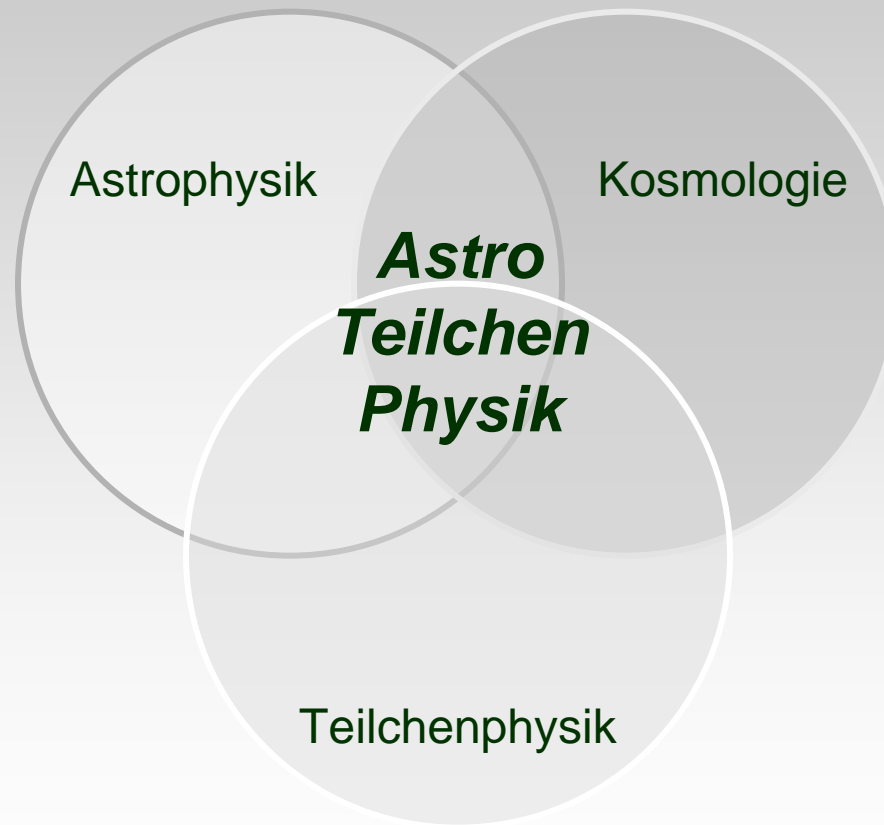


KAT Bericht zur Astroteilchenphysik



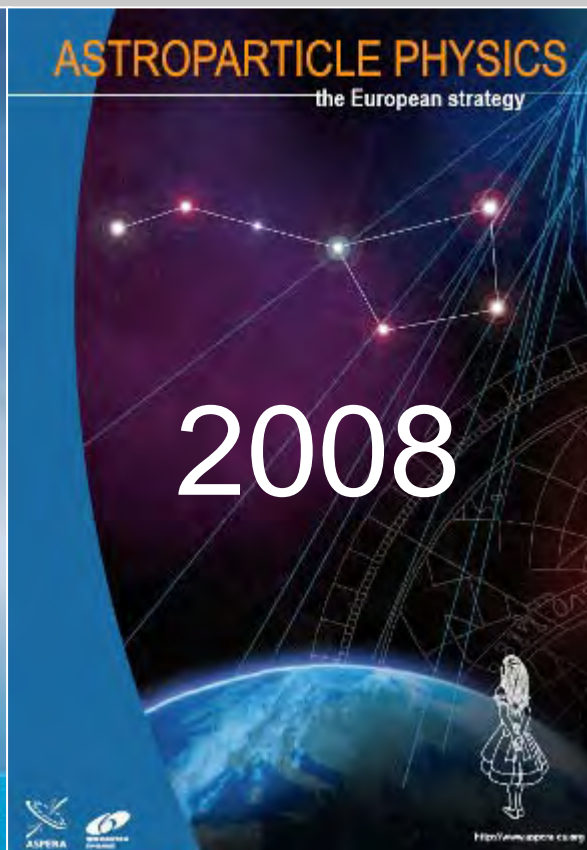
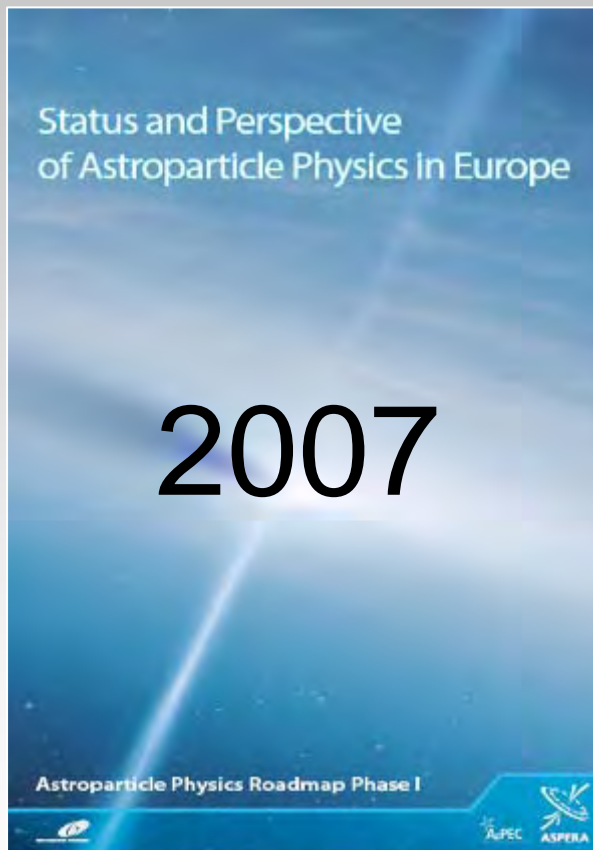
Christian Spiering
KET-Jahrestreffen 18.11.2011, Bad Honnef

- **KAT-Mitglieder**
- **ASPERA Roadmap**
- **Helmholtz Allianz**
- **Deutsch-Russisches Jahr der Forschung**
- **Helmholtz-Russian Joint Research Group**
- **Dunkle Materie**
- **Plan 2012**

KAT-Mitglieder

- | | | |
|--------------------------|----------------------|--------------------|
| • 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-Astronomie | 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 |

2011 ASPERA Roadmap



„Roadmap Event“ am 21/22. November in Paris

Medium Scale

Medium scale projects or medium scale upgrades being at different stages of realization (tens of M€). Funding has to be kept at substantial levels, be it because they have an impressive momentum which needs to be maintained; because they enter a phase with high discovery potential; because they go hand in hand with LHC physics; because they are technologically ready and have a worldwide community behind them; or, finally, because a delay of crucial decisions and funding could even jeopardize the project. :

- **Advanced Gravitational Detectors**

- advLIGO, advVIRGO, GEO-HF

- **Dark Matter**

- DAMA
- **XENON1t**, später DARWIN, **EURECA**

In rot: high priority

- Neutrino-Masse

- GERDA, CUORE, SuperNEMO, NEXT
- KATRIN

- **Erweiterung des Frejus-Laboratoriums**

Suche nach $0\nu\beta\beta$ Zerfall mit GERDA

Gefüllt bis an den Rand

GERDA Inauguration Nov 2010

Comissioning abgeschlossen

Start des ersten Physik-Runs am 1.11.2011 !

Large Scale, mid of the decade

Large scale projects whose construction needs to start towards the middle of the current decade (scale of hundreds of M€).

- **CTA**
- KM3NeT
- Auger
- LAGUNA ← Verknüpfung mit CERN-Strategie!

In rot: high priority

The presently conceived start of construction of KM3NeT, the ground based cosmic ray observatory and a low-energy neutrino detector is in the years 2014-2016. We would support a strategy to search for funding opportunities for these projects – both in Europe and worldwide – and promote any one of these projects as soon as a corresponding window appears.

10 fold sensitivity of current instruments

10 fold energy range

improved angular resolution

expect ~ 1000 sources

two sites (North / South)

operated as observatory

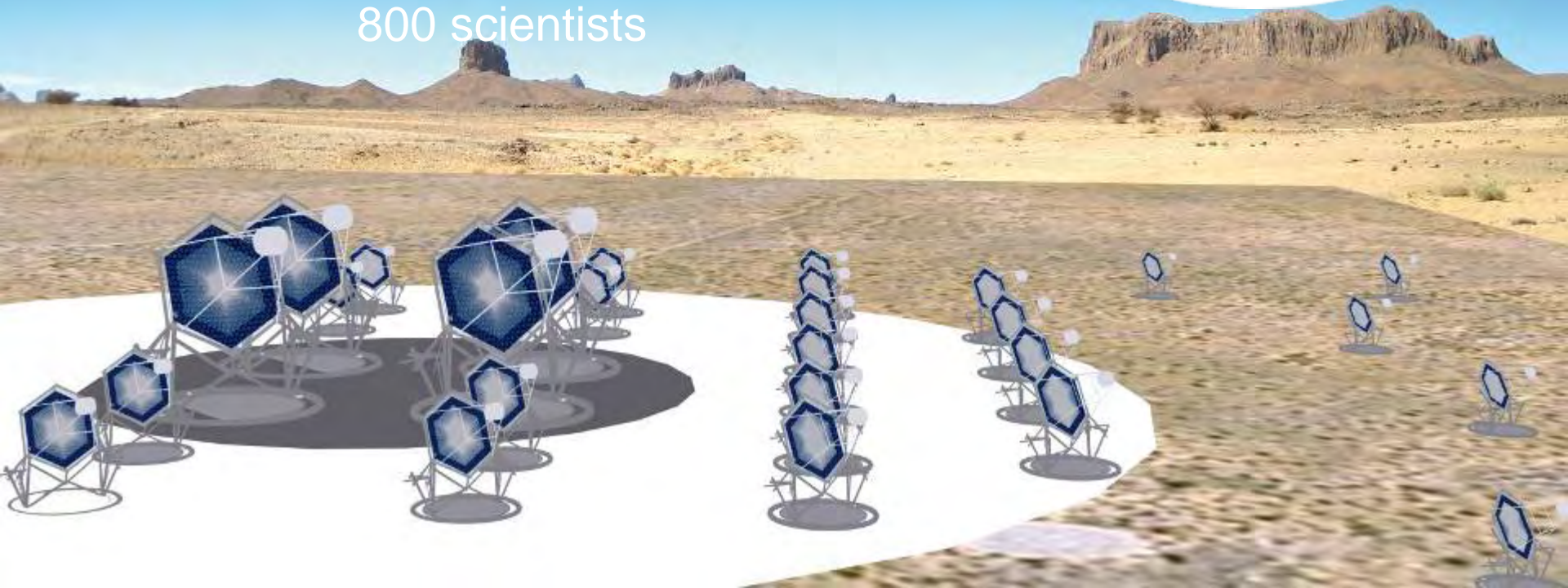
World-wide cooperation

25 countries

132 institutes

800 scientists

The future in
VHE gamma ray
astronomy:



