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Title:	Data Acquisition for the UCNB Experiment
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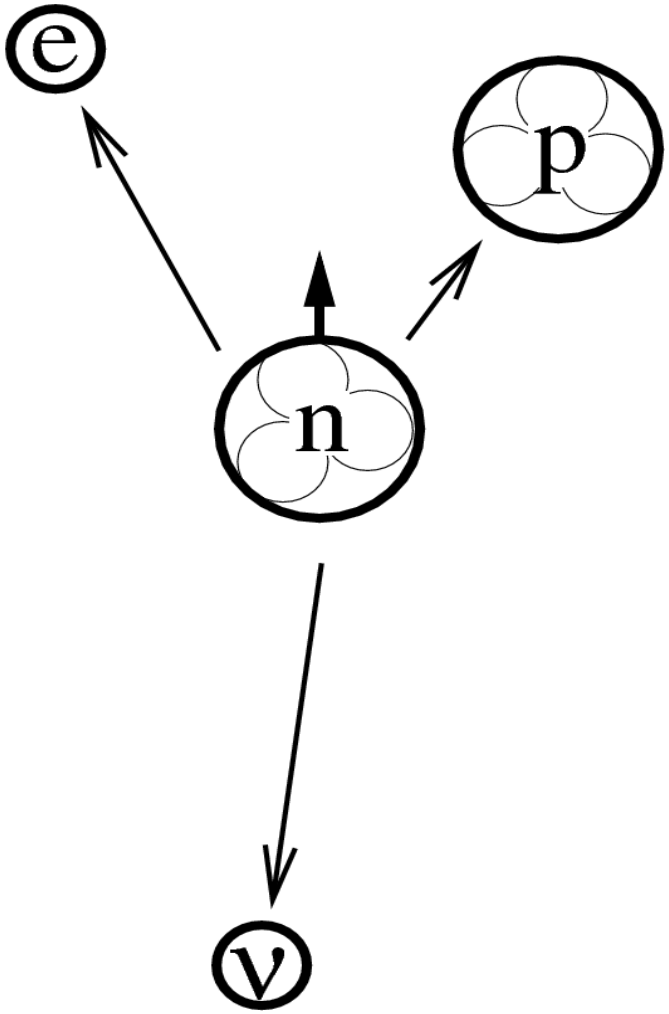
Data acquisition for the UCNB experiment



