Advanced Implantation Detector Array (AIDA)
HISPEC/DESPEC meeting 1 March 2016

presented by
Tom Davinson
on behalf of the AIDA collaboration
(Edinburgh – Liverpool – STFC DL & RAL)

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Introduction

• AIDA Collaboration
  – University of Edinburgh
  – University of Liverpool
  – STFC Daresbury Laboratory
  – STFC Rutherford Appleton Laboratory
• Multi-plane, highly segmented DSSSD implantation system
• ASIC instrumentation; 64-channel FEE cards with integrated DAQ
• Measure $t_{1/2}$ and $P_n$ values of exotic nuclei through implant-decay correlations
• Multi-GeV implant
• Subsequent low-energy decays
• May 2014 → RIBF, RIKEN
• November 2015 → LYCCA, Koln
128 x 128 strips (16384 pixels)
multi-guard ring
0.560mm strip pitch
1mm wafer thickness
MSL type BB18

384 x 128 strips (49152 pixels)
multi-guard ring
0.560mm strip pitch
1mm wafer thickness
Parasitic beam test to SEASTAR in-beam gamma measurement:
- setup at F11
- neutron-rich beams in Z~35 region; ≈kHz rate.
May 2015 Test: 3x MSL type BB18 DSSDs

3x MSL type BB18 DSSD (3mm Si)
1 cm x Al plates as stopper

*Edinburgh PhD student Chris Griffin – will be installing 8x MSL type BB18 stack at RIKEN later this week*
May 2015 Test: AIDA + EURICA + … at F11
FEE64 data merging

Each FEE64 card acts as an independent DAQ
Each data item encoded with 100MHz 48-bit timestamp
Data streams merged at Gbit network switch and time-ordered by Linux workstation

Data item = ADC, waveform, fast discriminator, external scaler/clock
Timestamping hardware with HDMI cabling to AIDA FEE modules
Correlation of AIDA data with DAQ in different time domain (e.g. BigRIPS)
Test results: DAQ Integration

- **AIDA (FEE64)**
  - IN: Pulser
- **AIDA (MACB)**
  - OUT: Clk(25 MHz)
  - Reset
  - IN: Reset, Corr. trigger
- **BRIKEN (SIS36/38xx)**
  - Clk IN
  - Clk OUT
- **BRIKEN (SIS3316)**
  - IN: Clk, User(Reset), Analog.
- **BRIKEN**
  - Reset Request OUT
- **PULSER**
  - Analogue OUT
  - Trigger OUT
- **RIBF (LUPO)**
  - IN: Reset, Clk
- **RIBF (ADC)**
  - IN
- **RIBF (Trigger Logic)**
  - IN
  - OUT
May 2015 Test: online DAQ synchronisation test

Synchronization Check

Partial

RIBF-BRIKEN time difference

AIDA-BRIKEN time difference

Courtesy J.Agramunt, J.L.Tain
May 2015 Test: online DAQ synchronisation test

Synchronization Check

Partial

RIBF-BRIKEN time difference

AIDA-BRIKEN time difference

Courtesy J.Agramunt, J.L.Tain
May 2015 Test Results: Implantation (100Kr setting)
Test results: Implant – Decay Correlations

Decay of integrated activity (i.e. no PID cut)

$^{88}$Ge setting

$^{100}$Sr (t$_{1/2}$ = 200 ms)

$^{99}$Rb (t$_{1/2}$ = 55 ms)
May 2015 Test Results: $^3$He Neutron Detectors

Courtesy J. Agramunt, J. L. Tain
FEE64 preamplifier waveforms

Preamplifier signals (~5MeV equiv pulser) with realistic load
(DSSSD + cabling)
16-bit ADC, sampling 50MSPS, 14-bit ADC and fast discriminator data streams now integrated and merging – CFD + MWD development
207Bi source tests

- MSL type BB18-1000
- DSSSD – FEE64 65cm Kapton PCB + HD IDC ribbon cable
$^{207}\text{Bi source tests}$

$E(\text{n+n strips})$ versus $E(\text{p+n strips})$: $m_{p+n} = m_{n+n} = 1$
E(n+n strips) versus E(p+n strips): $E(n+n) = E(p+n) \pm 100\text{keV}$
$^{207}$Bi source tests

E versus strip #
ADC offset corrected, no relative gain matching
Energy resolution $\sim 40$keV FWHM
(Slow comparator) threshold $\sim 5\sigma ~ 85$keV
Outlook

- Possible Experiments at RIBF for 2015
  - Decay spectroscopy with EURICA gamma-ray detector array
  - Half-lives and $P_n$ values as part of BRIKEN collaboration setup
    (Beta-delayed neutrons at RIKEN)

https://www.wiki.ed.ac.uk/display/BRIKEN/Home
https://indico.ific.uv.es/indico/conferenceDisplay.py?confld=2515

26 February 2016
BRIKEN (CH$_2$)$_n$ matrix delivered
See Ariel Tarifeno's presentation
Accepted RIKEN Proposals

Masses and $\beta$-decay properties of r-process nuclei around $N=56$
Estrade Vaz et al.

Measurements of new beta-delayed neutron emission properties around doubly-magic $^{78}\text{Ni}$
Rykaczewski, Tain, Grywacz, Dillman et al.

BRIKEN Neutron Detector – Detector Construction Proposal
BRIKEN collaboration

Studies of r-process nuclei around $A\sim100$
BRIKEN collaboration

Measurement of $\beta$-delayed neutron emission probabilities relevant to the $A=130$ r-process abundance peak
Estrade Vaz, Lorusso, Montes et al.
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**University of Liverpool**

**University of Edinburgh**
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**University of Brighton**
O. Roberts

**RIBF at RIKEN**
H. Baba, G. Lorusso, G. Kiss, K. Matsui, S. Nishimura, P-A Soderstrom, P. Vi, et al.

**IFIC at Valencia**
J. Agramunt.
AIDA: Project Partners

- The University of Edinburgh (lead RO)
  Phil Woods et al.
- The University of Liverpool
  Rob Page et al.
- STFC DL & RAL
  John Simpson et al.

Project Manager: Tom Davinson

Further information: http://www.ph.ed.ac.uk/~td/AIDA

TDR - November 2008: