



Theory for Astroparticle Physics and Aspera

17 March 2007

S. Katsanevas

Oxford



LES MOTS NOUVEAUX



À l'écoute d'une langue en perpétuel mouvement, forte de ses diversités régionales, le *Petit Larousse* s'enrichit cette année encore d'une centaine de mots, sens, locutions et expressions.

Mots nouveaux

ANTENNE-RELAIS ou **ANTENNE RELAIS** n.f. (pl. *antennes[-relais]*). Émetteur-récepteur d'ondes hertziennes servant à l'acheminement des communications dans un réseau de téléphonie mobile.

GNV ou **G.N.V.** n.m. (sigle de *gaz naturel [pour] véhicules*). Gaz naturel comprimé, utilisé comme carburant automobile. (Il offre un grand intérêt écologique mais son emploi est réservé à des véhicules adaptés.)

ASTROPARTICULE n.f. 1. Domaine de recherche situé à l'interface de l'astrophysique et de la physique des particules. 2. (Général. au pl.) Particule élémentaire constituant un objet d'étude en astrophysique.

INTERMODALITÉ n.f. Utilisation de plusieurs modes de transport au cours d'un même trajet, pour les marchandises ou les voyageurs.

IST ou **I.S.T.** n.f. (sigle). Infection sexuellement transmissible.



What is ASPERA ?

Astroparticle Physics for Europe
> **AS**tro**P**article European Research Area Network (ASPERA)

AStroparticle Physics European Coordination ERAnet

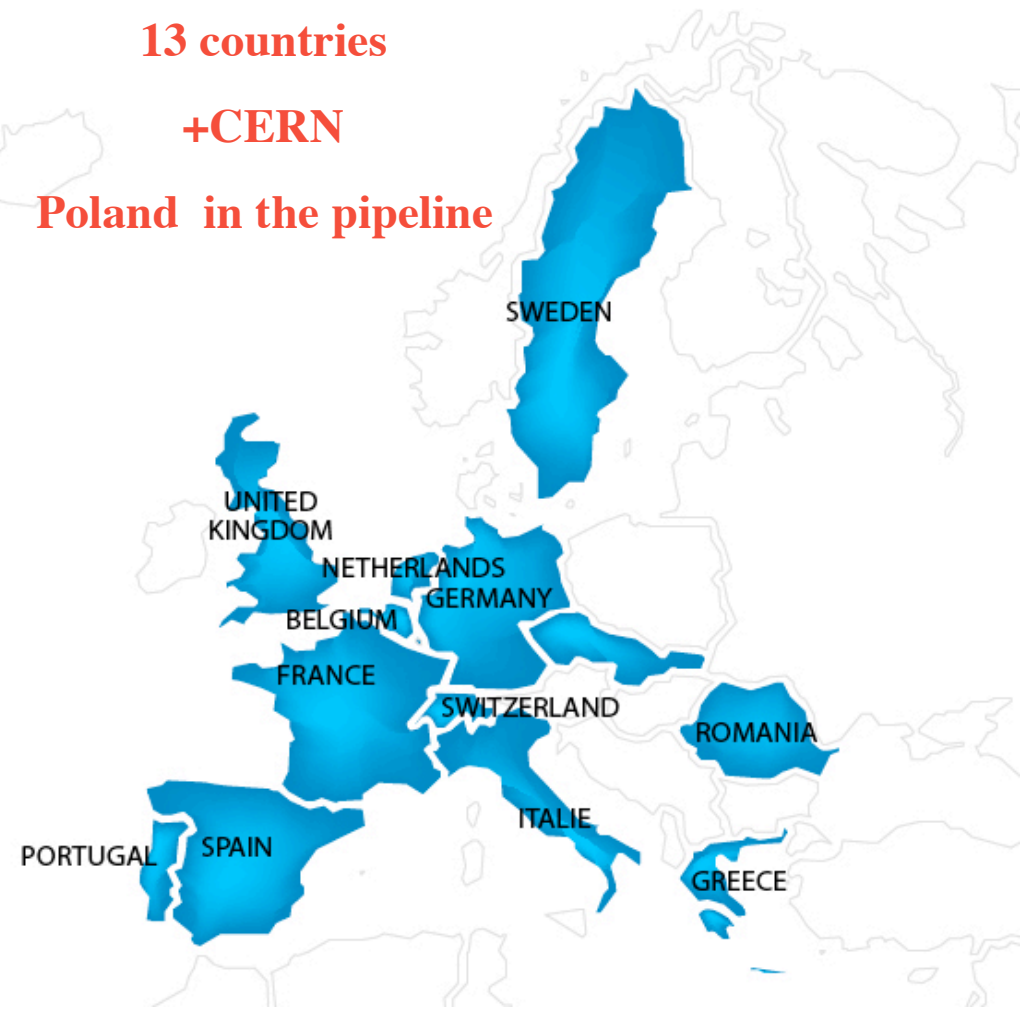
'per aspera ad astra'

