



Electronics for GLD Calorimeter

2005/08/24

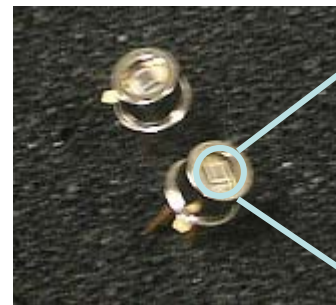
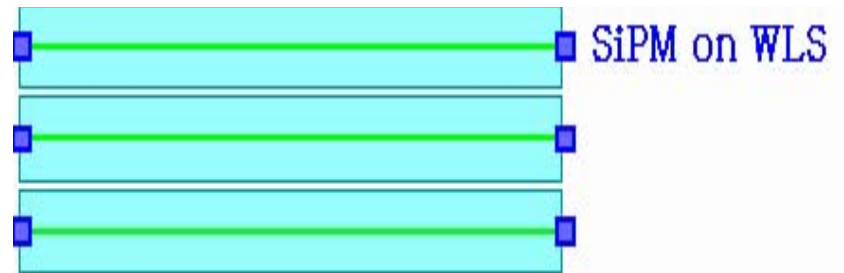
GLD CAL session at Snowmass

H. Matsunaga

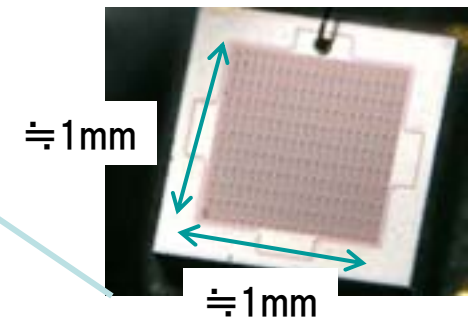
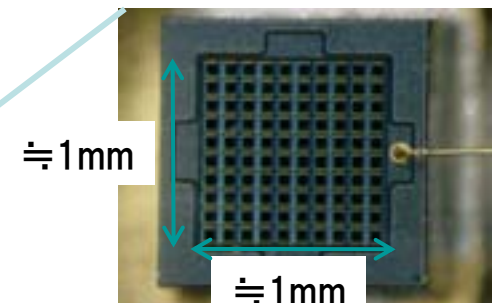


Photon Sensors

- Photon sensors
 - Hamamatsu MPC (Multi-pixel photon counter)
 - Russian SiPM
 - Directly attached to the scintillator end
- Common for ECAL, HCAL and muon detector
 - Huge number of channels:
 - ECAL: ~6M
 - HCAL: ~30M
 - (muon: ~10k)



HPK MPCs





Some issues on sensors

- Operational voltage range is narrow
 - ~ 0.1 V for MPC
 - Accurate bias voltage control (and also modest temperature control) is necessary
 - Power supply is also the key issue
- Probably, operational voltage of MPC varies from device to device
 - How to know the best voltage for huge number of devices ?
 - How to provide various bias voltages to them ?





