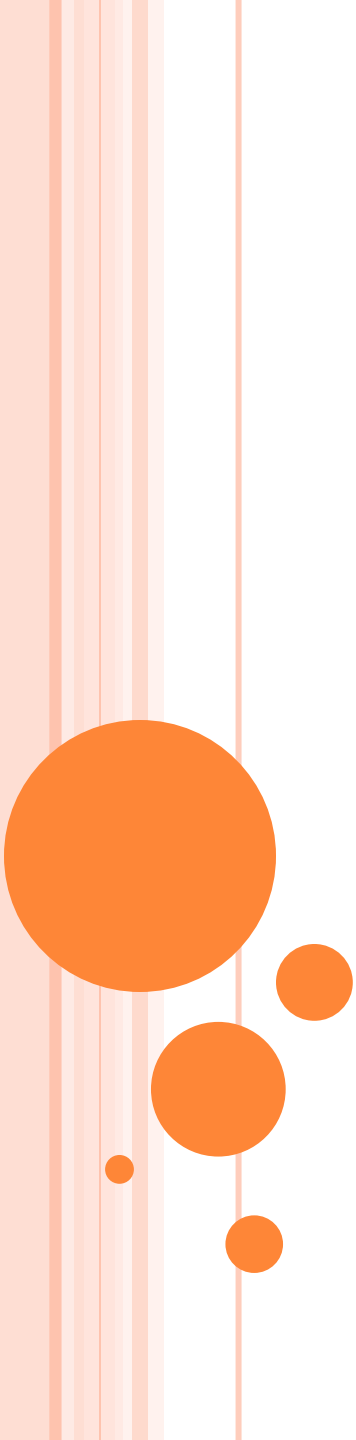


THE EFFICIENCIES OF THE ARAGATS SPACE
ENVIRONMENTAL CENTER (ASEC) PARTICLE
DETECTORS USED IN THUNDERSTORM GROUND
ENHANCEMENT (TGE) RESEARCH

Bagrat Mailyan



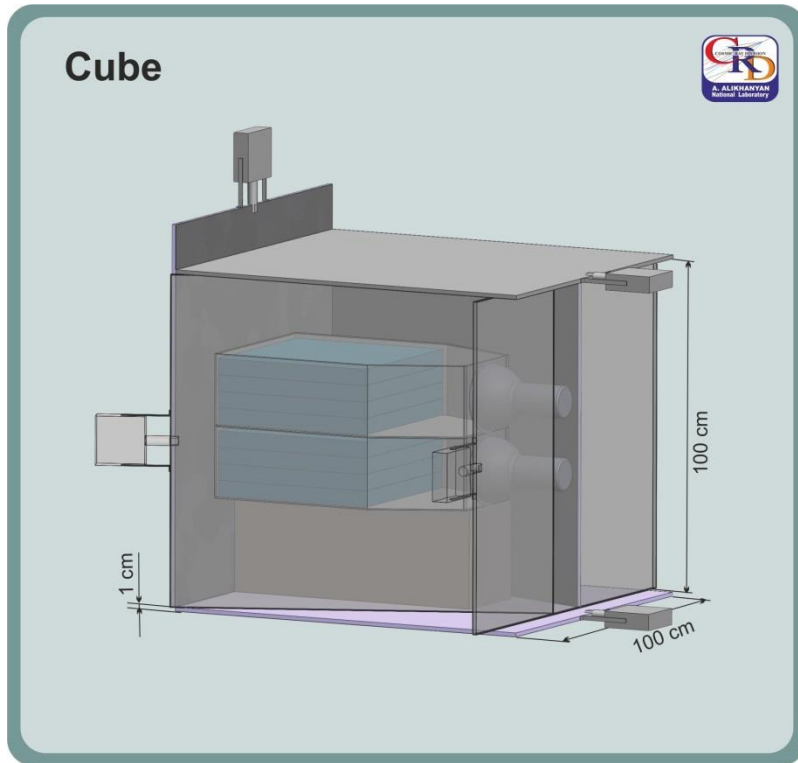


Till 2009, ASEC particle detectors were used to study High Energy Astroparticle physics (galactic cosmic rays) and solar activity effects on cosmic rays (Ground Level Enhancement, Forbush effect).

