMPLE (2012)
XENON10 (2011)
CRESST-II (2012)
COUPP (2012)
ZEPLIN-III (2012)
EDELWEISS (2011/12)
CDMS (2010/11)
XENON100 (2011)
WIMP-Nucleon Cross Section [cm^2]
WIMP Mass [GeV/c^2]
10^{-39}
10^{-40}
10^{-41}
10^{-42}
10^{-43}
10^{-44}
10^{-45}
6 7 8 9 10 20 30 40 50 100 200 300 400 1000

KATRIN Hauptspektrometer

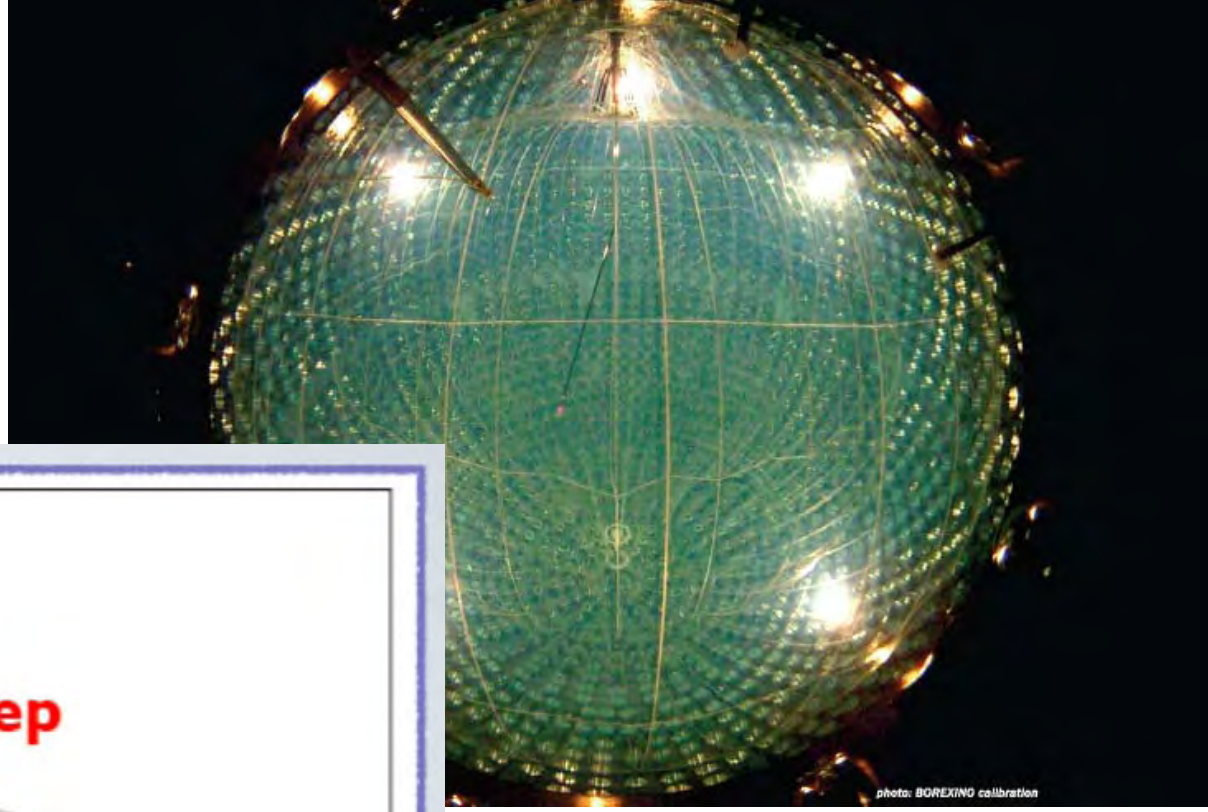
Elektrodensystem installiert (Jan 2012)

