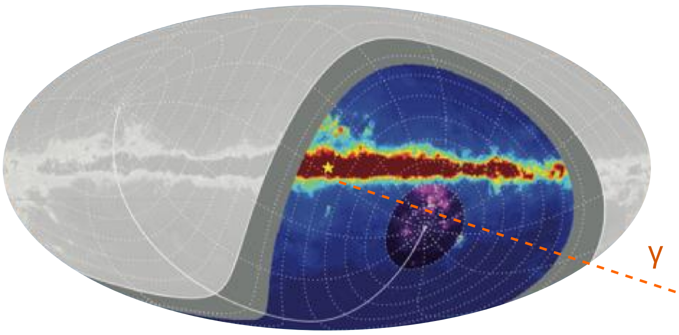
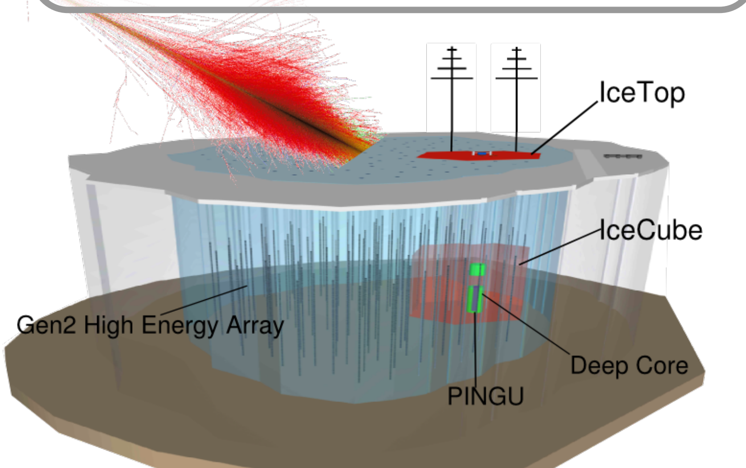
Radio Detection of Cosmic Rays with IceCube-Gen2



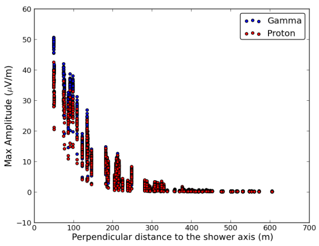
Motivation:

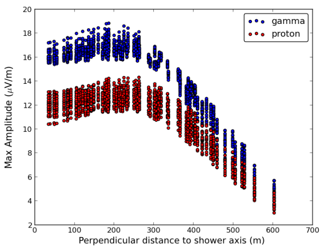
The galactic center lies at around 70° inclination at the South Pole. Searching for high energy photons approaching from this direction can provide interesting physics. The use of radio detectors is an effective method for observing such events and can help in exploring the galactic contribution to the flux of high energy photons.

IceCube-Gen2 [1] is the next generation of the IceCube Neutrino Observatory, with a volume of ~10km^3. It has the potential to provide an order of magnitude increase in neutrino detection rates. It also enables the identification of the most energetic processes in the Universe

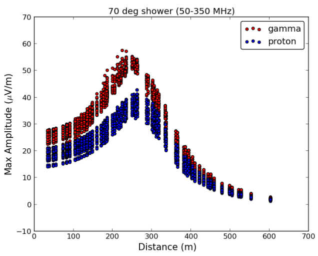


A surface array of scintillators and radio antennas will be installed for cosmic-ray studies and veto purposes. Such a combination will give a more exhaustive picture of the observed cosmic ray air showers.



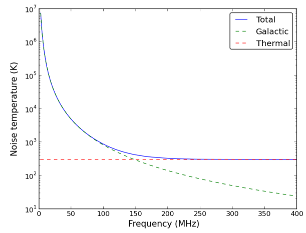


A separation is visible between the radio signals obtained for photon and proton showers simulated using CoREAS [2]. The signals are filtered to a bandwidth of 30-80 MHz. This gives a hint that information from radio signals of highly inclined showers can be used for composition studies.

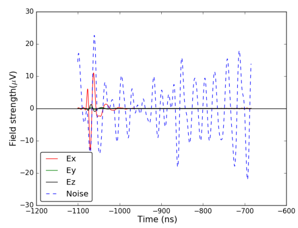


At higher frequencies, we can see the Cherenkov cone of the signal. Here, the signal is considerably higher and one has a better chance to detect them.

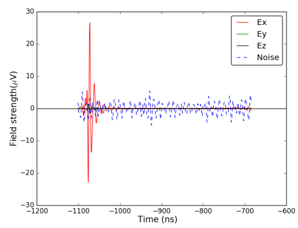
Galactic noise is the major source of noise at the South Pole, for radio detection. Here, the noise traces are extracted from a frequency dependent noise model [3].



The noise temperature can be related to the power delivered at the antenna (P=kTδν).



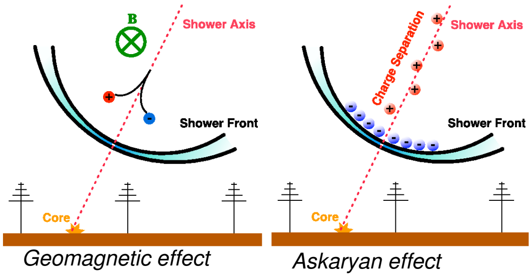
30-80 MHz.



80-180 MHz.

A resonable signal to noise ratio is desired. This can be achieved by going to higher frequencies.

Radio emission mechanisms [4]



References:

[1] IceCube Collaboration (Aartsen, M.G. et al.) arXiv:1412.5106 [astro-ph.HE]
[2] Huege, T., Ludwig, M, James, C.W., 2013, AIP Conference Proceedings 1535, 128-132
[3] H. V. Cane, Mon. Not. R. astr. Soc. 189, 465–478 (1979)
[4] Huege, T. Braz J Phys (2014) 44: 520. doi:10.1007/s13538-014-0226-6

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