Test of the advanced implantation detector array (AIDA) at RIBF

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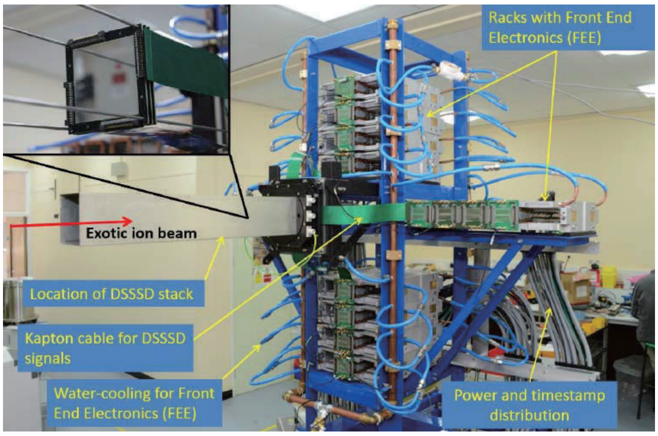

Fig. 1: A photograph of the fully constructed AIDA assembly.

The advanced implantation detector array (AIDA)[1)] represents the latest generation of silicon implantation detectors for use in decay spectroscopy measurements of exotic nuclei at fragmentation beam facilities.

Designed to improve upon current generation, the AIDA features high detector pixelation and fast overload recovery (~1 μs), required at modern RI facilities with increasingly high secondary beam intensity and access to isotopes with very short half-lives.

Application specific integrated circuits (ASICs)[2)] were specifically designed to meet the above requirements. One ASIC can process 16 data channels, each with two dedicated preamplifiers: one with selectable gain to cover the low and medium energy ranges of up to 1 GeV, and the other, a low-gain amplifier that covers the full dynamic range of 20 GeV. Detector signals are carried via flexible Kapton PCBs to the front end electronics (FEE) cards, which support 64 channels of instrumentation. The FEE cards contain the following: multiple analog-to-digital converters (ADCs) for use in signal processing; a field-programmable gate array (FPGA) for control, signal processing, and event building.

As each FEE card runs a separate data acquisition system (DAQ), reading data from only 64 channels, dead-time is significantly reduced compared to that in current generation detectors dealing with high pixelation. Fig. 1 shows the full AIDA assembly.

To study the response of the AIDA to implantation of heavy ions, an in-beam test was conducted at the Radioactive Ion Beam Factory (RIBF) at RIKEN. The test was conducted parasitically to the first SEASTAR campaign,[3)] placing the AIDA at the F11 focal plane. In this test configuration, AIDA comprised one DSSSD type BB18 with a thickness of 1 mm and featuring 128 strips with a 0.625 mm pitch in both the x and y directions. Our test demonstrated the capability of AIDA to detect position and energy of fast fragment beams, as shown in Fig. 2.

With promising progress being made on all fronts, the AIDA is planned for use at the RIBF throughout 2015-2016 with two focuses: β-decay half-life and decay spectroscopy measurements using the EURICA γ-ray detector, and measurements of β-delayed neutron emission probabilities as part of the BRIKEN collaboration.

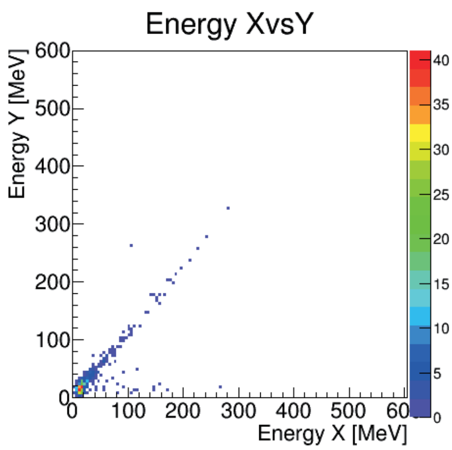

Fig. 2: Spectrum of energy measured using the front and back strips of AIDA's DSSD for fragments around ^{78}Ni, for events in coincidence with a veto scintillator in the front AIDA.

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References
1) http://www2.ph.ed.ac.uk/td/AIDA/welcome.html
2) D. Braga, P. J. Coleman-Smith, T. Davinson, I. H. Lazarus, R. Page, S. Thomas: ANIMMA 2nd International Conference Proc., IEEE, (2011), pp. 1–5.
3) In this progress report