> **ASPERA is a European network of national government agencies** responsible for coordinating and funding research in **astroparticle physics**.

> **ASPERA is funded by the European Commission** at the level of 2.5 Million € over a three years period. It started in July 2006.

> **ASPERA arises from the existence of ApPEC** (Astroparticle Physics European Coordination).

13 countries
+CERN
Poland in the pipeline



- **Study funding and evaluation of Astroparticle Physics in Europe**
 - **Study each others system (informal "visiting committees")**
 - **Identify formal and legal barriers to inter-european coordination**
 - **Study historical emergence of astroparticle**

- **Define a roadmap on infrastructures**
 - **Examine the links to R&D, Theory and Computing**
 - **Explore further linking of existing astroparticle infrastructures**
 - **Examine relations to existing international structures (eg. CERN)**

- **Implement joint programming of large infrastructures**
 - **Install a common information and outreach system.**
 - **Launch common actions (e.g. common fund for design studies)**
 - **Implement new European-wide, synchronised, procedures of common funding of large infrastructures**



> ASPERA organization

Governing Board

T. Baez, D. Bertrand, M. Bourquin, C. De Clercq, D. Espriu, P. O. Hulth, R. Koeple, F. Linde, I. Ridky, J. Seed, M. Spiro, R. Petronzio, M. Pimenta, D. Schlatter, I. Siotis, J. Zinn Zustin

Peer Review Comitee

Elena Aprile, Laura Baudis, Jose Bernabeu, Pierre Binetruy, Christian Spiering, Franz v. Feilitzsch, Enrique Fernandez, Andrea Giuliani, Werner Hofmann, Uli Katz, Paul Kooijman, Paolo Lipari, Manel Martinez, Antonio Masiero, Benoit Mours, Francesco Ronga, Sheila Rowan, Andre Rubbia, Subir Sarkar, Guenther Sigl, Gerard Smadja, Nigel Smith, Lucia Votaw

Coordinator, co-coordinator

S. Katsanevas, T. Berghoefer

Joint Secretariat

T. Berghoefer, C. Cavata, A. Coates, B. Dettore, A. Ferrer, J. Gillies, N. Olivier, D. Van Der Steenhoven

WP1

Status in Research Funding
G. Van Der Steenhoven

WP2

Roadmap
A, Coates

WP3

European Wide Procedures
B. Dettore

WP4

Electronic Infrastructure,
Outreach, Extension
T. Berghoefer

> **The Governing Board (GB)** responsible for all management decisions of the network and for approval of all documents

> (overlap with ApPEC SC)

> **The Joint Secretariat (JS)** assures the day-to-day follow up of the program.

> **The Peer Review Committee (PRC)** responsible for the evaluation of the network's activities

> (the same as the ApPEC PRC)

>Status of Astroparticle funding: WP1 findings

- **2000 FTE Astroparticle Physics in Europe**
- **70 M€/year in investment**
- **A complex landscape**

