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Simulations of an innovative ToF detector for high energy neutrons based on iron-less RPCs

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In the upcoming years, radioactive beam facilities as RIBF (Tokyo, Japan)[http://www.rarf.riken.jp/Eng/facilities/RIBF.html], FRIB (East Lansing, USA)[http://frib.msu.edu/] or FAIR (Darmstadt, Germany)[http://www.fair-center.de/index.php?id=1] will explore properties of unstable nuclei located within the limits of nuclear matter, the so-called "drip-lines". The detection of high energy neutrons is essential for the complete characterization of the reactions under studied. In most cases a high-resolution neutron ToF spectrometer is required to determine the momentum of high-energy neutrons resulting from the decay of the projectile with energies in the range of 200 MeV to 1000 MeV.

A novel concept for the detection of these relativistic neutrons is based on Resistive Plate Chambers (RPCs). The detection principle of the RPC-based detector relies on the detection of charged the particles created in hadronic showers induced by the incoming neutrons. The presented design only considers glass plates for holding the active gas acting simultaneously as converters for neutron detection. For the optimization of a large area detector based on RPCs several simulations were performed using the Virtual Monte Carlo framework FAIRROOT [http://fairroot.gsi.de/]. The detector was design as a structure of single RPCs modules with 5 gas gaps grouped sequentially reaching a total efficiency of one neutron detection higher than 90%. In this work we present the results of the simulations carried out and the evaluation of the performance of the detector.

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