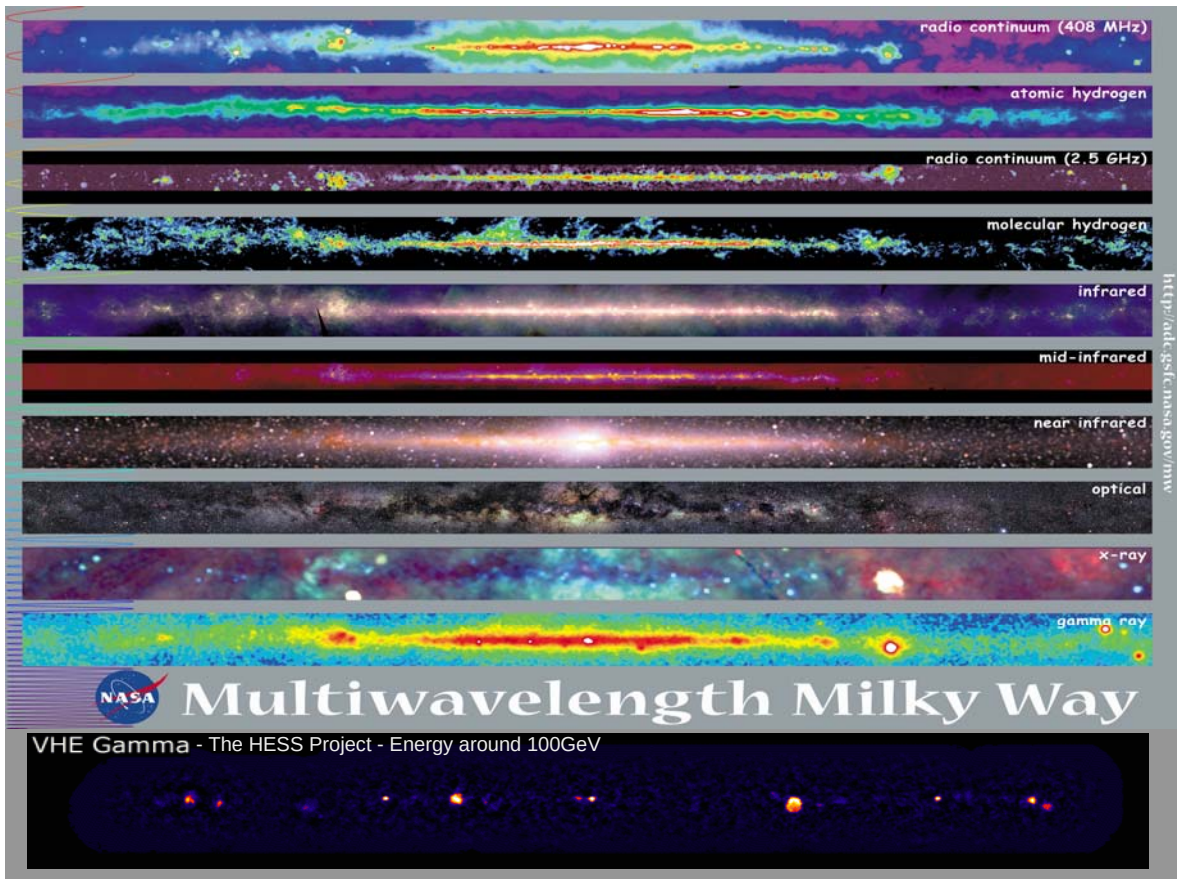
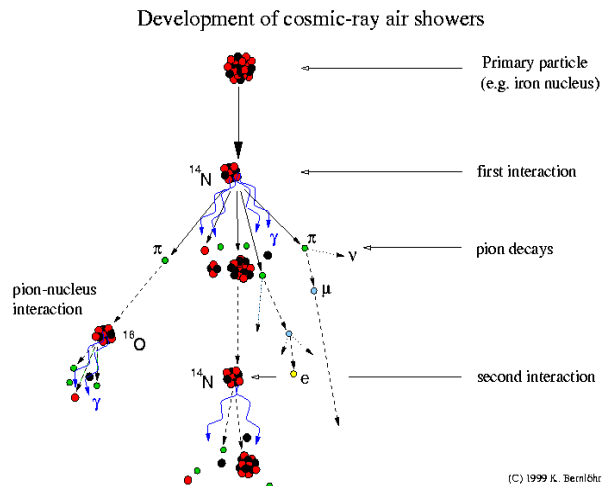


