ASPERA /ApPEC APIF/OECD

Antonio Ferrer

IV CPAN days – RENATA

Granada, Nov 26th, 2012

Introduction

- ApPEC: founded in 2001
- FP6 ERA-NET ASPERA: 2006-2009
- FP7 ERA-NET ASPERA-2: 2009-2012
- ApPEC: MoU signed on June 29th, 2012

Signatories to the ApPEC MOU

1 Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA).
2 Centre National de la Recherche Scientifique (CNRS).
3 Deutsches Elektronen-Synchrotron (DESY).
4 Stichting voor Fundamenteel Onderzoek der Materie (FOM, The Netherlands).
5 Fonds Wetenschappelijk Onderzoek - Vlaanderen (FWO, Belgium).
6 Croatian Science Foundation (HRZZ, Croatia).
7 Horia Hulubei National Institute of Research and Development for Physics and Nuclear Engineering (IFIN-HH, Romania)
8 Istituto Nazionale di Fisica Nucleare (INFN, Italy).
9 Narodowe Centrum Nauki (NCN, Poland)
10 The Royal Irish Academy (RIA, Ireland).
11 Science and Technology Facilities Council (STFC, UK)

ASPERA (FP7 ERA-NET) ends end 2012

ApPEC: MoU signed on June 29th, 2012

ApPEC continues as a Consortium

ApPEC Consortium

ApPEC organization:

- General Assembly (GA)
- Joint Secretariat (JS)
- Scientific Advisory Committee (SAC)

Functional centers:

1. International Contact, Computing and Industrial Relations

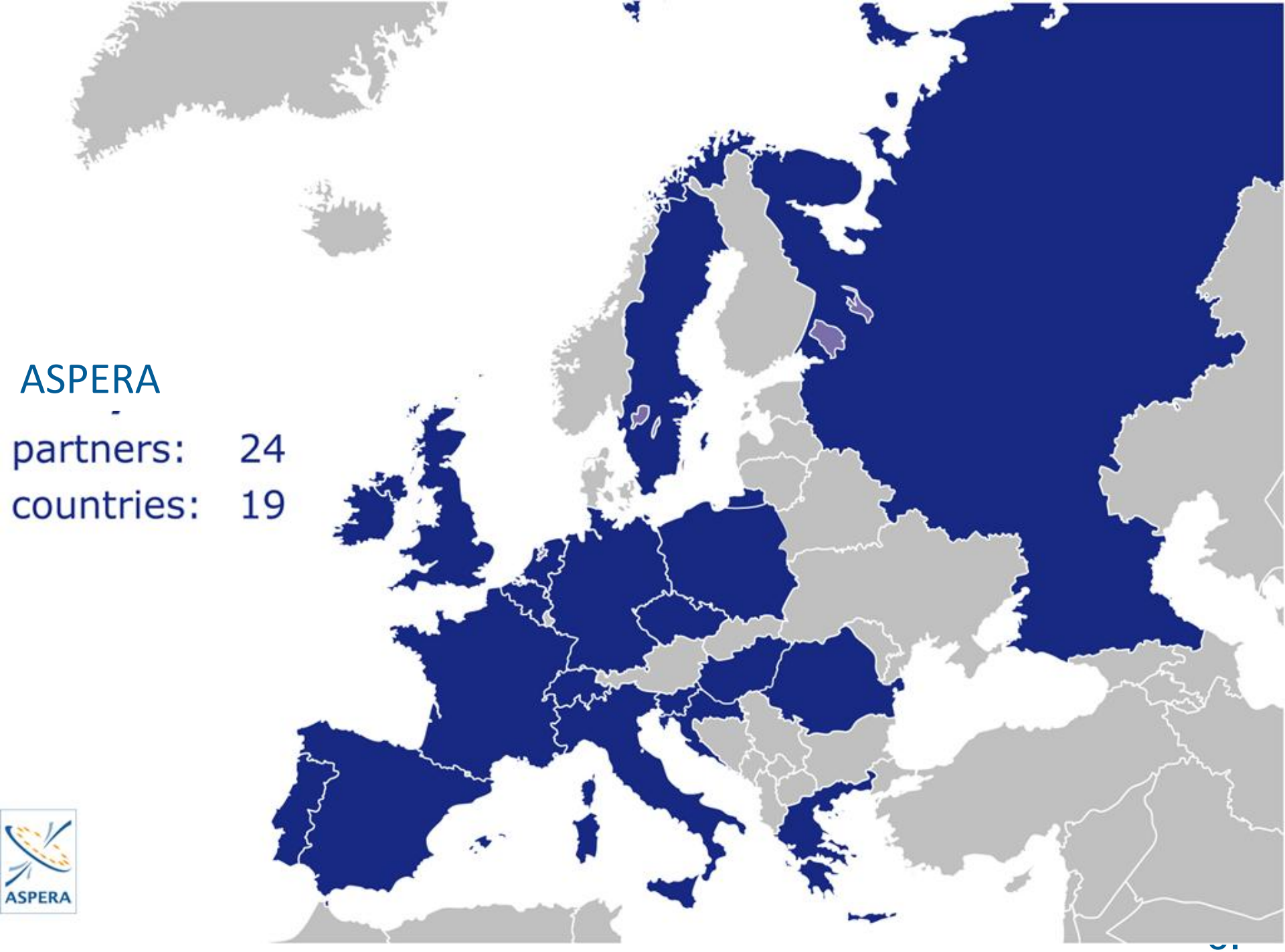
2. Networking, Theory and Education centre

3. Strategic Actions, Interdisciplinarity and Outreach

Laboratorio Subterráneo de Canfranc

Accession of Laboratorio Subterráneo de Canfranc (LSC) to ApPEC

Web portal and contribution to the outreach activities in coordination with ApPEC Partners


ASPERA
partners: 24
countries: 19

Aspera Activities

- Theory
- Computing
- R&D
- Environmental and Applied Physics
- Roadmap
- Census of ApP resources
- Outreach

ASPERA Activities

3 Technology Forums (with participation of SMEs)

Vacuum and cryogenics

Mirrors and lasers

Photosensors and auxiliary electronics

Underground Synergies with Astroparticle Physics

A total of 3 workshops on synergies with Astroparticle Physics

-Underground labs

-Underwater sciences

-From the Geosphere to the Cosmos

Website 2009-2012

WP6: Outreach and electronic tools (MICINN)

FECYT

Task 6.2: ASPERA Website: the Astroparticle Physics communication platform (MICINN)

The ASPERA website (www.aspera-eu.org) has accomplished all the objectives set during ASPERA-1. The network is now an important tool for the coordination of all the activities as well as an information platform. The web server is situated in Spain, and its maintenance allows having full time **availability**.

In addition to the present functionalities of the web page, there are several improvements that have to be implemented. A better **intranet service** has to be developed and the **tool for the common call** procedures, that is presently being designed, has to be implemented and frequently used during ASPERA-2. We plan to enlarge and update several content databases (**experiments, infrastructures**) to make the ASPERA-2 website the global reference in Astroparticle Physics activities. New **inputs** are expected from the previous work packages and they will be also integrated in the ASPERA website.

Outreach Tools

Facebook:

http://www.facebook.com/pages/Astroparticle/370095912571

twitter:

http://twitter.com/astroparticle

bit.ly:

s.aspera-eu.org

http://www.Astroparticle.org

Tracking

Astroparticle Physics experiments

Cosmic Rays (CR)
Cosmic Rays HE
ARGO-YBJ
Auger
CODALEMA
EUSO
KASCADE-Grande
LOFAR
LOPES
NuMoon
TUNKA
Cosmic Rays LE
AMS
CREAM
PAMELA
TRACER

Cosmology (Cosmo)
PLANCK

Dark Matter/Dark Energy (DM-DE)
ANAIS
ArDM
BAO
CAST
Cosmo mm (DE)
CRESST
DAMA/LIBRA
DRIFT
EDELWEISS
EURECA
GENIUS-TF
HDMS
LUX
PICASSO
PVLAS
ROSEBUD
SIMPLE
WARP

Gamma Rays (GR)
AGILE
CTA
GAW
FERMI (formerly GLAST)
H.E.S.S.
Integral
MAGIC
VERITAS

Gravitational Waves (GW)
advLIGO
AURIGA
DUAL
E.T.
GEO 600
LIGO
LISA
LISA PF
MiniGRAIL
ROG
VIRGO/EGO

Neutrinos High Energy (NU-HE)
ANTARES
IceCube
KM3NeT
NEMO
NESTOR
Baikal NT200
Double CHOOZ

Neutrinos Low Energy (NU-LE)
Double Beta
COBRA
CUORE
CUORICINO
EXO
GERDA
NEMO-3
SuperNEMO
TGV
Low Energy Neutrinos
BOREXINO
CTF
GLACIER
ICARUS
LENA
LVD
MEMPHYS
SNO
SNO+
Single Beta
KATRIN
MANU2
MARE
MIBETA

