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Electron-Neutron Detector Array (ENDA)

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By accurate measurement of components and energy spectrum in the knee region, problem of origin of cosmic ray can be solved. In one extensive air shower (EAS), high energy hadrons, which constitute the EAS skeleton as G.T. Zatsepin called it, carry important information for multi-parameter correlation studies. The nuclear reaction between hadrons and matter in the surrounding environment (such as soil, buildings, detector materials, and air) produces a large number of evaporation neutrons; moderating by matter in the surrounding environment, the evaporation neutrons become thermal neutrons. At the beginning of the 21th century, a new technology, electron-neutron detector (EN-detector) was designed by Y. Stenkin and his colleagues, and the PRImary Spectrum Measurement Array (PRISMA) project was proposed to reinforce array capability of cosmic ray composition separation and then improve measurement accuracy of cosmic ray components and energy spectrum. Besides, EN-detectors can be used for continuous environmental thermal neutron flux monitoring and its variation study needed not only for EAS experiment background estimation but also for geophysical applications (e.g. earthquakes, thunderstorms, radioactive aerosol control, etc) and solar activity study (e.g. solar flares, Forbush effects, etc).
Under the Chinese-Russian cooperation, we put forward to build so called EN-Detector Array (ENDA) at high altitude in China. In 2013, we placed a small array of 4 EN-detectors, so called PRISMA-YBJ in the ARGO-YBJ experimental hall at Yangbajing (YBJ) (4300m a.s.l.), Tibet, China, with which we achieved the simultaneous detection of thermal neutrons and electromagnetic components in EAS coincident events between PRISMA-YBJ and ARGO-YBJ. Up to now, one cluster composed of 16 EN-detectors based on new type boron compound scintillator is running in Moscow. Meanwhile, there are four clusters running in China for detectors and arrays specification test: one so called P-16-YBJ at YBJ, one so called ENDA-16-HZS at LHAASO (4410m a.s.l.), Daocheng, Sichuan, and two at Hebei Normal University (HNU) near sea level, Shijiazhuang, Hebei. ENDA-16-HZS has obtained coincident events with LHAASO. In the near future, we plan to extend ENDA to ENDA-64 with array area of 1000 m2 inside LHAASO to study the knee region of the light components (H and He). After it, ENDA will be extended up to 400 detectors with array area of 10000 m2 to study the knee region of the heavy components like Fe.

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