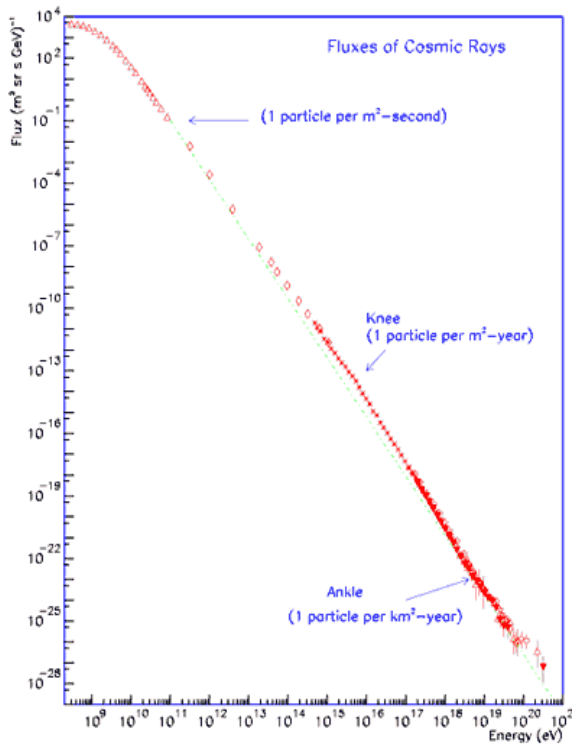


Astronomische Boten Teilchen und Kerne

1912 Viktor Hess Entdeckung der kosmischen Höhenstrahlung

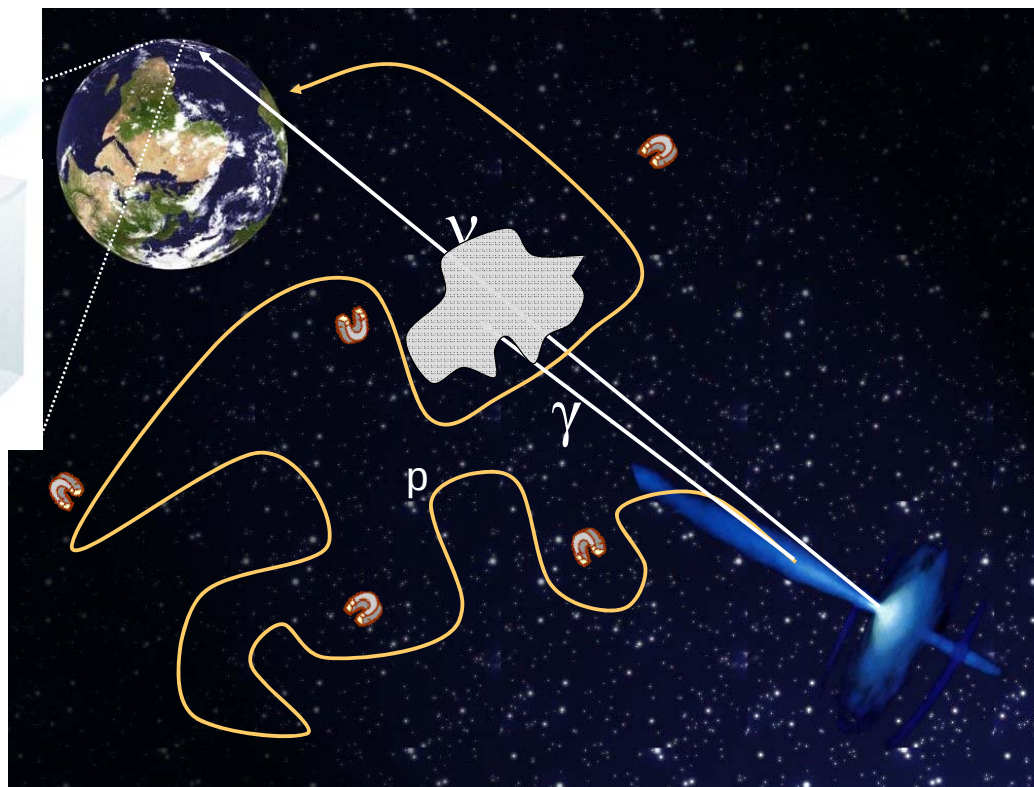


Spektrum der kosmischen Strahlung



- Geladene Teilchen
 - Protonen (86%)
 - α – Teilchen (11%)
 - Elektronen (2%)
 - Atomkerne schwerer Elemente (1%)
- Neutrale Teilchen
 - γ – Strahlung
 - Neutrinos