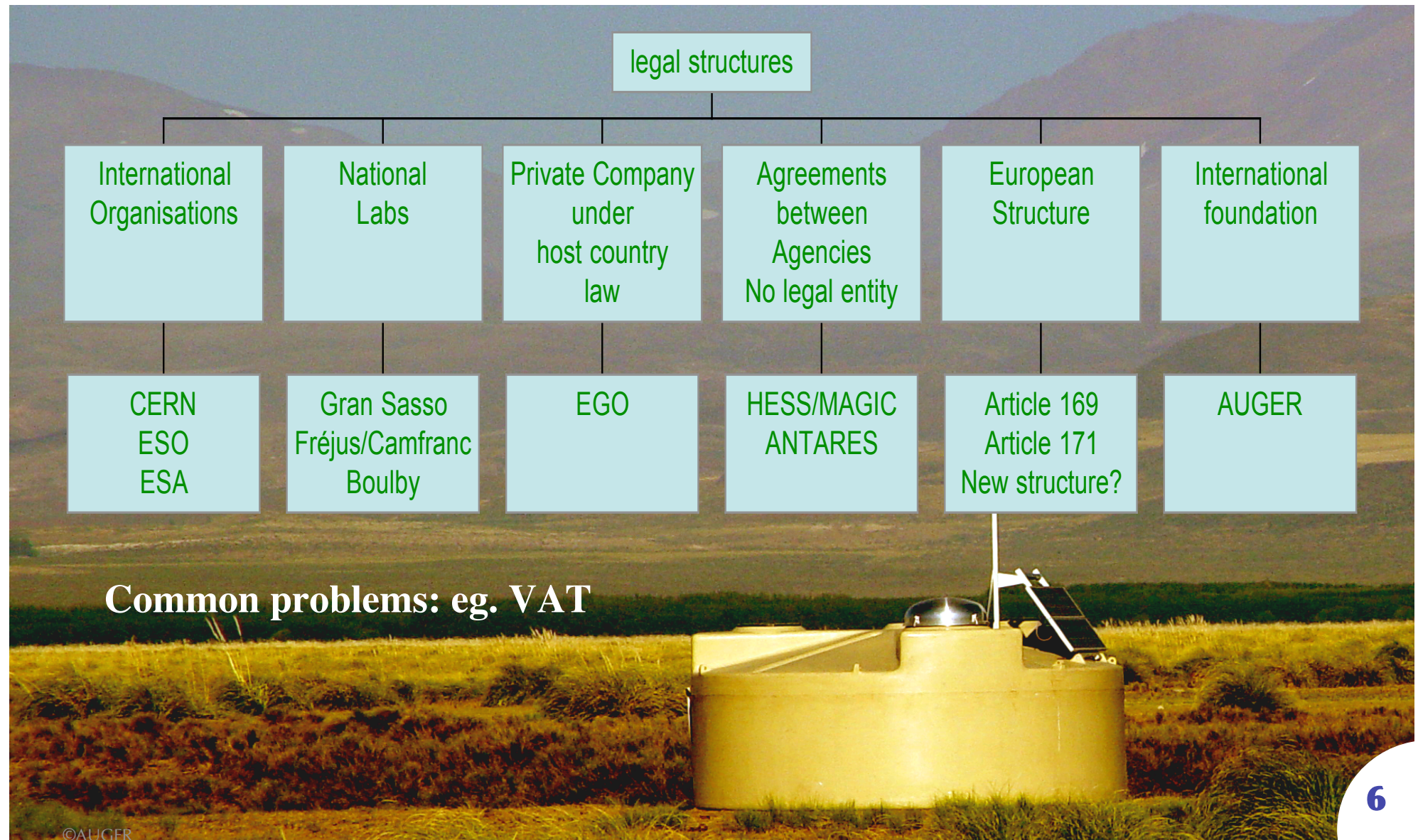
National Institutes: funds through internal evaluation for multi-annual projects

Ministries of Research funds from open calls to large infrastructures

Research Councils: grants through open calls

Large University Campuses or Large National Laboratories funds for their own research