ASPERA 2009 Census

Personnel

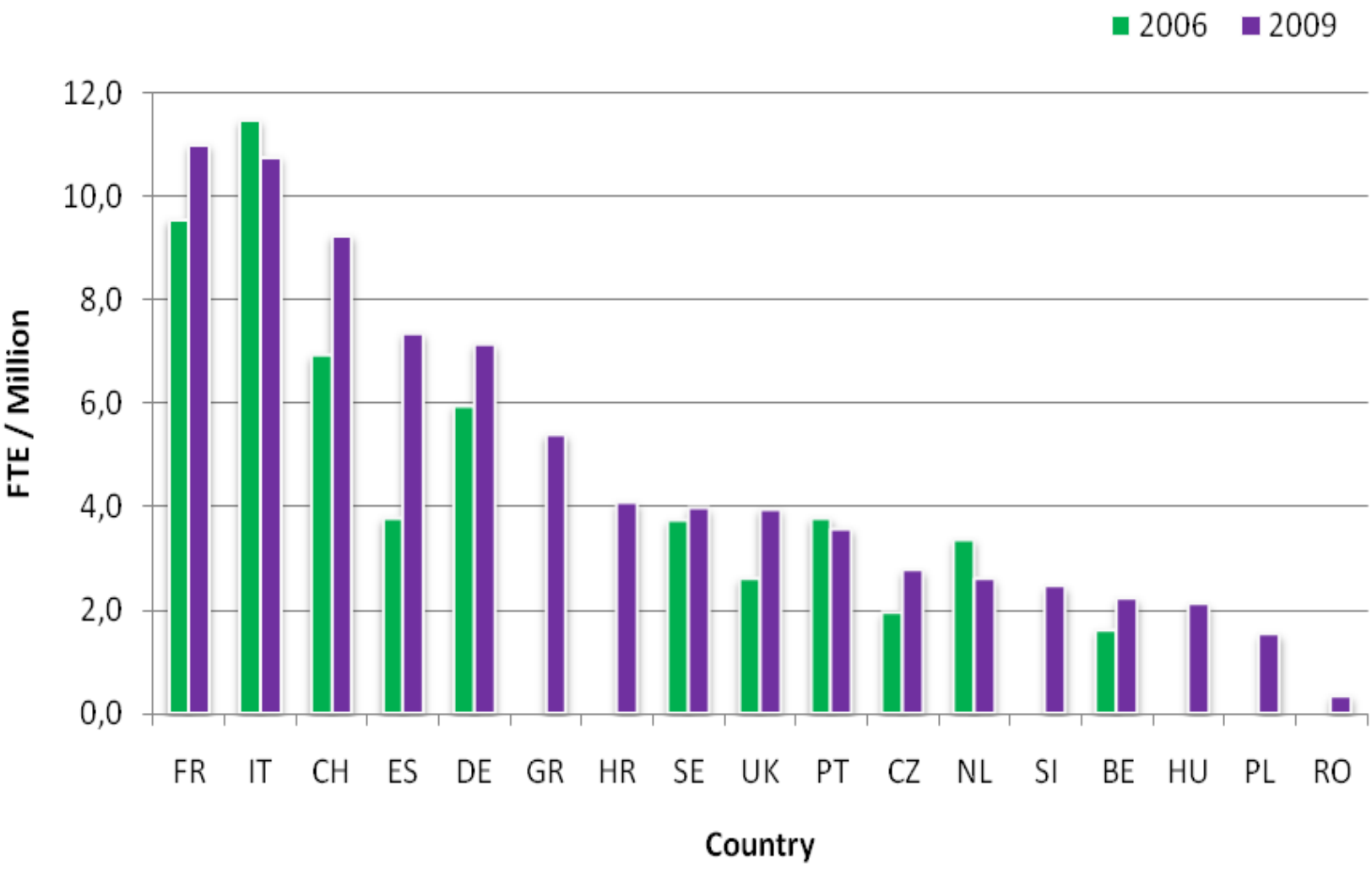
Institutions & laboratories

Experiments funding

ApP personnel (FTE), population and ratio

	Personnel ApP		Population		Personnel ApP / Population	
	2006	2009	2006	2009	2006	2009
	FTE	FTE	Million	Million	per Million	per Million
BE	17	24	10,6	10,8	1,6	2,2
CH	52	72	7,5	7,8	6,9	9,2
CZ	20	29	10,3	10,5	1,9	2,8
DE	490	584	82,3	81,8	6,0	7,1
ES	**168***	**338**	**44,5**	**46,0**	**3,8**	**7,3**
FR	608	712	63,6	64,7	9,6	11,0
GR		61	11,2	11,3		5,4
HR		18	4,4	4,4		4,1
HU		21	10,1	10,0		2,1
IT	679	650	59,1	60,3	11,5	10,8
NL	55	43	16,4	16,6	3,4	2,6
PL		58	38,1	38,2		1,5
PT	40	38	10,6	10,6	3,8	3,6
RO		7	21,6	21,5		0,3
SE	34	37	9,1	9,3	3,7	4,0
SI		5	2,0	2,0		2,4
UK	158*	245*	60,8	62,0	2,6	4,0
Total	**2321**	**2942**	**462,2**	**468,0**		**6,3**

FTE/total population ratio



Academic institutions in ASPERA countries

Country	2009			2006
	Universities	Research Institutes + National laboratories	Total	Total
BE	4	0	4	4
CH	4	2	6	7
CZ	4	1	5	5
DE	28	10	38	38
ES	**14**	**10**	**24**	**13**
FR	25	3	28	28
GR	5	3	8	8
HR	3	1	4	
HU	3	2	5	
IT	28	7	35	35
NL	6	2	8	8
PL	5	5	10	
PT	5	5	10	5
RO	2	2	4	
SE	5	0	5	3
UK	22	1	23	19
TOTAL	**163**	**54**	**217**	**173**

on-going experiments as for year 2009 in each of the four largest European Underground Laboratories in ASPERA countries

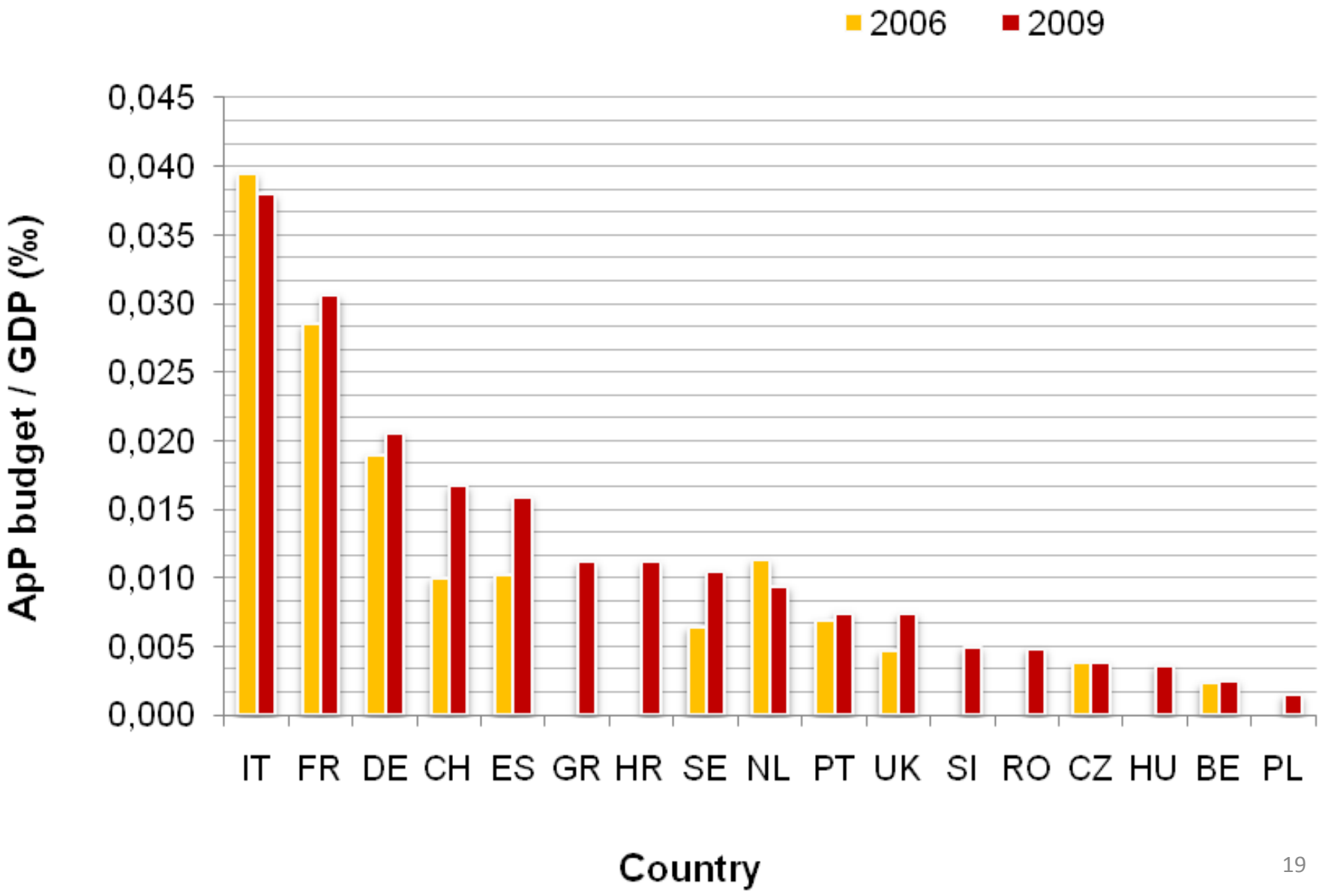
There are two other underground laboratories in ASPERA countries:
Polkowice-Sieroszowice (SUNLAB, Poland) and
Ultra-Low Radiation Background Laboratory (SLANIC, Romania).
* Salaries not included.
** Including 1,3 M€ construction costs.