Sky Sjue

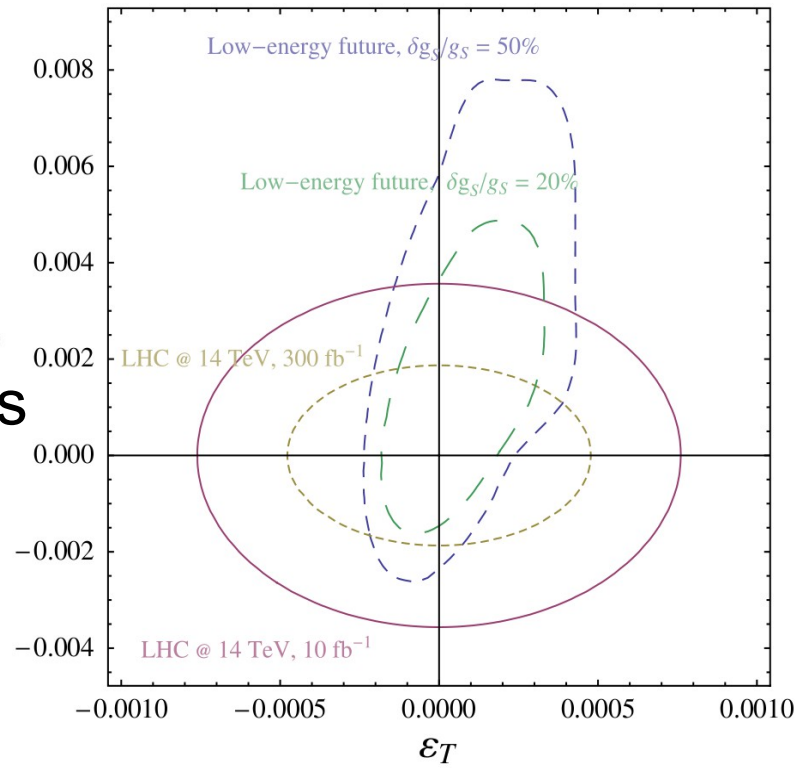
APS DNP 2012

Newport Beach, CA

27 October 2012

Physics motivation

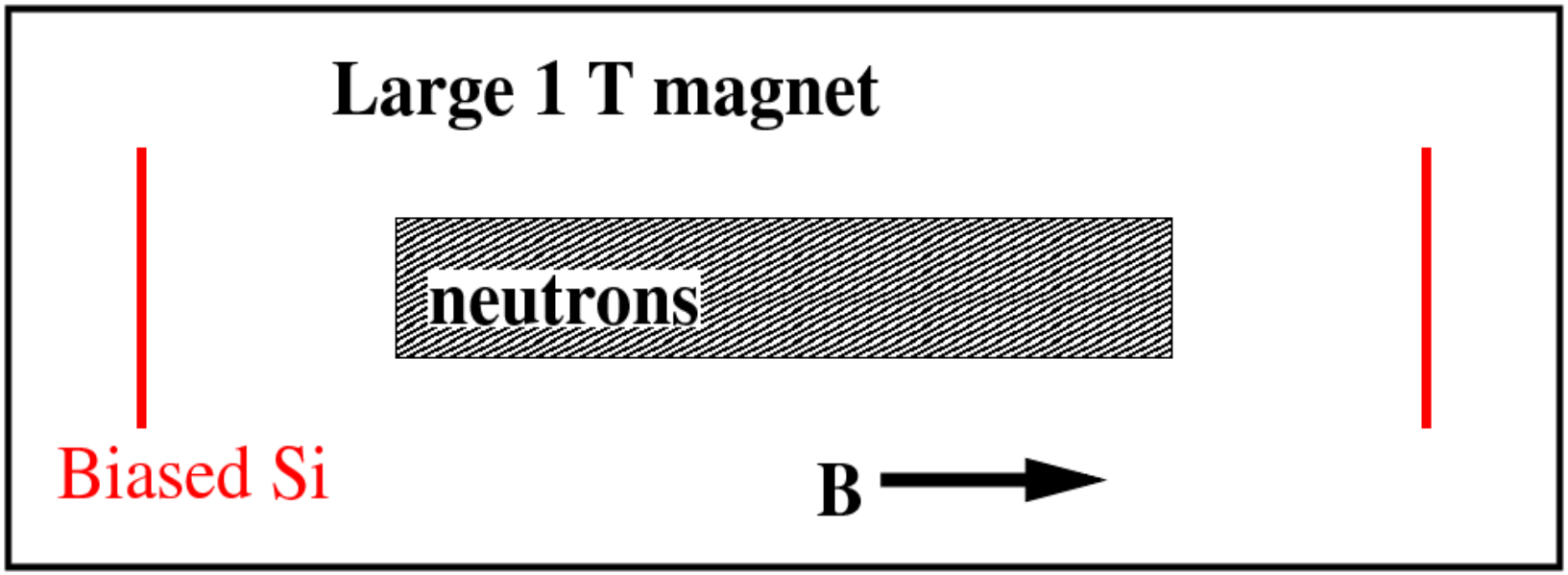
Precision measurements of neutron beta decay can provide limits on scalar and tensor currents complementary to the LHC.



Probing novel scalar and tensor interactions from (ultra)cold neutrons to the LHC

Bhattacharya et al, Phys Rev D **85** 054512 (2012)