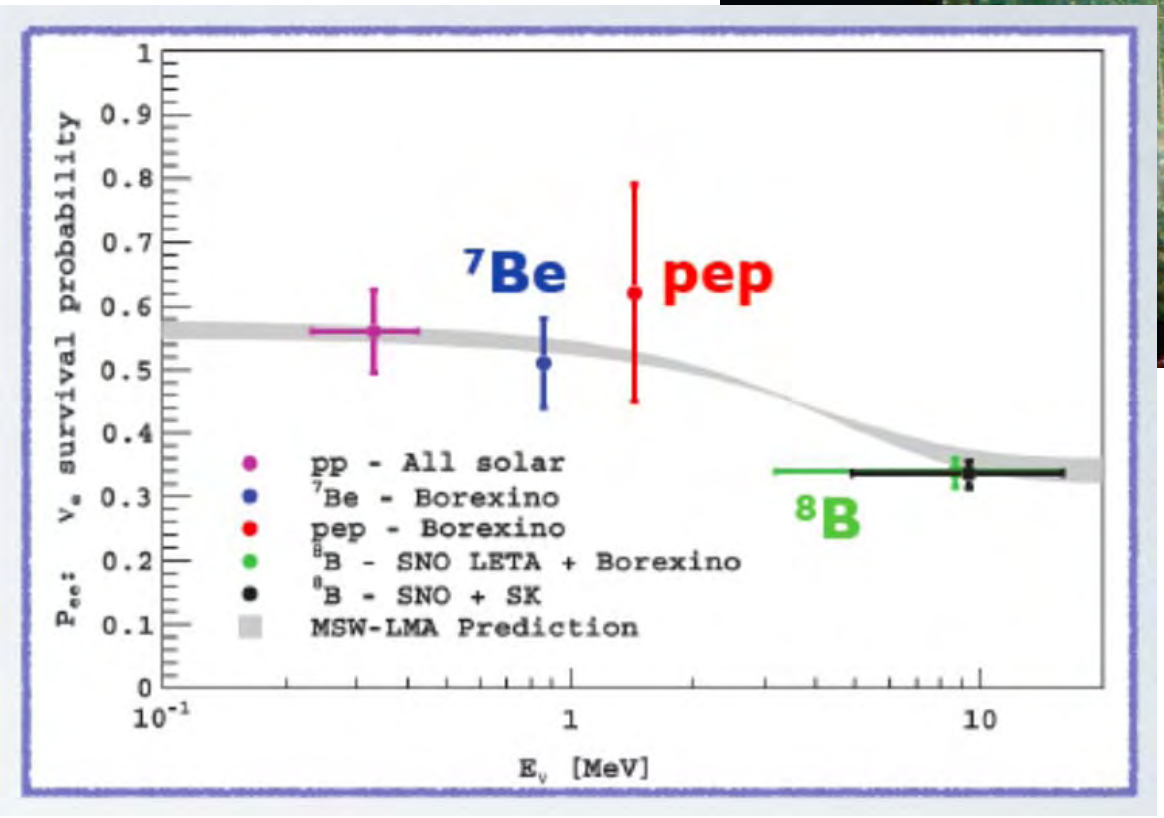


GERDA: Datennahme

Unblinding: Frühjahr 2013

Borexino





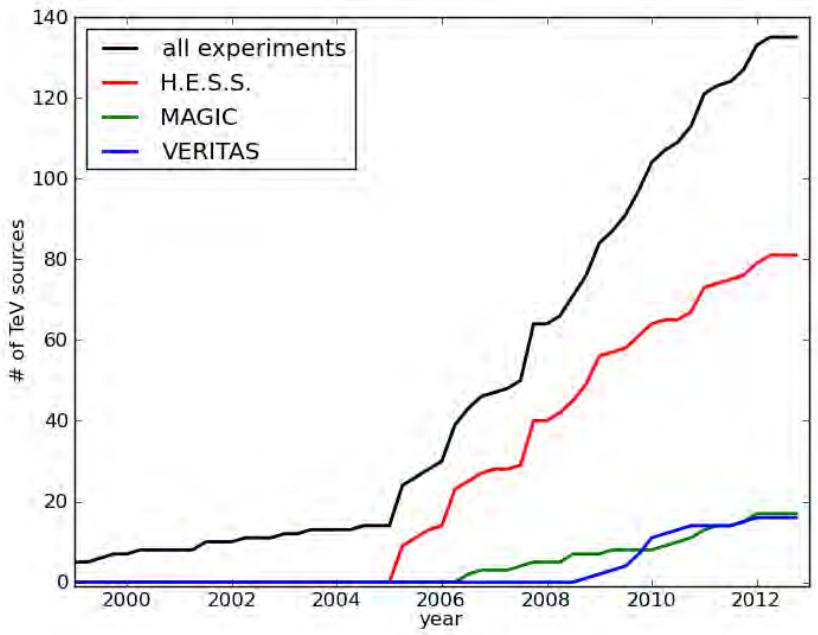
Solar nu: ^{7}Be, pep

Geoneutrinos

Gamma-Strahlen

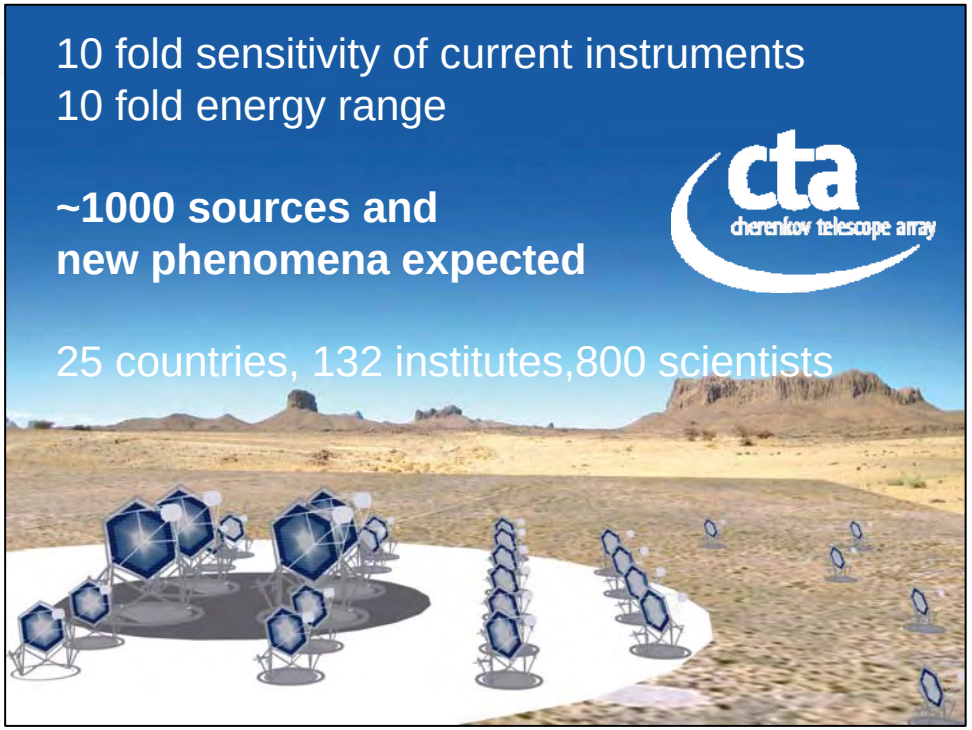