CTA Status und Pläne

Design study phase concluded in Fall 2010

- Design Concepts for the Cherenkov Telescope Array
(arXiv:1008.3703)

FP7-supported Preparatory Phase: Fall 2010 – Fall 2013

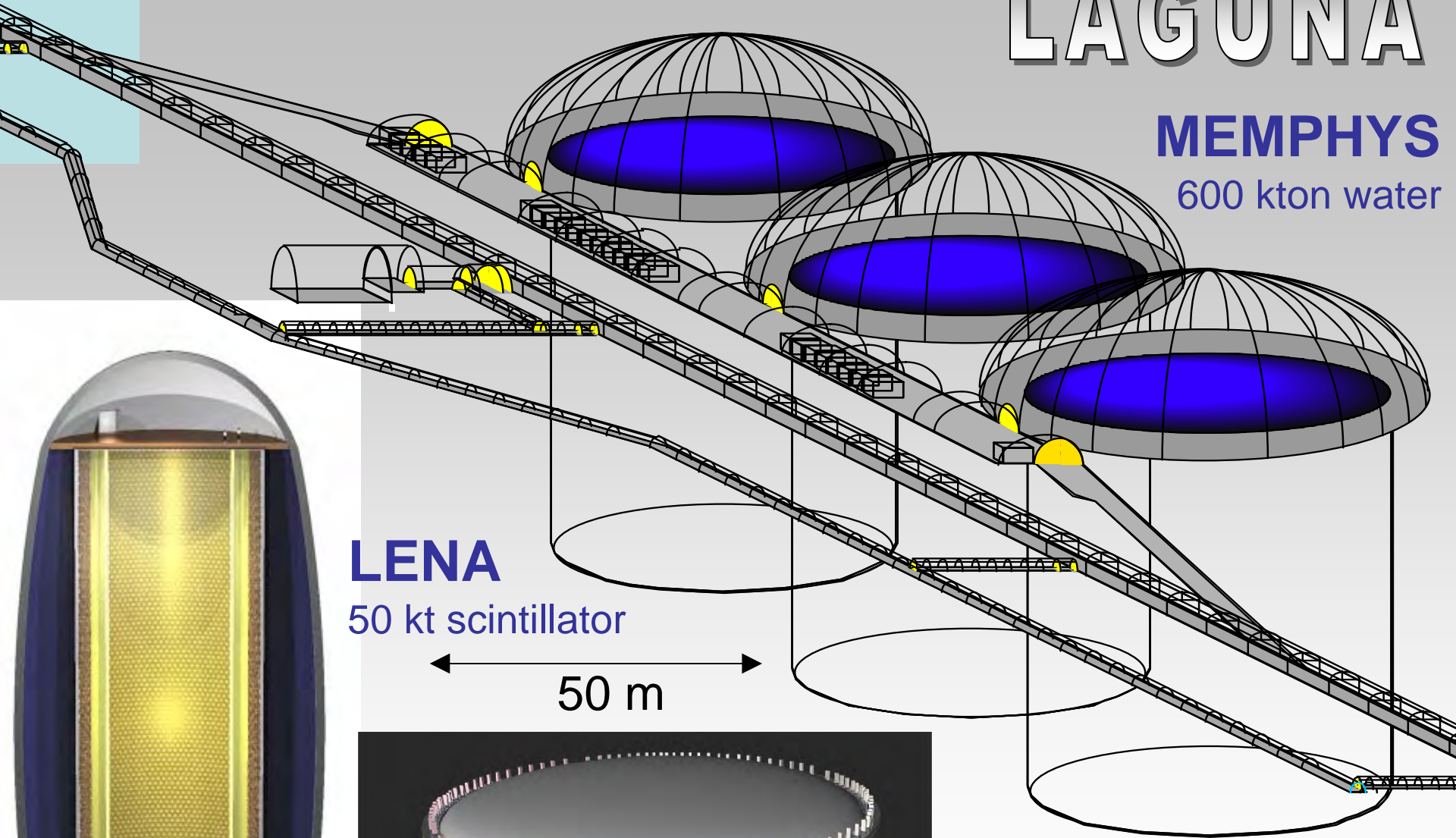
- Technical design, sites, construction and operation cost
- Legal, governance and finance schemes
- Small + medium-sized telescope prototypes

Aim for

- start of deployment in early 2014
- first data in 2016/17
- base arrays complete in late 2018
- expanded mid-energy array driven by US

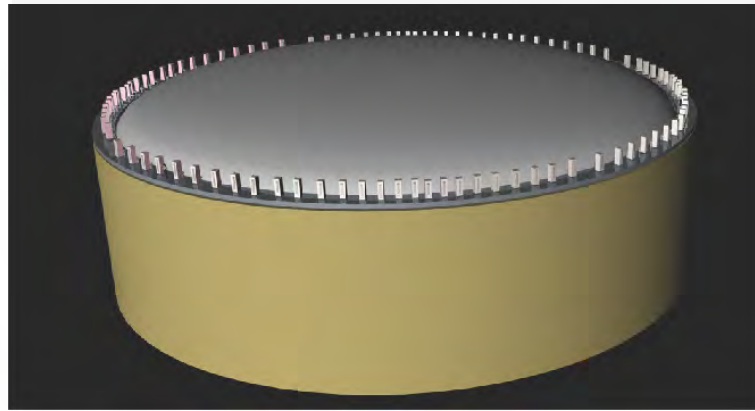
LAGUNA

MEMPHYS
600 kton water



LENA
50 kt scintillator

50 m



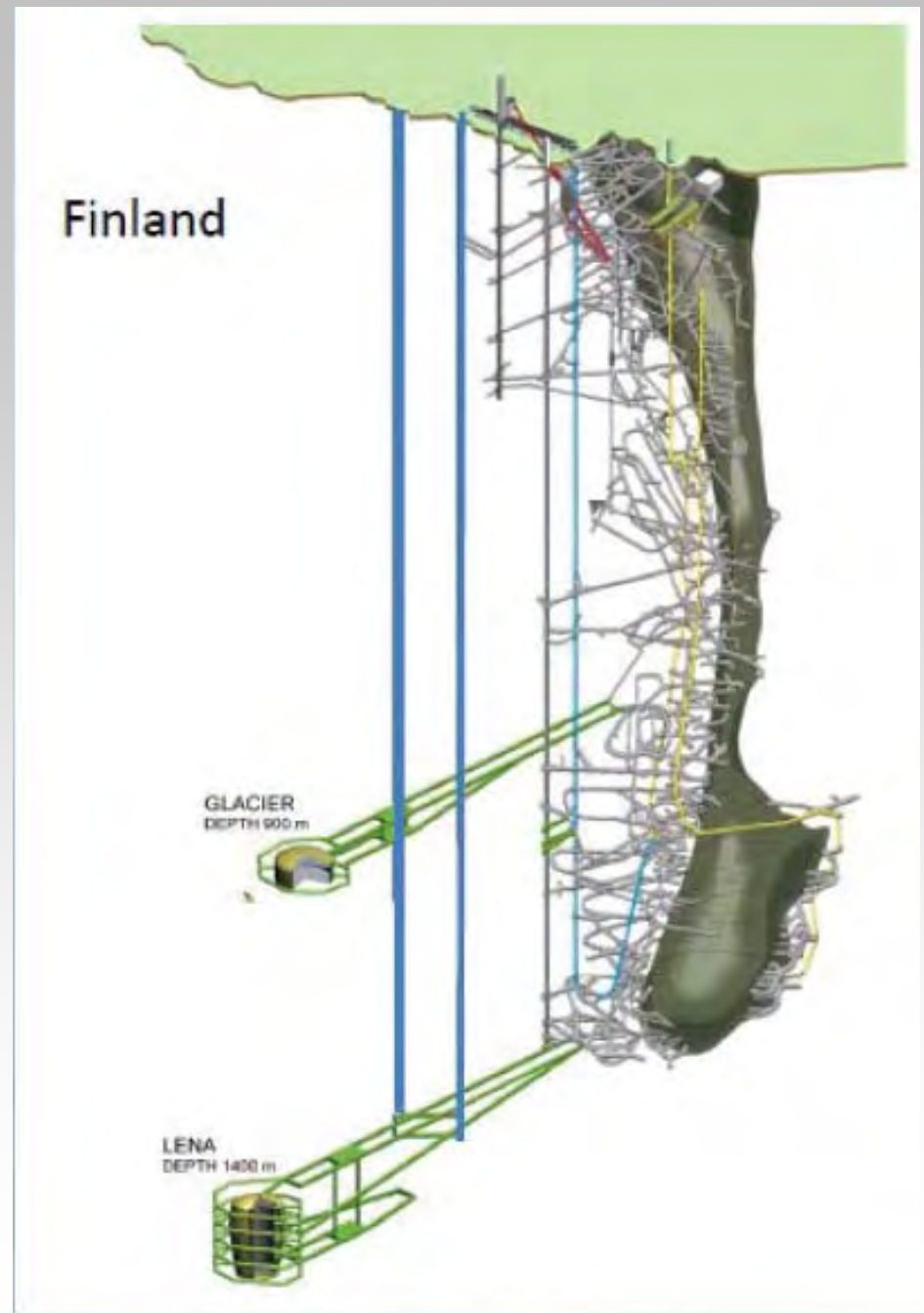
GLACIER
100 kton liquid argon

Bis 2013

(European Strategy for Particle Physics!)

