RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

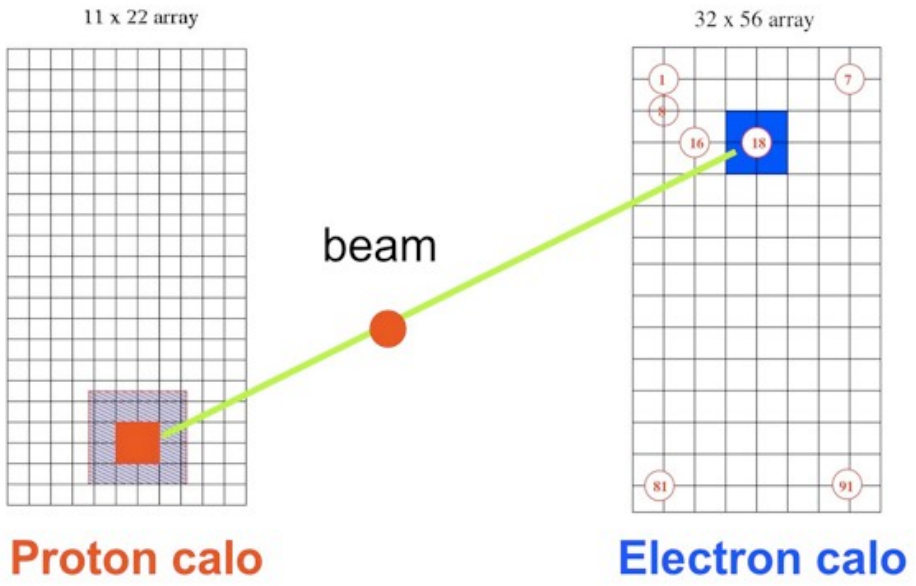
# SuperBigBite Trigger

R. Gilman, Rutgers University
J. Calarco, U. of New Hampshire

SuperBigBite CDR Review
17 November 2008

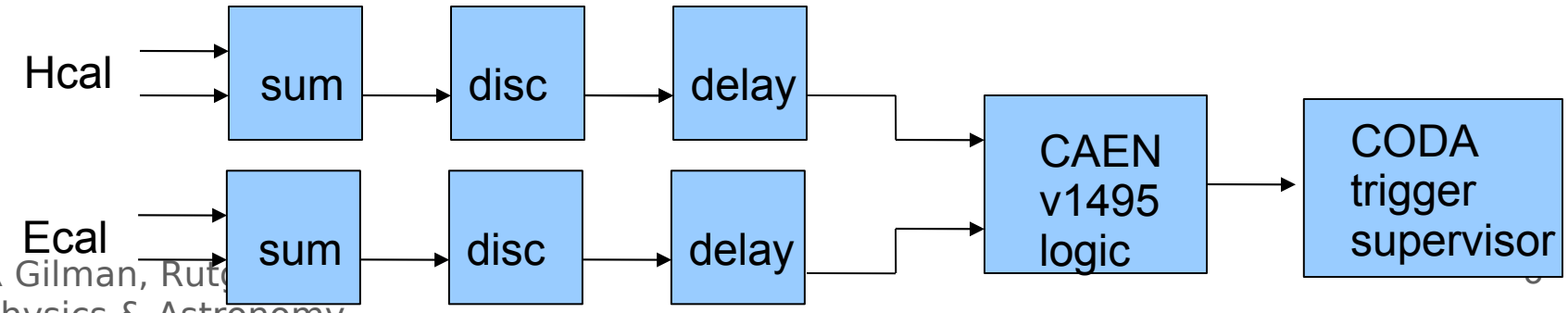
# Trigger Concept

- Focussed on $G_E^p$-V, but flexible enough for other experiments
- Level 1 trigger: electron arm calorimeter
- Level 2 trigger: electron arm calorimeter geometrically correlated with proton arm calorimeter
- Numerous additional trigger types available
- Currently expect 32x56 E-calo summed into 91 (7x13) signals, and 11x22 H-calo unsummed as 242 signals



