MULTI-PURPOSE DETECTOR SYSTEM FOR INVESTIGATIONS OF MULTINUCLEON TRANSFER REACTIONS

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The multinucleon transfer reaction is the perspective method for the investigation and production of the extreme neutron-rich heavy nuclei. The new setup is intended as a multi-purpose detector system optimized to study multinucleon transfer reactions and fission of neutron-rich excited heavy and super-heavy nuclei. The detector system is designed to provide multiparameter correlation measurements of the heavy fission fragments, prompt neutrons, and charge particles in quasi-fission and transfer reactions.

The Multi-Purpose Detector system consists of 12 neutron detectors and a Time-of-flight spectrometer for the fission fragments registration. The time-of-flight spectrometer includes micro channel plates (MCP) as start and stop detectors and assemblies of position-sensitive semiconductor (PIN) as E detectors. The "START" detector detects electrons knocked out by fission fragments passing through the Al oxide foil (60 μg/cm^2) located at a distance of 1 cm from the target, and the "STOP" detector detects electrons from PIN at the end of the fragment path. The TOF-E spectrometer allows the identification of the primary masses of the fission fragments and the full reconstruction of the kinematics of the sequential fission decay mode. The time resolution of whole spectrometer is 80 – 100 ps and energy resolution better than 40 keV. Thereby, we can measure masses of fission fragments with resolution about 1 a.m.u. The assemblies of position-sensitive semiconductor detectors are new multi-detector modules. They consist of 8 planar position-sensitive detectors on the basis of silicon. The position resolution of the detectors is 0.1mm x 3mm. The neutrons are measured in the energy range 0.5 – 20 MeV by the time-of-flight technique. Detectors are positioned in-plane and out-of-plane of the reaction at the various angles to the detected fragments. Energy resolution at neutron energy E_n = 2 MeV is about 4%. Stilbene is used as the active element of the neutron detectors. In addition to the stilbene neutron detectors we are using a new concept of a detector consisting of a bundle of scintillator bars (size 5x5x400 mm^3; 64 bars per detector). At each end of the bundle the scintillator elements is vied by segmented MCP-PMT tubes. The main advantages of these detectors are: high geometrical flexibility, fine granularity, fast response, position-sensitivity along all the 3 axes (5 x 5 x 5 mm^3) and time resolution of 100 ps. The same sensors will be used by NIKA in Dubna, PANDA at GSI and FIT detector at ALICE in CERN.