**Konzentration
auf die Option
CERN-Pyhäsalmi
(2300 km)**

**Detektoren:
LENA + GLACIER**



LENA

in Deutschland



- TU München und Aachen, Hamburg, Tübingen, Würzburg
- Langfristig interessiert: HGF
- Hohe Kompetenz deutschlandweit (Borexino, Double Chooz)
- Publiziert: **White Paper**

Large Scale, end of the decade

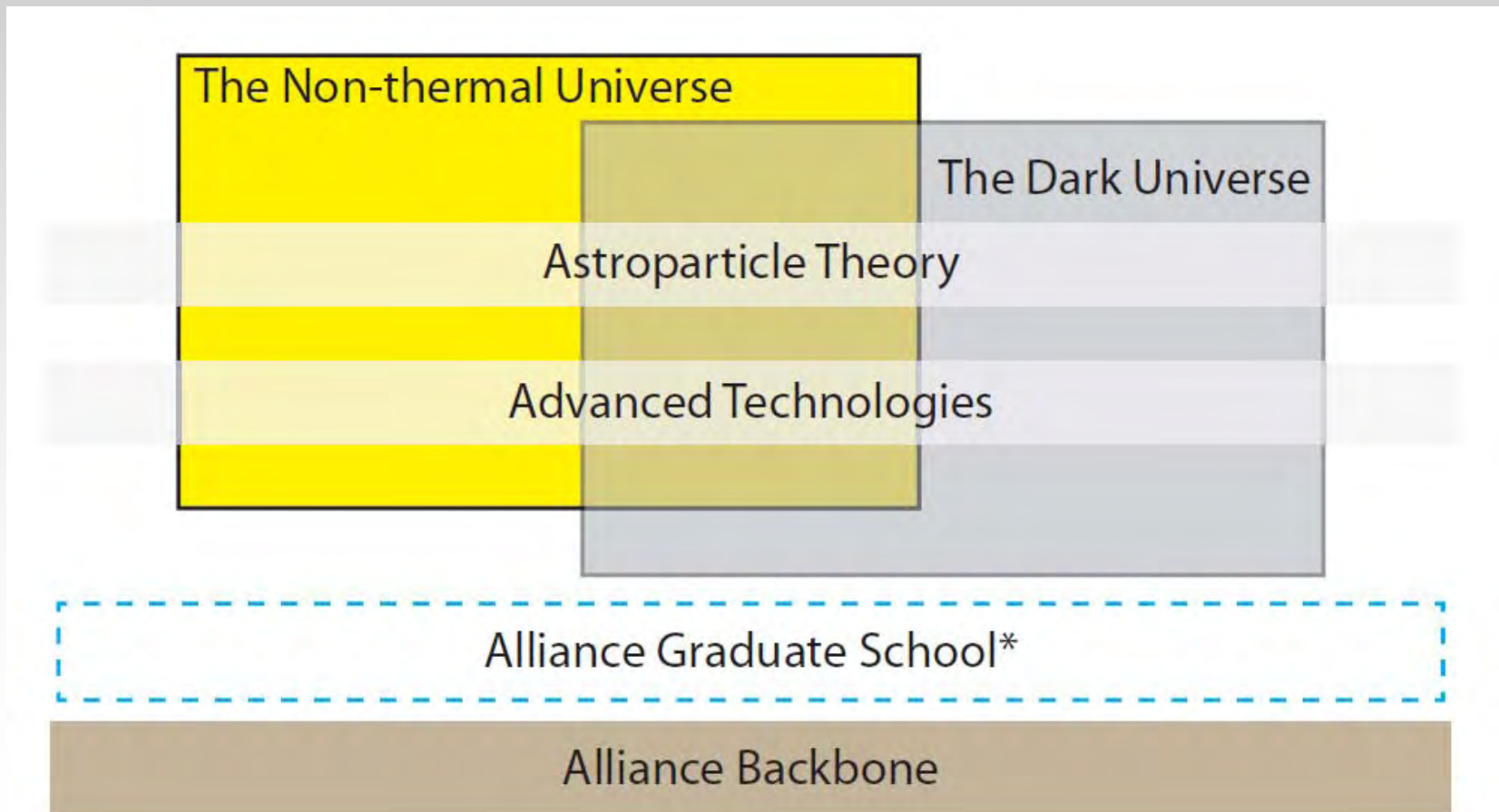
Large scale projects whose construction needs to start towards the end of the current decade (scale of hundreds of M€ to 1 G€).

- **Gravitational Waves:**
 - Einstein Telescope ET
 - LISA (space)
- **Dark Energy**
 - LSST (US-lead)
 - EUCLID (ESA)

Helmholtz-Allianz für Astroteilchen-Physik

HAP und Verbundforschung 2011-14

- HAP 2011-2016: 9.9 M€



Spokesperson: J. Blümer

Deputy Spokesp: J. Jochum

Coord.Admin.: N. Keller-Rau

Graduate School: G.Anton/C.Stegmann

Links Astronomy: K.Mannheim

Links LHC physics: T. Lohse

Outreach: N.N.

Officers:

- | Spokesperson, dpty. spokesperson;
- | coordinators of Administration, Topics,
- | Graduate School, Eq. Opportunities,
- | Astronomy, LHC Physics; Scientific
- | Outreach and Information Manager

International Advisory Board

Administration
Backbone Coordination
Scientific Outreach and
Information Manager

Executive Board (EB)
Officers, 4 elected MB
representatives

Member Board (MB)
Principal Investigators,
officers, elected alliance
members

Topic Coordinator
Astroparticle Theory
Sigl

Topic Coordinator
Non-Thermal Universe
Spiering

Topic Coordinator
Dark Universe
Eitel

Topic Coordinator
Adv. Technologies
Weber

Alliance Graduate
School Coordinator
N.N.

WP1.1: Propagation
and detection
Sigl

WP2.1: Multi-messenger
astroparticle physics
Schlenstedt

WP3.1: Analysis of
Dark Matter searches
Maier

WP1.2: Particle
Acceleration Sources
Pohl

WP2.2: Cosmic ray
composition & interactions
Engel

WP3.2: Novel detection
methods for DM
Weber

WP1.3: DM and non-
acc. signatures
Klasen

WP2.3: Novel detection
methods & future challenges
Haungs



PhD project partner groups

ASTROPARTICLE PHYSICS

Workshop on Russian-German Perspectives

Dark Matter · Neutrino Properties · Proton Decay · Cosmic Rays · Neutrino and Gamma-Ray Astronomy

- Broschüre zu gemeinsamen Projekten im Frühjahr 2012
- Workshop in Berlin im März 2012

<https://indico.desy.de/event/AstroGRY> | C. Spiering | christian.spiering@desy.de | G. V. Domogatsky | domogats@pcba10.inr.ruhep.ru | G. A. Shelkov | chelkov@jlnr.ru

JINR | Dubna | 8/9 December 2011

Workshop sponsored by BMBF and JINR



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

Helmholtz-Russian Joint Research Group

Existing: cosmic ray array Tunka-133, prototype radio antennas

2014:

- Upgraded Tunka-133 with C- and scint. detectors
- Radio array operating together with Tunka-133
- Gamma/CR detector HiSCORE



DESY (Tunka, HiSCORE)
KIT (Radio detection of CR, Tunka)
U. Hamburg (HiSCORE)
INR Moscow (Theory)
MSU Moscow (Tunka, Radio, HiSCORE)
ISU Irkutsk (Tunka, Radio, HiSCORE)