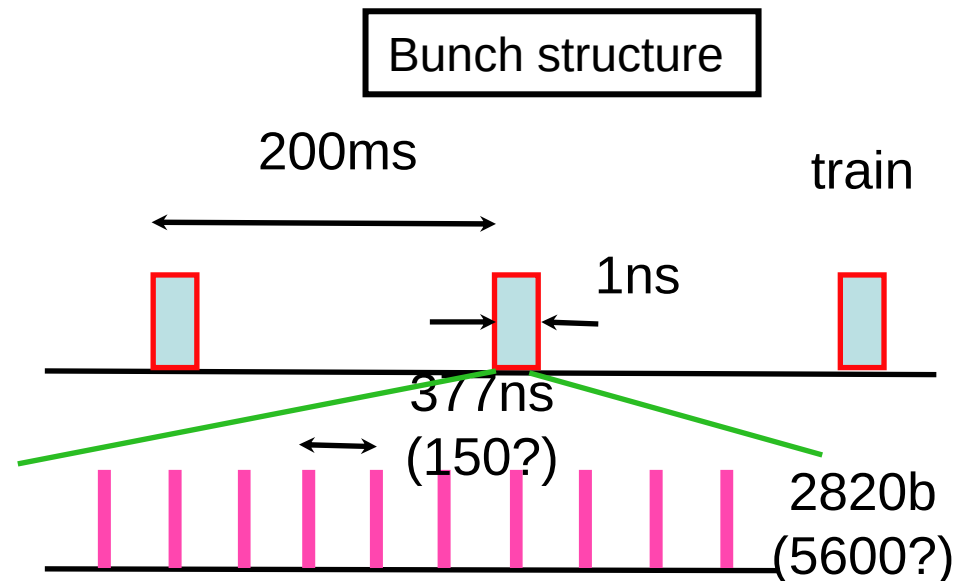
Requirement for FE Readout

- Number of pixels: $\sim 1000 \rightarrow 10\sim 12$ bit dynamic range
- Good timing resolution
 - Bunch ID
 - Slow neutron detection?
 - TOF at the innermost layer of ECAL ?
- Dark hit-rate: $< 1\text{MHz}$ tolerable ?
- Low power consumption:
 - $\sim 20\text{mW/ch}$ may be possible
 - Power loss in cable should be small



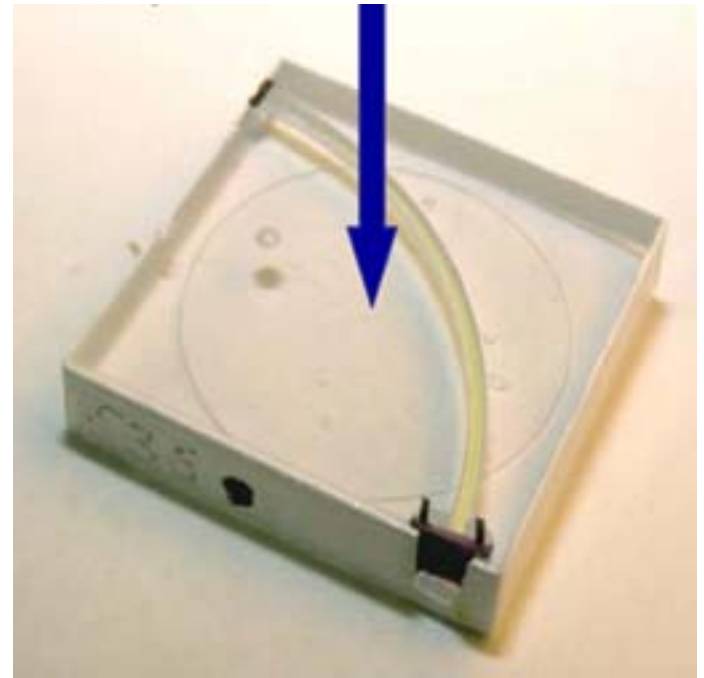
Requirement (cont)

- Readout between bunch trains (200ms)
 - Assuming 1Gbit/sec transfer rate,
 - ~25 Mbytes at maximum
 - 4 bytes/event x ~6k events/trains is possible
 - Zero suppression
 - Buffers



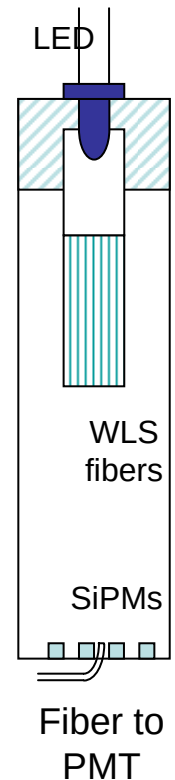
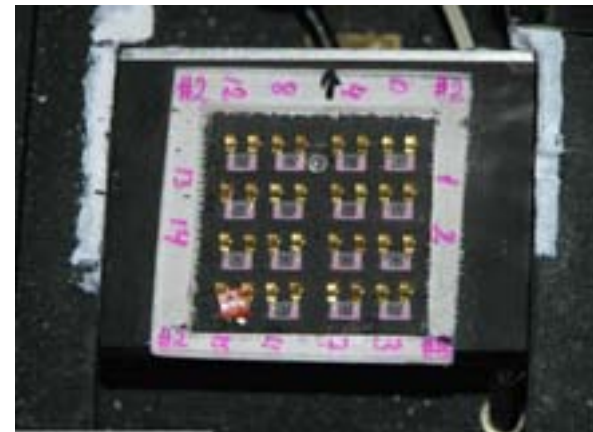
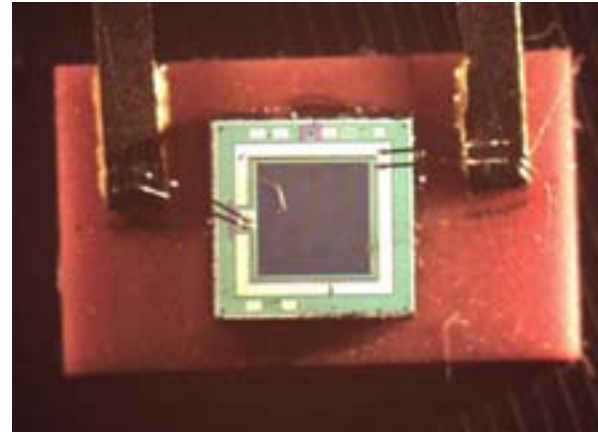
Solution by CALICE group

