lceCube





Christian Spiering, VLVNT Workshop Amsterdam, October 2003

IceCube Collaboration

Institutions: 11 US, 11 European, 1 Japanese and 1 Venezuelan

- 1. Bartol Research Institute, University of Delaware
- 2. BUGH Wuppertal, Germany
- 3. Universite Libre de Bruxelles, Brussels, Belgium
- 4. CTSPS, Clark-Atlanta University, Atlanta, USA
- 5. DESY-Zeuthen, Zeuthen, Germany
- 6. Institute for Advanced Study, Princeton, USA
- 7. Lawrence Berkeley National Laboratory, Berkeley, USA
- 8. Department of Physics, Southern University and A\&M College, Baton Rouge, LA, USA
- 9. Dept. of Physics, UC Berkeley, USA
- 10. Institute of Physics, University of Mainz, Mainz, Germany
- 11. University of Mons-Hainaut, Mons, Belgium
- 12. Dept. of Physics and Astronomy, University of Pennsylvania, Philadelphia, USA
- 13. Dept. of Astronomy, Dept. of Physics, SSEC, University of Wisconsin, Madison, USA
- 14. Physics Department, University of Wisconsin, River Falls, USA
- 15. Division of High Energy Physics, Uppsala University, Uppsala, Sweden
- 16. Dept. of Physics, Stockholm University, Stockholm, Sweden
- 17. Dept. of Physics, University of Alabama, USA
- 18. Vrije Universiteit Brussel, Brussel, Belgium
- 19. Chiba University, Japan
- 20. Dept. of Astrophysics, Imperial College, UK
- 21. Dept. of Physics, University of Maryland, USA
- 22. Universidad Simon Bolivar, Caracas, Venezuela
- 23. NIKHEF, Utrecht, Netherlands

 \rightarrow US Funding by NSF

→ Awardee is University of Wisconsin

→ IceCube belongs to the class of MRE (Major Research Equipment) projects.

→ IceCube has recently made the official step from the R&D phase (Year 1 and 2) to the implementation phase, i.e. it is installed as MRE project.

Design and Technology

IceCube

- 80 Strings
- 4800 PMT
- Instrumented volume: 1 km³
- Installation: 2004-2010

~ 80.000 atm. v per year





Hot water drilling

Hot-Water Drilling





Drilling: from Amanda to IceCube

Amanda IceCube

Heat (surface) 2 MW 5 MW

Time to 2400 m 120-140 hours 35-40 hours

Fuel (gal/hole) 10,000 - 12,000 7,000 - 8,000

Set-up Time5-6 weeks18-25 days



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Drilling

Hole #19 - Depth vs. Time





CEPTOPRET DOW ...

m will be at room Cemperature



Digital Optical Module - (DOM)

- \rightarrow Captures waveforms with
 - 250 MHz first 500 ns
 - 40 MHz over 5000 ns
- \rightarrow Time-stamps each pulse
 - r.m.s. < 5 nsec
- \rightarrow Dynamic range
 - 200 PE over 15 ns
 - 2000 PE over 5000 ns
- \rightarrow Dead time < 1 %
- → Noise rate < 500 Hz



33 cm

Digital Optical Model Block Diagram



DOM Main Board - March 2003



DOR PCI-Card

Read-out of 8 DOMs (2 per twisted pair cable)





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Amanda DOM test string



- timing 3.5 ns r.m.s.
- cable length << 1 ns r.m.s.
- gain drift << 0.2% per week
- down going muons as expected
- 15% of events have > 1 hit





Time **Synchronization**



Physics Capabilities

Effective Area of IceCube



Angular resolution as a function of zenith angle



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Energy Spectrum Point Source Search



Blue: after downgoing muon rejection Red: after cut on N_{hit} to get ultimate sensitivity

Energy Spectrum Diffuse Search



Blue: after downgoing muon rejection Red: after cut on N_{hit} to get ultimate sensitivity

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IceCube sensitivity vs time

Diffuse Fluxes

Point Sources



Search for diffuse excess of extra-terrestrial high energy muon neutrinos



Limit on all neutrino flavors







Supernova Monitor

B10: 60% of Galaxy

A-II: 95% of Galaxy





10/7/2





Functions of IceTop

- IceCube calibration with the help of downgoing muons (absolute pointing, angular resolution, detector geometry, ice atten.)
- Anti-Shield (helps to reject downgoing muons from independent air showers)
- Chemical Composition (IceTop measures electron component, IceCube muon component)



Chemical Composition







Schedule

03-04	drill equipment to Pole
04-05	first strings
	(proof that 16/season are feasible,
	prepare 6 full strings)
05-06	12 strings
06-07	16 strings
07-08	16 strings
08-09	16 strings
09-10	remaining strings

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06-07	16 strings
07-08	16 strings
08-09	16 strings
09-10	remaining strings

Cost including personnel, contingency and overhead: ~ 250 M\$ Detector: ~ 55 M\$, logistics including drilling: ~ 40 M\$

Addendum on Lake Baikal

The Baikal Collaboration

Institute of Nuclear Research, Moscow Irkutsk State University, Irkutsk DESY Zeuthen, Zeuthen Moscow State University, Moscow Nishni Novgorod State Technical University State Marine Technical University, St.Petersburg Kurchatov Institute, Moscow JINR, Dubna



complement Amanda.

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Lake Baikal: The Detector

Baikal Upgrade NT200+



36 additional PMTs \rightarrow 4 times better sensitivity !

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A lesson on electro-corrosion



unexpected electro-corrosion after > 6 years



Detector runs only with 5 strings in 2003. Two new cables in March 2004.

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End of Talk