The TRIUMF ISAC Gamma Ray Escape Suppressed Spectrometer

Requirements
- High Sensitivity
- High Granularity
Clover HPGe detector

- 4 crystals, each 90 mm by 60 mm, $\varepsilon = 40\%$
- Front 1/3 tapered at 22.5°
- Outer contact divided into 8 segments, 2 in x, y, z
- 4 core FETs cold
- 32 Outer FETs warm
- $\varepsilon_{TOT} = 230\%$ (~1% abs at 10-15 cm)
Escape suppression shield

- Back CsI, side and front BGO pieces
- 20 channels per shield
- High suppression configuration $r=14.5$
- High efficiency configuration $r=11.0$ $\varepsilon=150\%$
Digital data acquisition system

- Custom 10 channel cards (TIG10)
- 100 Mhz, 14 bit ADCs
- 11 large signal processing FPGAs
Event Collection

- Custom Collector card (TIG-COL)
- In: 100 Mbit/s data from up to 12 TIG10 cards
- Out: 800 Mbit/s VME64x2e readout
- 1 Khz raw-data event rate
- 800 kHz processed-data event rate
Firmware

Example firmware component (CFD)
Prototype detector and acquisition

(First detector May 2005, First TIG10 card Jan 2005)

- Prototype Detector arrived Mid 2004
- Digital system – 2 crystals
  - 1 * 4 channel 40 Mhz XIA DGF
  - 2 * 8 channel 100 Mhz SIS 3301
- Analog system – full detector and sheild
  - 56 channels of 12/13 bit ADCs
Source Measurements

- 0.5 mCi Collimated $^{137}$Cs Source
- Velmex planar motion table
  - 20 micron resolution
  - 300 lb capacity
Source Results \(x\)-\(y\)

Intensities [counts] and risetimes [ns] vs \(x\),\(y\) [mm]
Source results x-y-z

- 33 x-y positions measured
- 24 hour collection at each point gave around 200 gated events
Waveform variation with position

Average Segment 2 Waveform, $z = 15$ mm

Average Segment 1 Waveform, $z = 15$ mm

Average Segment 4 Waveform, $z = 15$ mm
Position sensitivity

- $X^2/v$ surface, contour interval 2
- 1.4 mm azimuthal position sensitivity
- 0.28 mm radial position sensitivity
- 2.2 mm beam FWHM
Crosstalk

Average Baseline shifts [keV] in White crystal
Gated on 662 keV in Photopeak segment

1st Prototype

Modified Detector

Average Peak Positive induced signal [keV] in White crystal
Gated on 662 keV in Photopeak segment
First Production Detector
Tasks remaining

- Finish Simulation
- In beam test of position reconstruction
  - Using final acquisition system
- multiple interaction position reconstruction
Prototype Frame
Prototype Source Measurements
Coincidence Spectrum

Position (40,40): Front

BGO Energy (keV)

Germanium Energy (keV)