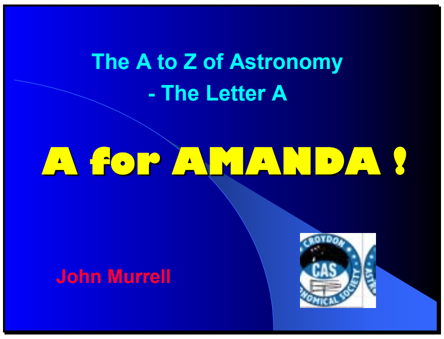
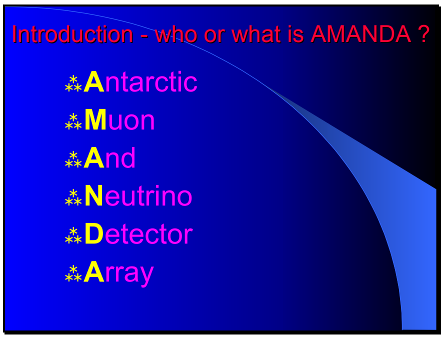
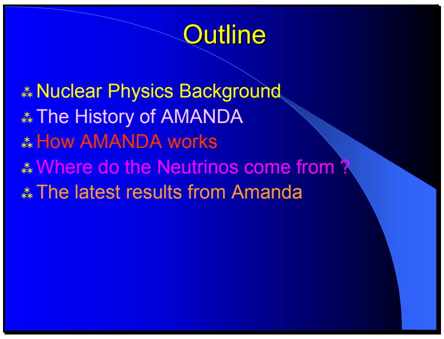
Slide 1



Slide 2

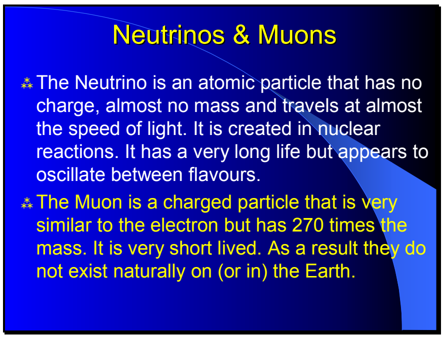


Slide 3



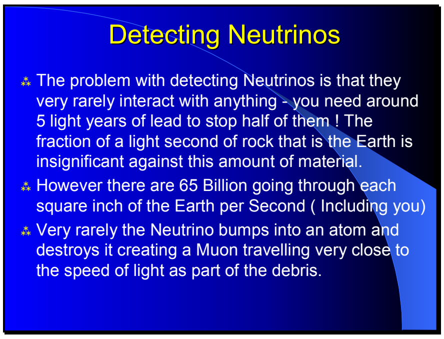
Tonight I am going to speak about a unique unique telescope - the only telescope in the southern hemisphere designed to look at the Northern Sky !

Slide 4



Explain that the Neutrino is very unlikely to react with any matter

Slide 5

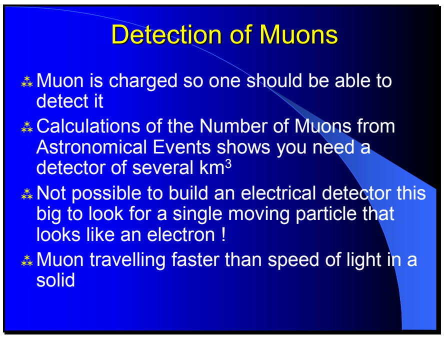


The 65 Billion are from the Sun - it does not matter if it is nighttime they just go through the Earth without noticing !

There are other sources as well including Nuclear Reactors & Natural Radioactivity.

As a trillion or so are passing through you a second it is a good thing they do not interact !

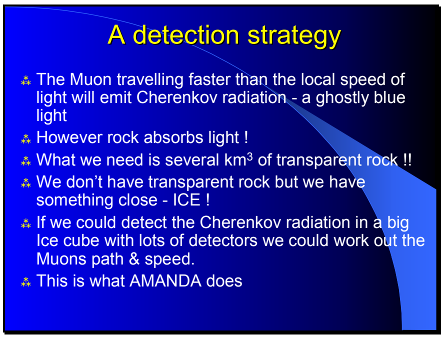
Slide 6



While the Muon is charged it has a short life so detecting it by it's electrical field in rock is impossible at present.

Rock is also not a very good detector as it is radioactive and thus produces 'natural' muons.