Direkter Kontakt mit Neutrinos

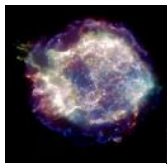


Mögliche Neutrinoquellen

Galaktisch:

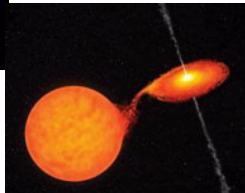
Extra-galaktisch:

Exotische Teilchen:



Super Novae Remnants

Binary systems

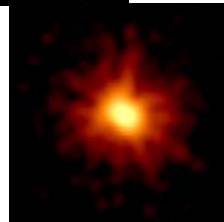


Pulsars



Active Galactic Nuclei

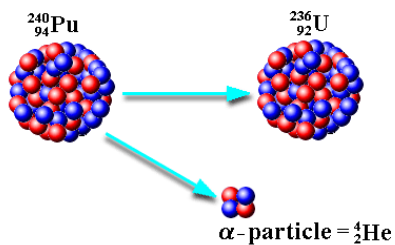
Gamma Ray Bursts



Dark Matter

Entdeckung des Neutrinos

alpha decay

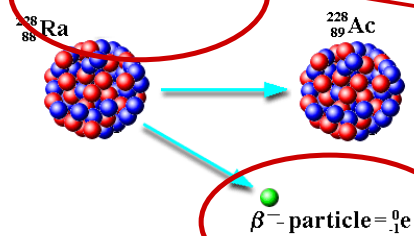


Relative Probability

1930 postuliert von W. Pauli
1956 erster Nachweis

Energy

beta minus decay

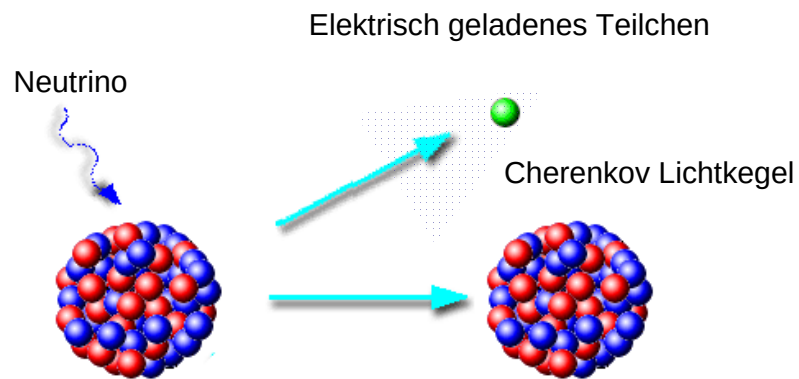


Relative Probability



Energie zu niedrig

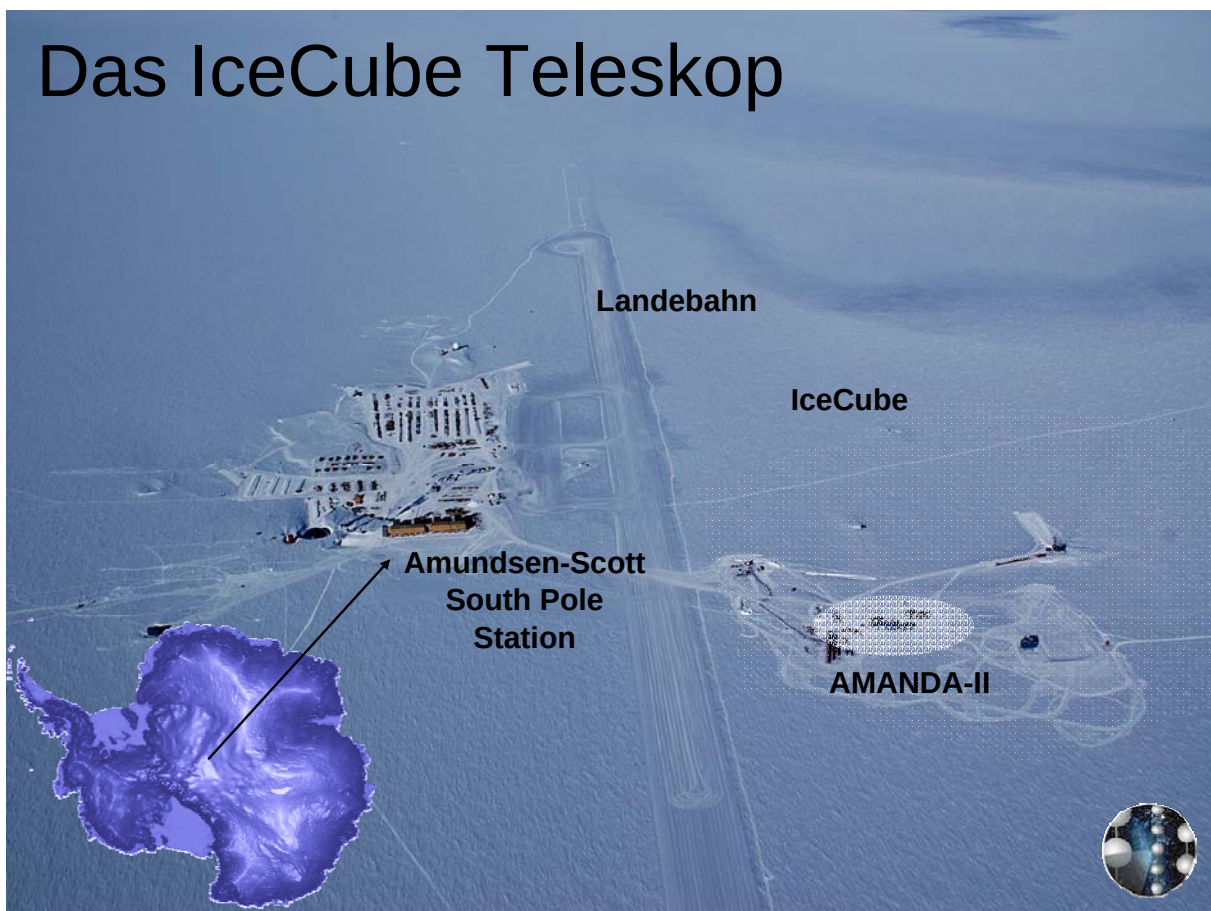
Neutrino nachweis



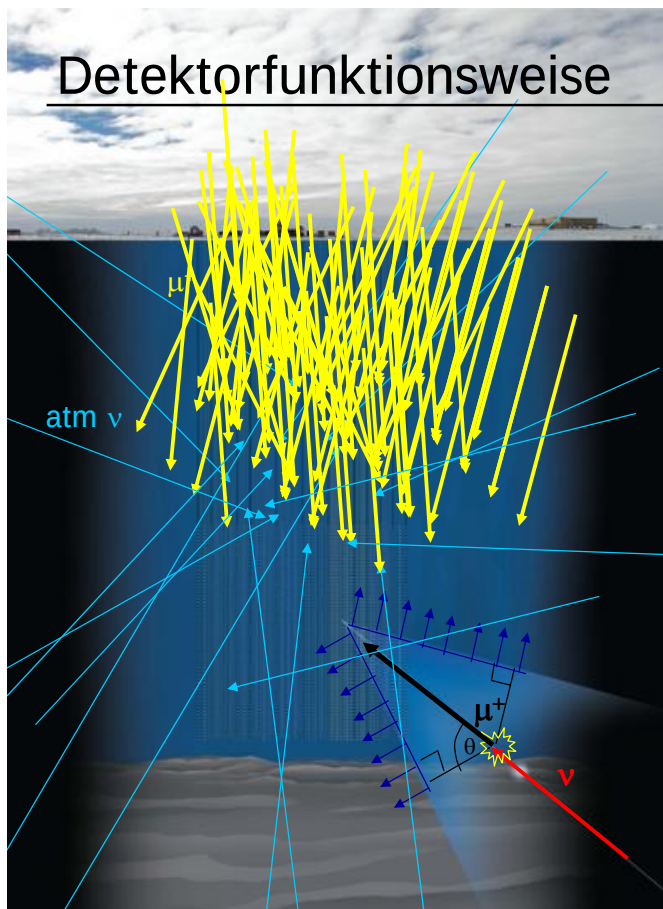
Das geschieht sehr selten !!!!