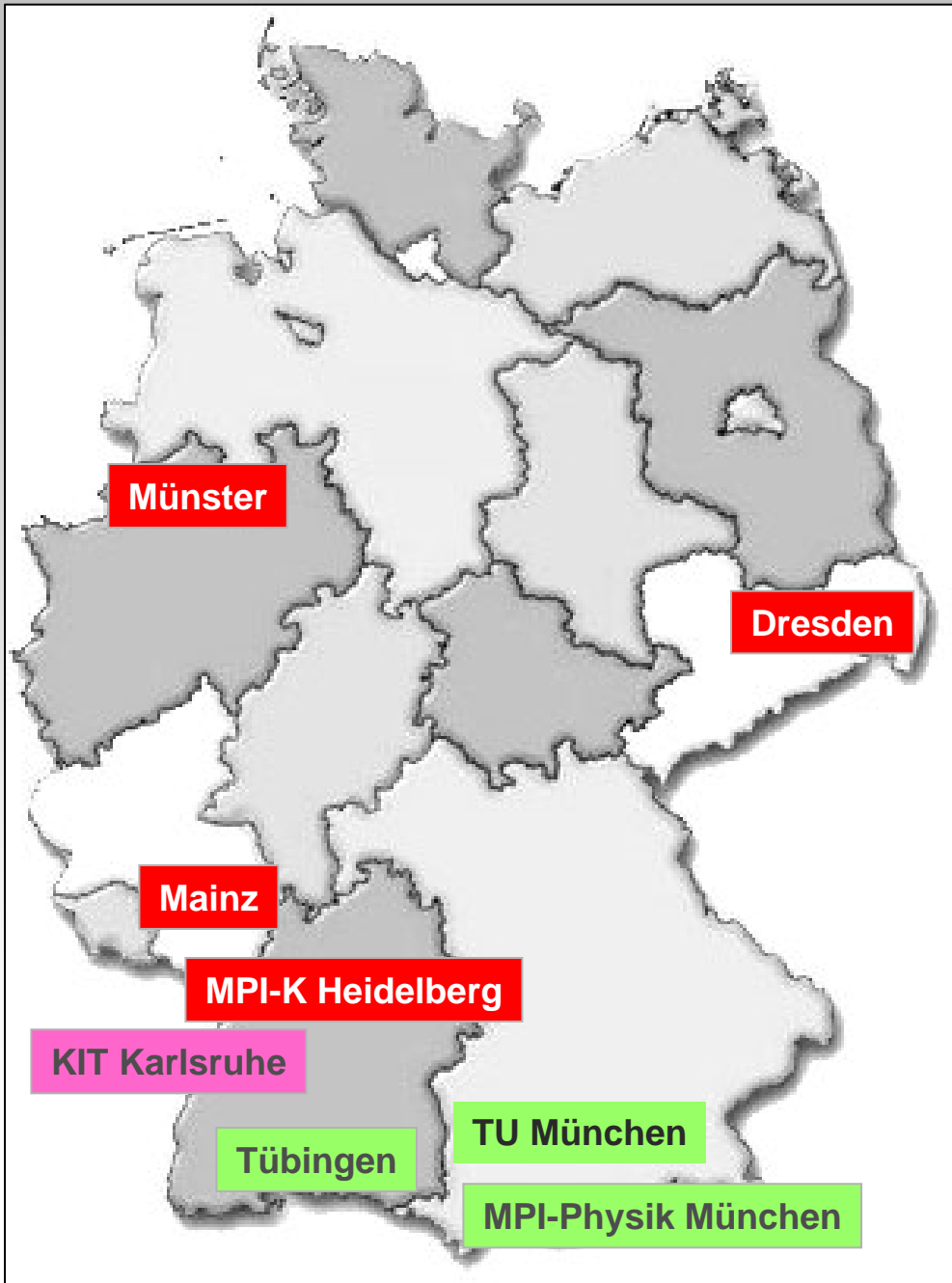
Dark Matter

XENON

CRESST

EDELWEISS

EURECA



Dark Matter Highlights 2011

Neue Resultate von:

- EDELWEISS (fast gleichauf mit CDMS)
- XENON100 (weltbestes Limit, Verbesserung in Sicht)
- CRESST (Überschuss bei (10-25) GeV?)

- Kominierte Analyse Edelweiss-CDMS
- XENON 1t Installation begonnen
- EURECA in Vorbereitung

Zusammenarbeit im Arbeitskreis DM:

- Erfolgreicher gemeinsamer Antrag Verbundforschung
⇒ BMBF-Förderung zur Vorbereitung von XENON1t and EURECA
- Zusammenarbeit im HAP Topic “Dark Universe”

XENON

Charge + Light

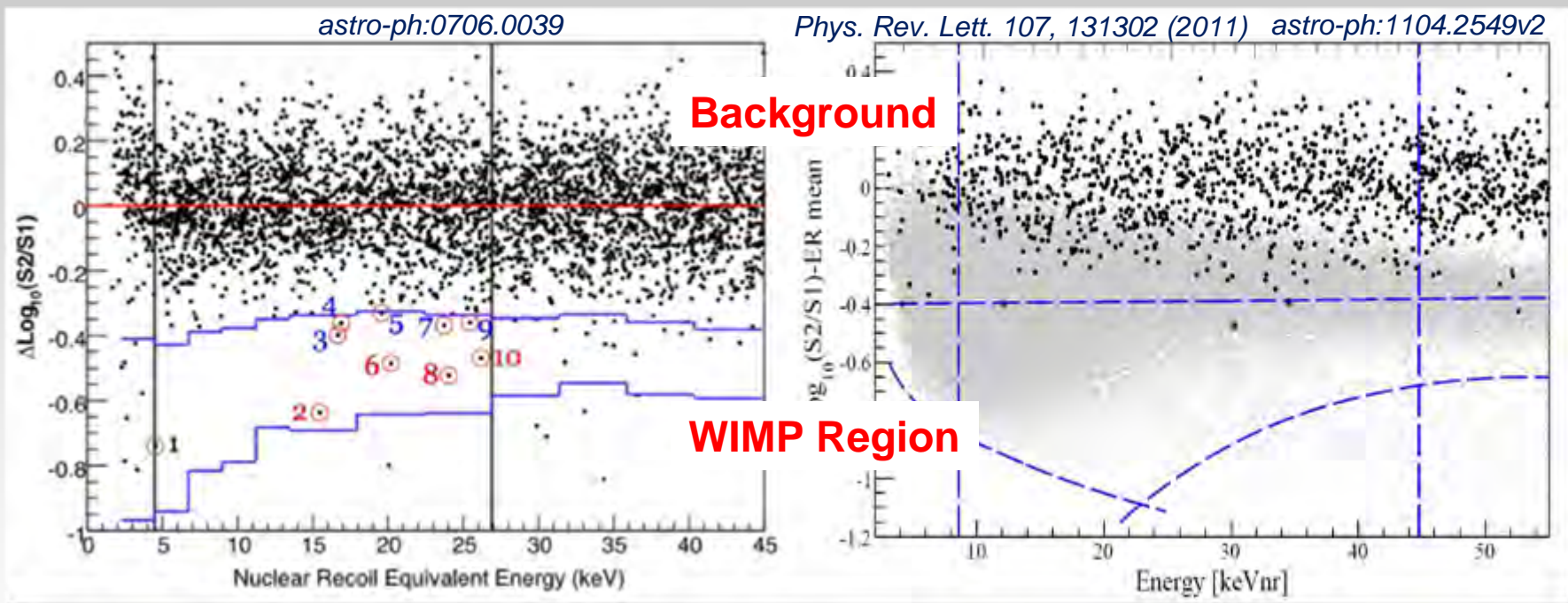
USA, Switzerland, Italy,
Germany, France,
Portugal, Japan, China

XENON10
2007

5.5 kg target,
58.6 kgd exposure
10 background events
~1 cts / 6 kgd

XENON100
2011

48 kg target,
1471 kgd exposure
3 background events
~ 1 cts / 500 kgd
 γ bckgrnd ~ 50 x lower



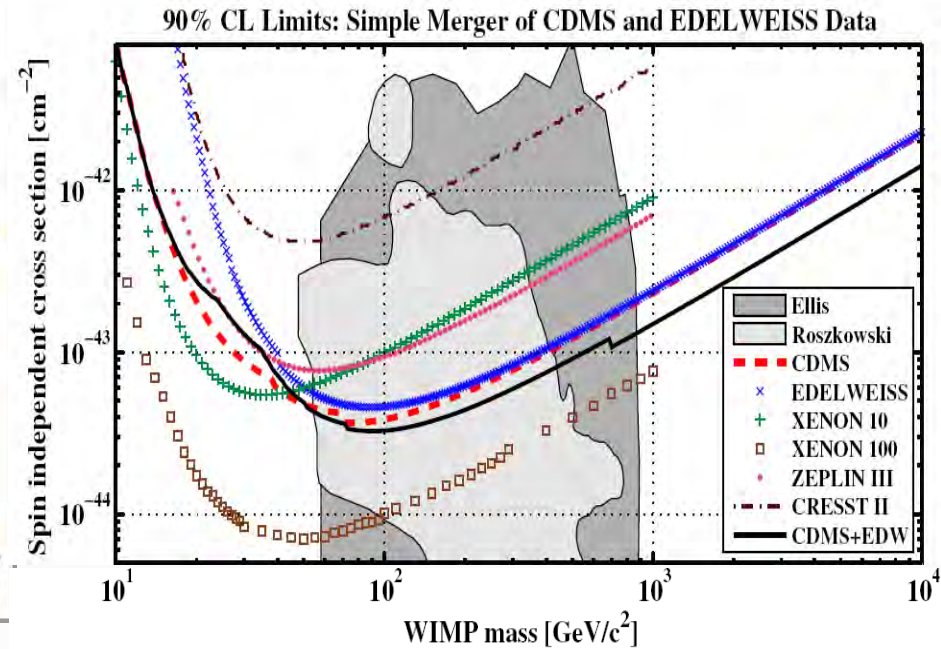
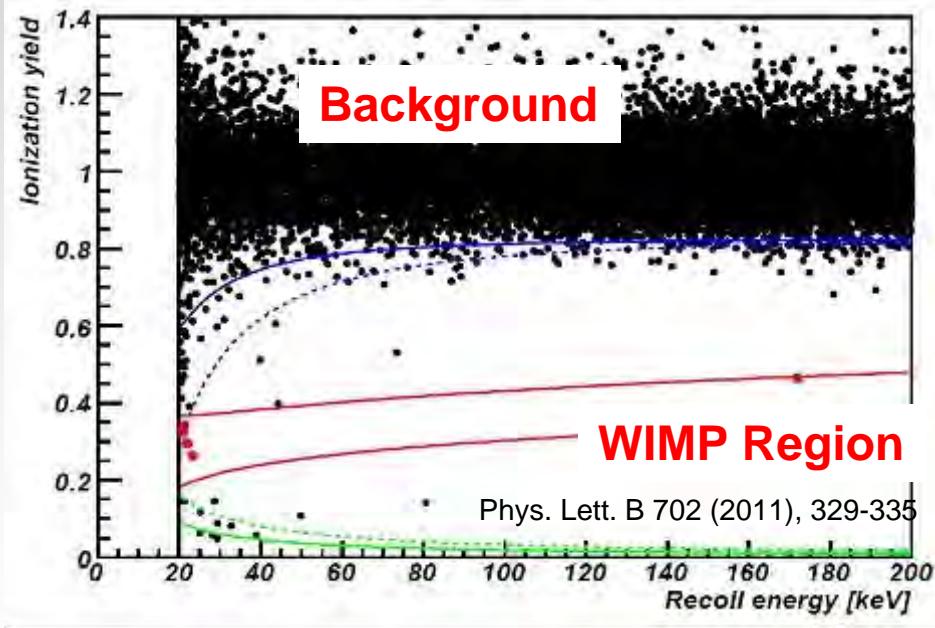
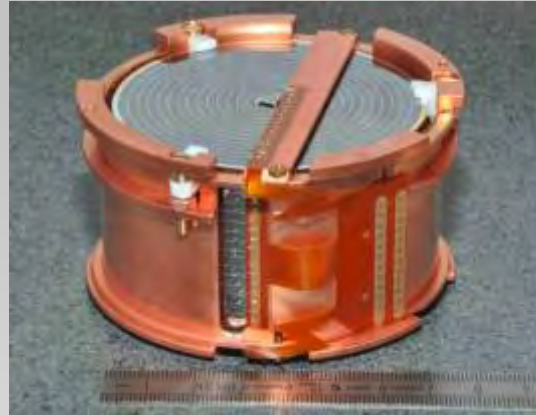
Large improvement on background