H.E.S.S., MAGIC, VERITAS, Fermi

+ new technologies: FACT, HISCORE



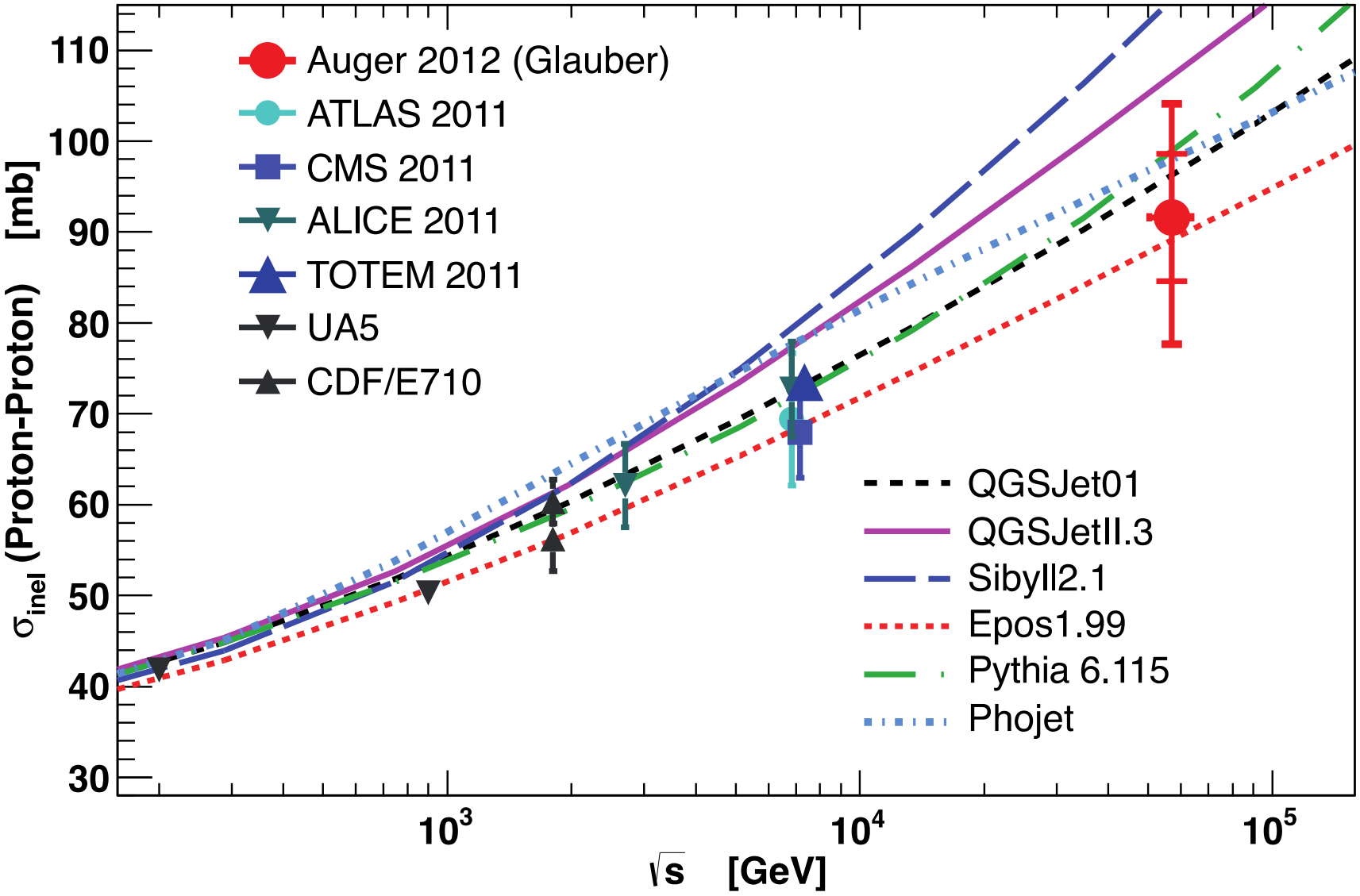
G-APD, La Palma

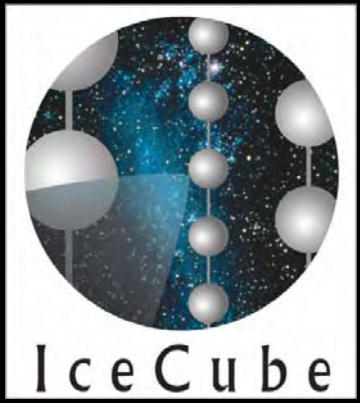
Timing Array, Sibirien (HRJRG)