- Talk by Felix Sefkow (DESY) in Calorimeter session
- This is just for testbeam; may need better method for production
 - Number of sensors: a few thousands
 - SiPMs with ~ 1000 pixels
 - During testbeam, they will be monitoring sensor gain with LED, without temperature control



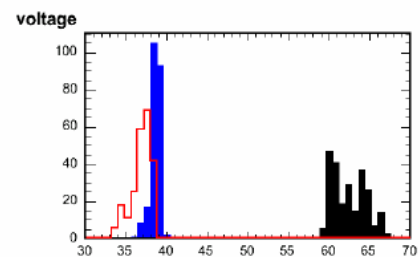
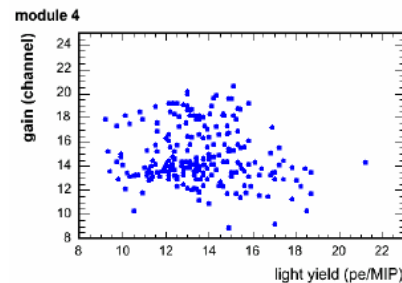
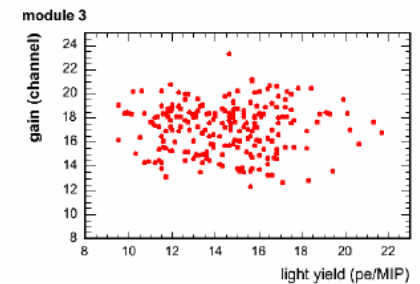
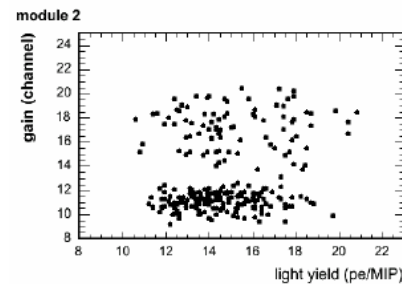
Bias voltage adjustment

- Bias voltages are determined at test bench in advance for all sensors
 - 15 SiPMs under monitored LED source
 - Adjust working point (bias voltage) to 15 pixels/MIP
 - Up to 500 / week