Even better in present data taking

→ Expect better results soon

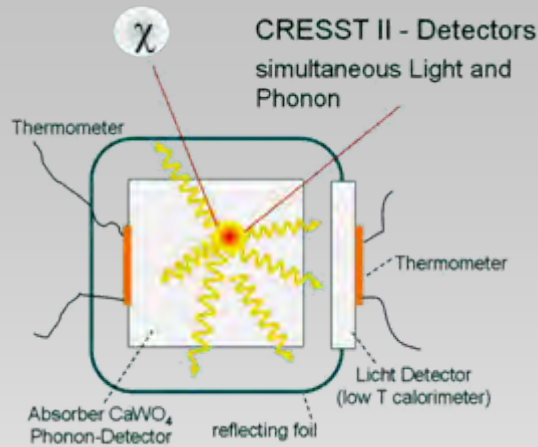
EDELWEISS – Charge / Phonon

- continuous data taking
- 384 kg d published
- one of the best limits
- 1 cts / 80 kg day

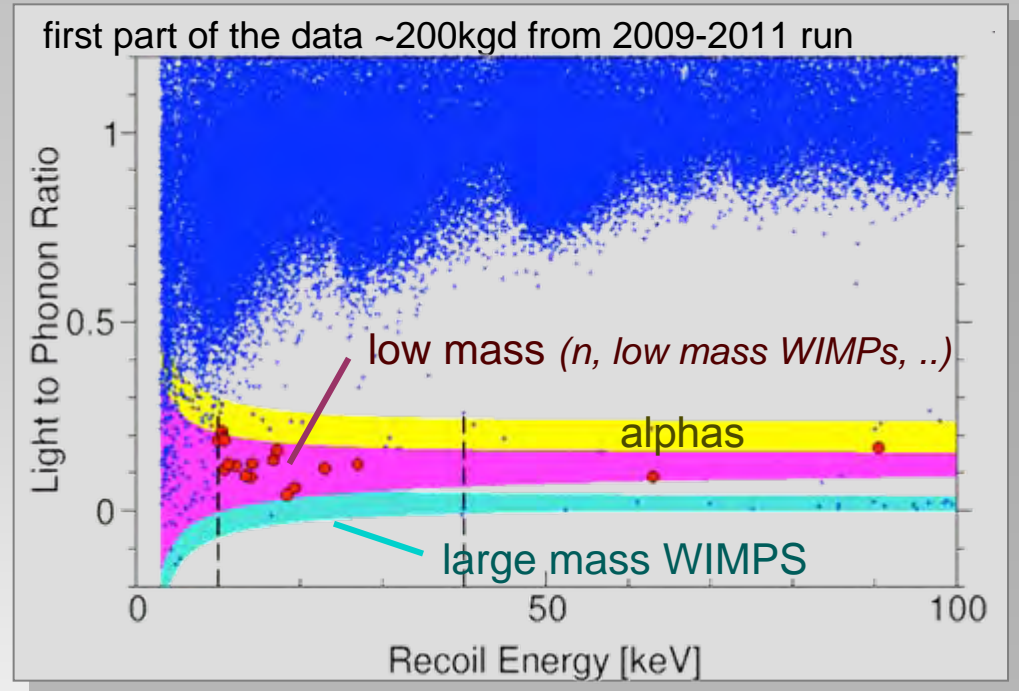


Cooperation with US project CDMS,
publication of combined limits
Phys.Rev.D84:011102,2011

CRESST – Light / Phonon – CaWO₄ Target



presently suffers
from α background



New physics run in preparation:

Reduced α - and Pb-recoil- background to see if excess persists or is related to backgrounds.

XENON

*USA, Switzerland, Italy, Portugal,
Germany, France, Japan, China*

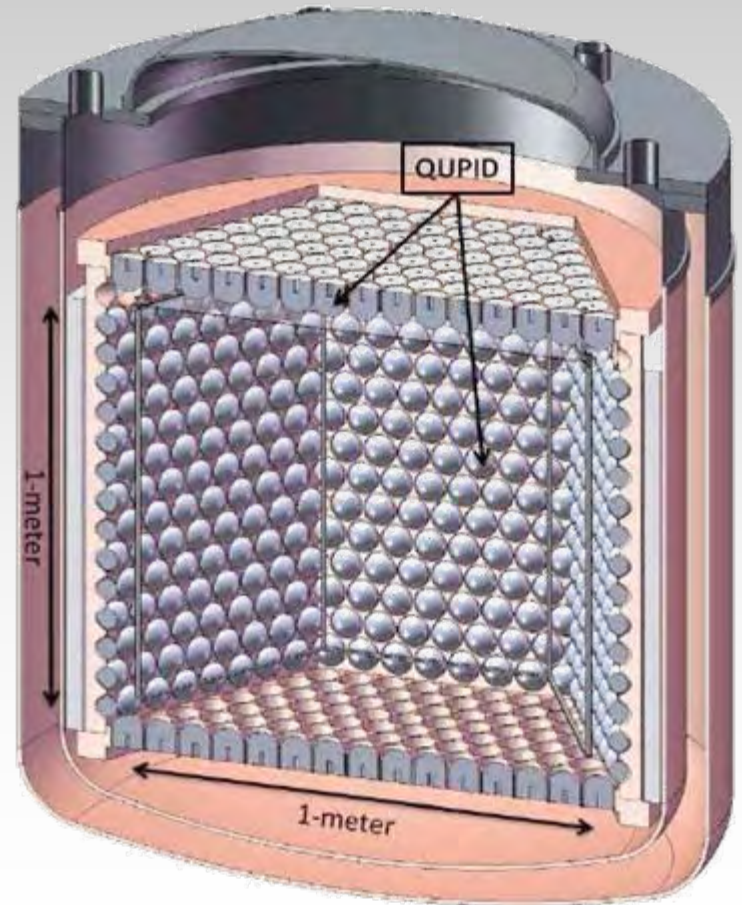


XENON 100 +

- at Gran Sasso
- 50 kg fiducial / 170 kg total
- starting end of 2009
- achieved 2011: $\sim 7 \times 10^{-45} \text{ cm}^2$
- projected 2012: $\sim 2 \times 10^{-46} \text{ cm}^2$

XENON 1t

- projected 2013:
1000 kg target $< 10^{-47} \text{ cm}^2$



EURECA

*Germany, France, UK,
Spain, Russia, Ukraine*

combines all European
cryogenic DM efforts:

R&D cooperation with CDMS/GeoDM

2009/11: design study → TDR

2011/12: LSM excavation
+ construction EURECA components
~ 100 kg fiducal target at present sites,
~ 10^{-45} cm²