Experimental strategy

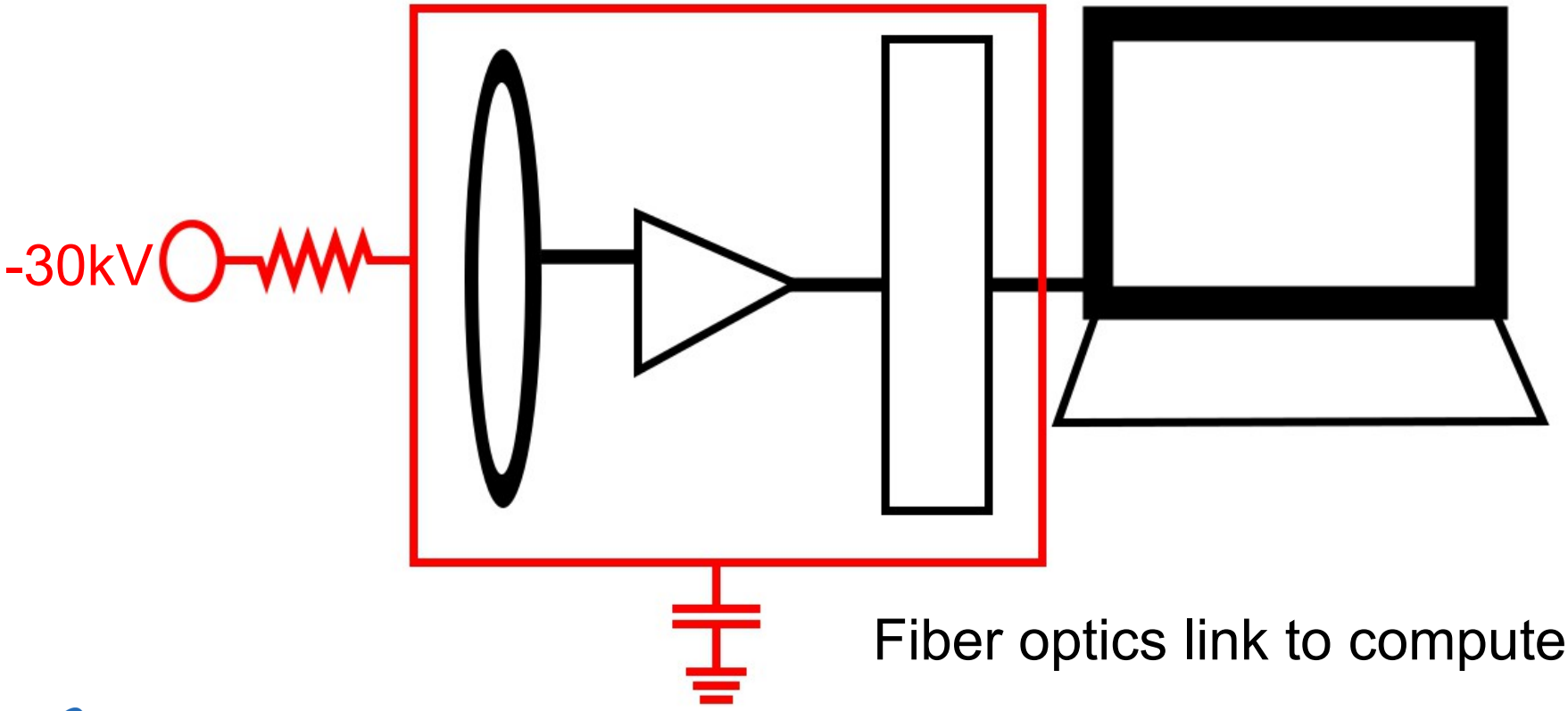


Bias voltage of -30 kV accelerates protons.

Simultaneous detection of protons and electrons allows inference of neutrino's momentum.

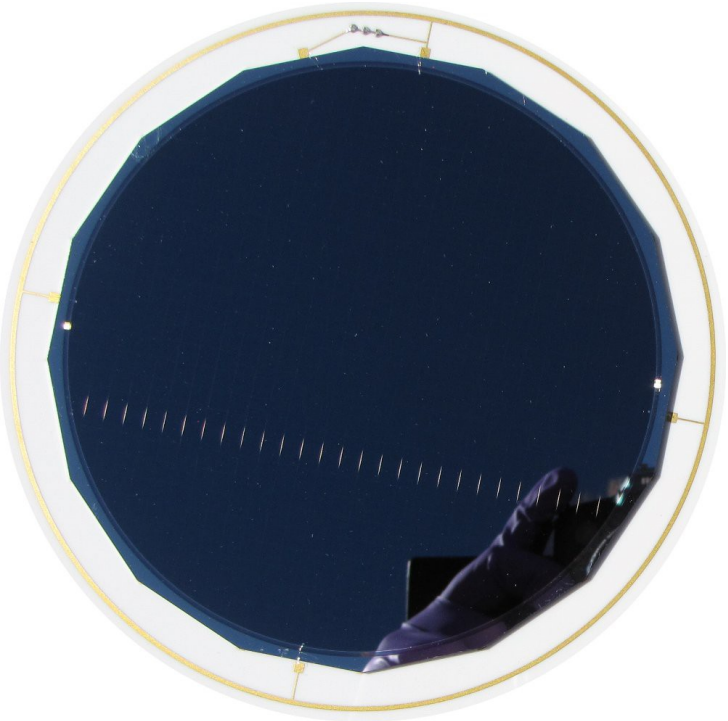
Bias scheme

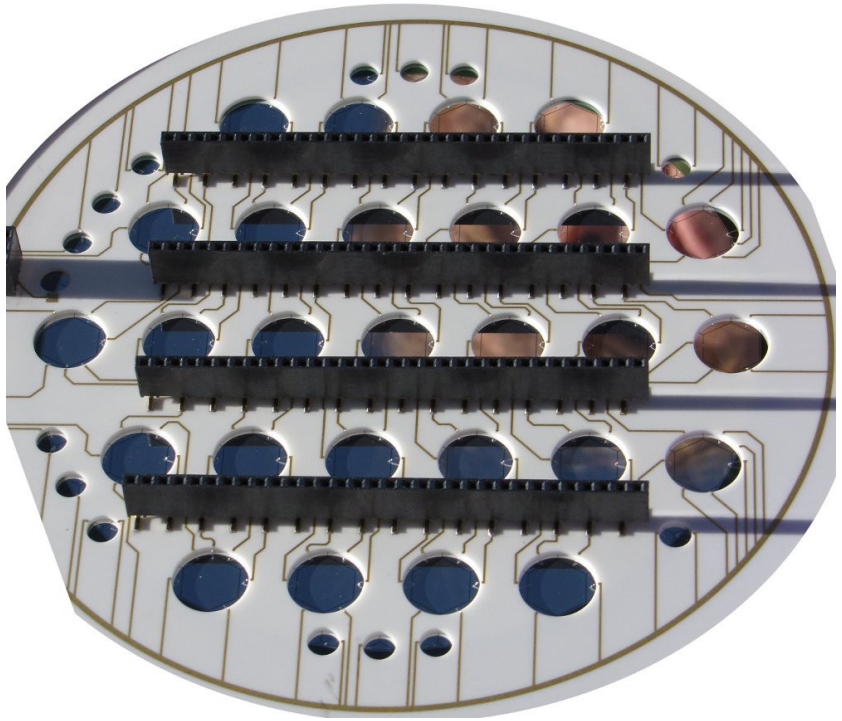
Detector, preamps and FADCs are at high voltage.