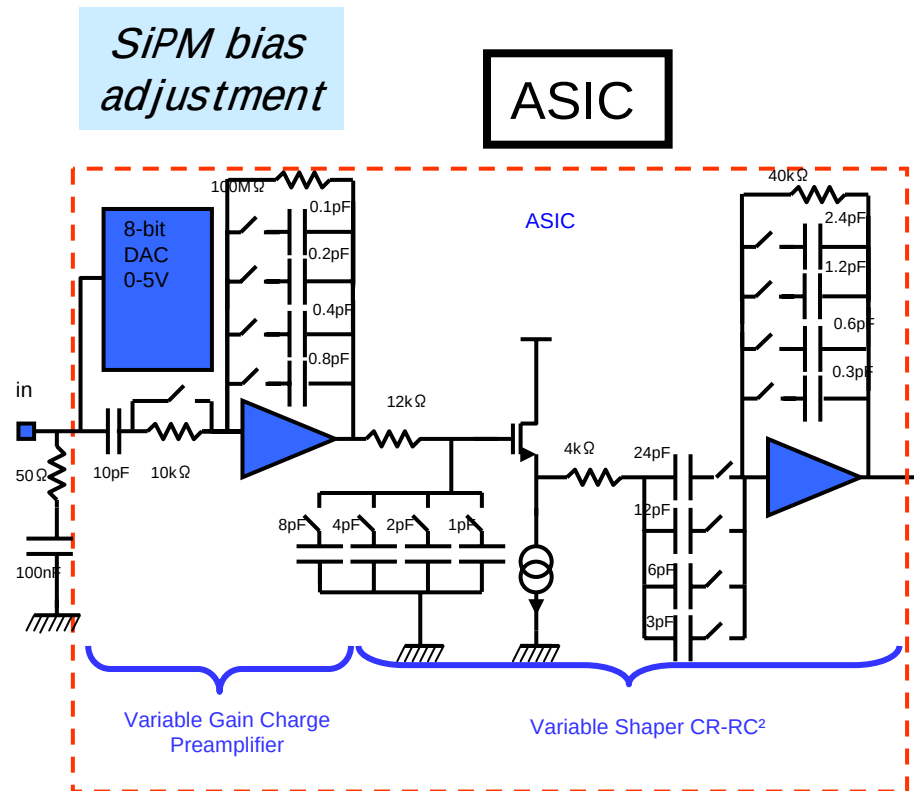
Voltage variation

- Two clusters for bias voltage setting:
 - 33~41V, 60~67V
- Sensors are grouped in modules according to bias voltage
 - 108 / half module
 - $\pm 2V$ / module



Front-end Electronics

- ILC-SiPM chip:
18ch Pre-amplifier,
shaper, track and
hold, mux
 - based on CALICE
SiW ECAL chip



