

Neutrino Astronomy: a new window on the Universe



Neutrino astronomy : sky map of the most catastrophic events in the Universe



Detecting neutrinos



neutring





Cherenkov light from μ induced by ν interaction detected by 3D PMT array Time & position of hits allows the reconstruction of the μ (~ ν) trajectory



ANTARES Collaboration

- NIKHEF, Amsterdam
- * University of Sheffield
- * University of Leeds
- * IFIC, Valencia
- * CPPM, Marseille
- * DSM/DAPNIA/CEA, Saclay
- * C.O.M. Marseille
- IFREMER, Toulon/Brest
- & LAM, Marseille
- * IReS, Strasbourg
- * Univ. de H.-A., Mulhouse
- * ISITV, Toulon
- *LOV Villefranche
- University of Bari
- * University of Bologna
- University of Catania
- * LNS Catania
- * University of Pisa
- University of Rome
- University of Genova
- * ITEP, Moscou
- * University of Erlangen







ANTARES Project History

1996 - 2000January20002001December2002March2003March200320042006

R&D, Site Evaluation Operation of 'Demonstrator' line Start of construction at Toulon site Deploy 'Prototype sector line' Connection with Nautile submarine Start operation of prototype lines Start final assembly 12 line production ANTARES 12 line detector finished



Line Storey Elements



Optical Module

Blow-up of an Optical Module





PMT: 10" Hamamatsu R7081-20

Main features

- Sensitive area \cong **500 mm**²
- Transit time spread < 3.6 ns (FWHM)</p>
- ✤ Dark count (@ 0.3 spe) < 10 kHz</p>
- Peak/valley > 2

The 900 PMT's have been



Electronics

Inside a Local Control Module





ANTARES Test Sites



Site Explorations

1) Optical background study:

- 2) Biofouling-sedimentation study:
- 3) Optical properties study:

15 deployments4 deployments28 deployments



Construction of ANTARES Detector

Deployment of cable, Oct 2001



Prototype Sector Line (PSL)

Prototype Lines operated in 2003

Probe for -Sound velocity

5 Storeys of Optical Modules

Probe for salinity and temperature (CTD)

hydrophone

Junction Box

Anchor with electronics containers LED Beacon

Mini

Instrumentation

Line

(MILL)

Profiler for

Sea currant

(ADCP)

hydrophones

Seismograph



Link Cables -

Prototype Line ready: Nov 2002



Time calibration in lab

Time difference of laser pulses between one PM and others



Deployment Prototype Line, Dec 2002









Deployment of Junction Box , Dec 2002









Submarine cable connection



Layout of ANTARES site in March 2003



Data from Prototype Sector Line



More than 90% of time below 200 kHz



Clock time reference system



Broken Optical Fibre in Line Cable

Fault position identified by light reflection methods "OTDR"





Cable dissection

Fault due to collapse of inner plastic tube under pressure





Connector Leak in MIL



MIL recovered and diagnosed May 2003

Movement of line



Inertial Oscillations of Sea Current

Inertial oscillations (Coriolis force) velocity and direction oscillate period $24h/2.sin(\lambda) \sim 17.6$ hours

Antares site: $\lambda = 43^{\circ}$



Oscillations in Line Orientation

Electronic compass in LCM's \rightarrow heading at 4 positions on line



Current meter on nearby line gives sea current velocity

Line movements correlated with current : period 17.6 hours

Correlation with Bioluminescence



ANTARES 12 line detector 2006



>2006

R

KM³