

ASPERA Workshop, Paris
19.07.2007

WG4: High-Energy Neutrinos: Mainly Neutrino Telescopes

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- The Working Group
- Projects
- IceCube and KM3NeT
- Acoustic activities

The Working Group

- Meeting in Amsterdam 20.02.2007
 - WG3 (Cosmic rays) and WG4 (high-energy neutrinos) cooperate but don't merge
 - Formation of WG4:
 - Antonio Capone
 - John Carr
 - Paschal Coyle
 - Els de Wolf
 - Vincenzo Flaminio
 - Juanjo Hernandez
 - Uli Katz (Co.)
 - Paolo Lipari
 - Emilio Migneco
 - Luciano Moscoso
 - Rolf Nahnauer
 - Paolo Piattelli
 - Miquel Ardid Ramirez
 - Petros Rapidis
 - Andrea Santangelo
 - Olaf Scholten
 - Mauro Taiuti
 - Lee Thompson
 - Spyros Tzamarias

The projects

- **First-generation neutrino telescopes**
 - South Pole: AMANDA
 - Mediterranean: ANTARES, NEMO, NESTOR
 - Lake Baikal
- **2nd-generation neutrino telescopes**
 - IceCube
 - KM3NeT
- **Neutrino chances for UHE cosmic ray experiments**
 - Pierre Auger South & North
 - JEM/EUSO
- **Radio detection**
 - NuMoon, LOFAR, ANITA, ARIANNA
 - IceCube extensions
- **Acoustic detection**
 - R&D: IceCube, Mediterranean (ANTARES)
 - ACORNE, SAUND, ...

The “selection criteria”

- Discussed in the context of the ASPERA Roadmap are experiments/facilities
 - which will require large invests on a European scale 2008-18
 - which exist but need further invest for operation
 - for which Lols/proposals are expected within a few years
 - which “belong” to different funding scheme but are of interest for astroparticle physics and need support.

- Association of experiments to WGs
 - Several experiments cover physics of more than one WG (in particular: Overlap WG3-WG4)
 - Decision by “center of gravity”, but attention in all WGs

The projects considered

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IceCube and IceCube Extensions