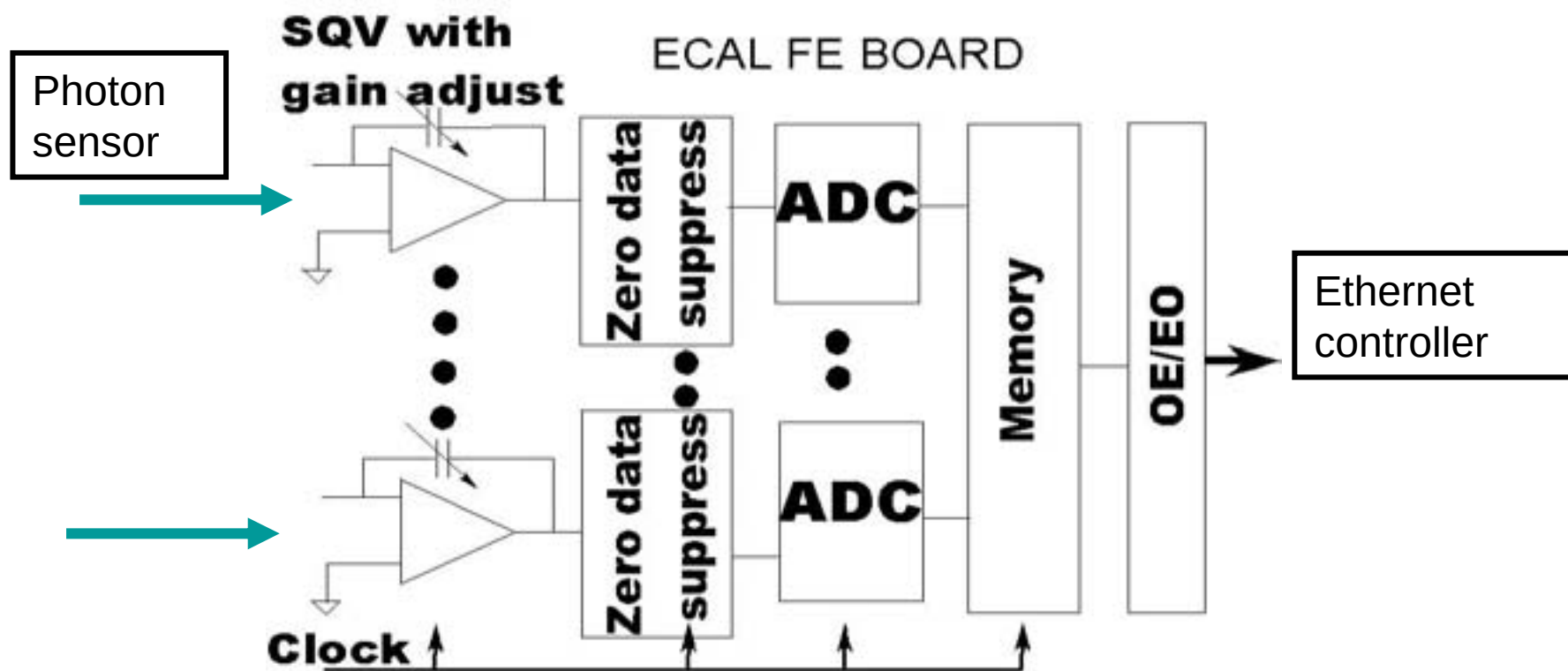


Our plan

- ECAL beamtest: ~2007 (FNAL / DESY) ?
 - Front-end electronics and DAQ
 - DAQ system might be shared with other groups?
 - Mass production and quality control
 - Beyond testbeam
 - ???
 - Manpower:
 - Manobu Tanaka (KEK) : ASIC development
 - Patrick LeDu is interested ...
 - Others?
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Basic idea of FE board

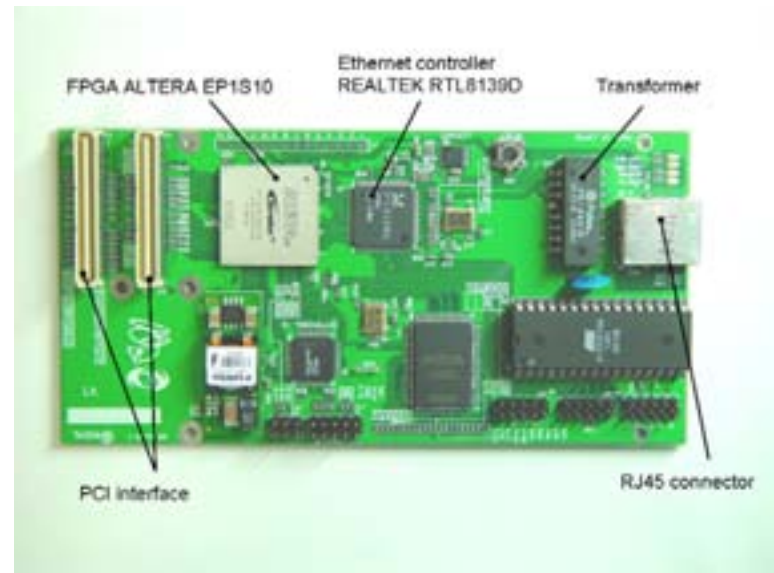
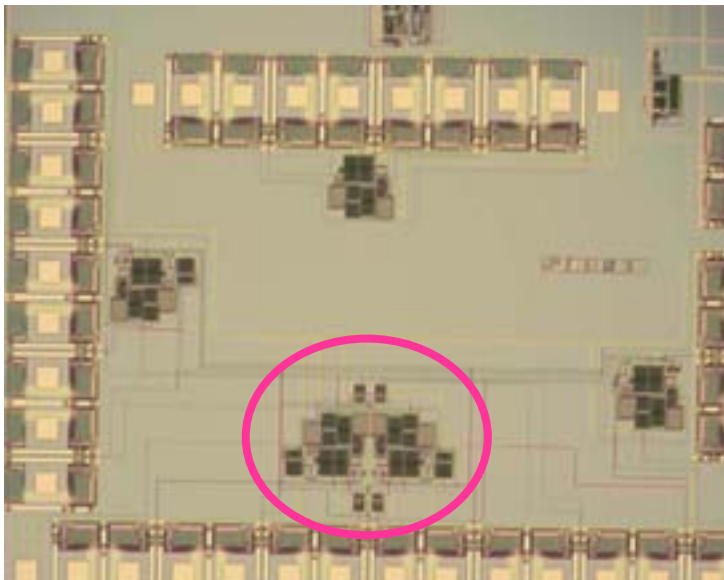
- **SQV**: Synchronous Current Integrator for Q-to-V conversion



By M. Tanaka (KEK)

SQV-TEG & Ethernet board

- Prototype boards already exist
- Bias voltage controller should be added





Backup





Some comments on DAQ

- In my opinion, there is no big difference between three concepts
 - No need for hardware trigger; Only software trigger (running on commodity PCs) may be sufficient
 - Number of channels are quite large compared to previous experiments
 - New technology should be followed up
 - GDN, Grid ?
- In order to establish the DAQ scheme, communication with sub-detector groups is necessary
 - Cost estimation
- Patrick will talk more details about (his) current idea