Lab	**Laboratori Nazionali del Gran Sasso (LNGS)**	**Laboratoire Souterrain de Modane (LSM)**	**Laboratorio Subterráneo de Canfranc (LSC)**	**Boulby Underground Laboratory (BUL)**
Country	**IT**	**FR**	**ES**	**UK**
Experiments (2009)	BOREXINO, COBRA, CRESST, CUORE, ERMES, DAMA/LIBRA, DAMA/R&D, GERDA, GIGS, ICARUS, LUCIFER, LUNA, LVD, OPERA, PULEX2, STELLA, TELLUS, UnderSeiS, VIP, WARP, XENON	EDELWEISS-II, NEMO-3, SHIN, TGV Gamma spectroscopy Logical test failure in microelectronics	ANAIS, ArDM, BiPo, GEODYN, NEXT, ROSEBUD, SUPER-KAMIOKANDE	DRIFT II, SKY-0, ZEPLIN III
Initial investment cost		1,5	3,5	4,6
Annual cost for 2006 (M€)	12,0	1,3	1,6	0,420
Annual cost for 2009 (M€)	9,3*	2,6**	1,3	0,320

Budget, GDP and ratios

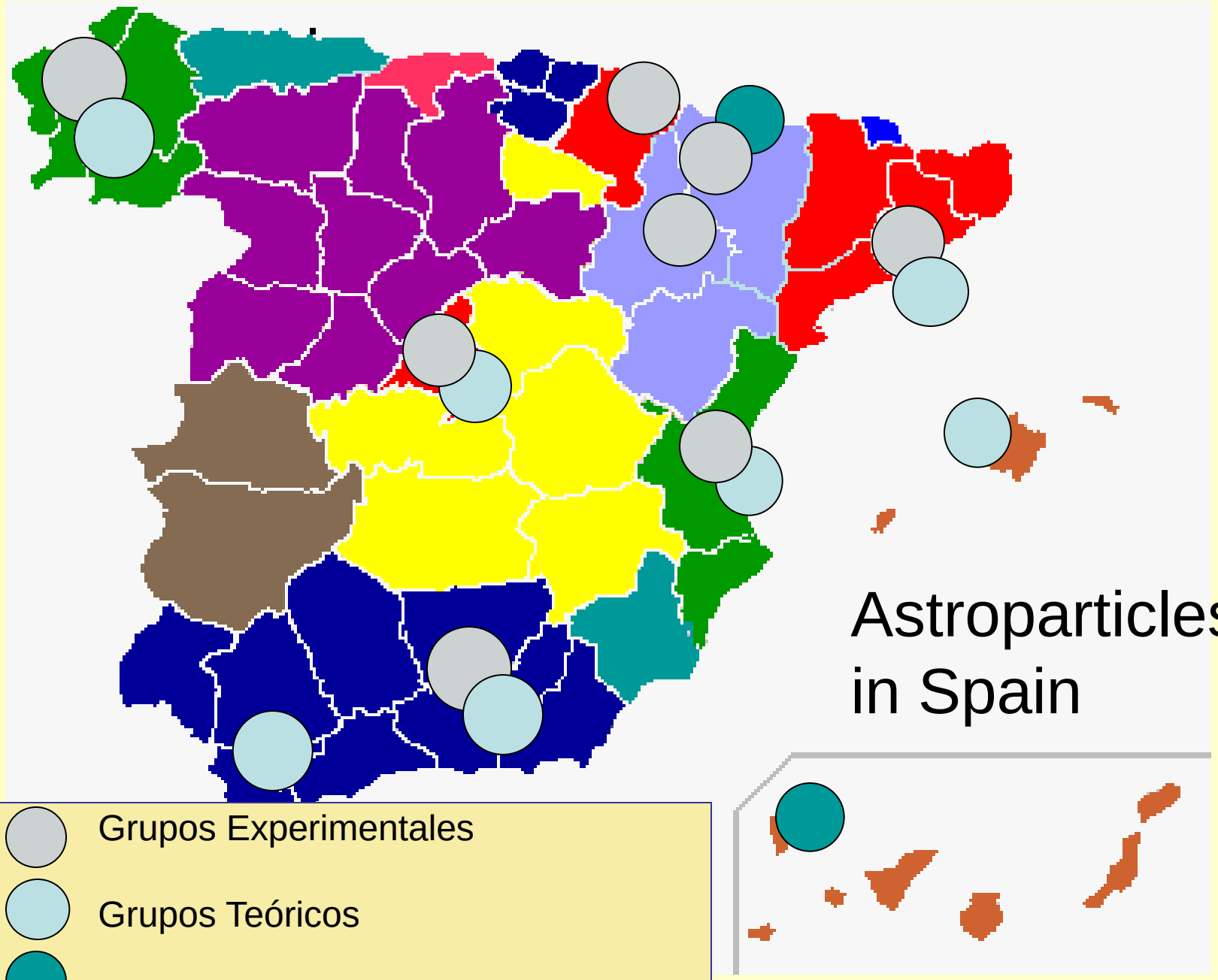
	ApP budget			GDP			ApP Budget / GDP	
	2006	2009	Variation 2006/2009	2006	2009	Variation 2006/2009	2006	2009
	M€	**M€**	**(%)**	**G€**	**G€**	**(%)**	**‰**	**‰**
BE	0,73	0,85	16,4	318,20	337,80	6,16	0,002	0,003
CH	3,10	5,93	77,0	311,90	354,70	13,72	0,010	0,017
CZ	0,43	0,51	14,0	113,70	134,50	18,29	0,004	0,004
DE	44,00	49,56	12,6	2 325,10	2 407,20	3,52	0,019	0,021
ES	**10,00**	**16,70**		**984,30**	**1 051,20**	**6,80**	**0,010**	**0,016**
FR	51,46	59,40	15,4	1 806,40	1 943,40	7,58	0,028	0,031
GR		2,65		210,50	237,50	12,83		0,011
HR		0,48		39,10	45,38	16,05		0,011
HU		0,34		89,90	93,10	3,56		0,004
IT	58,60	57,71	-1,5	1 485,40	1 520,90	2,39	0,039	0,038
NL	6,09	5,35	-12,2	540,20	570,20	5,55	0,011	0,009
PL		0,45		272,10	310,10	13,97		0,001
PT	1,08	1,22	13,0	155,40	163,90	5,47	0,007	0,007
RO		0,56		97,80	115,90	18,51		0,005
SE	2,00	3,00	70,0	313,40	287,90	-8,14	0,006	0,010
SI		0,17		31,10	34,90	12,22		0,005
UK	9,00	11,52		1 944,80	1 566,70	-19,44	0,005	0,007
Total	**186,40**	**216,40**		**11 039,30**	**11 175,28**	**1,23**	**0,017**	**0,019**

ApP budget/GDP

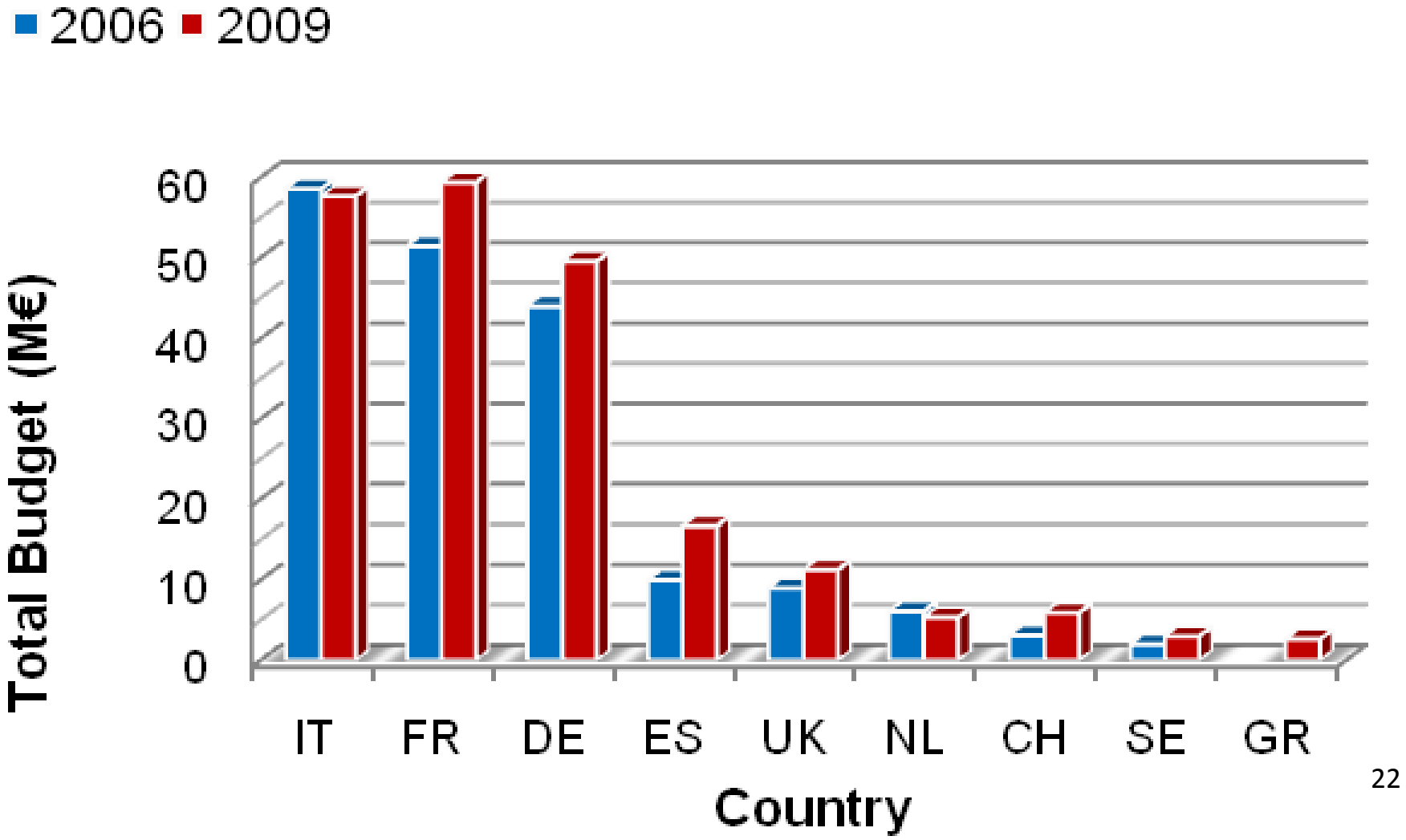


Astroparticles in Spain
24 groups, 7M€/year 2009
344 FTE

1. LSC CANFRANC & CAST	UZ
2. MAGIC/CTA	IFAE-UAB-UCM-UB-IEEC
3. ANTARES	IFIC - UPV
4. AMS	CIEMAT
5. AUGER	USC-UCM-UAH-UGR
6. DES/PAU	IFAE-IEEC-CIEMAT-IFIC-UAM
7. LIGO/VIRGO/GEO/LISA	UIB-ICE
8. 2-CHOOZ	CIEMAT
9. NEXT/SuperNEMO	IFIC-UZ-UPV-USC-UAM
10. EUSO	INTA-UAH-UC3M
11. FERMI	IEEC
12. INTEGRAL	CAB-INTA-UA-UVEG
13. Planck	IAC-IFCA-UGR