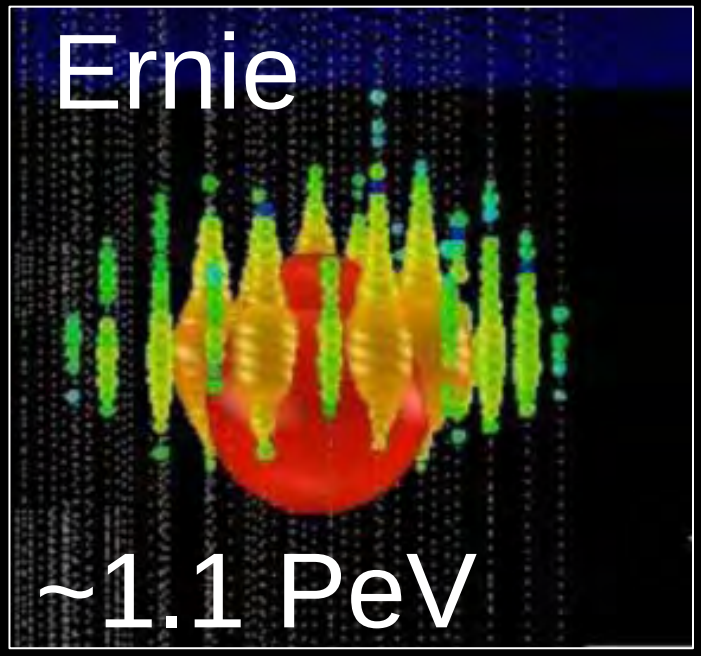


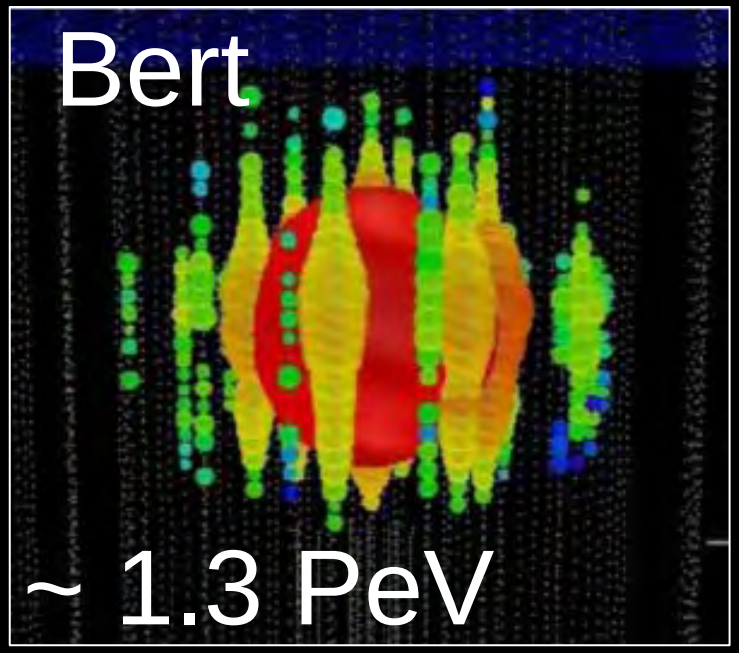
Prototyp für Mid-Size Telescope CTA, Berlin
(Fotomontage)

AUGER ↔ LHC

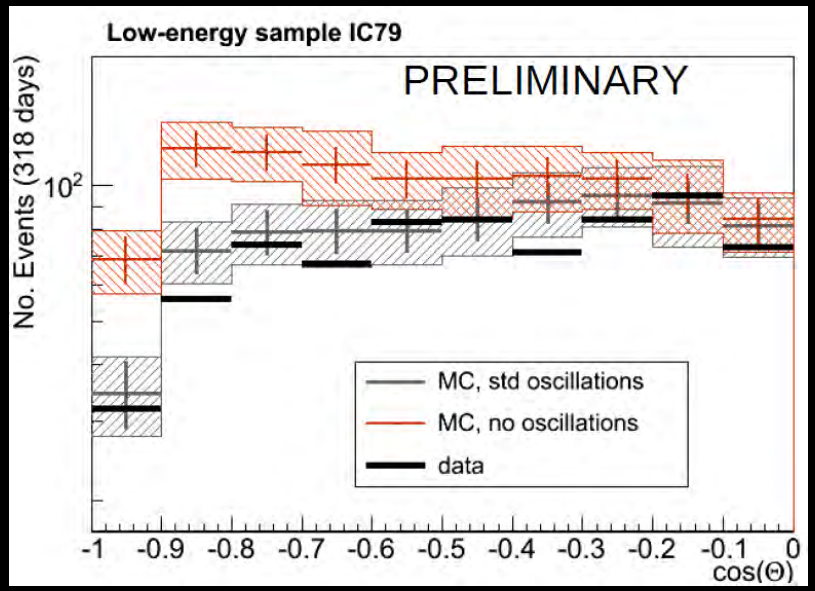

Auger 2012 (Glauber)
ATLAS 2011
CMS 2011
ALICE 2011
TOTEM 2011
UA5
CDF/E710
QGSJet01
QGSJetII.3
Sibyll2.1
Epos1.99
Pythia 6.115
Phojet
σ_{inel} (Proton-Proton) [mb]
$\sqrt{s}$ [GeV]
110
100
90
80
70
60
50
40
30
10^3
10^4
10^5







Überschuss bei hohen Energien



Neutrino-Oszillationen in DeepCore

→ PINGU (Massenhierarchie)?

100 Years Cosmic Rays

Anniversary of their Discovery by V. F. Hess

Conference Topics

- Tribute to Victor Franz Hess
- Research in the early years of the discovery
- From cosmic rays to particle and astroparticle physics: Historical development of the different fields based on cosmic particles

Location

The conference will be held in Bad Saarow/Pieskow (about 50 km from Berlin), where Victor Franz Hess landed after his successful flight.

www.desy.de/2012vhess

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Veniamin Berezinsky	Gran Sasso, Italy / Moscow, Russia
Johannes Blümer	Karlsruhe, Germany
Bruce Dawson	Adelaide, Australia
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Christian Stegmann	DESY / University of Potsdam
Michael Walter	DESY
Ralf Wischnewski	DESY

6–8 August 2012

DESY · Universität Potsdam · Max Planck Institute for the History of Science · IUPAP

The European Physical Journal volume 37 · number 3 · August 2012

EPJ H

Recognized by European Physical Society

Historical Perspectives on Contemporary Physics

Cosmic rays, gamma rays, and neutrinos: A survey of 100 years of research

Guest Editor: Christian Spiering

One of the three electroscopes Victo Hess used to measure the ionisation effect of cosmic rays (1911)

Smithonian National Air and Space Museum, Washington, DC

Two optical modules of the first underwater neutrino telescope in Lake Baikal, Russia (1993)