>Status of Astroparticle funding: WP1 findings



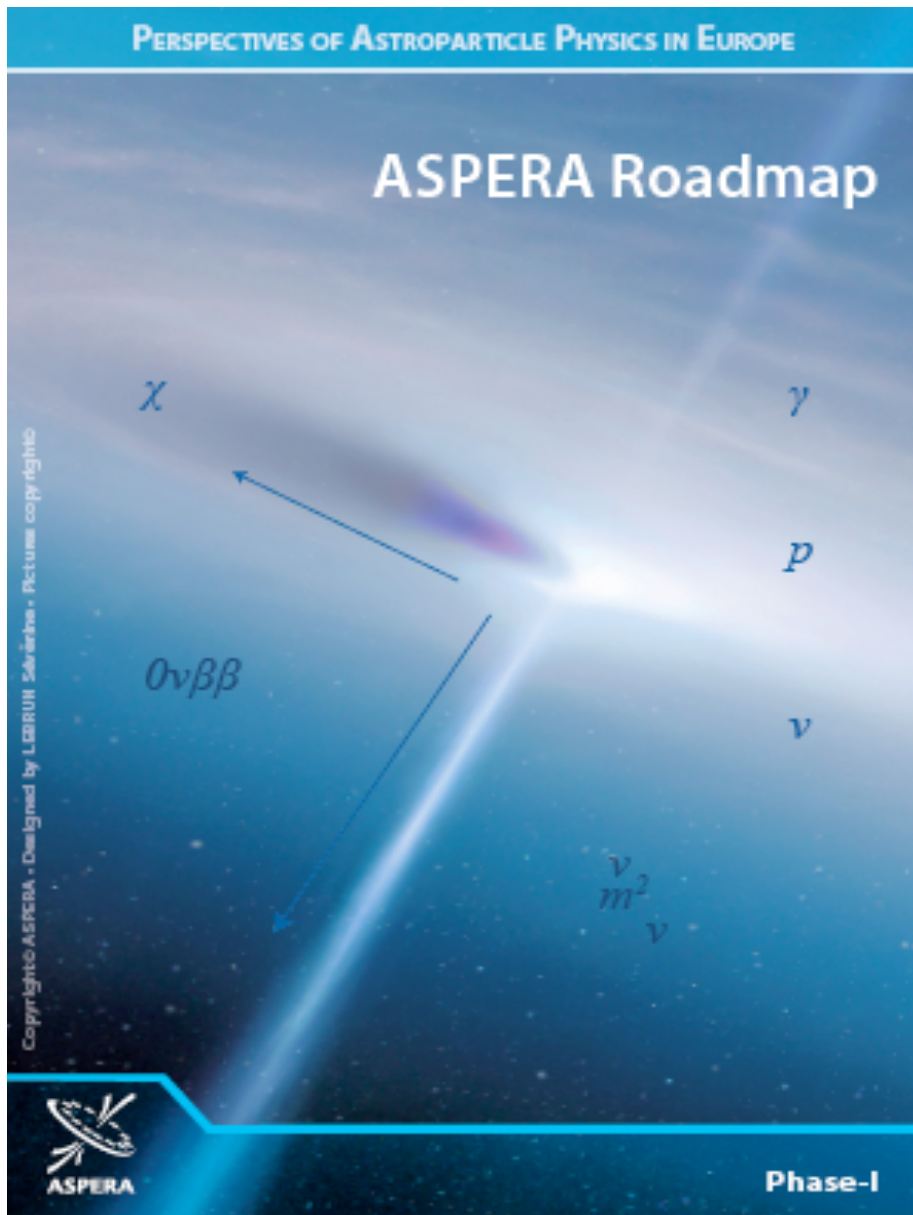
History of the Universe

1. What is the Universe made of? (dark matter and energy)
2. Do protons have a finite life-time?
3. What are the properties of neutrinos?
4. What is their role in cosmic evolution?
5. What do neutrinos tell us about the interior of Sun, Earth and Supernova explosions?
6. What is the origin of cosmic rays? What is the view of the sky at extreme energies?
7. What is the nature of gravity? Can we detect gravitational waves?

Key:	
W, Z bosons	photon
gluon	baryon
e electron	ion
Muon	tau
neutrino	atom
	galaxy
	black hole

Particle Data Group, LBNL © 2000. Supported by DOE and NSF

> Roadmap phase I the Opportunities (2005-2007)



- **Draft prepared by PRC, presented in Valencia Workshop November 2006**
- **Discussed in 7 working groups finalised by PRC**
 - **High Energy gamma**
 - **High Energy cosmic rays**
 - **High energy neutrino**
 - **Gravitational waves**
 - **Dark matter**
 - **Neutrino mass**
 - **Low energy neutrino and proton decay**
- ∅ **Not included: space and dark energy (implicit rule prioritize only the themes where aspera agencies give the majority of funds) . Added Dark Energy recently**
- **Phase I Roadmap Published May 2007**
 - www.aspera-eu.org

> Roadmap phase II the Possibilities (2007-2008)