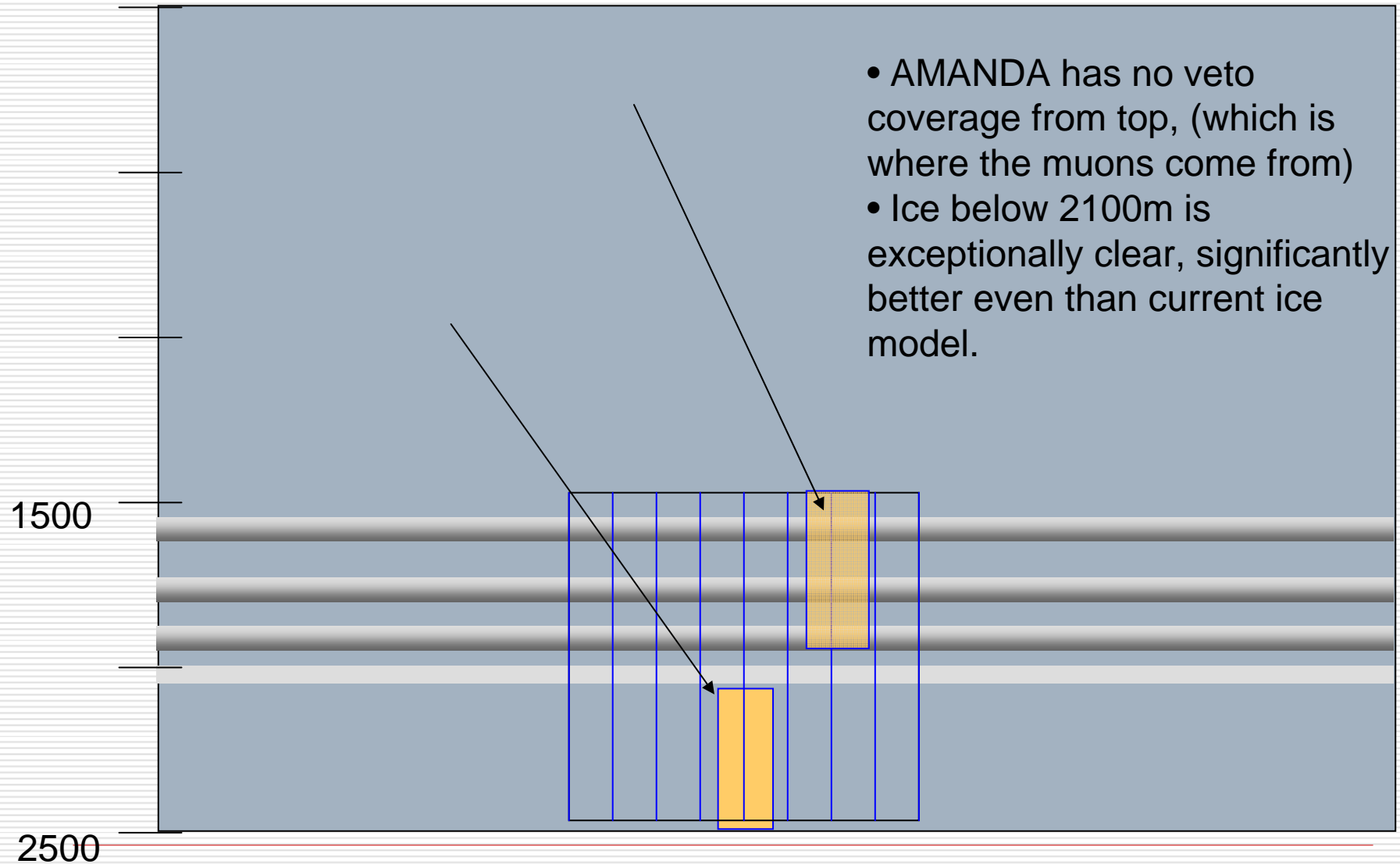
- IceCube construction

- on schedule
- funded
- not an issue for the roadmap

- IceCube extensions under discussion

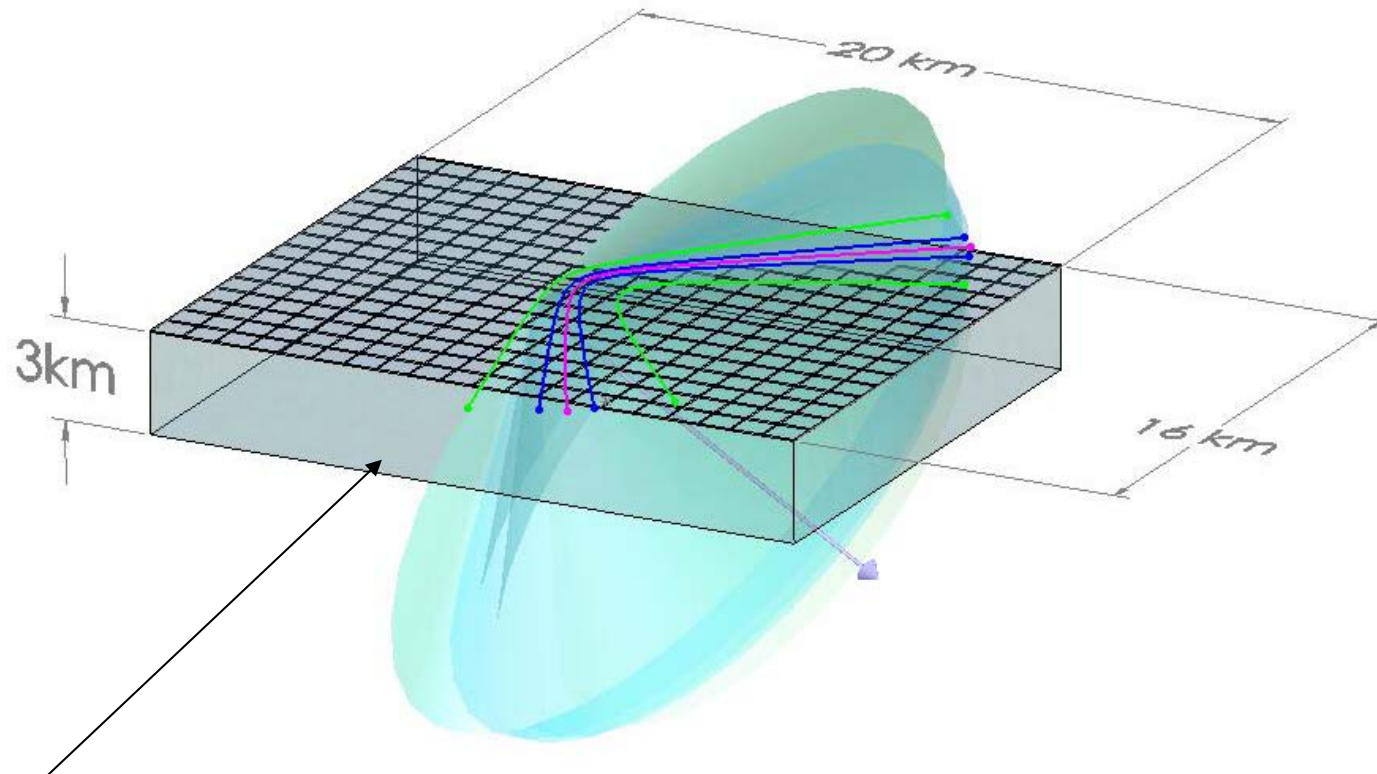
- Low-energy extension
- Deep-ice radio and acoustic detection (“Kilo-Cube”)
- Surface radio array for neutrinos and air showers (“IceRay”)