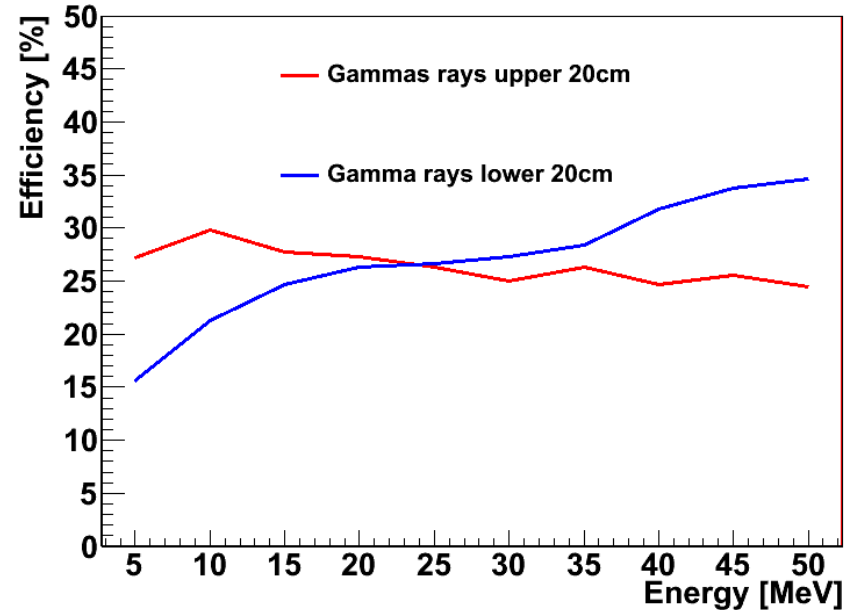
During solar activity cycle minimum, a research of another effect – TGEs, particle count rate increases caused by atmospheric electric field effects on the secondary cosmic rays . The study of phenomena connected with particle acceleration in the atmospheric electric fields was recently named “High Energy Atmospheric Physics”.

To study these effects several particle detectors were installed at ASEC. Since TGE particles are mainly electrons and gamma rays with relatively low energies ($<100\text{MeV}$), the new detectors should have low energy thresholds and allow electron/gamma ray separation.

CUBE – ALLOWING TO REJECT CHARGED PARTICLES AND GET GAMMA RAY ENERGY DEPOSIT SPECTRUM. LOWER 20 CM SCINTILLATOR LAYER HAVING >50 MEV ELECTRON THRESHOLD ALSO SENSITIVE MAINLY TO TGE GAMMA RAYS.



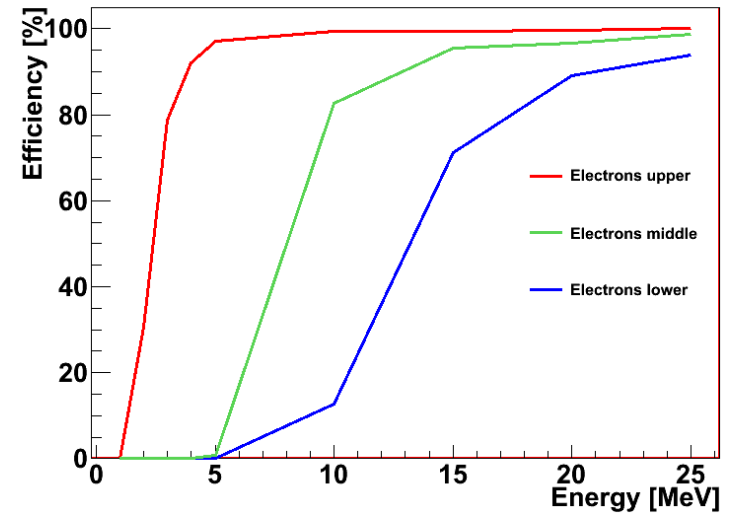
Gamma ray Registration Efficiencies



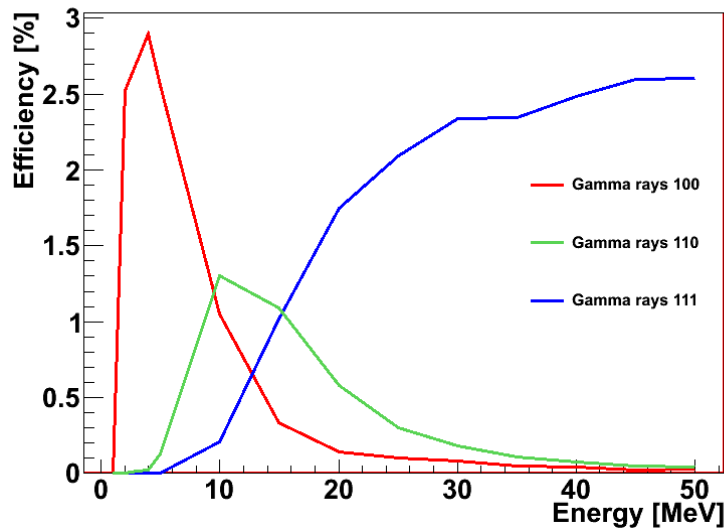
STAND LOW ENERGY THRESHOLD OUTDOOR DETECTOR ALLOWING TO MEASURE ELECTRON SPECTRUM AFTER CORRECTION FOR GAMMA RAY CONTAMINATION