European strategy
for astroparticle physics

Amsterdam
20 - 21 September 2007

Felix Meritis, at Keizersgracht 324, the Netherlands



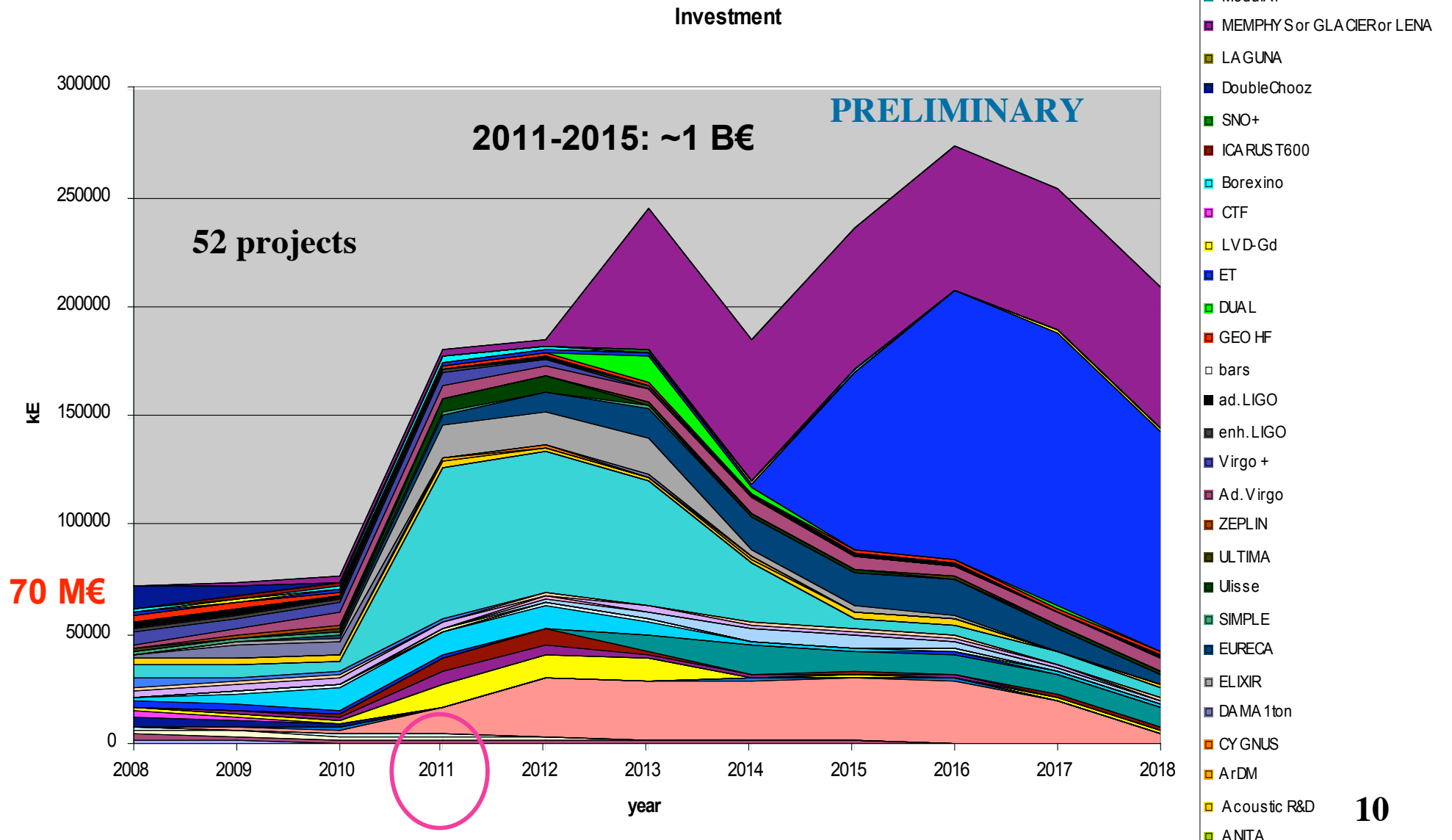
DEFINING PRIORITIES FOR ASTROPARTICLE PHYSICS

- Second of 3 workshops conducted by the ERA-NET ASPERA and ApPEC to define the strategy for astroparticle physics in Europe.
- Thematic priorities will be compared to the funding possibilities in Europe.
- The current astroparticle physics roadmap will be compared to roadmaps in nearby fields (astrophysics and particle physics) and in other regions of the world (US, Japan and China)
- Astroparticle Physics and Cosmology will be reviewed by Nobel laureates J. Cronin and G. Smoot

High Energy Gamma Rays
Neutrino Mass
High Energy Cosmic Rays
High Energy Cosmic Neutrinos
Dark Matter direct detection
Gravitational Waves
Low Energy Neutrinos & Proton decay

- The 7 working groups prepared timelines of 55 astroparticle projects detailing financial and human resources needed, milestones, enabling R&D, risks etc.
- First comparisons with available resources presented in a workshop in September 2007 in Amsterdam.
- The workshop was also the occasion to have a first comparison with non-European strategies (NSF, DOE, China)
- Currently the WG proposals are evaluated by the PRC for their science goals, and technical readiness
- Phase II will end with a workshop in Brussels on the 29 and 30 of September 2008
- Phase II document will be a 30 page detailed recommendation document

Roadmap phase II, investment wish list 2 B€ in 10 years

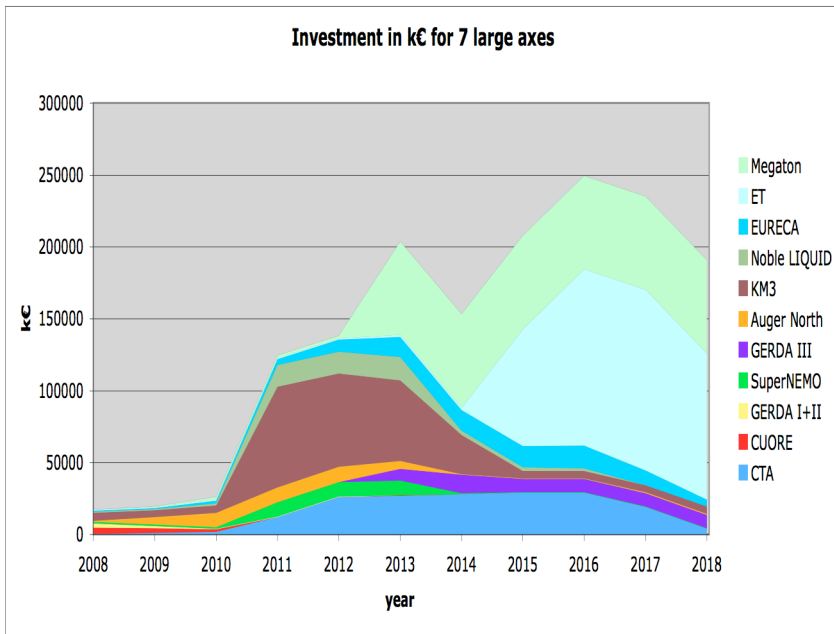


No other continents, no hard priorities



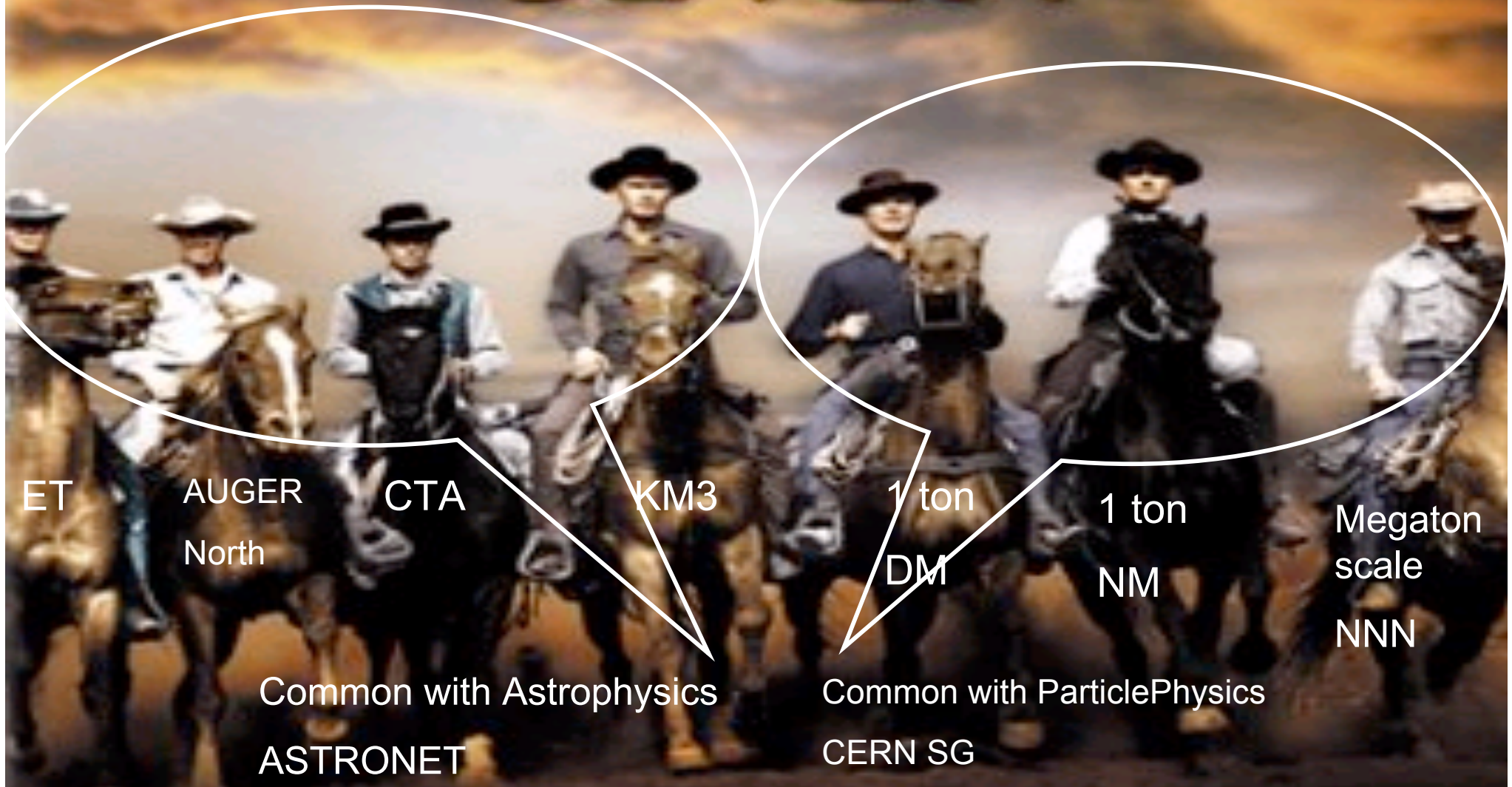
A summary ,from the phase I Roadmap

Astroparticle Physics for Europe



Field/ Experiments	Cost scale per experiment (M€)	Desirable start of construction	Remarks
Observatories of the high energy universe: <u>Gamma rays:</u> Cherenkov Telescope Array CTA	100-150 M€	2011	Physics potential defined from present gamma experiments. Emerging ESFRI
<u>Neutrinos:</u> KM3NeT	150-250 M€	2011	FP6 Design Study. ESFRI, FP7 Preparatory Phase
<u>Charged Cosmic Rays:</u> Auger North	40-50 M€	2011	Worldwide sharing (shown 50% Europe is shown)
Underground Observatories: <u>Dark Matter Search:</u> Low background experiments ton-scale mass	50-100 M€	2013	2 different techniques (shown cost of one)
<u>Properties of neutrinos:</u> Double beta experiments ton-scale mass	50-150 M€	2013	2 experiments with different nuclei or different technique (shown cost of one)
