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Conceptual design and simulation of a Proton Detector for studying low-energy resonances relevant in thermonuclear reactions

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Classical novae and type I x-ray bursts are explosive events that occur in close binary systems where hydrogen-rich material is accreted on the surface of a compact object.
This accreted material is heated and compressed until a thermonuclear runaway occurs. During this explosion heavier nuclei are produced via proton captures and beta decays.
In many proton capture reactions, resonant capture dominates the reaction rate. Sometimes the measurement of these resonances cannot be done directly with radioactive ion beams. However, they can be studied indirectly via beta-delayed proton emission of proton-rich nuclei. The main challenges in the detection of these emitted protons are that the kinetic energies and the branching ratios of the protons are very low and the corresponding peaks are overcome by beta particle backgrounds using standard solid state detectors .
In order to overcome this difficulty, a novel detection system has been developed by a group at Texas A&M and CEA Saclay. It consists of a gas volume where radioactive ions are implanted. Gas reduces the sensitivity to the beta-particles emitted minimizing their contribution to the background. The use of Micro Pattern Gas Detectors like MICROMEGAS assures a good resolution, efficiency and gain.
A detection system based on this technique is being designed at NSCL to measure these resonances using intense NSCL beams and the SeGA array of HPGe detectors.
References:
[1] E. Pollacco et al. NIMA 723, 102 (2013)

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