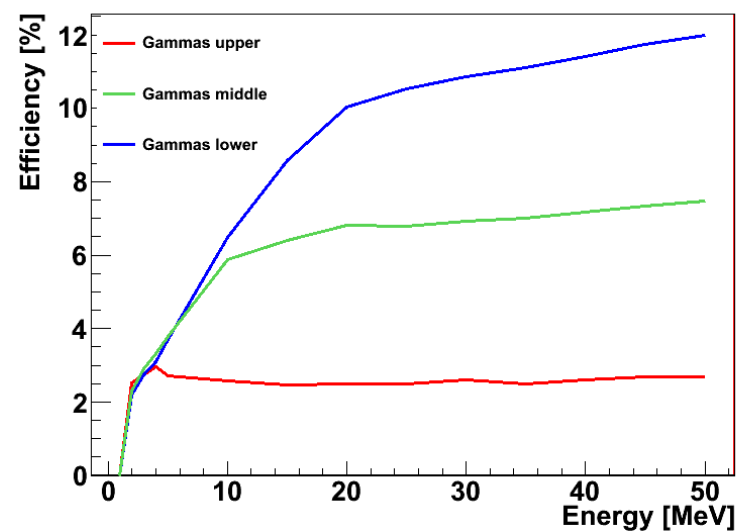
Electron Registration Efficiencies



Gamma Ray Registration Efficiencies

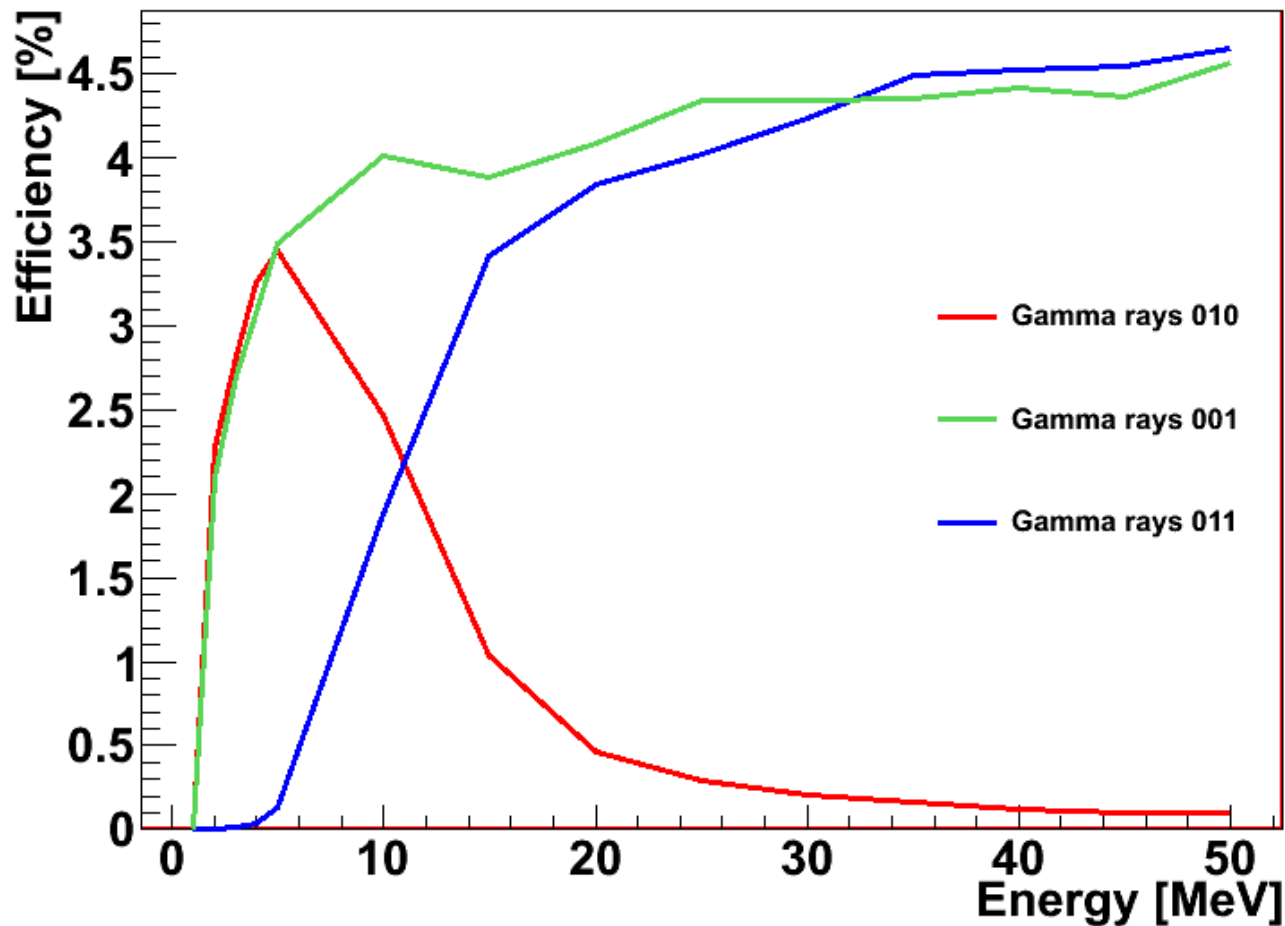


Gamma Registration Efficiencies

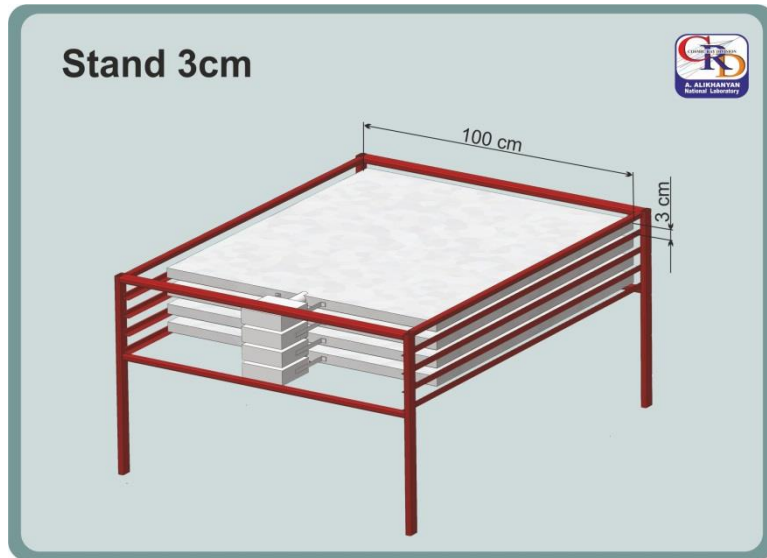


STAND EFFICIENCIES FOR SOME COMBINATIONS: LOW ENERGY PARTICLES CAN BE DETECTED ONLY AT