A low-energy core for IceCube



"Kilo-Cube" Array (here: Radio)

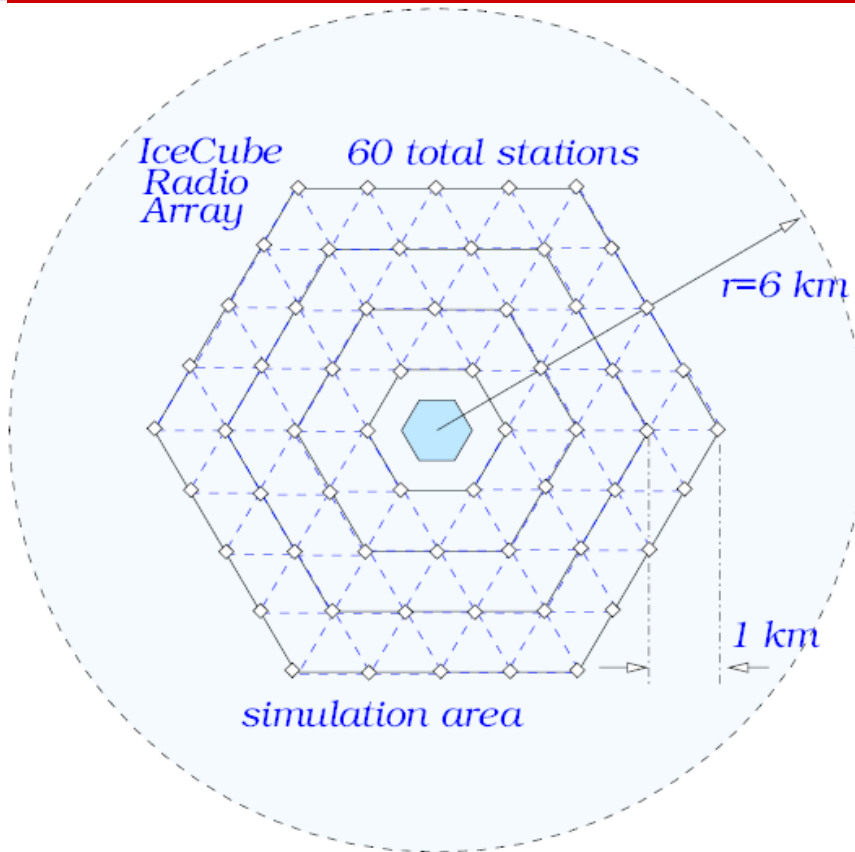
Current project: AURA



Sensor plane located near firn/ice boundary to avoid signal loss from refraction

~3000 sensors for 1000 km³

IceCube Radio Array (IceRay)



Goals:

- GZK neutrinos ($10^{17-19.5}\text{ eV}$)
- Lowest possible cost
 - o Surface array, sparse
 - o Give up resolution for volume
- Hybrid events with IceCube
 - o Primary vertex calorimetry in radio, HE muon or tau secondary in IceCube
 - o (Acoustic possible from surface??)