Astroparticles
in Spain
Grupos Experimentales
Grupos Teóricos
Infraestructuras Científicas

Total budget per country



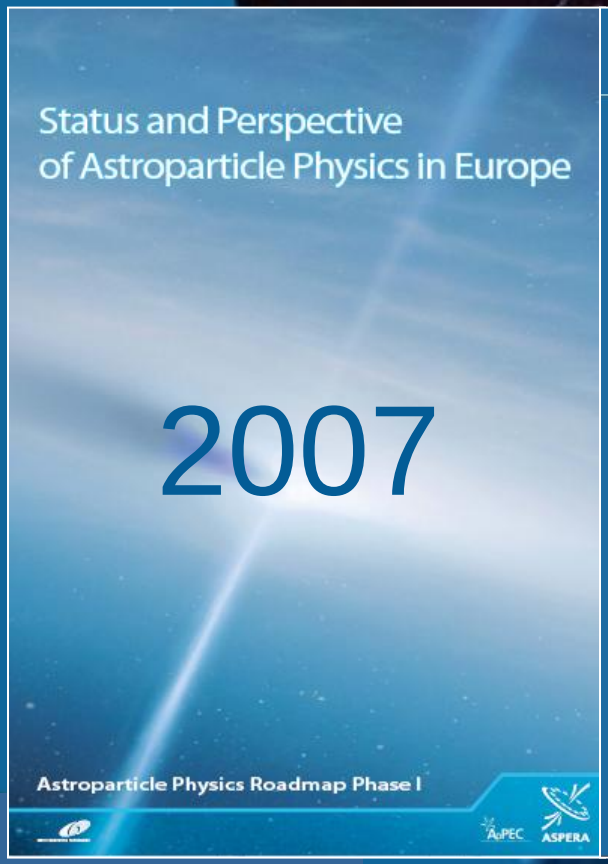
Astroparticle Physics

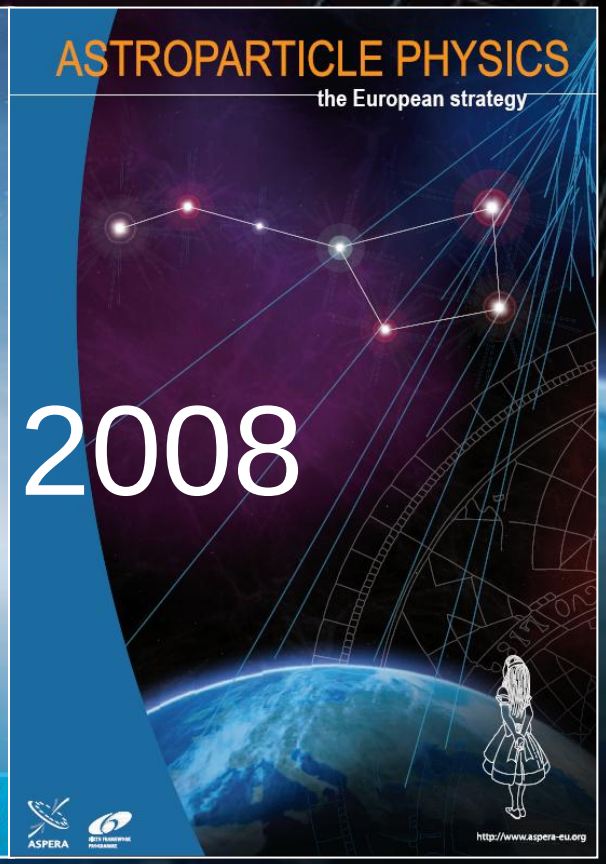
The 2011 ASPERA Roadmap

http://www.aspera-eu.org

Christian Spiering, DESY

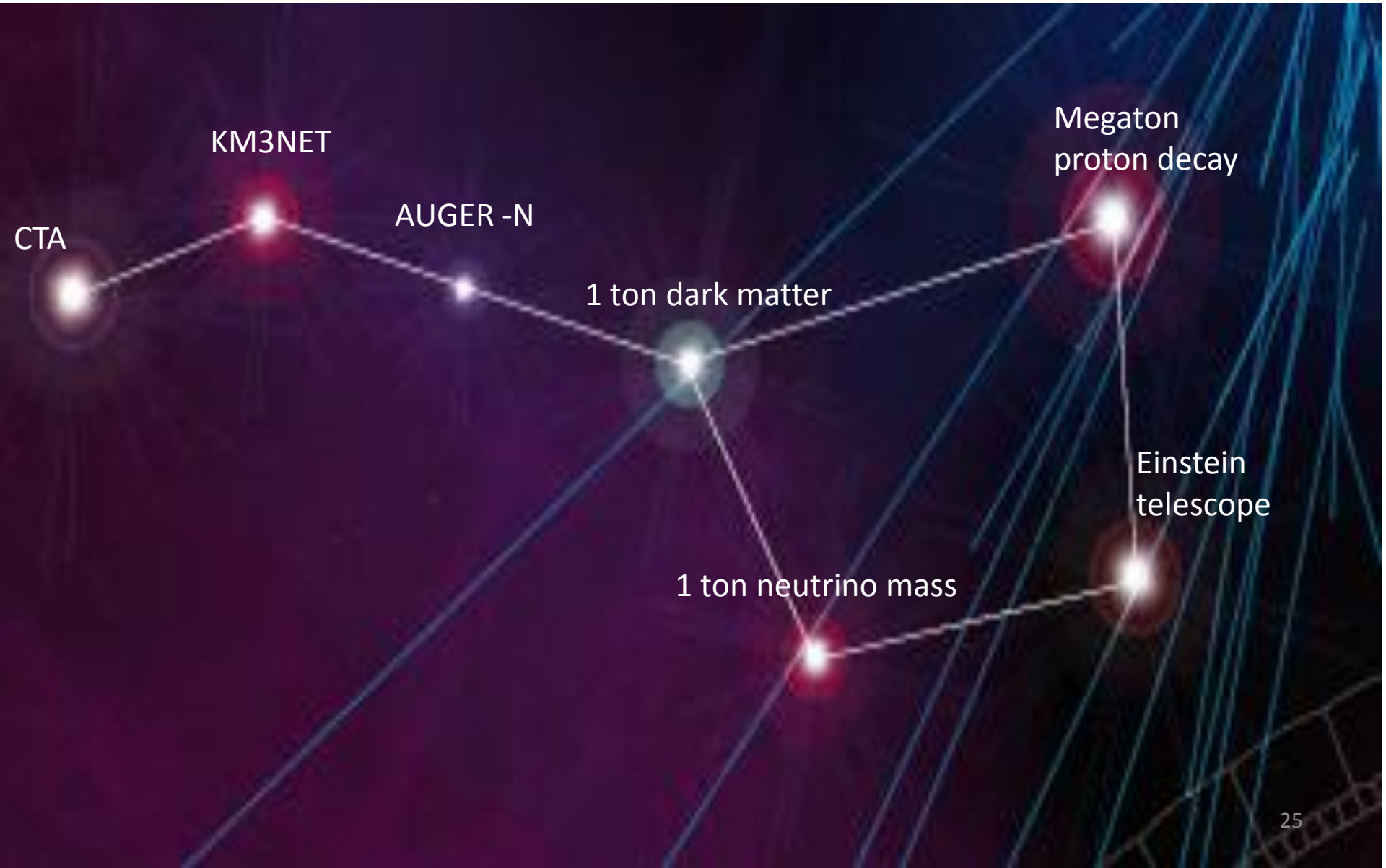
Paris, Nov. 21, 2011





http://www.aspera-eu.org

The 7 magnificent ASPERA-1 Rdmap



Common Call Tool

Roles

- User (edit proposal): Applicants
- Referee (view proposals, edit evaluations)
- Observer (view proposals and evaluations): National Contacts, Program Committe, Evaluation Panel
- Manager (view and modify, asign referees): Call Secretariat
- Administrator (create users): technical staff

Number of proposals

- 2009: 5 proposals (Gamma rays, Dark Matter)
- 2010: 4 proposals (Cosmic rays, Neutrinos)
- 2012: 2 proposals (G. Waves, Neutrino)

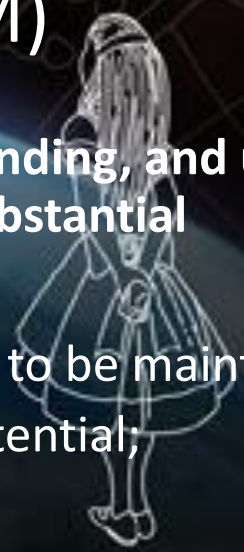
- Medium scale, ongoing/extension
- Large scale (few hundred M€), mid of decade
- Very large scale (several hundred M€ to G€), end of decade

