Data acquisition and timing performance of the fast timing array for NUSTAR

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3. The data acquisition system
4. First test results
5. Outlook
Introduction

Detectors with LaBr$_3$(Ce) crystals
- Good time and energy resolution
- Good efficiency
- $\gamma\gamma$ fast timing feasible
- Measure exotic nuclei
- Fast timing array for FAIR

Time spectra:
- Prompt response
- with lifetime

\[ \log(N) \quad t \quad P(t) \]
\[ \log(N) \quad t \quad D(t) \]
DESPEC Layout
The detectors

- LaBr$_3$(Ce) from Saint-Gobain
- 2 x 1.5 in cylindrical
- H10570 PMTs
- Lead shield to suppress cross talk
- Timing and energy output
- 36 detectors in Surrey
The frame

at the University of Surrey

- Built in Daresbury
- 36 mounting positions
- three rings: one ring at 6° and two at ±44°
VME based data acquisition

- CAEN modules
- V1728 controller (optical link to A3818)
- Energy: V1751-DPP digitizers, 1GS/s (4x8ch)
- Timing: V812 CFD and V1290A TDC (32 ch)
- no common operation of V1290 and V1751 yet
V1751 digitizer with DPP firmware

\[152\text{Eu source}\]

\[\text{401 keV and 444 keV well separated}\]

\[60\text{Co source}\]

Energy resolution:
- 19% at 121 keV
- 8% at 344 keV
- 4% at 779 keV
- 3% at \[60\text{Co lines}\]

PMTs operated at 1250 V
V812 CFD and V1290A TDC

First result

- 24 ps/chn time resolution (matches 25 ps LSB)
- Prompt from $^{60}\text{Co}$ source
- CFD delay 8 ns
- No correlation with V1751 yet
- “Gated” with CFD threshold
- Comparable to earlier test with analog electronics (FWHM 291 ps)

Graph:

- $^{60}\text{Co}$ source
- 1173 keV, 1333 keV prompt coinc.
- FWHM 275 ps

Counts vs. $\Delta t$ (ns)
Timing with the V1751 digitizer

- get timing directly from digitizer
- implement time pick-off algorithm
- tests with wave forms from V1751 promising (NPL)
- CAEN announced timing firmware for V1751
- simplify the system
- has to be tested
Future integrations

Layout for array at GANIL

2015/2016
Proposals accepted at

- GANIL with AGATA and VAMOS
  \( (2^+_1 \text{ half life of } ^{190,192}\text{W}, \text{P.R. John et al.}) \)
- Argonne with Gammasphere 32 LaBr detectors
  \( (^{252}\text{Cf source, S. Lalkovski et al.}) \)
Frame for FAIR ready
36 detectors ready at Univ. of Surrey
Work on DAQ in progress
Experiments using the system late 2015/early 2016
Prospect for fast timing with V1751 alone
Thank you

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and all others from the

Fast timing for DESPEC Collaboration