

Pixel-based Target Recoil Tracker (TRT) for R3B at FAIR

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The upgraded setup for the R3B experiments at FAIR introduces a pixel-based Target Recoil Tracker (TRT) detector, designed to enhance the detection capabilities of light-charged particles, such as protons, emitted in nuclear reactions. The TRT surrounds the reaction target and is further enclosed within a highly segmented calorimeter, named CALIFA, focusing on precise angle measurements of these particles. This innovative detector utilizes the fully developed ALPIDE Monolithic Active Pixel Sensor (ALPIDE MAPS) technology, originally designed for ALICE/CERN experiments. With the TRT the full kinematics of the recoil and scattered particles can be measured and the missing-mass and missing-momentum spectra can be reconstructed on an event-by-event basis, enabling a model-independent extraction of the complete spectral function. Such measurement will provide unprecedented insight into short-range correlations, single-particle strength quenching, and the underlying nuclear dynamics that drive both electron and hadron induced knockout reactions.

The TRT consists of a barrel-shaped detector array with large angular coverage and an optimized material budget. A future stage of this detector envisions integrating next-generation sensors using large, ultra-thin silicon wafers bent and arranged in perfectly cylindrical layers.

In this contribution, we report on the latest performance studies of the final barrel design. Using R3BRoot (Geant4) simulations, we evaluate its detection efficiency and spatial resolution, and we describe the assembly and characterization procedures for the individual modules. Finally, we will present the results from the last year experimental campaigns at GSI using ALPIDEs in beam, demonstrating the excellent performance of the TRT.