MIDDLE LAYER WITHOUT INTERACTING IN UPPER LAYER, IF THE ENERGY IS HIGHER THEY WILL INTERACT ALSO IN THE NEXT LAYER

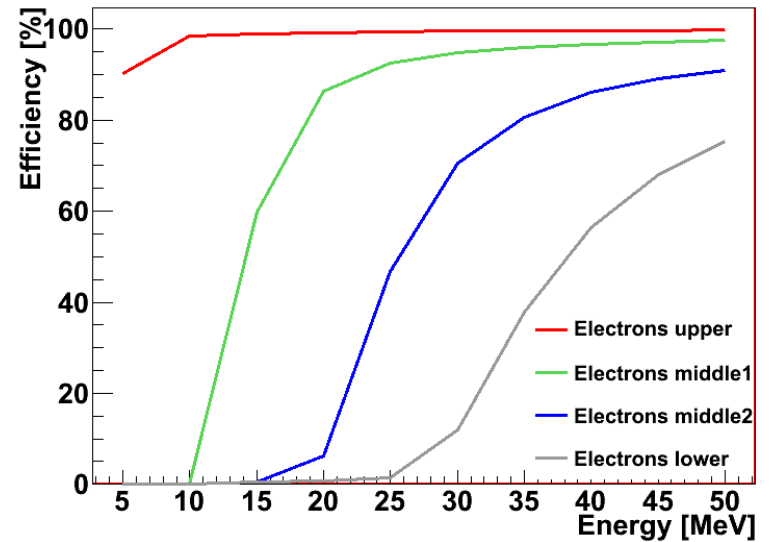
Gamma ray Registration Efficiencies



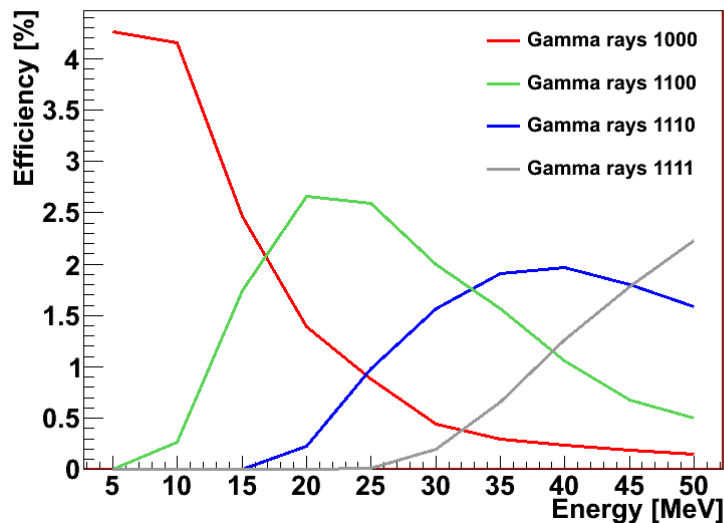
STAND 3CM DETECTOR ALLOWS TO STUDY THE TGEs WITH INTENSE ELECTRON FLUXES UP TO 40 MeV