Medium scale

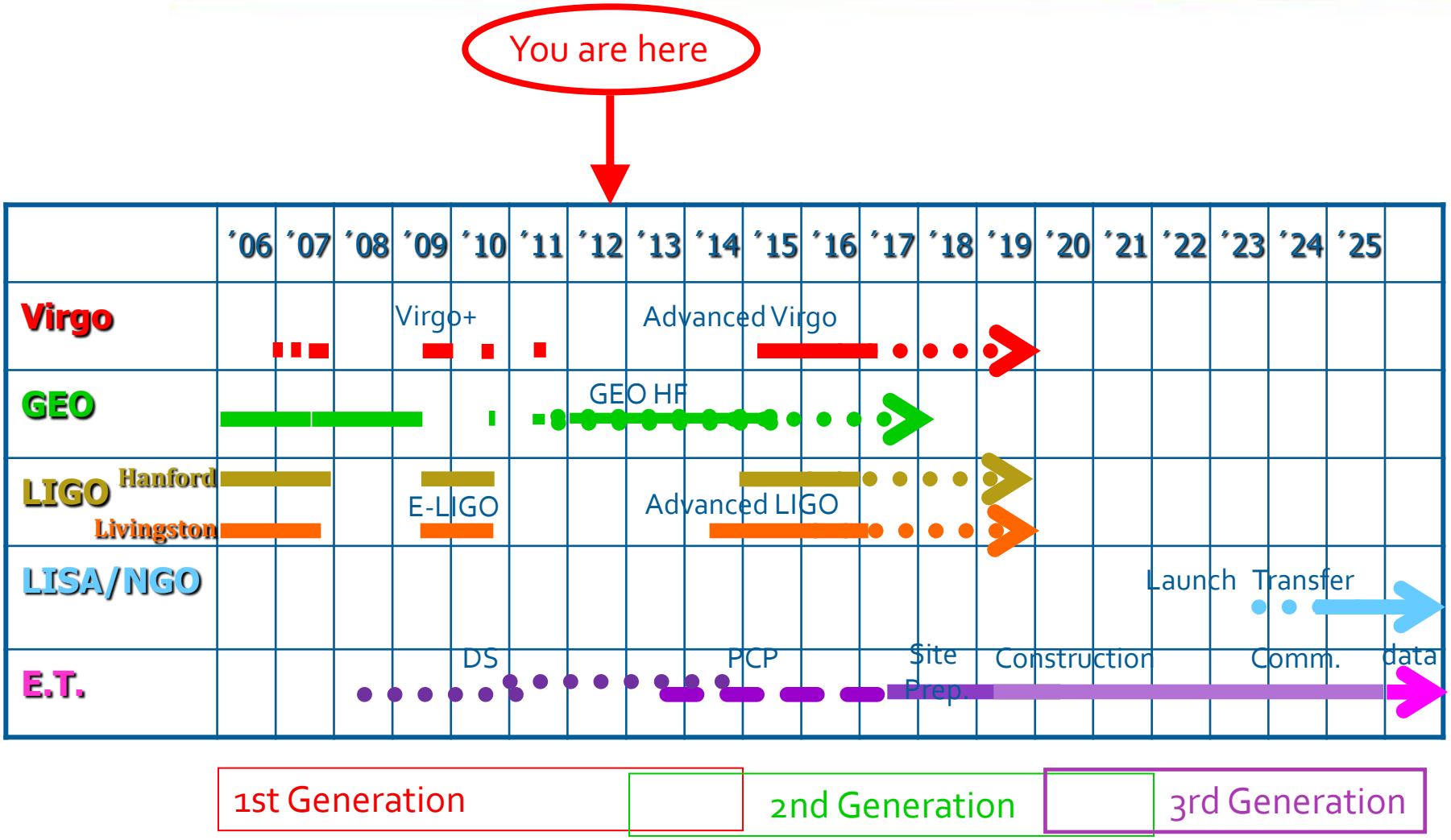
- Advanced detectors for gravitational waves
- Dark Matter
- Neutrino properties
- Extension of the Modane Underground Laboratory (LSM)

"We prioritize these projects for immediate funding, and urge agencies to join their forces for an effective, substantial support"

- impressing momentum which needs to be maintained;
- enter a region with high discovery potential;
- hand in hand with LHC physics;
- technologically ready and worldwide community



GW Timelines

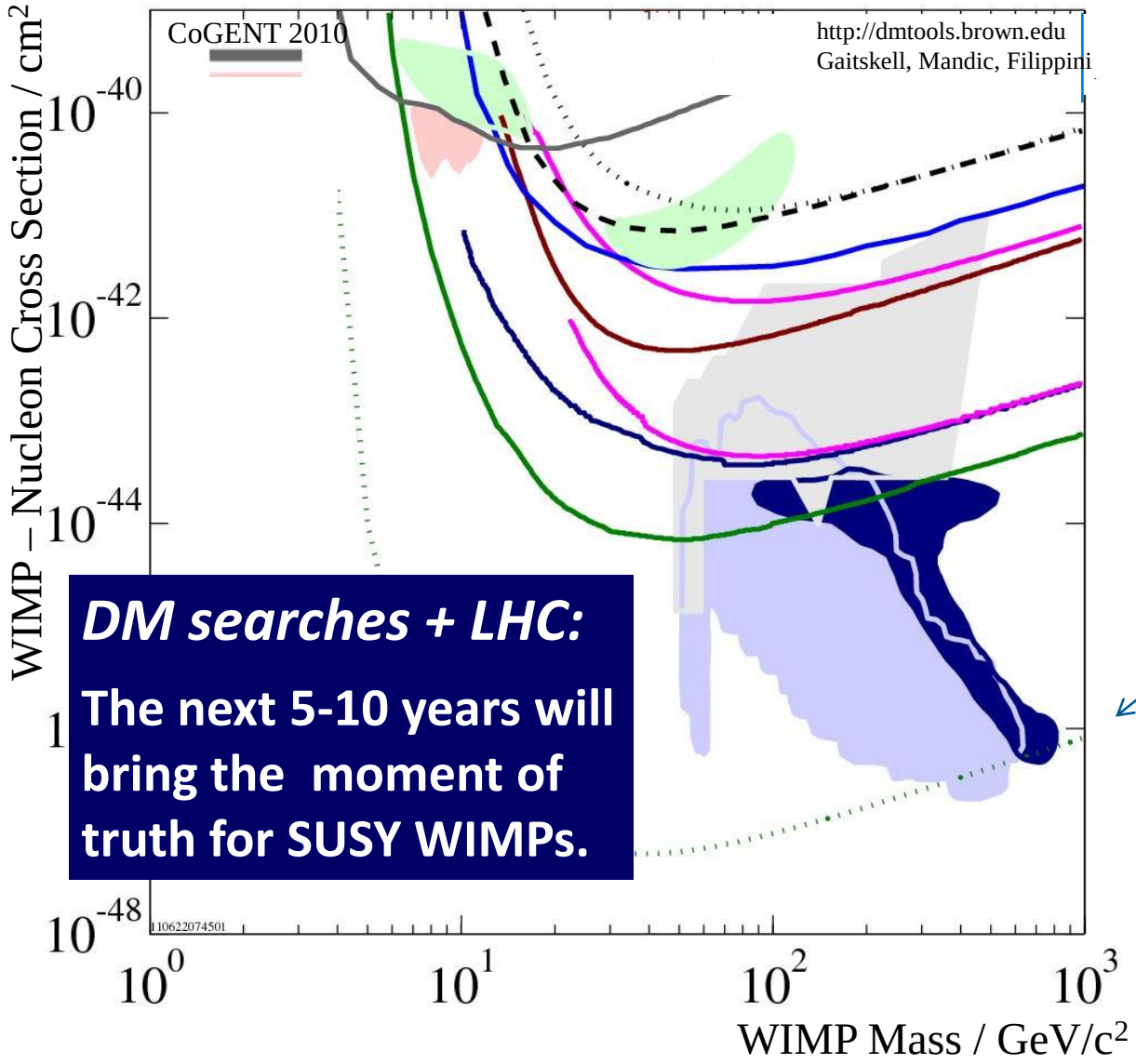


Recommendations Gravitational Waves
Advanced Detectors

With advanced VIRGO, advanced LIGO and GEO-HF, a discovery in the next five years becomes highly probable. This would open an entirely new window to the Universe.

We urge the agencies to continue substantially supporting the on-going and planned upgrades to advanced detectors.

DM: Towards the ton scale



DM searches + LHC:

The next 5-10 years will bring the moment of truth for SUSY WIMPs.

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

~ 0.002 cts / kg / d
goal 1ton projects

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

Other DM activities

- NAI
  - DAMA/LIBRA @ Gran Sasso
  - ANAIS @ Canfranc
  - IceDM @ South Pole?

The committee strongly supports improving the DAMA/LIBRA experiment in terms of a lower detection threshold and a lower background, in order to better understand the modulation signal. A fully independent experiment based on the same or on a similar technology would be crucial to cross-check the DAMA/LIBRA effect.

- LAr
  - WARP @ Gran Sasso
  - ArDM @ Canfranc
  - Darkside @ Gran Sasso

The committee endorses an expansion of the experiment SIMPLE with a lower background level in order to further increase its sensitivity to spin-dependent interactions. This search can be done in synergy with the possibilities provided by xenon (about 50% nuclei have half integer spin) and by the bolometric approach which offers the chance to study different odd-A target nuclei.