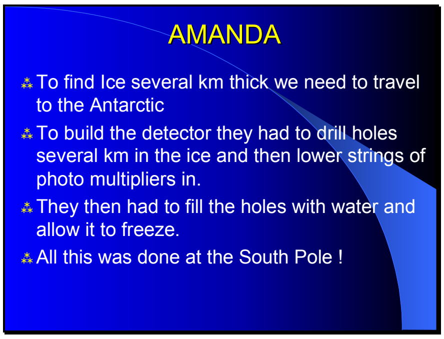
Slide 7



We need detectors all round the block of ice to allow us to triangulate the path

Ice in the Antarctic also has a low level of natural radioactivity.

Slide 8

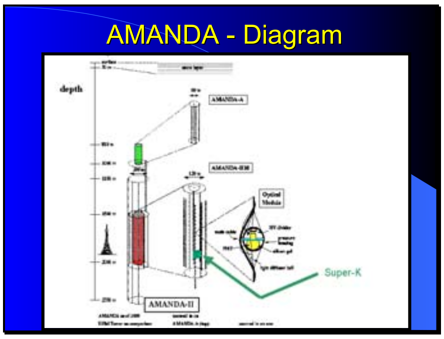


Freezing of course applies great pressure to the detectors, just like your pipes bursting in the cold at home - so they and the cable connections had to be engineered to withstand this.

The ice is only transparent to the Blue Light at depths > 1,400m this defines the height of the top of the string together with -It also has to be deep to stop the Muons generated in the Atmosphere by cosmic rays interfering.

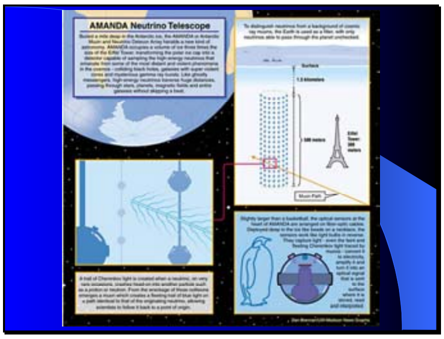
The detector arrays extend from 1,300m to 2350m currently 19 strings with 680 detectors in total

Slide 9



Note the size of the detector relative to The Eiffel Tower as well as Super-Kamiokande the Japanese Neutrino detector (the green cube).

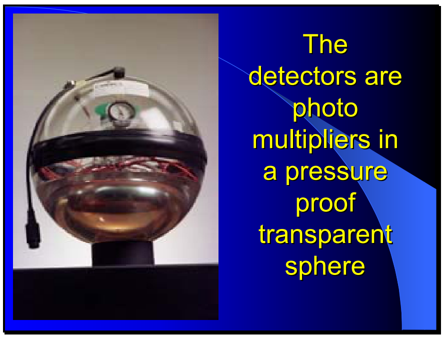
Slide 10



Another diagram,

Beware top right is not to scale

Slide 11



THE PMT multiplies the light by at least 100 million times and can detect single photons.

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Hole drilled with hot water
Hole is about 0.5 m diameter and 2350 m deep !

When the string of detectors is lowered into position the hole is back filled with water that then freezes.

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You may think building a detector in Antarctica is very expensive but building a conventional neutrino detector with of piles of ultra pure lead to shield an above ground detector has been estimated to cost 10 k dollars / sq m. So a km sq array is 10E6 x 10E4 = 10E10 = 10 Billion Dollars !

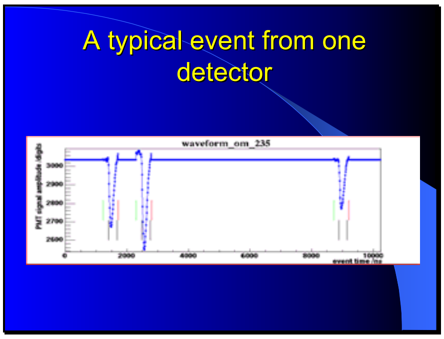
In fact the US has got quite a good science infrastructure at the South Pole and it is not too difficult to work there in the Antarctic Summer.

Slide 14

The electronics looks for the light pulses and times them very accurately. By timing when the light arrives at each detector it is possible to plot the path of the Muon through the detector. This then gives you the path of the original Neutrino (within 0.6 degrees).

Time resolution is 3ns (light travels 3 feet in this time)

Slide 15



The flat parts of the trace are where the uninteresting bits have been cut out.

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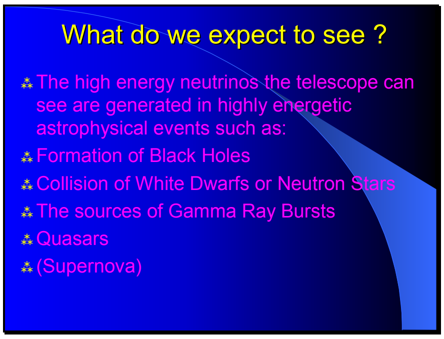
Explain !

Slide 17

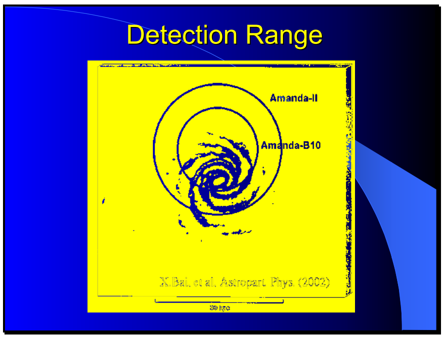


Explain the phenomena

The first ones generate very high energy neutrinos which will directly create Muons that can be detected.

Galactic Supernova are to low an energy to be detected

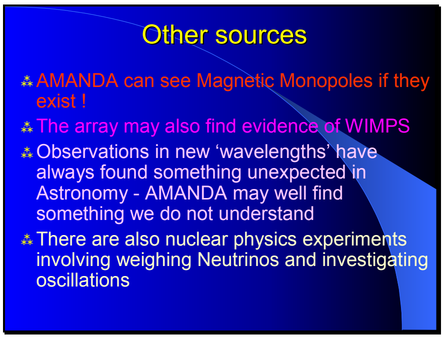
Slide 18



Detection range for supernova.

This is a lot lower than for other (higher energy !) events as the Neutrinos only have a low energy of around 20eV, detection is via a secondary phenomena.

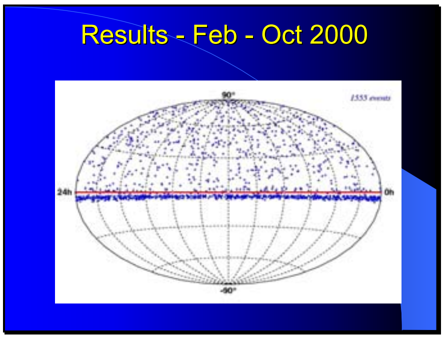
Slide 19



Magnetic Monopoles MAY be part of dark matter
WIMPS - some may collide with atoms in the earth and get slowed down and captured - they may then annihilate a bit of matter producing Neutrinos

Neutrinos are now believed to have mass and oscillate between the three ‘flavours’ - Electron Neutrino, Muon Neutrino or Tau Neutrinos. (Tau is like a much heavier electron or Muon)

Slide 20



1555 events
The horizontal band is due to Muons from Atmospheric Cosmic Rays entering the ice from the edge and is to be expected.

There is no statistical evidence from the initial data for any point sources of Neutrinos in the Northern Sky. Though there is a hint that Markarian 501 (a BL Lac object - elliptical galaxy with a compact highly variable nucleus) may have been detected but it was not very active during the observation period.

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Future Results

- The real results will come if we have another nearby Supernova such as 1987A - AMANDA will detect many more Neutrinos than the few dozen detected by the previous detectors.

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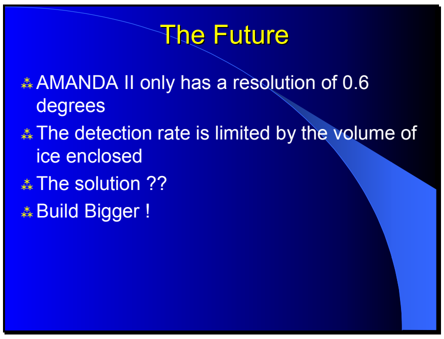
Other Neutrino Detectors

- There are the ‘small scale’ detectors such as Super-Kamiokande, Solar Neutrino Observatory near Sudbury, Canada & GranSasso
- Deep Underwater Muon and Neutrino Detector (DUMAND) being built in a deep part of the Mediterranean
- ANTARES underwater neutrino telescope also planned for the Mediterranean

Slide 23



Slide 24