A NEW LOW-ENERGY PLASTIC SCINTILLATION NEUTRON DETECTOR FOR REAL TIME PULSE SHAPE DISCRIMINATION

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A new low-energy neutron detector has been developed to investigate the spin-isospin responses of exotic radioactive nuclei using the (p,n) or (d,n) reactions in inverse kinematics. In these cases the detection of recoil neutrons is crucial for the missing mass reconstruction, but it is suffering from the high gamma-ray background. Therefore, to achieve higher signal-to-noise ratio in neutron detection, the online separation of neutrons and gammas is a key challenge. This endeavour fits to the general trend at radioactive beam facilities: to improve the experimental devices to handle the higher beam intensities despite the limitation of DAQ or storage capability. The existing spectrometers (WINDS, LENDA or ELENS) for (p,n) reactions are not able to provide online particle identification.

We have designed a new system using advantages of plastic scintillator composition and digital electronics. The new EJ-299-34 type plastic scintillator capable for neutron and gamma-ray discrimination. While the digital data acquisition system offers the possibility to lower the neutron detection threshold, increase the neutron detection efficiency and decrease the dead time. It is based on CAEN's V1730D digitizer module and the new on-board Digital Pulse Processing for Pulse Shape Discrimination (DPP-PSD) software.

After an overview, of existing methods of pulse shape discrimination, evaluation of digital modules and the properties of our large volume detector will be presented, as well as the real time pulse shape discrimination capability. The quality (Figure-of-Merit) of the neutron and gamma peak separation and the position sensitivity of the PSD along the scintillator bar will be also discussed.