# Research of the Galactic Cosmic Rays from "knee" till "cutoff" ($10^{16}$-$10^{19}$) eV at Aragats Cosmic Ray Observatory

**A.Chilingarian, G. Hovsepyan**

*Cosmic Ray Division, Alikhanyan Physics Institute, Alikhanyan Brothers 2, Yerevan 375036, Armenia*

## Abstract

Measured intensities of the galactic cosmic rays are described rather satisfactory till energy ~$10^{17}$ eV by the acceleration of protons and nuclei in supernovae explosion blasts in presence of strong magnetic fields. At ~$10^{15}$eV this mechanism faded producing the first "proton" knee; at ~$10^{17}$eV, the iron nuclei also cannot gain additional energy crossing SNR generated shock

The energy domain $10^{17}$eV~$10^{18}$eV is an enigmatic region where may be mysterious extragalactic CRs, presumably produced in Active Galactic Nuclei are mixing with fading galactic iron flux. There are different scenarios of mixing of both components and absolutely not enough experimental evidence for comparisons. KASCADE, MAKET-ANI and HighRes data seem to suggest a "bump" after $10^{17}$ eV, although error bars are too large for the physical inference. AKENO data suggested rather smooth transition. This important question of transition from galactic to extragalactic component can only be solved by measuring partial energy spectra of light and heavy nuclear groups. The explanation of the spectra features (2nd knee, ankle and the GZK cutoff) are possible only after disentangling all-particle spectra into 2 or more components. Furthermore, the attenuation length of the particles due to the various energy loss mechanisms depends on the particle type and without determination of the primary particle type on the event-by-event basis even all-particle energy spectra will be biased. Of course, new type of particle detectors with enhanced flexibility to precisely and simultaneously measure changing fluxes of different secondary particles with different energy thresholds will be a key element of new Extensive Air Shower (EAS) array.

We propose to build the new large EAS detector in Nor-Amberd – Antarut region on slopes of mt. Aragats at altitude ~ 2000 m. Two separate networks of particle detectors will be formed around central part of ~ 20 $m^2$ hybrid particle detectors, measuring neutrons, electrons and muons of the shower. Both sites have total area ~0.35 $km^2$, and will detect primary particles with energies up to several units of $10^{17}$ eV. Huge events triggering 2 arrays will correspond to the primary energies above $10^{18}$ eV, EAS core collection area will be ~15 $km^2$. As a second phase of project we consider incorporation of the Aragats research station EAS arrays, operated at altitude 3200 and within 10 km distance from proposed new detector. Adding Aragats detection site equipped with ~300 $m^2$ of scintillators can significantly enlarge the area of collecting EAS cores and enlarge maximal attainable energy of array up to $10^{19}$ eV if all 3 detecting sites register EAS electrons (from 75 $km^2$ area ~150 events with energy above $10^{19}$ eV are expected per year). In the second phase of the project we plan to deploy additional scintillator modules in Burakan Astrophysical Observatory (BAO), in the Institute of radio-measurements in Orgoff, in village schools fallen within big detector area. Ultra-high energy cosmic rays detected by the NewANI detector will be correlated with optical data obtained by NOMOT mini observatory now under construction in Nor Amberd and with data from world largest Cherenkov Atmospheric Telescope MAGIC operated on Canarian Islands.