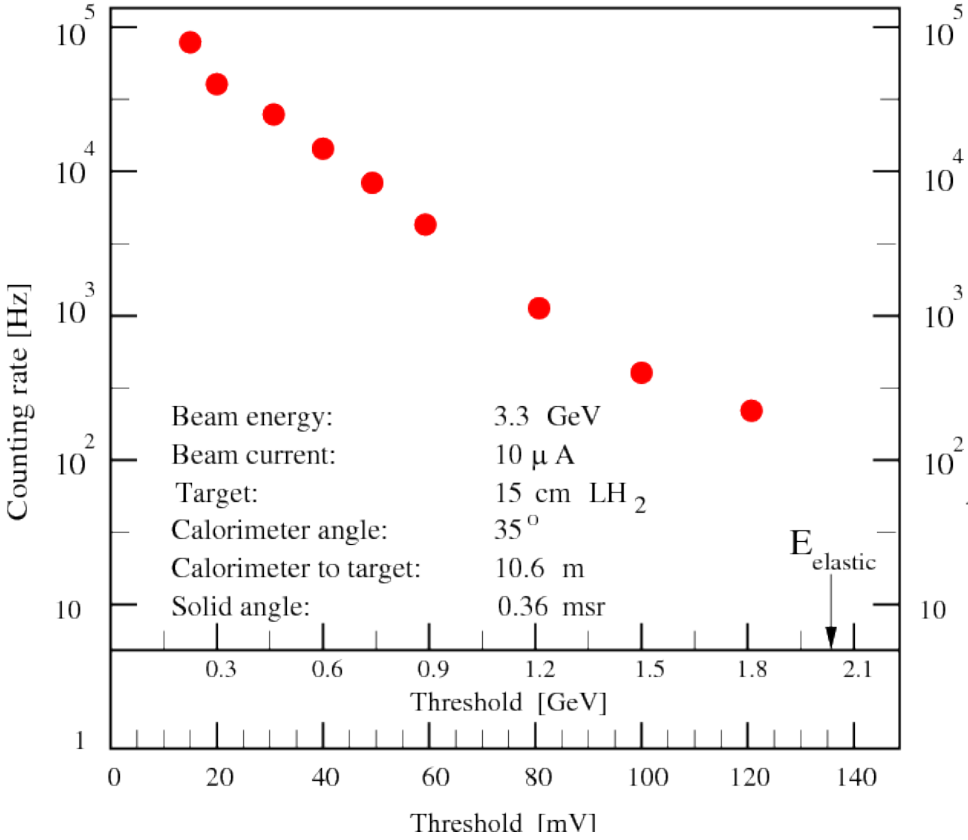
# Trigger Implementation. I

- Since shower extends over several blocks, sum analog signals into 8 block groups with analog summers
- Summed signal gets discriminated with 4.5 (2.55) GeV threshold H-cal (E-cal) (and fed to ADCs)(calibrate with ep elastics)
- Feed discriminated signals into trigger logic (and TDCs), which correlates positions of clusters in the two calorimeters
- Total rates about 60 kHz E-cal, 1.5 Mhz for H-cal
- Random coincidence rate ~ 5 kHz reduced ~ two orders of magnitude through position correlations