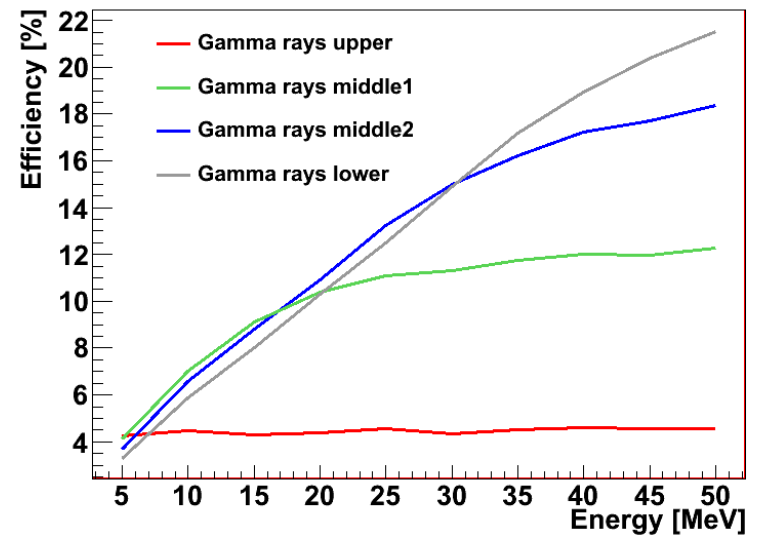
Electron Registration Efficiencies



Gamma ray Registration Efficiencies

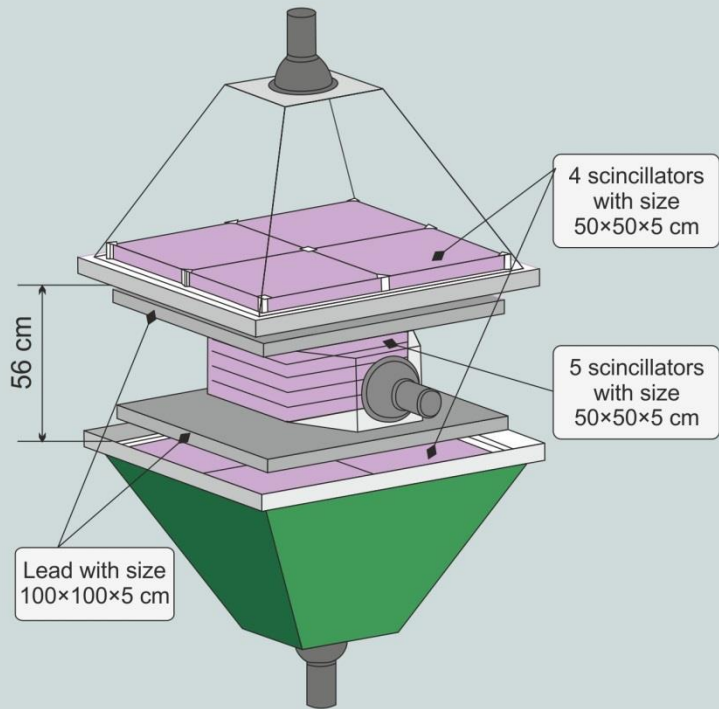


Gamma ray Registration Efficiencies

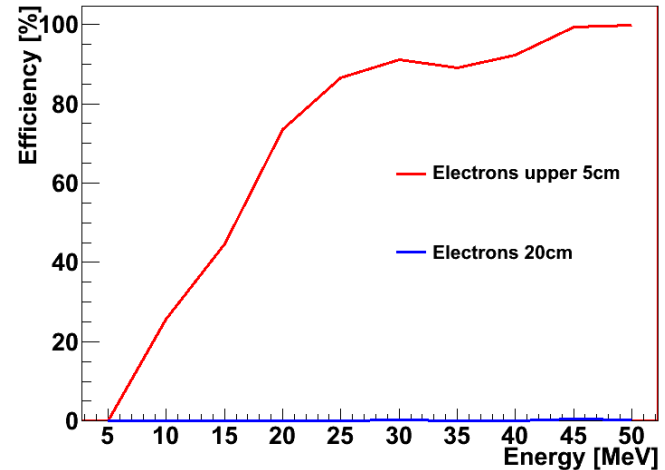


SEVAN – DETECTOR SIMULTANEOUSLY MEASURING LOW AND HIGH ENERGY CHARGED PARTICLES, ALSO NEUTRAL PARTICLES, ALLOWS TO PROVE THAT THE INCREASE IS CAUSED BY TGE PARTICLES

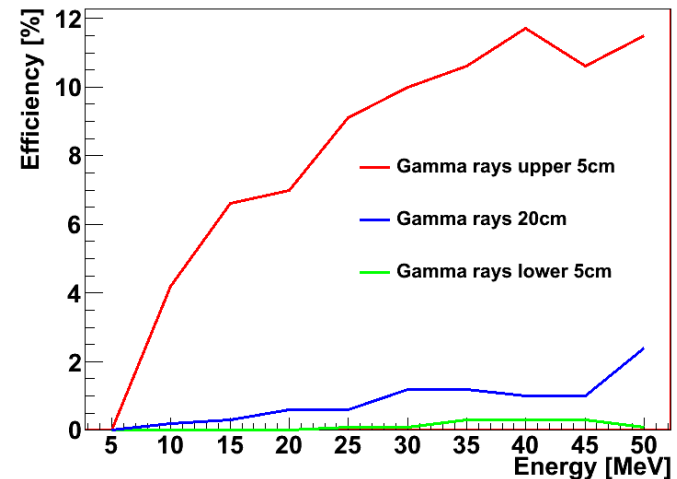
SEVAN (Space Environmental Viewing and Analysis Network)