<u>Proton decay and low energy neutrino astronomy:</u> Large infrastructure for p-decay and ν astronomy on the 100kt-1Mton scale	300-500 M€	Civil engineering: 2013-2015	3 technological options FP7 Design study (Worldwide, shown 30-50 % the European part)
<u>Underground gravitational wave antenna:</u> Third generation GW interferometer	300 M€	Civil engineering 2013-2015	FP7 Design Study

THE MAGNIFICENT SEVEN



ET

AUGER
North

CTA

KM3

1 ton
DM

1 ton
NM

Megaton
scale
NNN

Common with Astrophysics
ASTRONET

Common with Particle Physics
CERN SG

- **ApPEC/ASPERA will**
 - **Issue general priorities by 29-30 September, Brussels 2008**
 - **draft already communicated to ESFRI**
 - **Examine ways to form common fund for Design studies**
 - **Form PACs in 2009-2010?**
 - **Coordinate with ASTRONET and CERN strategy group**
 - **Discuss relationships of APP with CERN**
 - **Coordinate with other regions (OECD, PANAGIC)**

- **It is also a very active period for EU, concordant with our current actions (towards major decisions in July)**
 - **Joint programming a buzz word**
 - **Encourage roadmapping and prioritising**
 - **Help joint programming with a series of schemes (structure funds, IB, PPP, tax incentives)**
 - **New versatile legal/formal scheme (VAT exceptions, foundation style help with industry, many other schemes along article 171)**
 - **Encourage virtual communities (e-infrastructure schemes)**
 - **Europe participation in global infrastructures**
 - **Strategic coordination mechanism for RI: European Research Infrastructure Programme**

TAKEN from: Developpig World-class Research Infrastructures for the European Research Area (ERA), the ERA Expert group report