- SIMPLE (superheated droplets @ Rustrel)
- ROSEBUD (R&D for bolom. @ Canfranc)

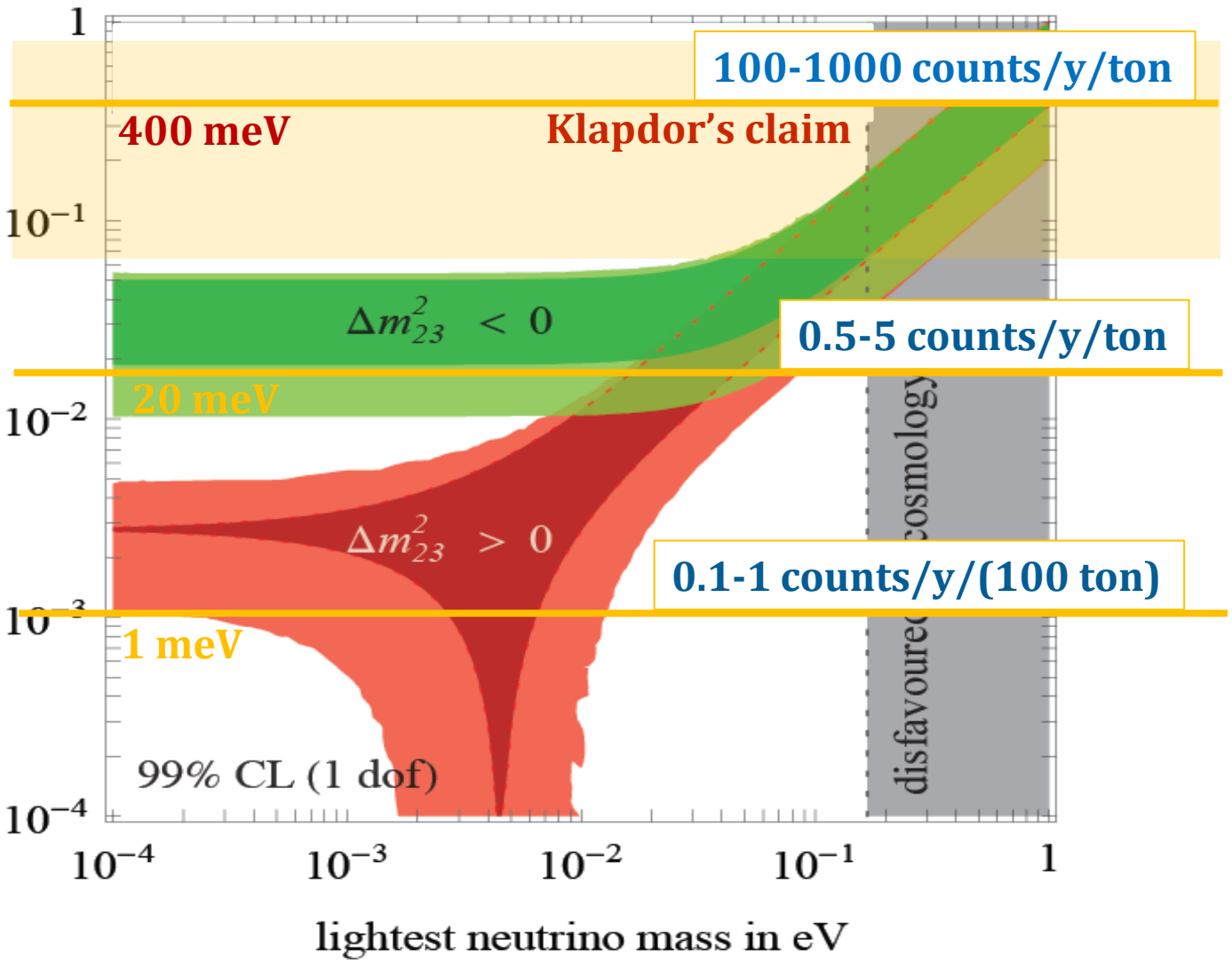
- Directional detectors
  - DRIFT (prototype @ Boulby)
  - MIMAC, DM-TPC, NEWAGE

The committee recommends supporting the R&D activities related to the directional detection of WIMPs, in particular aiming at a substantial background reduction, as this may become essential to confirm the Galactic dark matter origin of the signal in case of a positive signal from the high-density target detectors.

Recommendations Dark Matter

- With the advent of the LHC and thanks to a new generation of astroparticle experiments using direct and indirect detection methods, the well-motivated SUSY - WIMP dark matter hypothesis will be proven or disproven within the next 5-10 years.
- The highly significant annual modulation signal observed by **DAMA/LIBRA**, and its interpretation in terms of dark matter interactions, will also be scrutinized in the next years**.**
- The dramatic progress of the liquid-xenon technology over the past 2-3 years demonstrates a high momentum, which must be maintained. The recently approved **XENON1T** at Gran Sasso laboratory is expected to start operation in 2014/15.
- The bolometric experiments **CDMS** and **Edelweiss** have recently provided upper limits close to those of XENON100 and move towards a closer US-Europe coordination. We recommend supporting the development of **EURECA**, which envisages one ton of sensitive mass, eventually in a common US-Europe framework.
- Looking beyond the scale of one ton, we strongly recommend that **DARWIN,** a program to extend the target mass of noble liquids to several tons, is pursued and supported.

Neutrino-less double beta decay



DBD experiments

GERDA, CUORE, SUPER-NEMO, NEXT

other:

EXO-200:

- Xenon
- Swiss participation in US experiment
- Commissioning

SNO+:

- UK, German Participation in Canada experiment
- Construction

COBRA:

- High CdZnTe crystals operated as semiconductor detectors
- LNGS
- Advanced prototyping

LUCIFER:

- scintillating bolometers (^{82}**Se,** ^{100}**Mo,** ^{116}**Cd)**
- LNGS, LSM ?
- Prototyping

Large scale, mid of decade:

- TeV gamma-ray astrophysics: CTA
- High energy neutrinos: KM3NeT
- High energy cosmic rays: 30,000 km² ground based array
- Low energy neutrinos & p-decay: LAGUNA

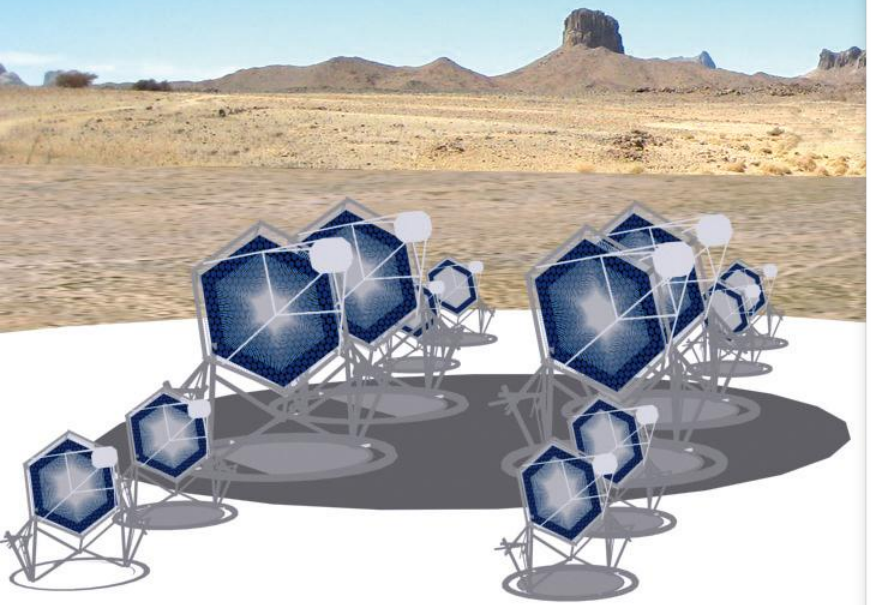
http://www.aspera-eu.org

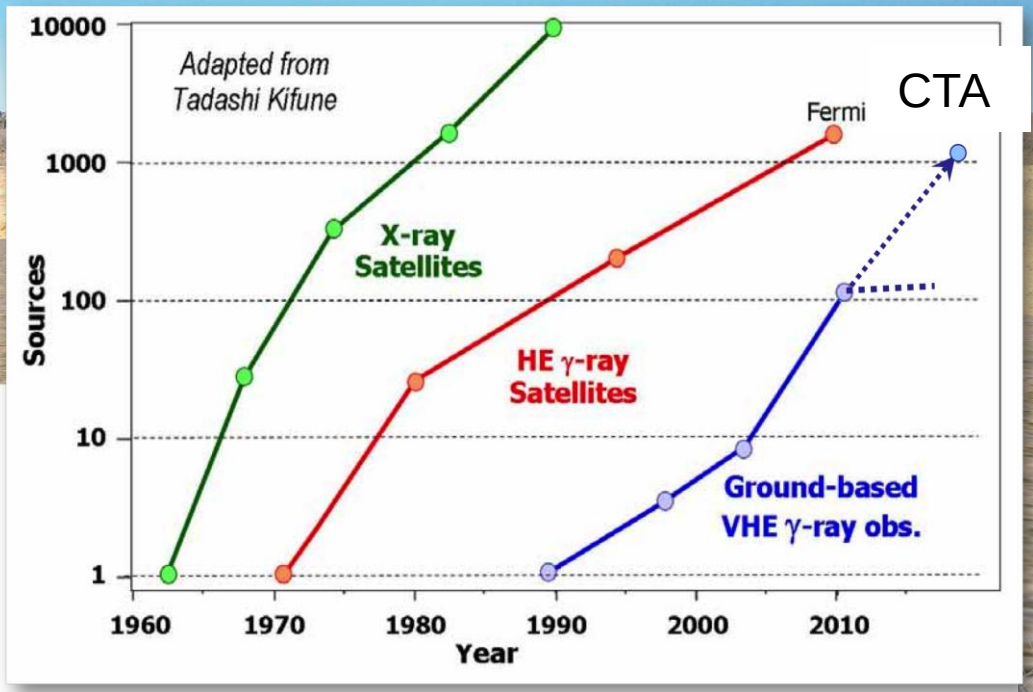
10 fold sensitivity of current instruments
10 fold energy range
improved angular resolution
~1000 sources expected
two sites (North / South)
operated as observatory