SEVAN Electron Registration Efficiencies

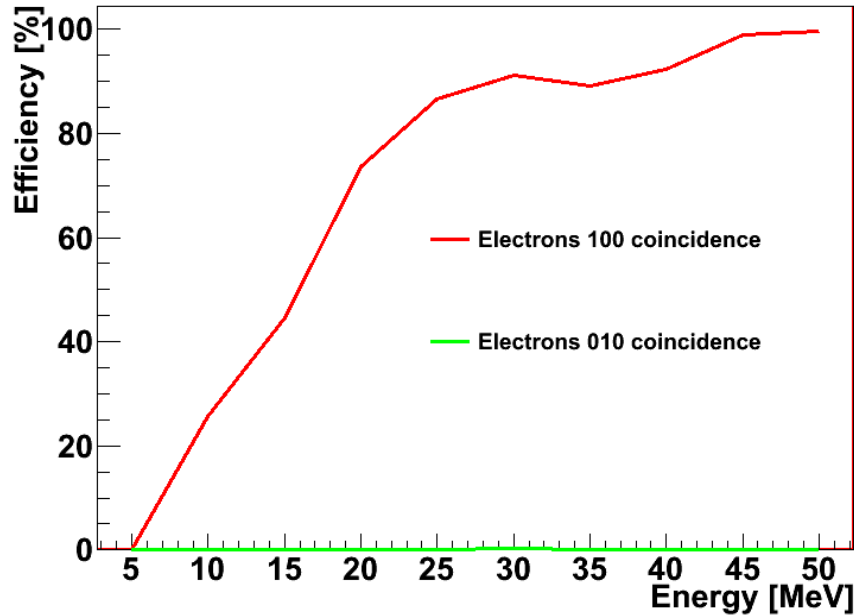


SEVAN Gamma ray Registration Efficiencies

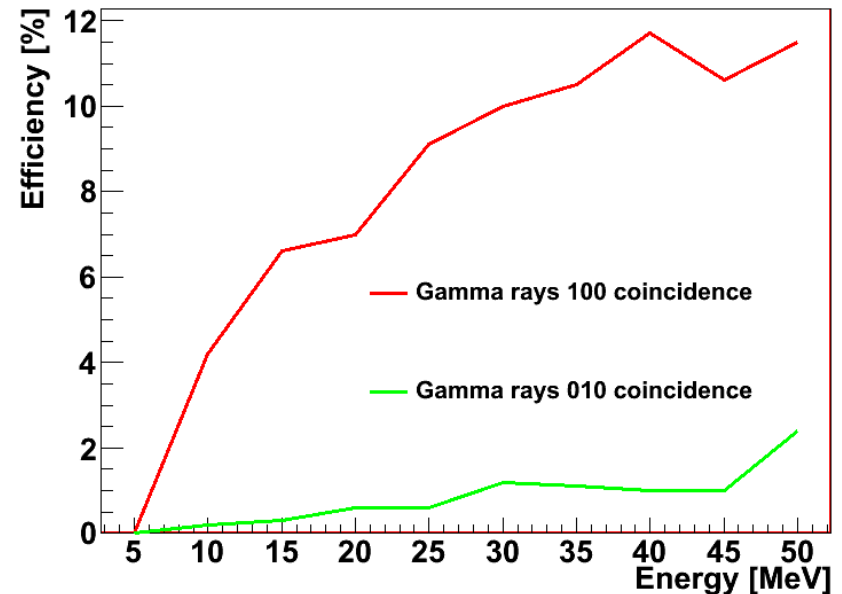


SEVAN EFFICIENCIES ARE NEAR THE SAME AS FOR THE LAYERS, SINCE LOW ENERGY ELECTRONS AND GAMMA RAYS CANNOT PASS 5 CM OF LEAD

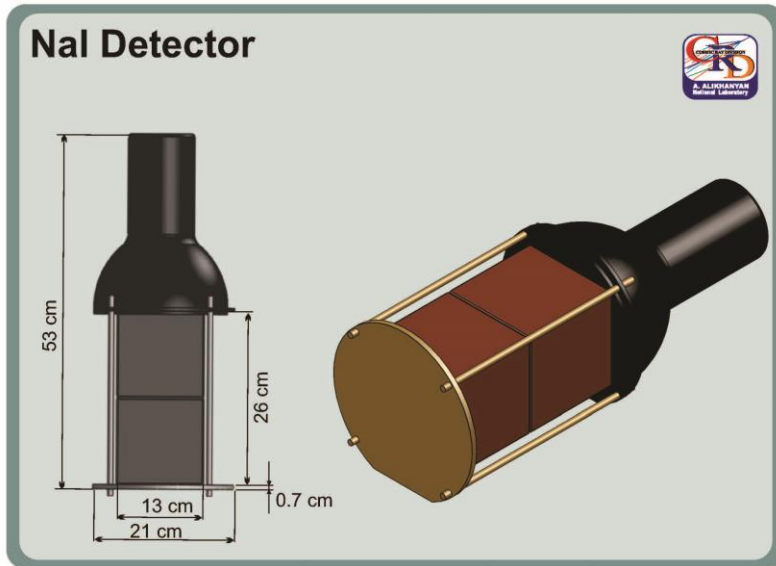
SEVAN Electron Registration Efficiencies