IceCube time scales and vision

- 2007:
 - prototypes in radio and acoustics in ice
 - New Proposal for a km scale AURA (?)
 - Letter of intent for future large array (too early?)
- 2008:
 - Continue building AURA
 - Take data
 - R&D
- 2009:
 - sizeable detector in place, mature technology
 - Design study for integrated radio, acoustic, optical hybrid array, technical design document
- 2010: proposal for a large scale GZK detector

KM3NeT: Activities and plans

- **FP6 Design Study**

- started 1. Feb. 2006
- towards Conceptual Design Report end of 2007 (basis for rough cost estimates)
- Technical Design Report 2009 (basis for solid cost estimates)

- **FP7 Preparatory Phase**

- proposal submitted May 2007
- expect evaluation results any day
- if successful: framework (and funding) for path to start of construction in 2010-2011

- **ESFRI**

- opened door to Preparatory Phase call
- stimulated already substantial political activity/commitments

The KM3NeT Design Study

- 3-year FP6 Design Study, Feb. 2006 – Jan. 2009, 9 M€ from EU, overall budget ~20 M€

- Participants:

30 Particle/Astroparticle institutes +
7 Sea science/technology institutes

} from 9 EU countries:



- Main Deliverables

- Conceptual Design Report (fall 2007)
- **Technical Design Report (early 2009)**

Current National/Regional Funding

■ Pilot projects:

-	ANTARES (cap. investment only)	20.1 M€
	□ FR, GER, IT, NL, ES funding agencies	14.5 M€
	□ France: Regional sources	1.9 M€
	□ FEDER/France	3.7 M€
-	NEMO (IT, cap. investment only)	17.0 M€
	□ IT funding agencies	10.9 M€
	□ FEDER/Italy	6.1 M€
-	NESTOR (GR, cap. investment only)	8.0 M€
	□ Greek government	6.5 M€
	□ FEDER/Peloponnese	1.5 M€

45.1 M€

■	KM3NeT (cap. + pers.)	ca.	11.0 M€
	□ CY, FR, GER, GR, IRL, IT, NL, ES, UK funding agencies and other sources		

The KM3NeT Preparatory Phase proposal

- Application be same partners as in Design Study, except some marine research institutions (EMSO)
- Work package structure
 - WPA Management
 - WPB Political convergence
 - WPC Legal, governance, financial engineering and site issues
 - WPD Strategic issues and international networking
 - WPE Marine and environmental agencies and networks
 - WPF Production preparation of telescope components
 - WPG Industrial partnerships for auxiliary vessels
 - WPH Industrial production of deep-sea components and partnership for deep-sea infrastructures
 - WPJ Data handling and dissemination

Resources for KM3NeT

■ Overall cost

- ESFRI: 230-250 M€ (“official number”)
- Solid estimates not before 2008
- What is driven by what: Money by physics or physics by money?

■ Personnel needs

- Same time frame for assessment as for costs
- Statement for ASTRONET (>100% error margin):
The FTE requirements depend on the technical design and are still under study; a very rough guess might be 500 FTE-years for construction and 50-100 FTE-years per year of operation/exploitation

■ Commitments

- Several 10 M€ each from Italy, Greece, possibly France
- Mostly money from regional funds!

Acoustic detection

■ European Activities

- IceCube/SPATS & future plans for large hybrid detector
- Acoustics @ ANTARES
(feasibility study for large acoustic water detector)
- Acoustics @ NEMO
- ACORNE
- ...

■ General status

- Approaching “decision point” for large project(s)
- Time scales not clear, but <10 years for positive developments
- European lead in the field

■ Question

- How to include acoustics in Roadmap Phase II?

Final remarks

■ Questionnaires

- In the works (IceCube & KM3NeT)
- Difficult: Mismatch of time scales for KM3NeT (solid cost evaluation by 2008/09, questionnaires “now”)
- Technical: Does “cost” include “FTEs”?

■ Regional money

- Impact on financial and scientific planning unclear
- Requires high-level political communication

■ ASTRONET connection

- Difficult that thing stay coherent and consistent
- What is the cross-relation between both roadmaps?