- **Theory impact on the roadmap of the infrastructures:**
- **Computing needs?**
 - **Astronet recommendation**
 - **Virtual Observatory**
 - **Astrophysical Software Library**
 - **Grids**

Areas of theory impact (a personal list)

- **Cosmology: dark energy and dark matter, inflation**
 - Upcoming data: PLANCK, DM searches, impact of LHC
- **GUTS: neutrino physics and proton decay**
 - GUT modelling, Leptogenesis, neutrino phenomenology, nuclear matrix elements for double beta
 - Upcoming data: theta13, mass hierarchy, mass determination
- **Gravitation**
 - Gravitational wave sources, templates, numerical relativity, GW predictions of different cosmological models
 - GW detection by 2012?
- **High Energy Universe**
 - Origin of cosmic rays, compact objects, dark matter effects, cosmological markers
 - Upcoming and present data: HESS/MAGIC, AUGER, Neutrino telescopes, satellites, GLAST, ...
- Strings and co for al of the above

- **Theory impact on the roadmap of the infrastructures:**
- **Computing needs?**
- **Education?**
 - **Do we need One Astroparticle School ? (ISAPP, IDAPP)**
 - **Virtual Institute (VIA)?**



VIA program (past and future)

Astroparticle Physics for Europe

Lectures, given each Friday at 16.00 (GMT+1), beginning from 18.01.

<http://www.aspera-eu.org> (Virtual Conferencing)

Can be seen in free streaming on the same site. Attendance 20 to 40 participants (not bigger publicity up to now for technical reasons)

- J. Ellis (CERN, Geneva) "Big issues in Particle Physics and Cosmology"
- A. Letessier-Selvon (LPNHE, Paris) "High Energy Cosmic Rays at the Pierre Auger Observatory"
- A. Morselli (Roma 2) "GLAST and the future of High Energy Gamma-ray astrophysics"
- D. Fargion (Roma 1) "Solving UHECR AUGER puzzles?"
- D. Horns (Hamburg) "Indirect Dark Matter search with ground based Cherenkov telescopes"
- A. Sakharov (ETHZ, CERN) "Effects of quantum gravity in MAGIC experiment"
- M. Khlopov (MIFI/APC) "Dark Matter from Stable charged particles?"
- S. Rubin (MIFI, Russia) "Multidimensional gravity"
- D. Spergel (Princeton, USA) "CMB observations as a Probe of Fundamental Physics"

Future lectures

- 21 March 2008, Gianni Fiorentini (INFN, Ferrara) "Geo-Neutrinos"
- 28 March 2008, Manel Martinez (IFAE, Barcelona) "MAGIC highlights"
- 4 April 2008, Ignatios Antoniadis (CERN, Geneva) "Cosmological Dark Energy"

In April-May are planned lectures by

G. Dvali, P. Binétruy, J. Carr, C. Frenk, P. Picozza, J. Silk, F. Aharonian, F. Fidecaro...



Some statistics of VIA activity

Visits to VIA site (01.03-15.03)



Continent	Nombre
Europe	229 (68.56 %)
Asie	76 (22.75 %)
Amérique du nord	17 (5.09 %)
Amérique centrale/sud	7 (2.10 %)
Inconnu	5 (1.50 %)

	Mars 2008
Pages vues	1066
Pages vues différentes	71
Record de pages vues pour 1 visiteur	23

→ Pages vues

Programme VIA	443
Index enter in the web site	345
videothèque	130
Maxim Yu Khlopov	36
virtual conferencing	34
accueil	28
nom_a_donner_a_la_page	13
Alexander Sakharov	8
John Ellis	8
Dieter Horns	8

- **Theory impact on the roadmap of the infrastructures:**
- **Computing needs?**
- **Education?**
 - **Do we need One Astroparticle School ? (ISAPP, IDAPP)**
 - **Virtual Institute (VIA)?**
- **Networks (EU and non-EU supported)**
 - **Existing (ILIAS, String theory), push for new ?**
- **Astroparticle Physics Centers?**
 - **Link existing ones, invent new (examples, IPMU, Kavli, Perimeter)**
 - **Bring in new disciplines: mathematicians theoretical and applied (IPMU)**
 - **Can e dream of such a center at CERN?**
- **Can we implement a European wide common call for theoretical proposals based on a virtual common pot?**



Astroparticle Physics for Europe

Science

9 November 2007 | \$10

Thanks