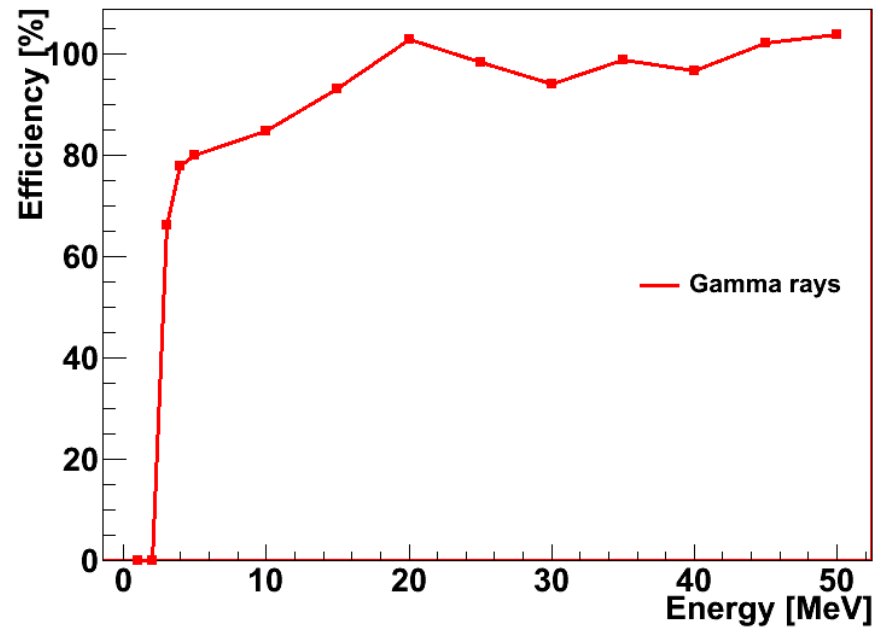
SEVAN Gamma ray Registration Efficiencies