World-wide cooperation
25 countries, 132 institutes,800 scientists

The future in VHE gamma ray astronomy:

cta
cherenkov telescope array





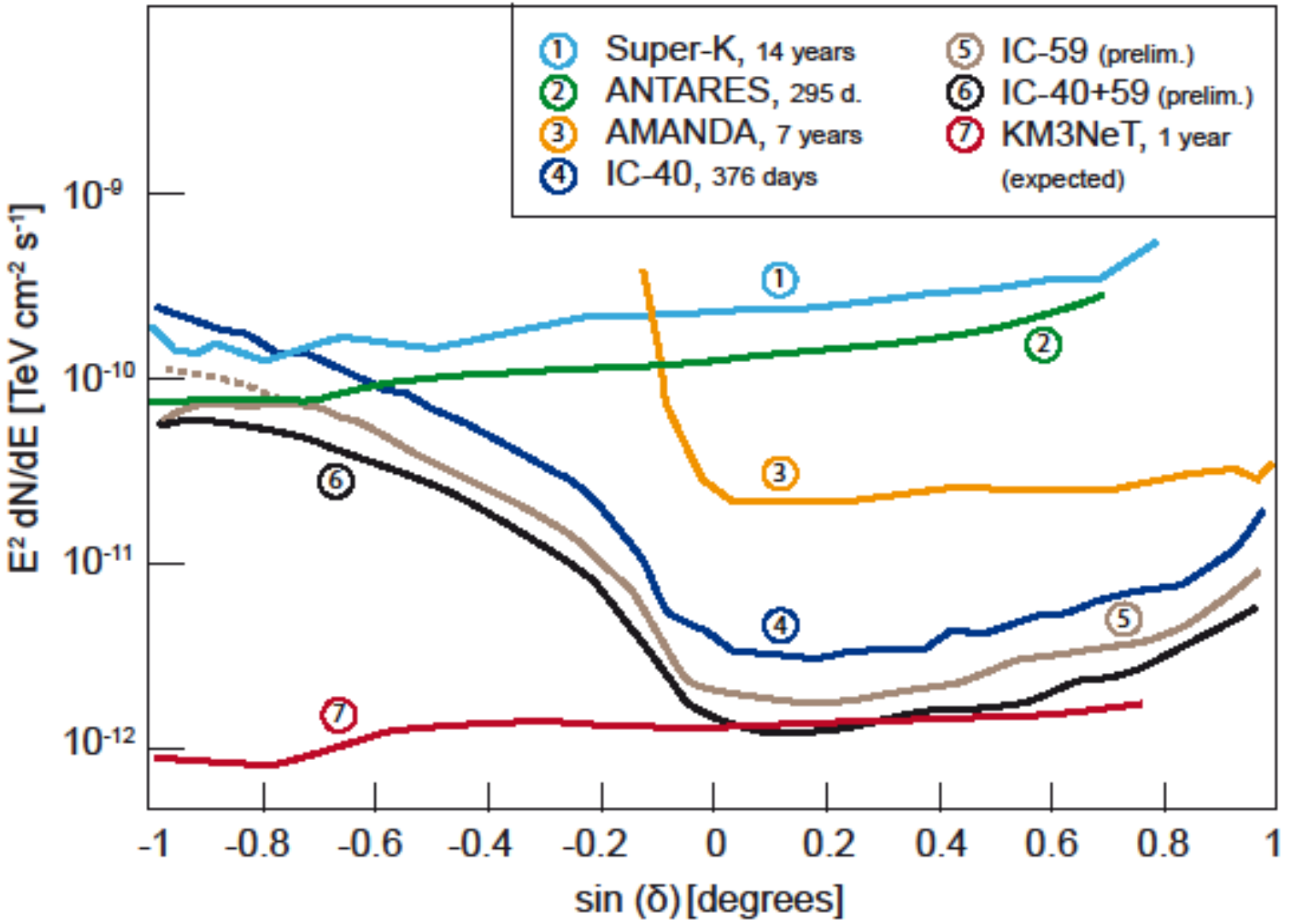
TeV gamma-ray astrophysics:

- The Cherenkov Telescope Array (CTA) is the worldwide priority project of this field. It combines proven technological feasibility with a high speed towards prototyping, with a guaranteed scientific perspective and a mode of operation and wealth of data similar to mainstream astronomy.

- The cost scale of CTA is 200 M€.

- **We recommend to design and to prototype CTA, to select the site(s), and to proceed vigorously towards start of construction in 2014.**

HE neutrinos: Last 12 years: a factor of 1000 !