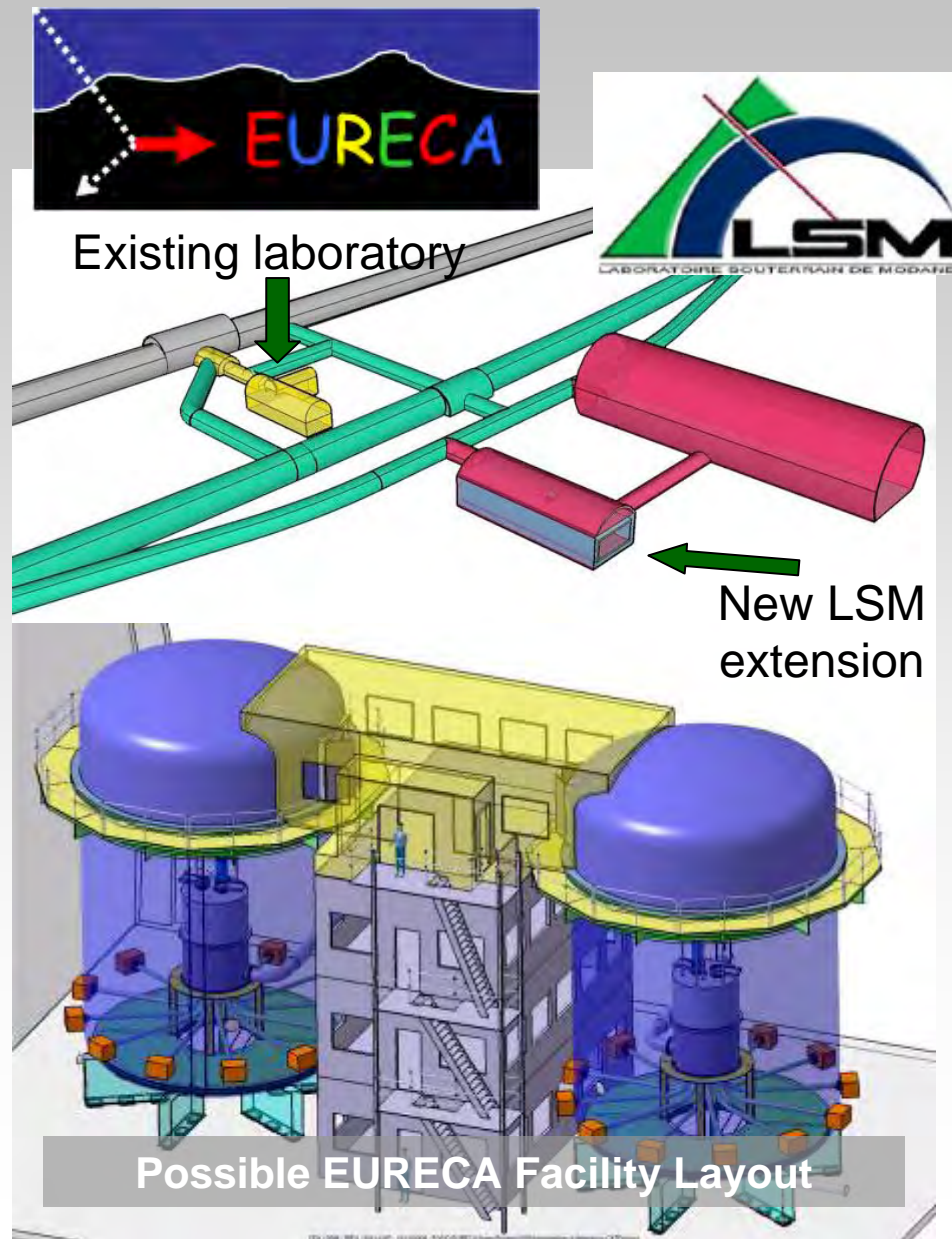
2013/14: construction at LSM

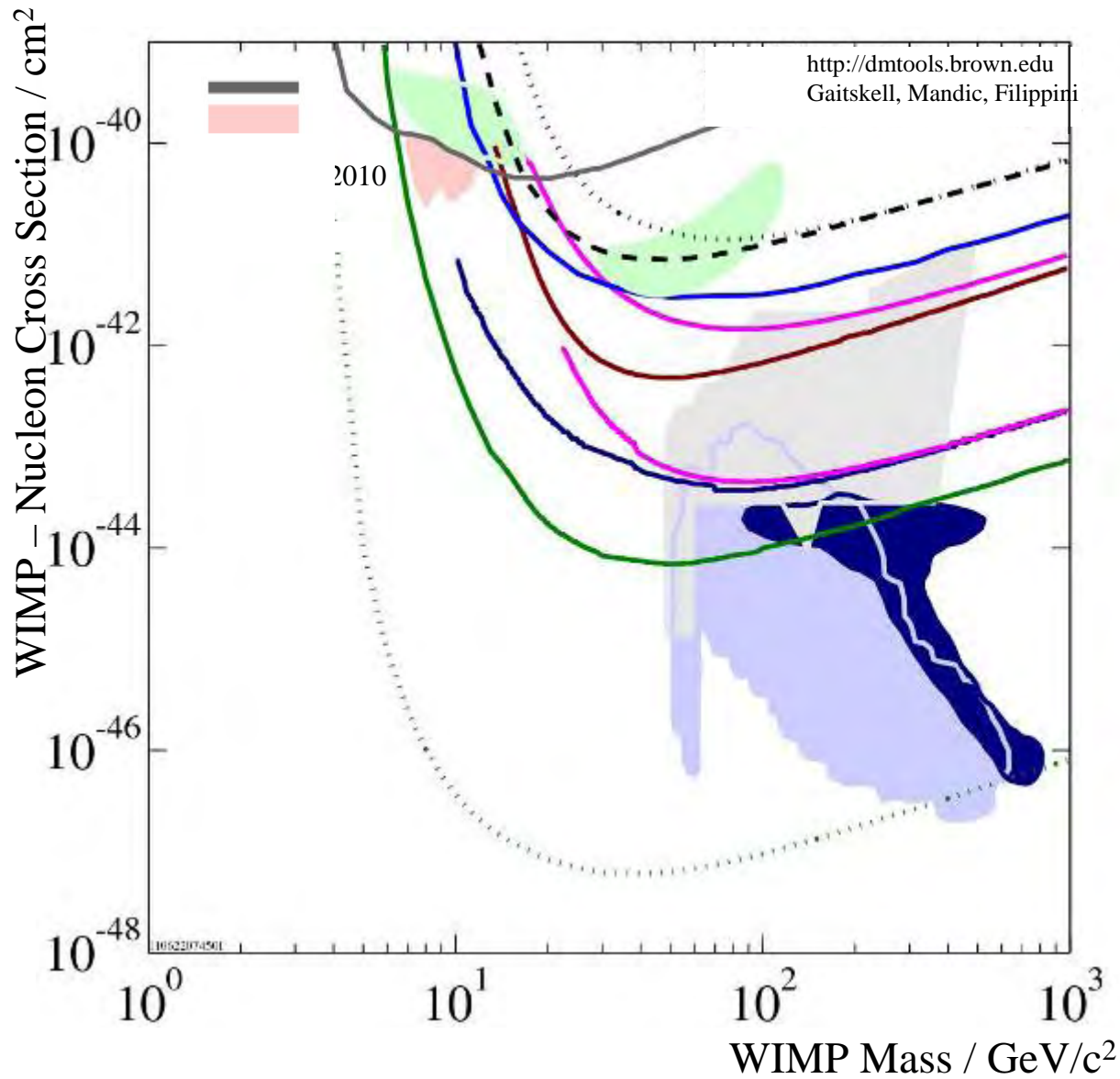
2015: begin data taking at LSM

2015 – 2018:

- continuous upgrade to 1t target
- ~ 10^{-46} cm²

+ GeoDM (SuperCDMS)





- Heidelberg Moscow 1996
- IGEX 1998
- DAMA 1998 / LIBRA 2008
- CDMS 2000
- EDELWEISS 2002
- CRESST 2009
- EDELWEISS 2011
- CDMS 2011
- XENON 2011

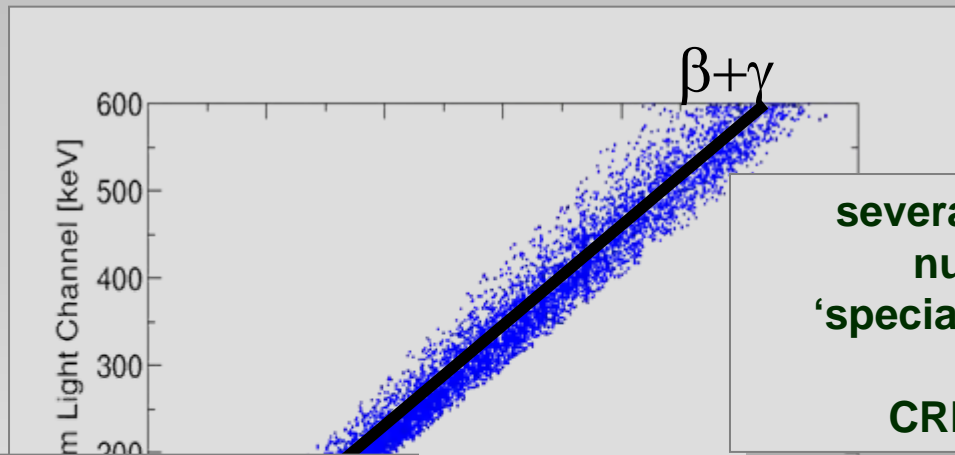
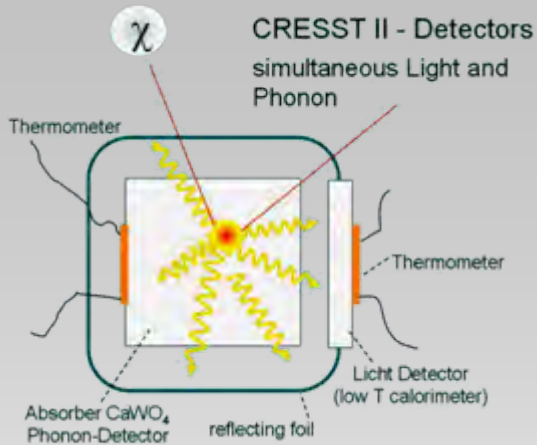
$\sim 0.002 \text{ cts / kg / d}$