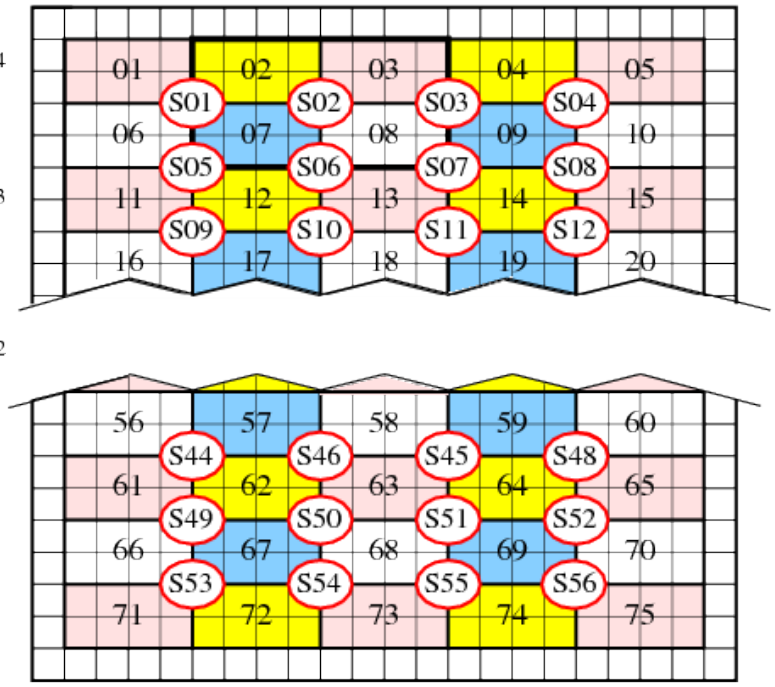


# Trigger Implementation. II

- E-cal rates

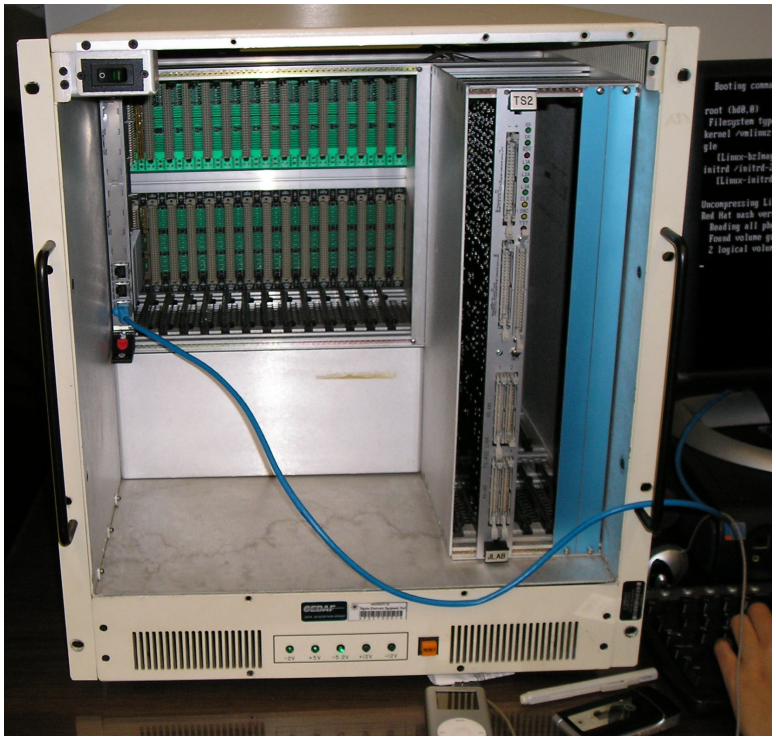



- Trigger topology – block sums



# Trigger Implementation. II

- Use field-programmable gate array (FPGA)
- Present choice: CAEN v1495, being used in Hall B, being developed for Qweak, Hall C Moller, Fermilab 906, etc.
- Supported in CODA
- Up to 160 inputs / module
- 3 v1495s for calos position correlations
- 1 v1495 for other detectors
- 1 v1495 to identify triggers from the 4 "detector" v1495s




Rutgers DAQ: VME6100 and trigger supervisor, before v1495s installed

# Budget. I

- FPGA units: currently $6500 for fully loaded v1495 with 160 input channels, including special cables
  - Our system of 5 FPGAs, three fully loaded: $28000
- Summers and discriminators:
  - For E-calo: all needed available from "$G_E^p$-III" BigCal detector
  - For H-calo: all discriminators needed should be available from either Hall A ($G_E^n$ experiment neutron detector) or Fermilab, already on loan (CAMAC with ECL output)
- Long cables already largely exist, give much of needed delay
- Need for manpower, cables, crates, VME CPU, NIM-ECL converters (?), delay, trigger supervisor + crate... upgrades / replacment of existing equipment

# Budget. II

- Trigger itself (crate, trigger supervisor, CPU, FPGA units, cables) about $50,000 total.
- Summers, discriminators, delays / cables already largely exist, and are being used currently in various experiments. But will need to assess what needs upgrades / replacement in a few years. Likely $50,000-$100,000.
- Also need to evaluate need for cables / ADCs / TDCs / scalers for DAQ system, outside trigger. In principle these also largely exist, but will need to assess what needs upgrades / replacement in a few years. Likely $50,000-$100,000.

# Timeline

- RU currently developing Fermilab E906 system: 3 CAEN v1495 FPGAs
  - 128 x + 128 y scintillators to determine triggers
  - Primary trigger: two tracks pointing at target
  - One track triggers, efficiency triggers, ...
- UNH has requested funding of trigger / DAQ project with DOE, of order $250,000 over 5 years
- Due to advances in technology / reductions in cost over time, expect low level of work on SBS trigger for next few years.
- Significant purchasing of equipment will start about 2012 - 2013, giving ~2 years to implement trigger before start of experiment