Deutsches Museum, Bonn

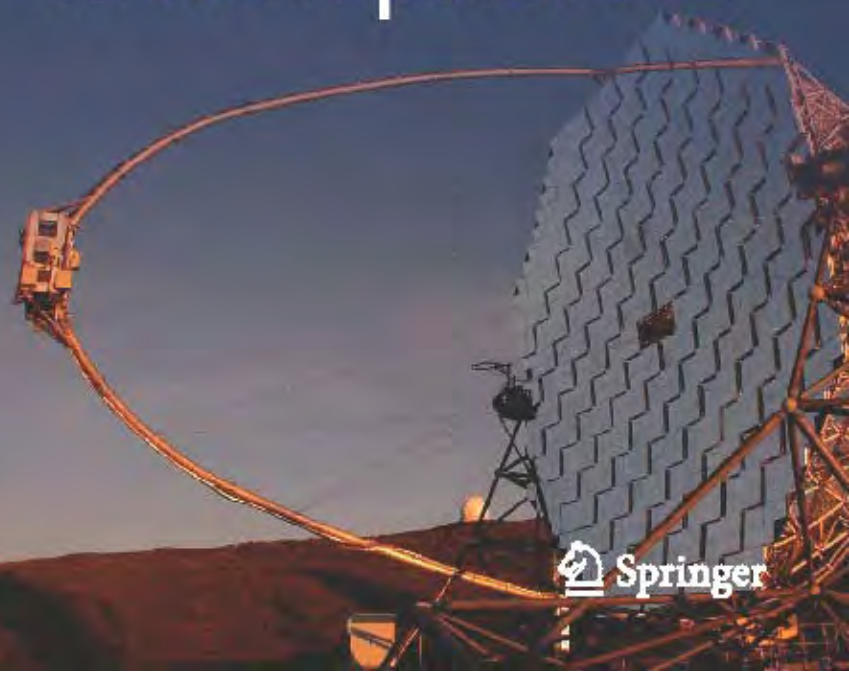
edp sciences Springer

Brigitte Falkenburg
Wolfgang Rhode

Falkenburg · Rhode

From Ultra Rays to Astroparticles

From Ultra Rays to Astroparticles

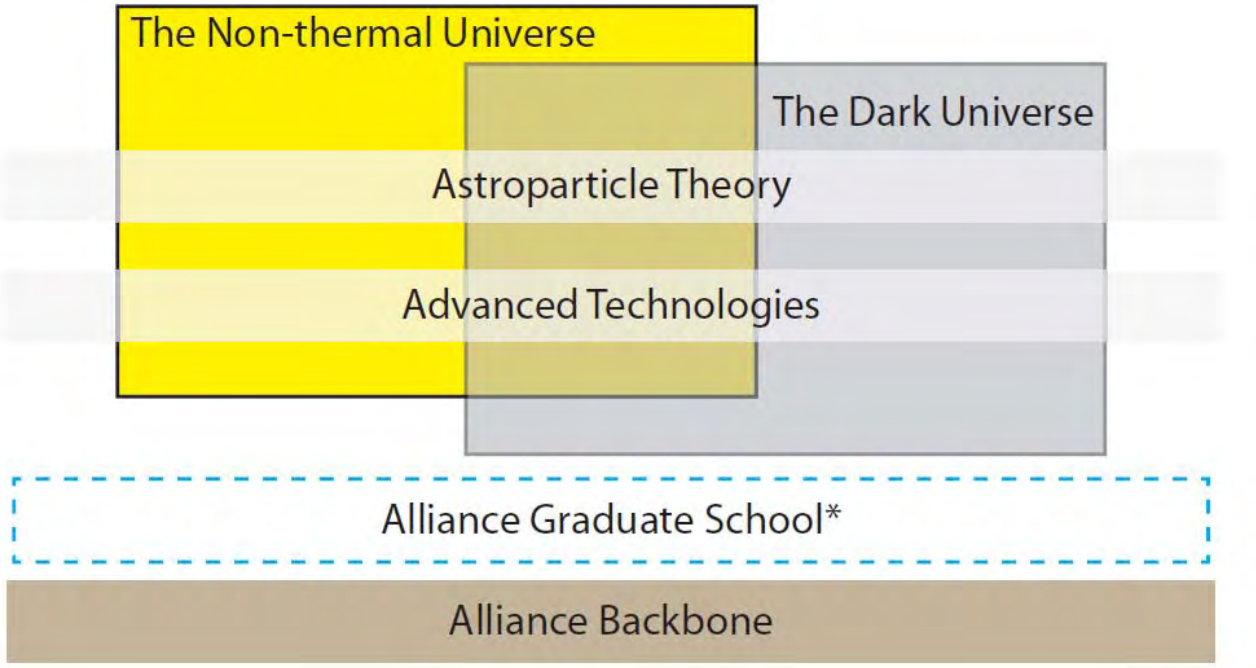


Springer

HAP

HELMHOLTZ | ASSOCIATION

Alliance for Astroparticle Physics



2011-2016

BROSCHÜREN

„ASTROTEILCHENPHYSIK IN DEUTSCHLAND“

UND

„ASTROTEILCHENPHYSIK – DEUTSCH-RUSSISCHE PERSPEKTIVEN“

- 88 000 als Beiheftung SdW
- 10 000 extra

- 54 k€ aus HAP
- 10 k€ von BMBF

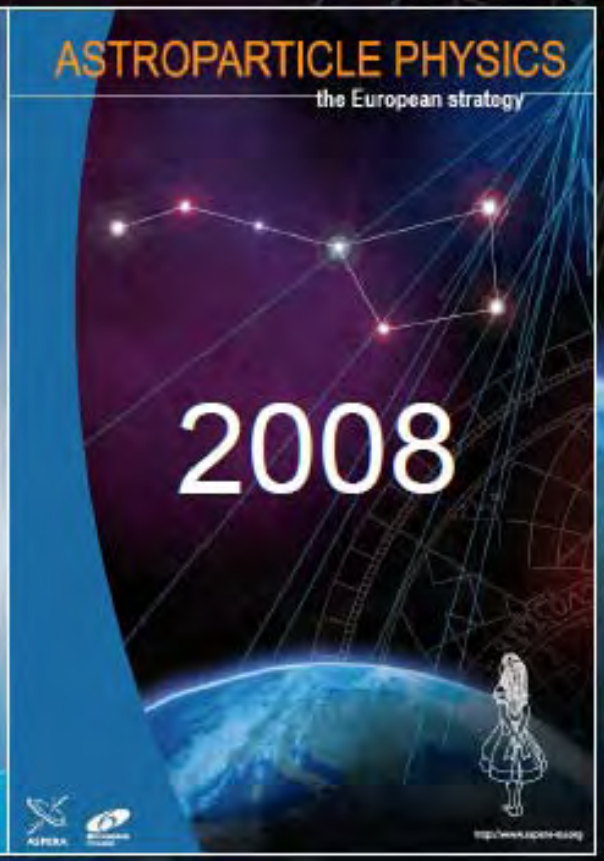
- Sondermittel BMBF im Rahmen des Deutsch-Russischen Jahres der Wissenschaft

Российско-Германский год образования, науки и инноваций 2011/12
Deutsch-Russisches Jahr der Bildung, Wissenschaft und Innovation 2011/12

- 600 Exemplare
- Zweisprachig deutsch/russisch

- **Deutsch-Russ. Workshop ATP Dez. 2011**
- **BMBF Förderung ATP über JINR Dubna**
- **Helmholtz-Russ. Joint Research Group**
- **Unterstützung Int. Baikal School 2012**
- **ASPERA Meeting in Dubna (Sept. 2012)**

ROADMAPS UND
INPUT EUROPEAN STRATEGY



http://www.aspera-eu.org

JULY 31ST 2012

Astroparticle Physics European Coordination (ApPEC) and AStroparticle Physics ERA network (ASPERA)

Recommendations for the European Strategy on Particle Physics

Science Advisory Committee

Ad M. van den Berg, Roberto Battiston, Laura Baudis, Jose Ber
Pierre Binetruy, John Carr, Enrique Fernandez, Francesco Fid
Andrea Giuliani, Andreas Haungs, Werner Hofmann, Steven Kahr
Hans Kraus, Antoine Letessier-Selvon, Manel Martinez, Benoit M
Rene Ong, Michal Ostrowski, Sheila Rowan, Subir Sarkar, Stefan
Ion Siotis, Christian Spiering, Robert Svoboda, Francesco Vissani, L

Abstract: We revisit the ApPEC/ASPERA roadmap recommendations, published in November 2011, focusing on those fields which are of relevance for particle physics. This text constitutes therefore the ApPEC/ASPERA input to the European Strategy for Particle Physics. The recommendations take into account recent extraordinary scientific developments, such as the measurement of a surprisingly large third neutrino mixing angle θ_{13} and the discovery of a particle compatible with the long sought Higgs boson predicted by the Standard Model, but they are not a rewriting of the November 2011 roadmap, nor a change of the order of priorities.

Science Advisory Committee

