

The IceCube Neutrino Observatory: Status, Initial Results and Future Prospects

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Cosmic Rays and the high energy Universe

• Victor Hess measures radiation of cosmic origin first in 1912

- Charged particles, so they don't point back to their sources
- Clues from spectrum, composition
- Astrophysical accelerators?
- How are they accelerated?



Victor Hess

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compilation

by T. Gaisser

10⁰

All particle spectrum JACEE[11] Akeno[12]

n Shan[13] MSU[14]

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* 1







The IceCube Neutrino Observatory

Very large scale "hybrid" observatory ~\$272M to construct (NSF, Sweden, Germany, Beglium)

IceCube:

- ~1 cubic-km instrumented volume
- 78 strings with 60 Digital Optical Modules (DOMs) per string
- Interstring spacing of 125 m, DOM spacing 17 m.
- Designed to detect neutrinos with energies between 200 GeV and 10 PeV.

Completed December 18, 2010

• DeepCore extension:

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- 8 new strings ~\$6M addition.
- Dense instrumentation lowers the energy threshold to 10 GeV

• 4π detector using the IceCube array as an active veto. Access to southern hemisphere sources.

IceTop:

- Surface air shower detector array.
- Threshold approx. 300 TeV

Som Jestime Jestime



















Here I show the primary astrophysics topics for which IceCube was designed to search.



































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The World's largest neutrino data set...

• Caveat: preliminary studies

- Full detector simulation of signal (only)
- Assume high suppression of atmospheric muons by veto trigger level
- Specialized reconstruction algorithms for low energy events needed, now under development
- Mainly using low level quantities, assumptions seem reasonable, but...

• Three possible measurements

- Muon neutrino disappearance
 Feasible
- Tau neutrino appearance
 Reasonable
- Neutrino mass hierarchy?
 Challenging

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The basic idea for an indirect search – wimp capture is occurs mainly via spindependent scattering on protons (is the only significant cross-sections –this assumption gives us conservative limits). Self-annihilation of the wimps produces muon neutrinos at the end of the chain and we can detect these at the earth- assume that we achieve equilibrium between capture and annihilation.



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Now-lets consider the solar indirect wimp search: As you might expect, we utilize the data coincident with the Sun being below the horizon. For the datasets I show today that amounts to:... The data passes through a series of filter stages-











Summary

 The IceCube Observatory is now
COMPLETE and actively taking data with
79 strings. On track for full 86 string
observatory operation in March 2011.

• First results from the 22 and 40 string
detectors are now available. Analyses
underway on 59 and 79 string detector
configurations.

- Incredible discovery potential going forward - currently more than 1 cubic-km instrumented volume.
- Plans are developing for an large-scale particle physics program in the Antarctic with MC studies underway.

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