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The Kinematic Lightweight Energy Meter (KLEM) method for the NUCLEON space experiment

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The NUCLEON apparatus is a low orbit space ray detector positioned on the Resurs-P satellite. The main detector for measuring space ray energy is the kinematic lightweight energy meter (KLEM). The KLEM method is a development of the kinematic calorimeter method proposed by Castagnoli in 1953. The main principle of a basic kinematic calorimeter is to measure primary particle's energy by measuring spatial distribution of secondary particles produced by first hadron interaction in the target. The difference of the KLEM from such calorimeter consists in presence of the gamma converter. Its task is to convert gammas, produced in neutral pions'decays, into electron-positron pairs. This increases number of registered secondary fragments and accuracy of the method. Application of the KLEM method has allowed to design the detector that is lighter than a traditional ionisation calorimeter, to create the apparatus with greater effective surface and geometrical factor. The KLEM of the NUCLEON space experiment consists of the carbon target of one nuclear length thickness and six planes of silicon strip detectors with tungsten converters 0.5 radiation lengths each. Size of sensitive region is 50x50 cm^2, geometrical factor of the KLEM and the trigger system is 0.2 m^2*sr. To distinguish elements of space rays, a charge measurement system is included into the NUCLEON apparatus. It consists of four planes of silicon pad detectors, which are positioned in front of the target. The test sessions on the SPS CERN beam have shown that the energy measurement accuracy is 80%, and the charge measurement system can distinguish nuclei with Z from 1 to 30. The NUCLEON experiment's KLEM calorimeter is able to increase accuracy of spectra of space ray elements with energies from 100 GeV to 10 TeV.

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