One needs a lot of transparent, dark and cheap stuff

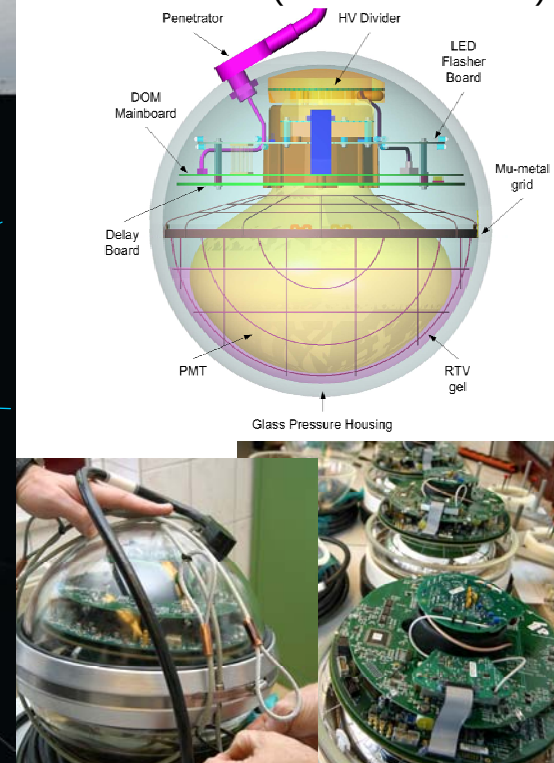
Das IceCube Teleskop



Die IceCube Kollaboration



Lichtsensoren (made in Zeuthen)



