Realtime CRES DAQ for Project 8

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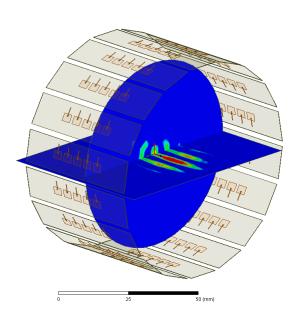
Digital Beamforming DAQ for a CRES Experiment (Cyclotron Radiation Emission Spectroscopy)

Pacific Northwest
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- An antenna array detects microwave cyclotron radiation from beta-decay electrons in a magnetic field

- Each antenna is independently digitized

- A linear combination of signals gives a sensitive region with high SNR

Process

Off the digitizers
- Raw data for all channels
- 75 channels
- 500 MSPS
- 16-bit samples
- = 75 GB/s
- Or 2.4 EB/yr

Trigger: identify potential tracks
- Search for tracks
- Parallel beamforming
- *Requires all data*

Tracking electron
- Electron moves in space (∇B motion)
- Scatter results in new track
- Changing beamforming parameters
- *Requires all data*

Write full event to disk
- Data reduced to a single "channel"
- 1 channel
- 500 MSPS
- 16-bit samples
- = 1 GB/s
- 1 ms event = 1 MB

Digitizer + FPGA

CASPER SKARAB Board
casper.berkeley.edu

Compute Node

Algorithms under development
Hardware optimized for real-time performance
Considering real-time ML

Storage

Compatible with periodic unreduced streaming

Hardware