Neutrino Detector in Armenia

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Abstract
We suggest to construct Neutrino Detector in salt mine near Yerevan.
First We intend to detect ultra high energy neutrinos. Rock salt is considered as a radio wave transmission medium. The radio waves are generated by Askaryan effect (coherent impulsive radio Cherenkov radiation from the charge asymmetry in an electromagnetic shower) in the neutrino interaction in the rock salt.
Second We intend to construct very large Water Cherencov (multipurpose) detector (depth ca. 2800 m w.e.). The detector may be used in the future neutrino beam from the CERN. The site is in the "Golden Distance" from the CERN - ca. 3200 km.

1 UHE neutrino detection via Askaryan method

The maximum energy exceeds 10^{20} eV for observed cosmic rays. That energy is over the allowed energy limit for cosmic rays traveled from the extra galaxy (over 50 Mpc). The particles lose their energy in interaction with the cosmic microwave radiations (GZK cutoff). It is one of the most attractive problem in astrophysics.

In order to detect the UHE neutrinos, we need a huge mass of the detector ($> 10^9$ t) since neutrinos interact in the detector volume via electroweak interactions (cross-section $< 10^{-33}$ cm^2) and the flux of UHE neutrinos is very low.

The rock salt mine in nature is a perfect huge mass UHE neutrino detector. An event rate is expected to be 10/year/km^3 for over 10^{18} eV neutrinos.

UHE neutrino interaction with the matter generate a shower. Gurgen Askaryan proposed detection of radio emission with coherent amplification from the excess negative charges of an electron-photon shower in a medium. In the range of wavelengths greater than the dimensions of the excess electron cluster, the intensity of the radiation is proportional to the square of that total excess: $(N_{e^-} - N_{e^+})^2$.

The rock salt medium is very transparent for radio waves. The transparency of electromagnetic wave in microwave region. Therefore moderate number of radio wave antenas/sensors (placed in the holes in the salt mine) could detect the neutrino interaction in the massive rock salt.

We intend to measure the absorption length of the GHz radio waves in the salt mine. The result of that measurement will show the further possibilities for construction the full size (ten's of km^3) radio detector in the salt mine near Yerevan for detection of the UHE neutrinos via Askaryan's method.

2 Megaton Water Cherencov Detector

The detector R&D on large (Megaton) Water Cherenkov (WC) devices is based on the experience of running the Super-Kamiokande detector.

Megaton WC detector in Armenia may be used for the proton decay, for detection of the solar, atmospheric and Supernovae neutrinos, neutrinos from the future beam from the CERN (the site is located ca 3150 km from the CERN).

The geological (anti)neutrinos from decay of the Th and U also may be detected if the $GdCl_3$ will be added to the water. In the salt exist potassium. But the energy of the neutrinos from K^40 decay is less than 2 MeV (the energy of neutrinos from Th and U decays > 2 MeV) and don't create a background.

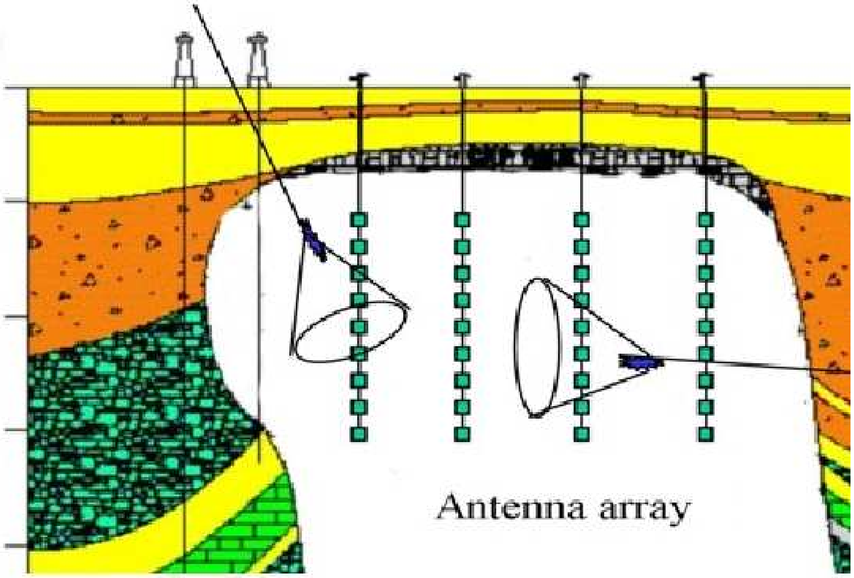

Fig. 1: UHE neutrino detector via Askaryan's method

Rock salt is very strong material and has low density ($\rho \approx 2.2\ g/cm^3$). The tunnels and large cavities in the salt mine are very stabile.

The radon background is very low in the salt mine. The salt rock is not transparent for the radon. As showed measurements the radon becomes available in the tunnels after technical explosions (for the salt exploration) when the ground is shacked and radon makes its way out of the salt rock.

The site is more close to the equator (40^0) than other proposed Megaton detectors and may be used for direct search of Earth's core via solar neutrino regeneration effect when they cross the core of the Earth (day-night effect).

The GasProm company has several large gas reservoirs in the salt mine at 1200 m depth (ca. 2800

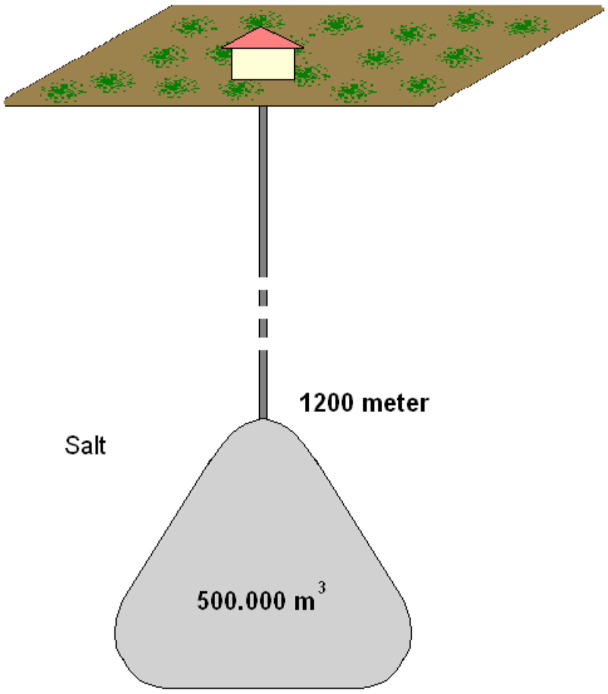

Fig. 2: The stability of Half-Megaton cavity is investigated for the Water Cherencov Neutrino Detector

m w.e.). The technique (to make large cavities) is very simple. They just wash the salt with water and pump the salt water to the surface. The salt water than used for getting the food salt.

We intend to investigate the stability of the very large (several Megaton) cavities in the salt mine.

References

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