IceCube

IceTop

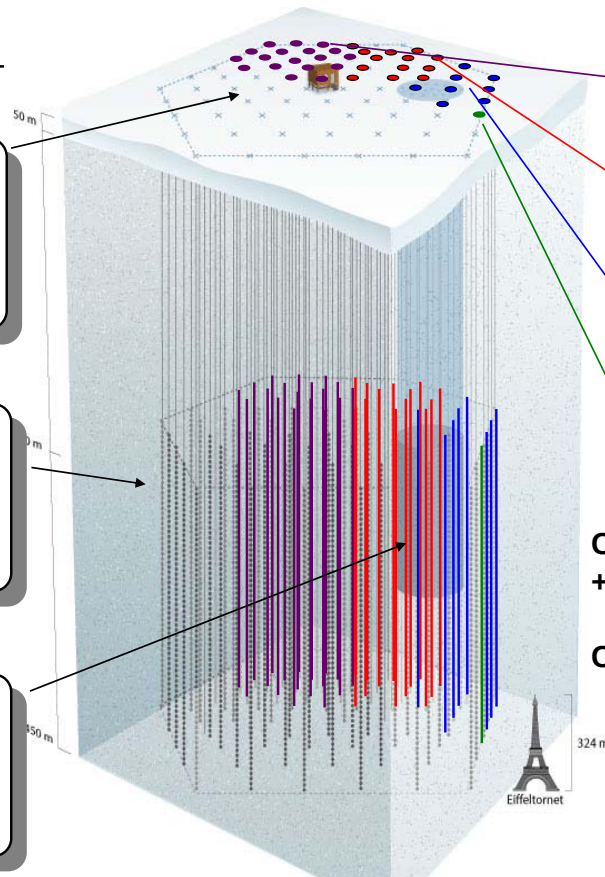
160 Tanks
320 Modules

IceCube

75 Strings
4200 Modules

AMANDA-II

19 Strings
677 Modules



2007/08: 18 Strings
IC 40 – IT 40

2006/07: 13 Strings
IC 22 – IT 26

2005/06: 8 Strings
IC 9 – IT 16

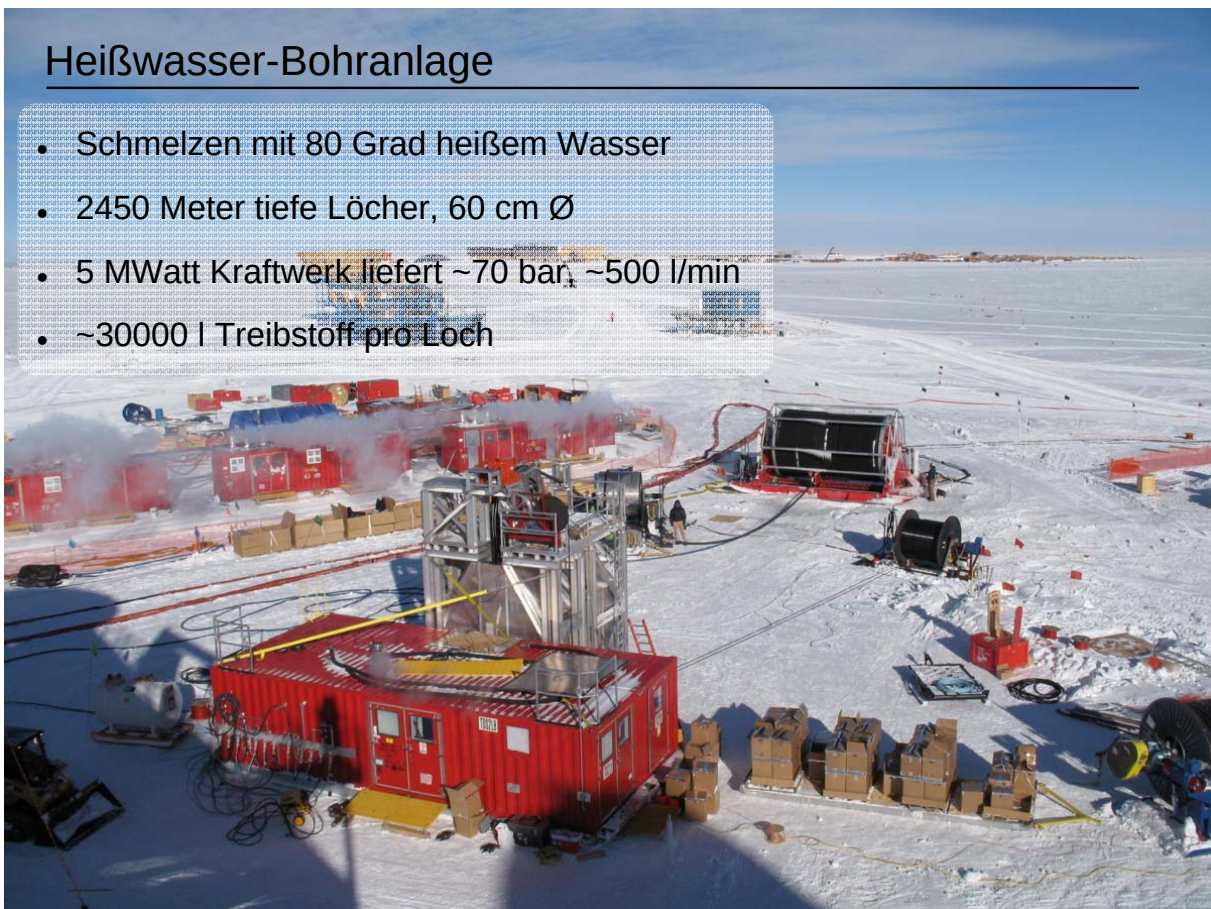
2004/05 : 1 String
astro-ph/0604450

**Currently: 40 Strings
+ 40 IceTop Stations**

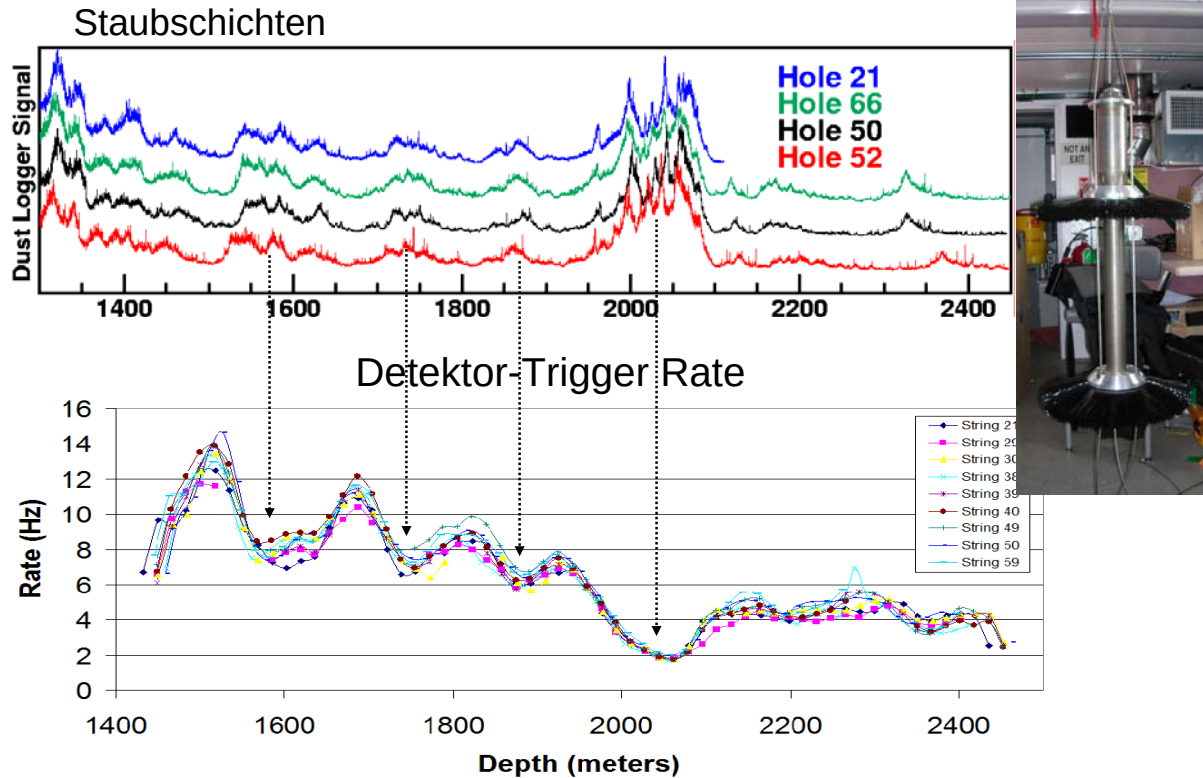
Completion: 2011

Heißwasser-Bohranlage

- Schmelzen mit 80 Grad heißem Wasser