Ad M. van den Berg, Roberto Battiston, Laura Baudis, Jose Bernabeu, Daniel Bertrand, Pierre Binetruy, John Carr, Enrique Fernandez, Francesco Fidecaro, Gilles Gerbier, Andrea Giuliani, Andreas Haungs, Werner Hofmann, Steven Kahn, Uli Katz, Paul Kooijman, Hans Kraus, Antoine Letessier-Selvon, Manel Martinez, Benoit Mours, Lothar Oberauer, Rene Ong, Michal Ostrowski, Sheila Rowan, Subir Sarkar, Stefan Schoenert, Guenter Sigl, Ion Siotis, Christian Spiering, Robert Svoboda, Francesco Vissani, Lucia Votano, Roland Walter

Executive Summary of the German Roadmap on Astroparticle Physics

Input for the European Strategy for Particle Physics

Komitee für Astroteilchenphysik, KAT. 13.10.2012

The present document is an executive summary of the German Roadmap on Astroparticle Physics from 2010. It has been revisited with respect to the actual status of the field. We focus on those questions which are of relevance to particle physics rather than to astrophysics. The document is submitted by the Komitee für Astroteilchenphysik (KAT, Committee for Astroparticle Physics) which is the elected representation of all German astroparticle physicists at Universities, Helmholtz Centers and Max-Planck Institutes (about 600 FTE). Our description and recommendations are in accordance with the ASPERA Roadmap for Astroparticle Physics and the ASPERA Input to the European Strategy Process; at the same time we highlight the German priorities.

1. Dark Matter
2. Mass and nature of the neutrino
3. Particle physics and the high-energy Universe
4. Nuclear astrophysics
5. Neutrino astrophysics, neutrino physics and the search for proton decay with detectors deep underground, underwater or in ice
6. Relations between CERN and ApPEC/APIF

1. Dark Matter

- Direct & indirect searches and LHC

Recommendation: Given the close connection to SUSY searches at the LHC, the high momentum of the direct and indirect searches and the possibility to prove or disprove the SUSY WIMP hypothesis within 5-7 years, we give WIMP dark matter searches a high priority. We strongly recommend support for XENON1t and EURECA. We suggest a close collaboration between the CERN community and the astroparticle community. Dark Matter searches could become an item of the recently established Astroparticle Forum in CERN which was motivated by the LHC--cosmic ray connection. With respect to direct searches, we support a global strategy with several target material and technologies.

- Axions

With strongly tightening constraints on SUSY parameters, **axion searches** attract fresh interest. Germany is participating in CAST and several smaller ongoing activities to search for axions, axion-like particles or dark photons in Hamburg.
We support these activities, as well as R&D work towards a CAST follow-up.