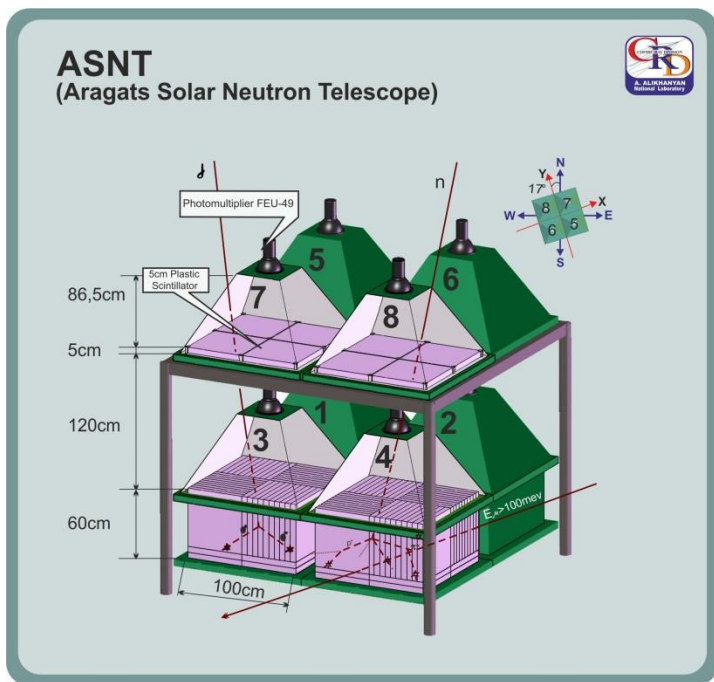
NAI DETECTOR HAS HIGHER EFFICIENCY FOR GAMMA RAY DETECTION



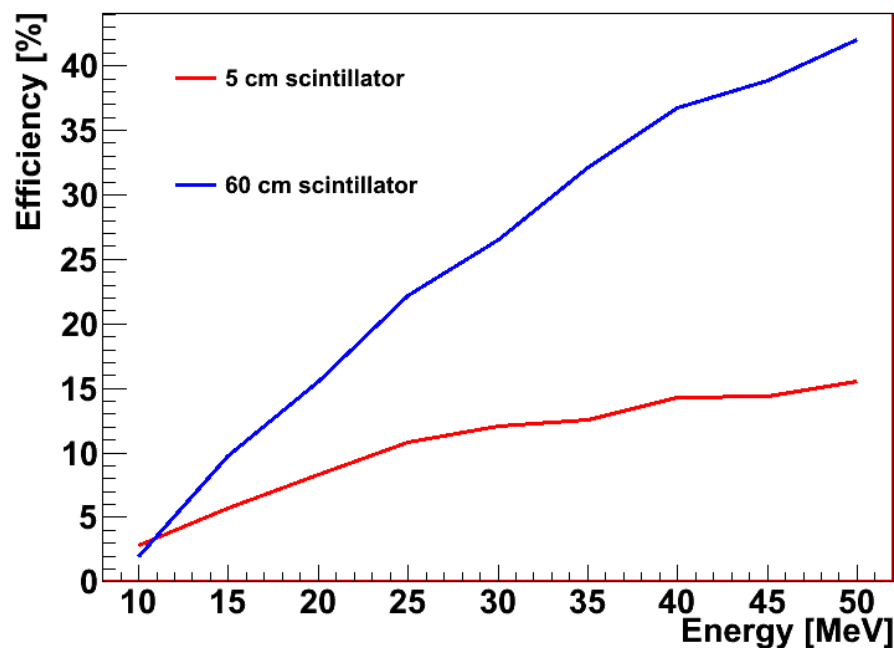
NaI Gamma ray Registration Efficiencies



ASNT 5 AND 60 CM SCINTILLATORS ALLOW CHECKING THE ELECTRON/GAMMA-RAY RATIOS, SINCE 60 CM HAS VERY HIGH ELECTRONIC THRESHOLD >30 MeV AND IT'S SENSITIVE MAINLY TO GAMMA RAYS DURING TGEs. 5 CM SCINTILLATOR HAS A HIGHER SENSITIVITY TO ELECTRONS AND SMALLER GAMMA RAY EFFICIENCY

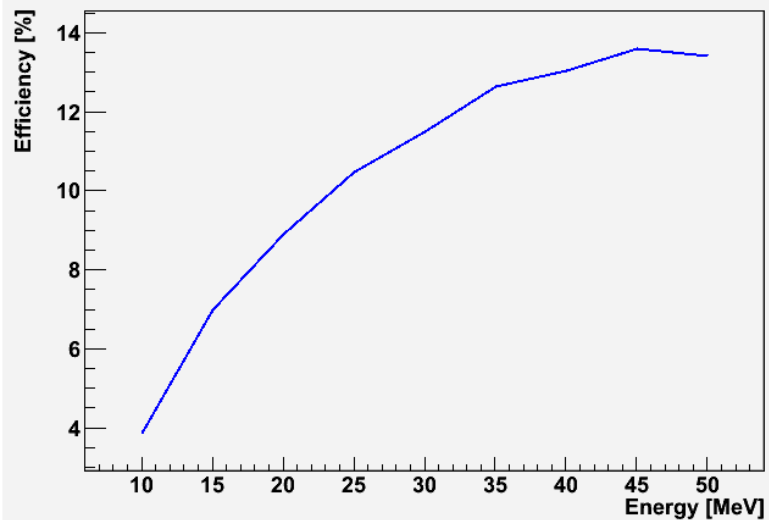


Gamma Registration Efficiency

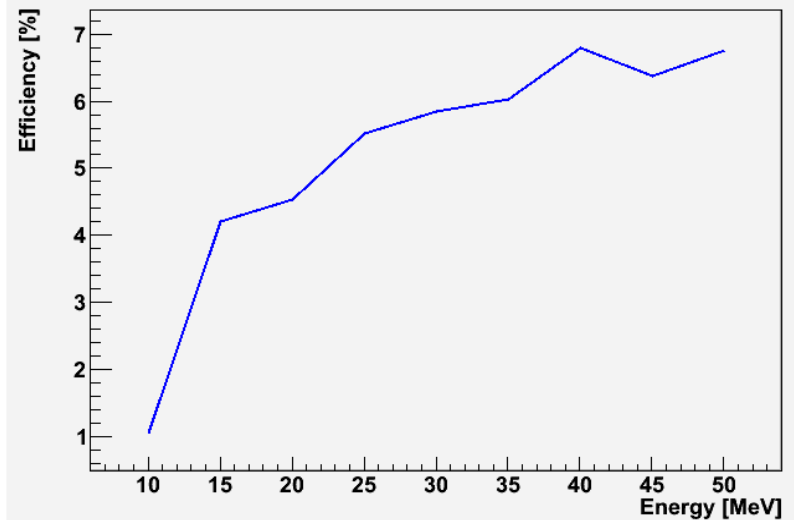


EFFICIENCIES OF 5 CM SCINTILLATORS LOCATED INDOORS AND OUTDOORS; GAMMA RAYS INTERACTING IN THE ROOF OF THE MAKET LABORATORY BUILDING PRODUCING CHARGED PARTICLES, THUS, THE GAMMA RAY EFFICIENCY OF OUTDOOR DETECTORS IS HIGHER

Gamma ray Efficiency of Maket indoor detector



Gamma ray Efficiency of Maket outdoor detector



- Variety of ASEC detectors along with field meters and lightning detectors allow to study the TGEs and related high energy atmospheric phenomena.