- Baltz, Gondolo MSSM 2001
- Baltz, Gondolo 2004
- Trotta et al CMSSM 2008

Plan 2012

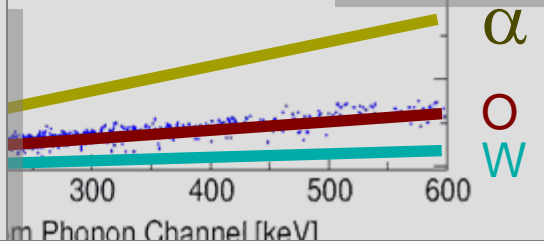
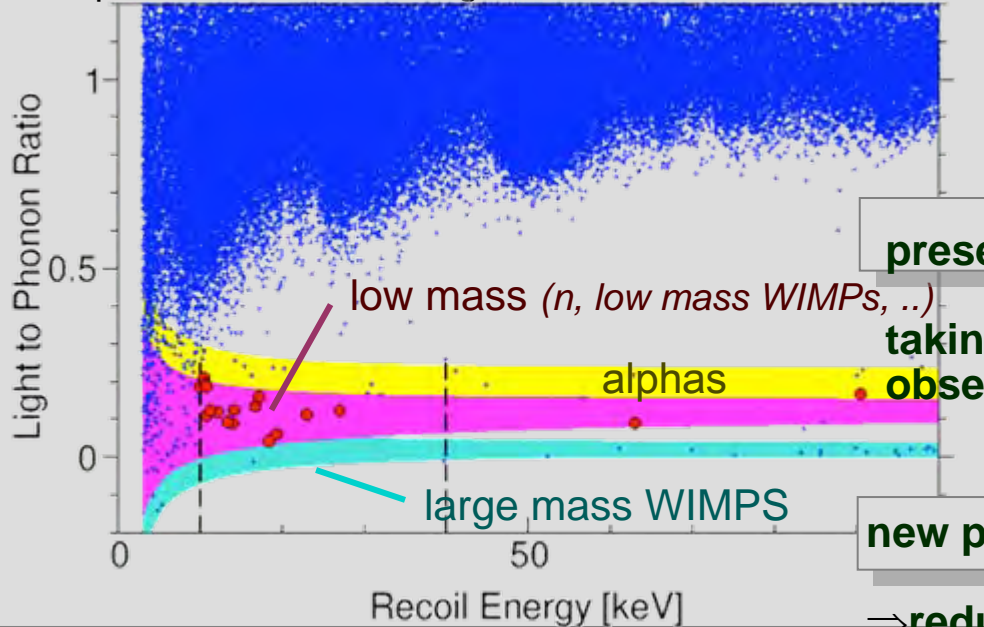
- Jahrestreffen Astroteilchenphysik in Deutschland
- Wahl des neuen KAT
- Deutsch-Russischer Astroteilchen-Workshop in Berlin (März), zweisprachige Broschüre zu gemeinsamen Projekten
- 24-Seiten Beilage zur Astroteilchenphysik in „Spektrum der Wissenschaft“ (Mai-Heft 2012)
- Workshop zum 100. Jahrestag der Entdeckung der kosm. Strahlen durch Viktor Hess, Bad Saarow (August)
- Update der 2010 deutsche Roadmap und 3-Seiten-Extrakt (Frühjahr)

CRESST – Light / Phonon – CaWO₄ Target



several target nuclei
'special feature' of CRESST

first part of the data ~200kgd from 2009-2011 run



presently suffers Alpha-Background,

taking this into account observes excess events

new physics run in preparation

⇒ reduced alpha- and Pb-recoil – bckgrnd
 ⇒ to see if excess persists or is related to backgrounds

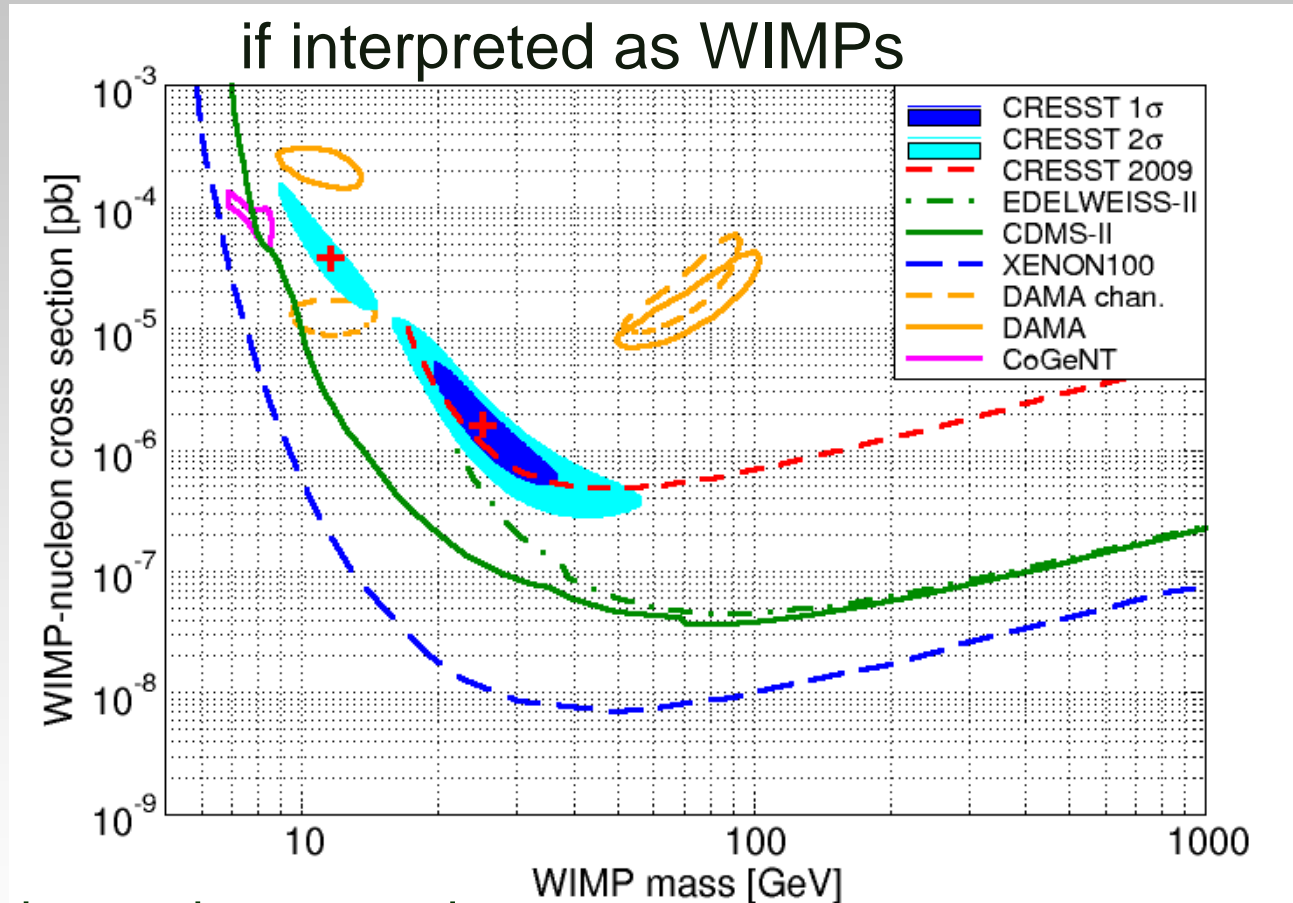
Pierre Auger Observatory
KASCADE-Grande
TUNKA-133
*Auger-Next**
*JEM-EUSO**

H.E.S.S.
MAGIC
VERITAS
*CTA**

IceCube
ANTARES
*KM3NeT**
*LENA**

Institution	Cosmic Rays	Gamma Rays	Neutrinos
Aachen	•		•
Berlin		•	•
Bonn			•
DESY	•	•	•
Dortmund		•	•
Erlangen		•	•
Hamburg		•	
KIT	•		
Mainz			•
München TU			•
Potsdam		•	
Siegen	•		
Wuppertal	•		•
MPIK		•	
MPPMU		•	
APC		•	

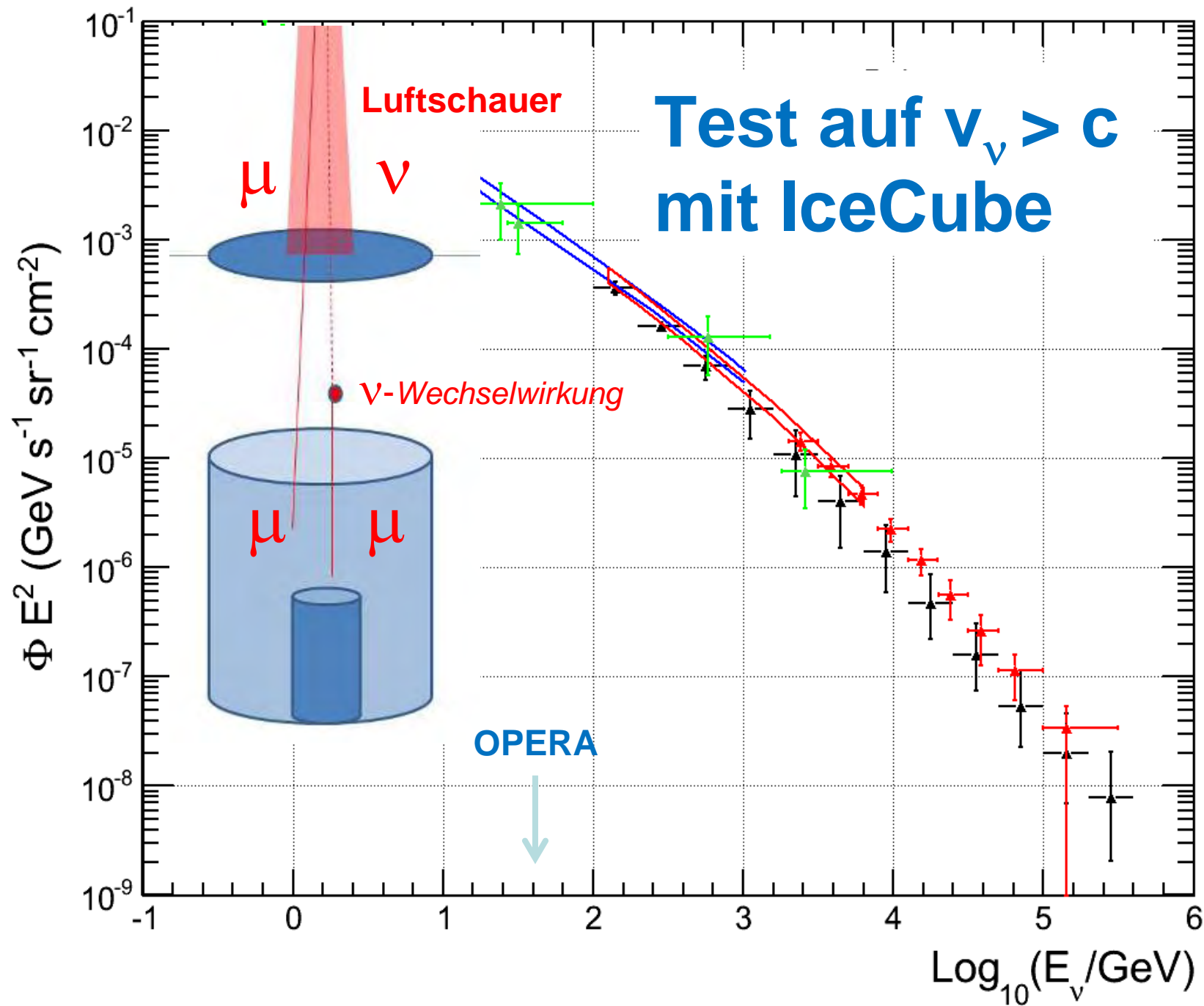
CRESST presently suffers from Alpha-Background, but observes Excess Events – if interpreted as WIMPs