2. Mass and nature of the neutrino

- Direct mass and DBD

Recommendation: We recommend the continued support of the KATRIN experiment to ensure the commissioning as soon as possible and to operate the apparatus as required. For 0νββ experiments we support a multi-isotope approach on the global scale and recommend convergence (as the GERDA and MAJORANA collaborations are considering) wherever possible. Investigation of more than one double beta isotope is essential to provide an unambiguous signature of neutrino-less double beta decay and to determine the effective Majorana mass. Support of R&D for new methods is considered as an important investment into future. We also urge further support for calculating nuclear matrix elements for 0νββ decay which requires both theoretical and experimental investigations.

- Sterile neutrinos

The past years have provided accumulating indications for **sterile neutrinos**. None of the indications (and even in combination) are significant by themselves, but most point to a mass range in the eV region. As a next step, **we recommend support of projects on an intermediate cost scale which could test these indications**. These include e.g. exposing underground detectors like Borexino or SAGE to strong radioactive neutrino sources or small-distance experiments at nuclear reactors. The release of Planck data could provide additional cosmological constraints. Oscillation experiments at accelerators on the 100 M€ scale might be justified after firmer evidence provided from these sources during the next 2-4 years.

3. Particle physics and the high-energy Universe

- SUSY Dark Matter
- Hadron-hadron/nucleus interactions at highest energies
- Exotic physics

Recommendation: We welcome the close cooperation between LHC and cosmic ray physicists and recommend support for an Astroparticle Forum as it is presently being installed as a discussion platform within CERN.

Recommendation: We recommend close cooperation between particle and astroparticle communities making maximal use of the synergetic effects between the exploration of the high-energy universe and the study of fundamental physics phenomena. We also support explorations towards improving the capabilities of Astroparticle Observatories with respect to particle and fundamental physics.

4. Nuclear Astrophysics

Nuclear Astrophysics addresses nuclear reactions in cosmic objects. This includes the generation of the lightest elements in the primordial universe, the equation of state of neutron stars, and the nuclear reactions in stars or Supernova explosion. Space based telescopes like **INTEGRAL** can study cosmic nuclear processes via gamma radiation.

We note the close connection between understanding the corresponding cosmic objects and studying nuclear reactions with isotope separators at accelerators. On a small scale this concerns accelerators in caverns (like **LUNA** in the Gran Sasso Lab which already delivered unique data for the understanding of solar reactions), on a larger scale ISOLDE at CERN and the future FAIR complex in Darmstadt. We also note that the small scale activities in this field notoriously fall between the main funding lines.

Recommendation: We emphasize the importance of nuclear reaction studies for our understanding of the cosmos and recommend continued support of related studies at accelerators.

5. Neutrino physics & astrophysics and search for p-decay with detectors deep underground, underwater or in ice

Liquid Argon ↔ Liquid Scintillator ↔Water

- **Proton decay**
  - Test further classes of SUSY models with tenfold sensitivity
- **Galactic Supernova**
  - Bonanza for astrophysics and particle physics
  - Incredibly detailed information on early SN phase and explosion mechanism
- **Solar neutrinos: details of solar model with percent accuracy** **LSc**
  - Metallicity problem ← ν from **CNO** cycle → burning of heavy stars
  - Time variations on the 10^{-3} level
  - Transition vacuum/matter oscillations
- **Geoneutrinos** **LSc**
  - What generates the heat of the Earth (about 30-50% due to U/Th decays).
  - How much U, how much Th? Crust, mantel? (Reactor inside Earth?)
- **Diffuse background of past Supernova** **LSc**
  - „average“ SN spectrum, star formation rate, „failed“ supernova
- **Oscillation physics** **LAr, H_20**

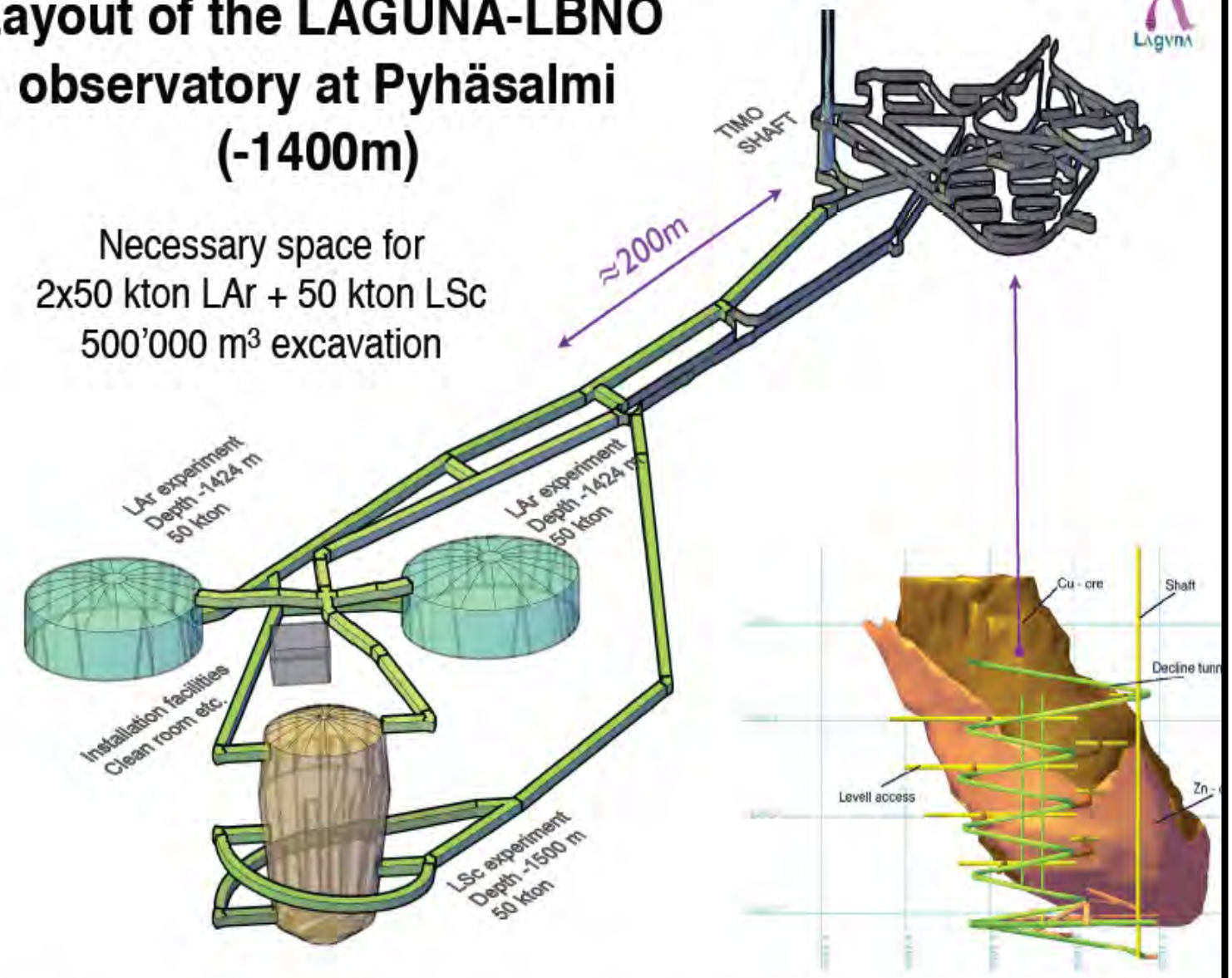
Naturally, the possibility for **long-baseline physics with a neutrino beam** from an accelerator (in Europe: SPS at CERN, U70 in Protvino, the future ESS in Lund) represents the closest connection to the CERN strategy. A long-baseline configuration would address two major questions:

a) Determination of the **neutrino mass hierarchy**

b) Measurement of a **CP violating phase**

Layout of the LAGUNA-LBNO observatory at Pyhäsalmi (-1400m)

Necessary space for
2x50 kton LAr + 50 kton LSc
500'000 m^3 excavation



Recommendation: Guided by the superior astroparticle capabilities of LENA, by its proven principal feasibility and by the strong German tradition in this field, we recommend to pursue the LENA project on an equal footing as GLACIER (with its superior potential for beam physics). Given the enormous cost of such detectors and the obvious worldwide interest, we support the ASPERA/ApPEC recommendation that "*CERN, together with key European agencies and ApPEC, enter into discussions with their US and Asian counterparts in order to develop a coherent international strategy for this field, including relevant astroparticle physics issues*". We emphasize that the high cost poses a high threshold for firm commitments to any of these projects. A solution can be only found via global coordination and by attracting new partners (from neighbouring fields like geophysics or solar physics, or from the same field but new countries).

Recently it has been suggested to decide on the mass hierarchy by measuring atmospheric neutrinos with densely instrumented detectors in ice (project PINGU at the South Pole) or underwater (ORCA in the Mediterranean Sea). At this point it is not clear how accurate energy, angle and flavor can be determined and how well systematic effects can be controlled. PINGU and ORCA proponents, together LENA members from Germany and Russia, have applied for support within an ASPERA common call to coherently explore of the capabilities of these detectors.

Recommendation: An early determination of the mass hierarchy with atmospheric neutrinos would impact strategies for long-baseline experiments with accelerator beams. We urge to determine the feasibility of this new experimental approach as soon as possible.

KAT-KET-KHuK Meeting zu LENA

DESY, Hamburg, 14.6.2012

9:30-9:40	C. Spiering	Einführung	10
9:40-10:05	G. Raffelt	Neutrinoastrophysik	15+10
10:05-10-35	W.Winter	Neutrinophysik	20+10
10:35-10:55	S. Schönert	Erfahrungen Borexino	10+10
10:55-11:20	L. Oberauer	LENA Detektor	15+10
11:20-11:35		Kaffee	15
11:35-12:05	M. Wurm	LENA Performance Astro+Geo	15+15
12:05-12:35	C. Hagner	LENA Performance LBL	15+15
12:35-13:25		Mittag	50
13:25-13:45	L. Oberauer	LENA Kosten, Status, Zeitpläne	10+10
13:45-14:15	C. Spiering	KAT/ASPERA Roadmap	10+20
14:15-14:35	A. Stahl	CERN Strategie und Status	10+10
14:35-16:00	Diskussion, Nächste Schritte		1:25

6. Relations between CERN and ApPEC/APIF

Given the strong synergies described in the previous sections, we propose a close cooperation between CERN and the 'Astroparticle Physics European Consortium' ApPEC in determining the strategy in the fields of mutual interest. The exchange of information should also include the recently established 'Astroparticle Physics International Forum' APIF. While for most projects the development of joint strategies would be extremely helpful, it is indispensable for some of the large-scale projects.

ENDE

▪ Dunkle Materie	Josef Jochum	U. Tübingen
▪ Neutrinomasse	Christian Weinheimer	U. Münster
▪ LE-Neutrinoastrophysik	Caren Hagner	U. Hamburg
▪ Kosmische Strahlung	Karl-Heinz Kampert	U. Wuppertal
▪ Gamma-Astrononomie	Christian Stegmann	U. Erlangen → DESY
▪ HE-Neutrinoastrophysik	Christian Spiering	DESY, Zeuthen
▪ Gravitationswellen	Karsten Danzmann	AEI, Hannover
▪ Nukleare Astrophysik	Roland Diehl	MPI Garching
▪ AT Theorie	Günter Sigl	U. Hamburg

- **Direct searches: factor of 100**
- **Indirect searches: factor 10-30**
- **LHC 7 → LHC 14: factor 300-1000**