- 2450 Meter tiefe Löcher, 60 cm Ø
- 5 MWatt Kraftwerk liefert ~70 bar, ~500 l/min
- ~30000 l Treibstoff pro Loch



Eiseigenschaften



Installation



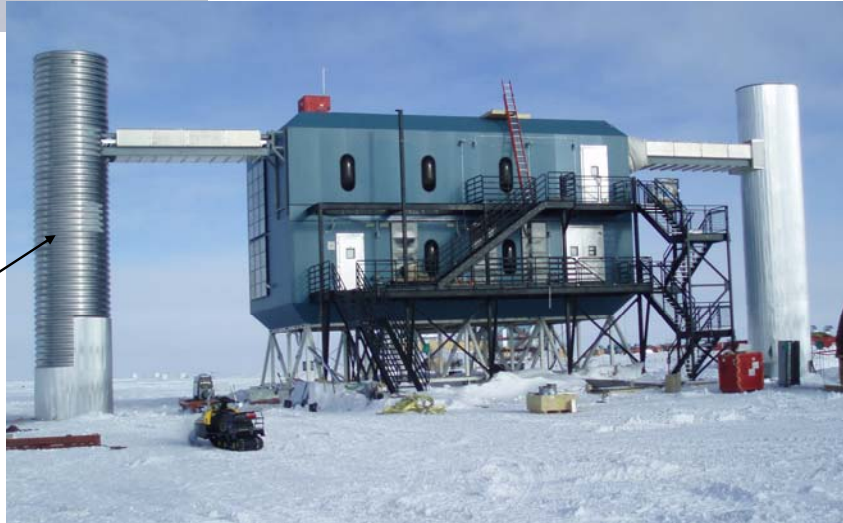
- 2500 Meter Kabel
- Gewicht 6 Tonnen
- 60 Module pro String



Das IceCube – Labor

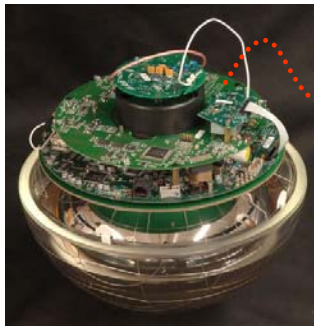


- Experimentsteuerung
- Datennahmesysteme
- Filtern, Speichern und Senden
- Online Verbindung per Satellit

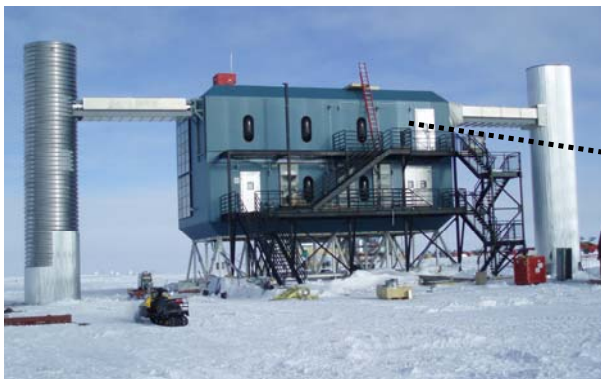
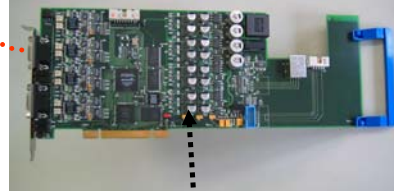


