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ACTAR-TPC: new active target for nuclear physics experiments

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Active target detection systems, where the gas used as the detection medium is also a target for nuclear reactions, have been used for a wide variety of nuclear physics experiments since the eighties. The improvement in MPGD (Micro Pattern Gaseous Detectors) and in micro-electronics achieved in the last decade permits the development of a new generation of active targets with higher granularity pad planes that allow spatial and time information to be determined with unprecedented accuracy. A novel active target and time projection chamber (ACTAR-TPC with 16k channels), that will be used to study reactions and decays of exotic nuclei at facilities such as SPIRAL2, is presently under development and will be based on MPGD technology. Several MPGD (Micromegas and Thick GEM) coupled to a 2×2 mm² pixellated pad plane have been tested and their performances have been determined with different gases over a wide range of pressures. Of particular interest for nuclear physics experiments are the angular and energy resolutions. The angular resolution has been measured to be 1° FWHM for short traces of about 4 cm length and the energy reconstruction resolution deduced from the particle range was found to be better than 5% for 5.5 MeV particles. These experimental results could be compared to expected performances based on detailed GEANT4 simulations. These results have validated the use of MPGD for active-target applications and a demonstrator version of the ACTAR-TPC detection system with 2048 pixels in micromegas configuration is presently tested using GET (General Electronics for TPCs) front end cards.

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