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Detection Systems and Research Opportunities at KoBRA

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The Korea Broad acceptance Recoil spectrometer and Apparatus (KoBRA) was recently established at the Institute for Rare Isotope Science (IRIS) and successfully commissioned in 2024 using a $^{40}\text{Ar}^{8+}$ and ^{25}Na beams. This work provides an overview of the beamline detectors installed in KoBRA and highlights their performance during the commissioning process. It also describes the data acquisition (DAQ) methods employed for processing detector signals, which include conventional approaches using Analog-to-Digital Converters (ADC) and Time-to-Digital Converters (TDC), alongside state-of-the-art digitizers offering 14-bit resolution and a 500 MS/s sampling rate.

In addition, strategies for integrating data to support researchers conducting experiments at KoBRA are discussed, together with plans to apply deep learning algorithms and Monte Carlo simulations for analyzing HPGe detector waveform signals. The application of CdZnTe room-temperature semiconductor detectors (RTSD) for gamma-ray spectroscopy is also under exploration. With their pixelated structure and 3D calibration techniques enabling good energy and 3D interaction position resolution, CdZnTe detectors are well-suited for precise gamma-ray measurements and imaging. Integrating these detectors into KoBRA's detection system is expected to enhance its functionality and expand opportunities for a wider range of nuclear physics experiments.

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