new physics run in preparation

⇒ reduced alpha- and Pb-recoil – background

⇒ **to see if excess persists or is related to backgrounds**

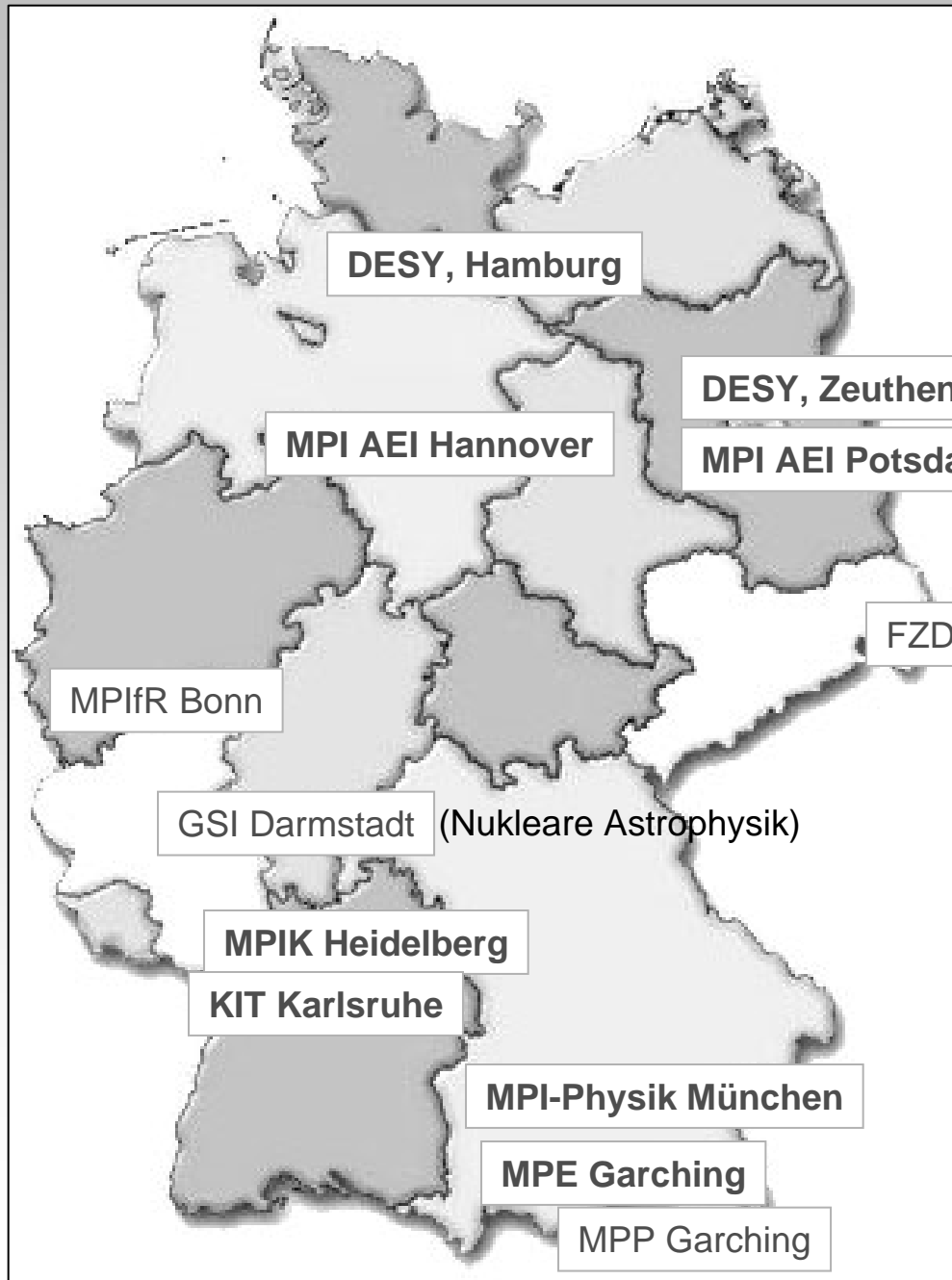


AT in Deutschland: Universitäten



- 27 Universitäten mit knapp 90 Professuren, die ganz oder teilweise der AT gewidmet sind.
- Verbundforschung
2008-2011: 12.8 M€
2011-2014: 16.4 M€

AT in Deutschland: Helmholtz Max-Planck



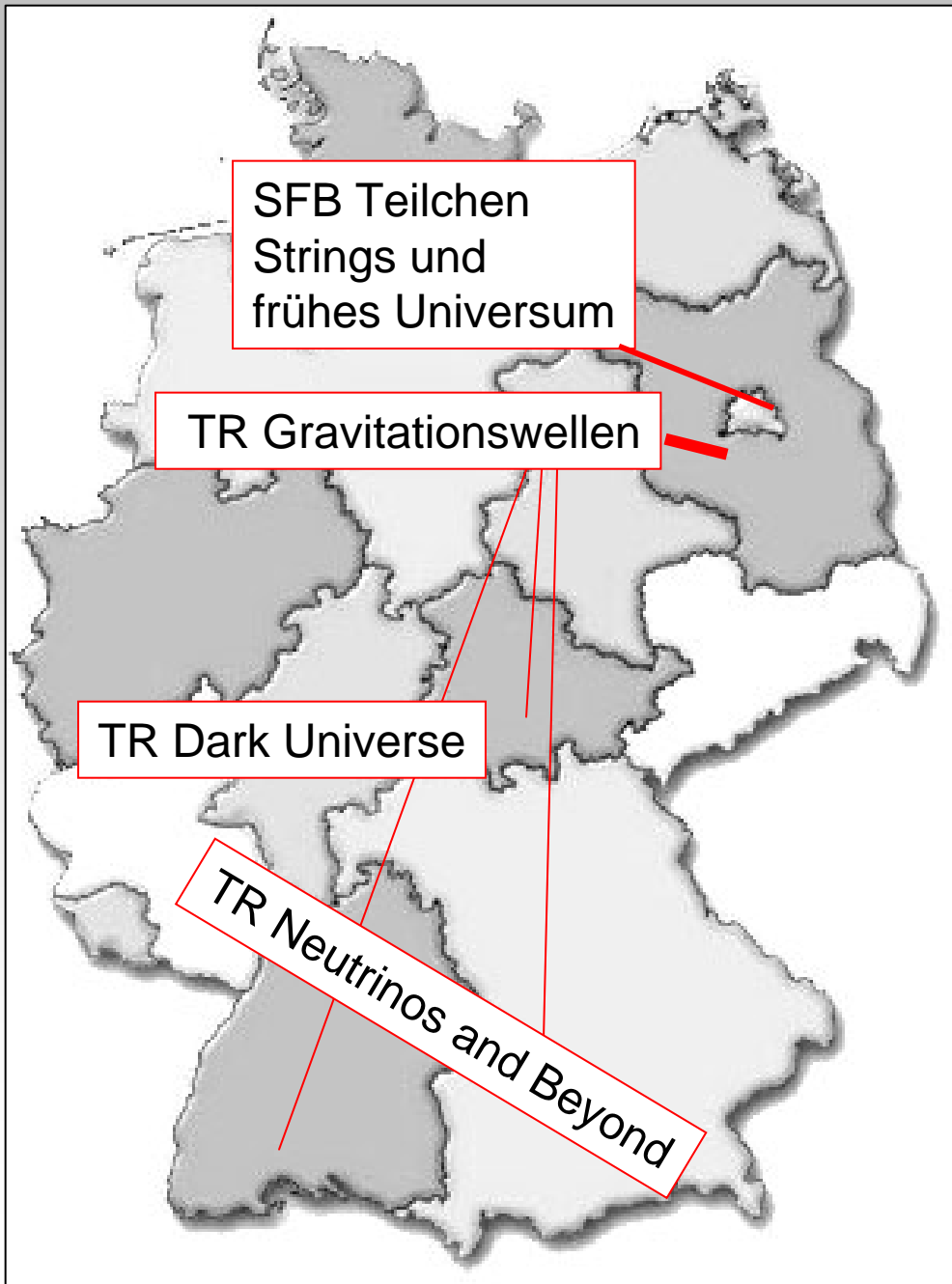
Schwerpunkt
Astroteilchen .
Nachfolge Gensch:
C. Stegmann

(Nukleare Astrophysik)

- 2 (4) Helmholtz-Zentren
- 4 (6) Max-Planck-Institute

AT in Deutschland:

SFBs & TR



Dark Matter: Empfehlung

Wir empfehlen für die nächsten 3 Jahre die gleichgewichtige Förderung beider Technologie-Linien, XENON und EURECA.

Die auf dem gesamten Gebiet engagierten deutschen Gruppen haben sich auf Initiative des KAT zu einer Strategiediskussion getroffen und in deren Ergebnis einen **Arbeitskreis Dunkle Materie** gegründet. Sie werden einen gemeinsamen Antrag für die nächste Förderperiode der Verbundforschung stellen.

Ziel der Förderung soll sein, XENON beim Aufbau von XENON1t zu unterstützen und EURECA bei den vorbereitenden Arbeiten zu fördern. Die Förderung des eigentlichen Aufbaus von EURECA bliebe dann der nächsten Förderperiode vorbehalten.