Oberflächenkabel aller Strings

Datennahmesystem



PCI Readout (made in Zeuthen)

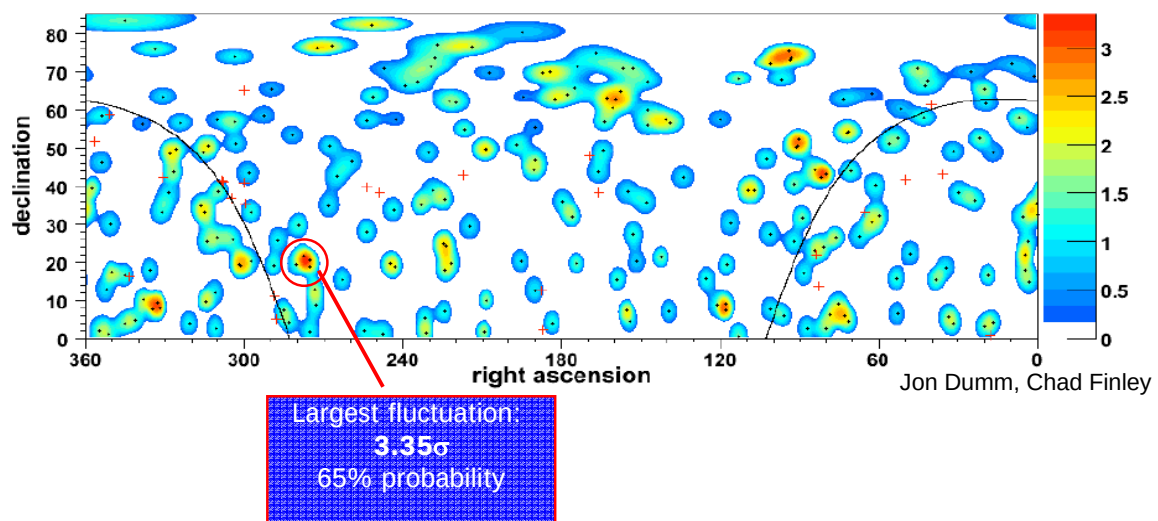


Standard Server
High Level Software

Flasher Event und Myon-Spur (Luftschauer)

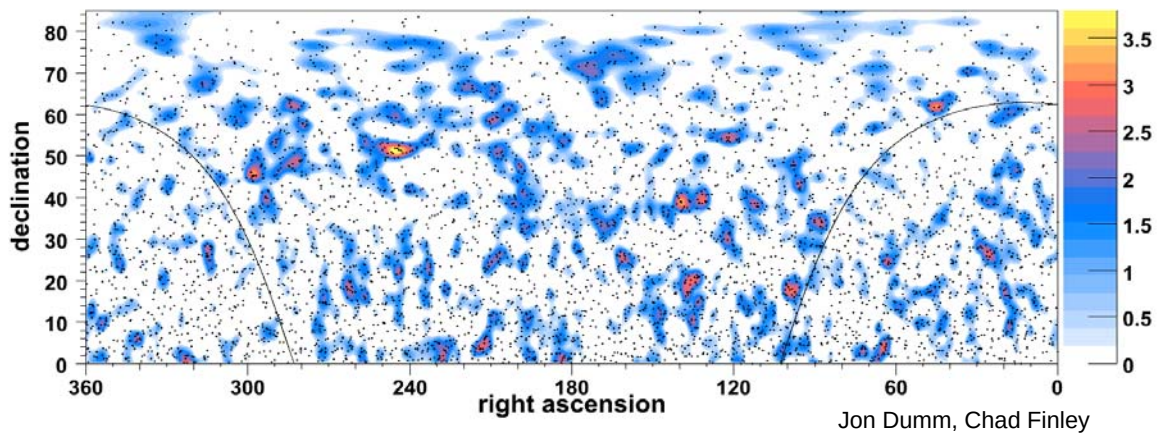
Animation fehlt leider!

IceCube 9 String 2006er Daten



- Juni 2006 – November 2006
~ 137.4 days livetime – 233 neutrino events

IceCube 22 String 2007er Daten



- Juni 2007 – März 2008
~ 250 days livetime – 5000 neutrino events
- Noch in Arbeit

Eine spannende Zukunft

- Kontinuierliche Datennahme seit Beginn der Konstruktion
- Erfolgreiche Verifizierung des Detektorbetriebs
- Erste Analysen sind publiziert
- 2009 integriertes Volumen $> 1\text{km}^3$

Vielen Dank!