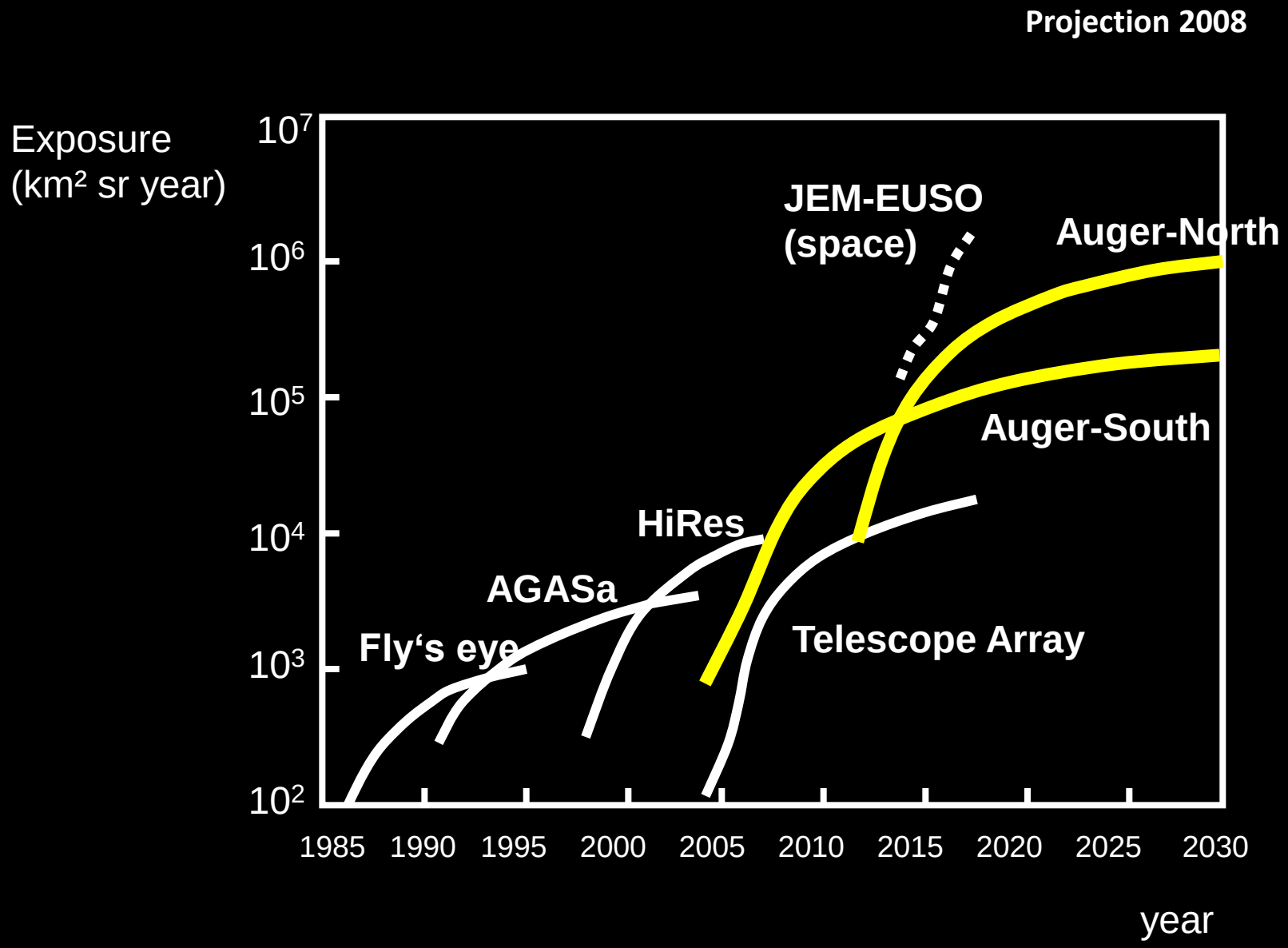
Amanda 2000

IceCube 2012

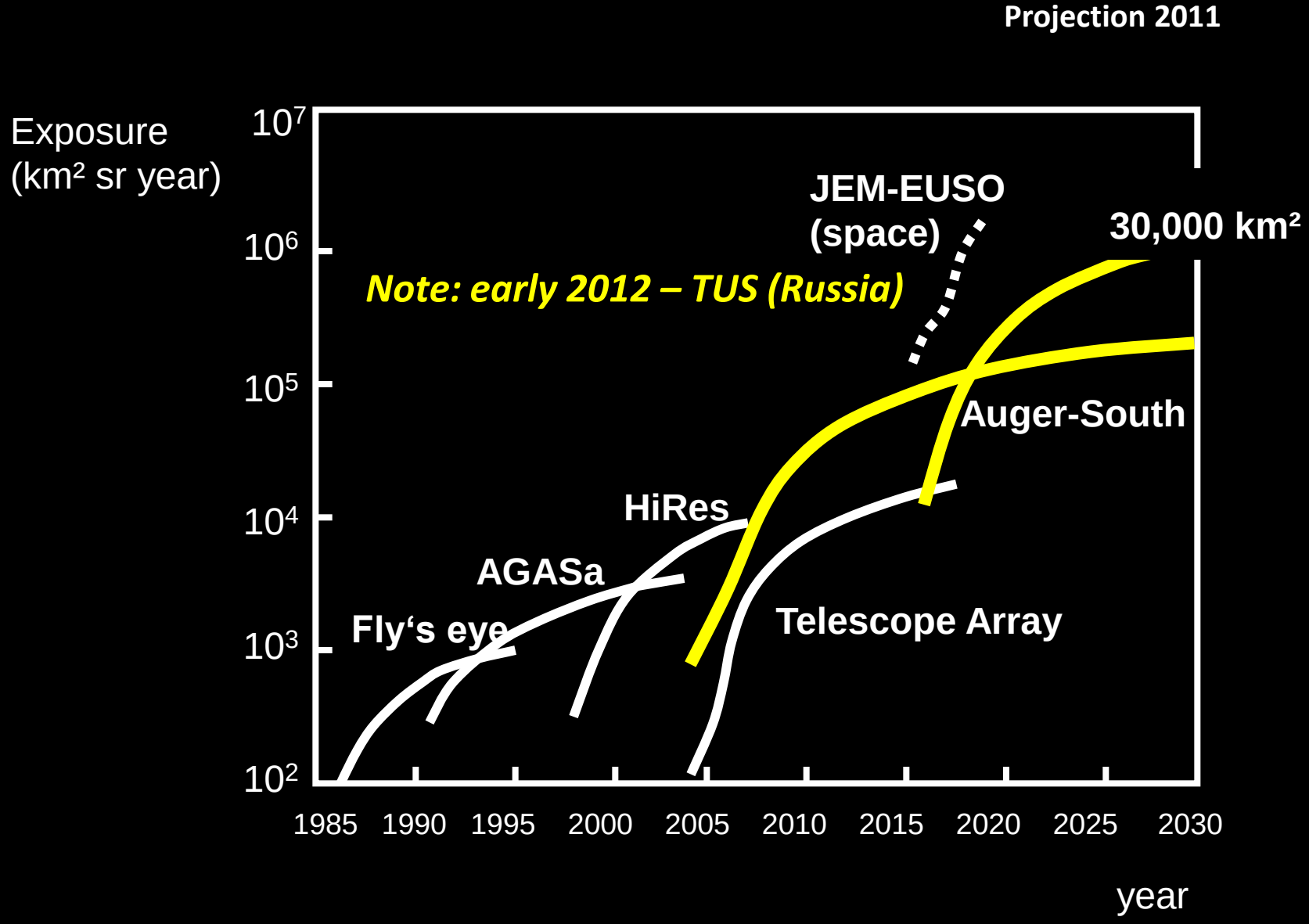
High-energy neutrinos

- IceCube is now providing data with unprecedented quality and statistics. **The European partners should be supported in order to ensure the appropriate scientific return**.
- There is a strong scientific case for a neutrino detector in the Northern hemisphere, with a substantially larger sensitivity than IceCube. **Resources for a Mediterranean detector should be pooled in a single optimized design for a large research infrastructure. The KM3NeT collaboration is encouraged to present a technical proposal matching these requirements and in particular take final site and design decisions that would enable start of construction in 2014.**
- The IceCube, ANTARES and KM3NeT collaborations are encouraged to strengthen cooperation, with the vision to form a **future Global Neutrino Observatory**, including also other projects like GVD-Baikal.
- **Ultra-high energy cosmic neutrinos:** Given the recent indirect constraints from Fermi on the cosmogenic neutrino flux at 10^9-10^{11} GeV, it seems clear that detectors of many tens of cubic kilometers will be necessary to record more than a handful of neutrinos from GZK interactions. **We encourage R&D efforts towards this goal.**

Perspective for cosmic rays at highest Energies



Perspective for cosmic rays at highest Energies



High energy cosmic rays

- We reiterate the definition of a **substantially enlarged ground-based cosmic-ray observatory as the priority project of high energy cosmic-ray physics** – wherever it will be deployed.
- Cost scale 100-150 M€
- We encourage the community to work towards a global common path for such a substantially enlarged observatory including the **development of new detection technologies**. We recommend that **European groups** play a significant role in preparing a proposal for the next generation experiment, and, after its approval, make a **significant contribution to construction and operation**.
- We also support European participation in **JEM-EUSO** with its novel technology. We encourage cross coordination between these two approaches.

Science on the Megaton scale

- **Proton decay:** improve sensitivity by > factor 10 and test a new class of Supersymmetry models
- **Galactic Supernova:** 10^4- 10^5 events
  Incredibly detailed information on the early SN phase
- **Diffuse flux from past SN:** probe cosmological star formation rate
- **Solar neutrinos:** details of the Standard Solar Model determined with percent accuracy
- **Atmospheric neutrinos:** high statistics would improve knowledge neutrino mixing and provide unique information on the neutrino mass hierarchy
- **Geo-neutrinos:** improve understanding of the Earth interior
- **Indirect WIMP search**
- **Neutrinos from accelerators** over a long baseline (also with dedicated smaller detectors): neutrino properties !

Large scale, mid of decade: All Four ?

- The presently conceived start of construction of KM3NeT, “AugerNEXT” and LAGUNA is between 2014 and 2016.
- It seems likely that this does not fit into a realistic funding scheme!
  - **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.**

Very Large scale, end of decade:

- Gravitational Waves:

ET and **LISA**

- Dark Energy:

LSST and

EUCLID

APIF
Astroparticle Physics International Forum

Manel Martínez/ IFAE

Beyond Europe: Astroparticle Physics International Forum **APIF**

- Formed in 2011, under the auspices of the **Global Science Forum** (GSF) of the **Organization for Economic Co-operation & Development** (OECD)
- Outgrowth of **the OECD GSF Working Group on Astroparticle Physics** (2009-2011)
- World-wide forum for funding agency representatives to exchange information and to facilitate coordination and cooperation.
- Analogous to Funding Agencies for Lepton Collider (FALC)

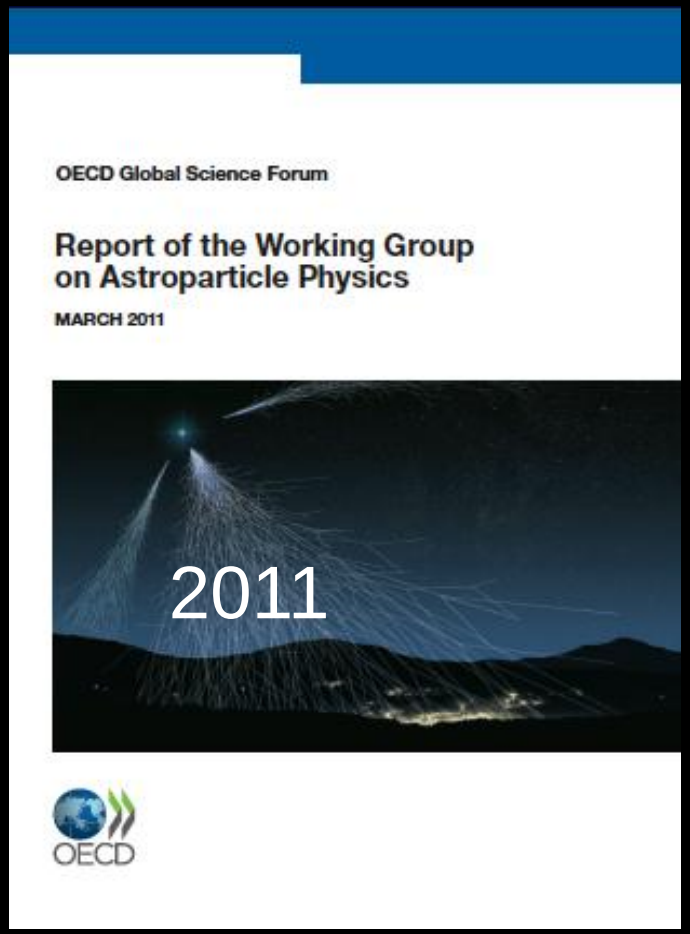
The APIF „Roadmap“

A Worldwide Vision
Creation of APIF

➢ APIF tasks:

- **Exchange information between agencies**
- **Prepare joint actions**
- **Propose solutions for governance structures**
- **Propose solutions to science policy issues, (facility access, operation costs etc)**
- **Engage collective dialogue with governmental and non-governmental entities**
- **Develop strategies for transfer of technology and other benefits to industry and to society in general.**
- **Develop educational and outreach materials.**

www: Google “Astroparticle Physics International Forum OECD”



- Meets twice per year.

- Typical agenda:
  - Short status report of ApP fields worldwide
  - News from each APIF country
  - Discussion of specific issues of general interest. For instance:
    * data access policy,
    * legal, administrative and financial framework for big worldwide projects

- Chair does not represent a funding agency -> Michael Turner (University of Chicago)

- Some scientists representing countries act also as ApP-fields rapporteurs.

Current Members
(Feb.2012)

- Argentina
- Belgium
- Canada
- China
- **European Commission**
- France
- Germany
- India
- Israel
- Italy
- Japan
- Korea
- Netherlands
- Poland
- Russian Federation
- Spain -> Manel Martinez

(+HE messengers rapporteur)

- Sweden
- Switzerland
- United Kingdom
- United States
- Stefan Michalowski (GSF)

Conclusions

ASPERA has managed an interesting coordination job

ApPEC will continue the original task:

New MoU and maybe more resources.

Spain found its place thanks to LSC

BACKUP