Fiber optics link to computer.

Segmented Si detectors





Front of detector has Al mesh with 5 mm spacing for fast response.

Detector is segmented into 128 hexagonal pixels for spatial resolution.

Electron-proton coincidences

-Maximum Larmor radius is ~4 mm.

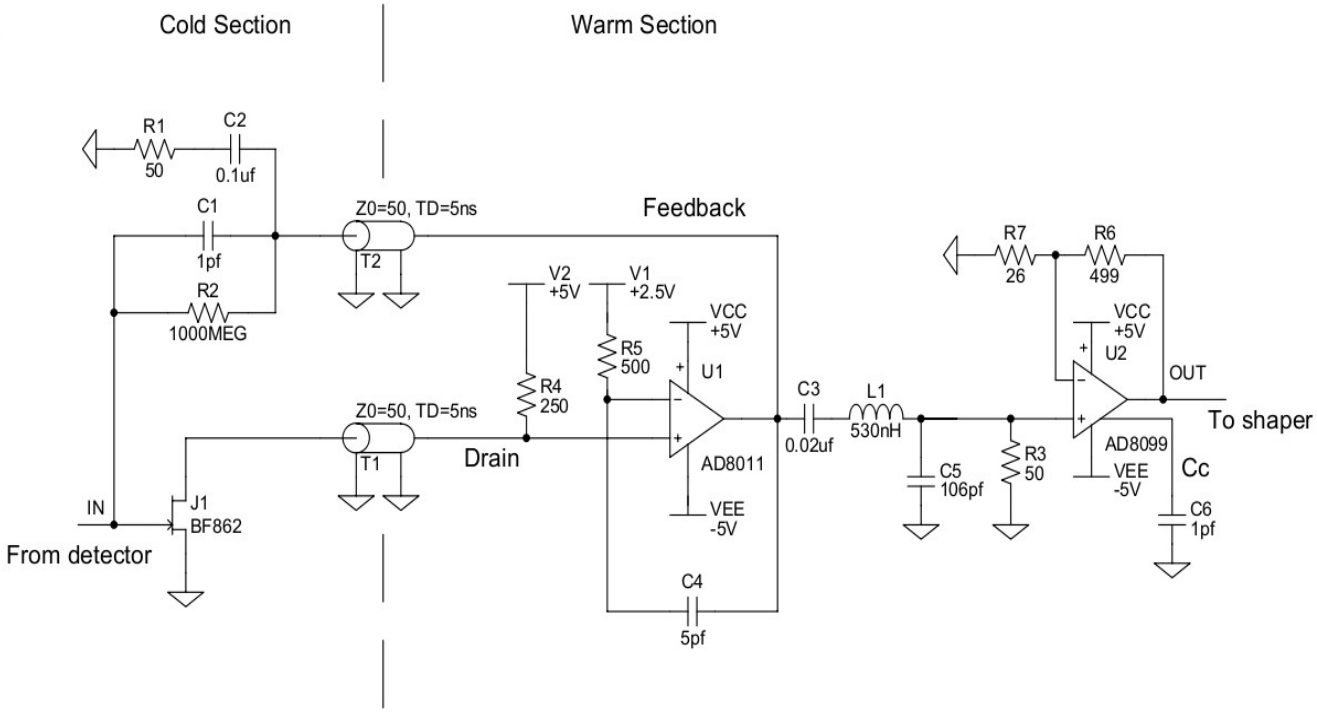
-Electron-proton timing coincidences range from a few microseconds to several milliseconds.

-Electron backscattering gives coincidences on the order of ten nanoseconds.

DAQ requirements:

Good energy resolution, fast timing and many channels

Preamplifier



The preamps consist of a cold section mounted to the detector and a warm section with additional amplification.

Eight channel FET card

-Mounted on detector

-T ~ 100 K

-16 cards cover 128 channels (one detector).

Six channel preamp cards

This is the warm side of the preamp.

There are three channels on each side.

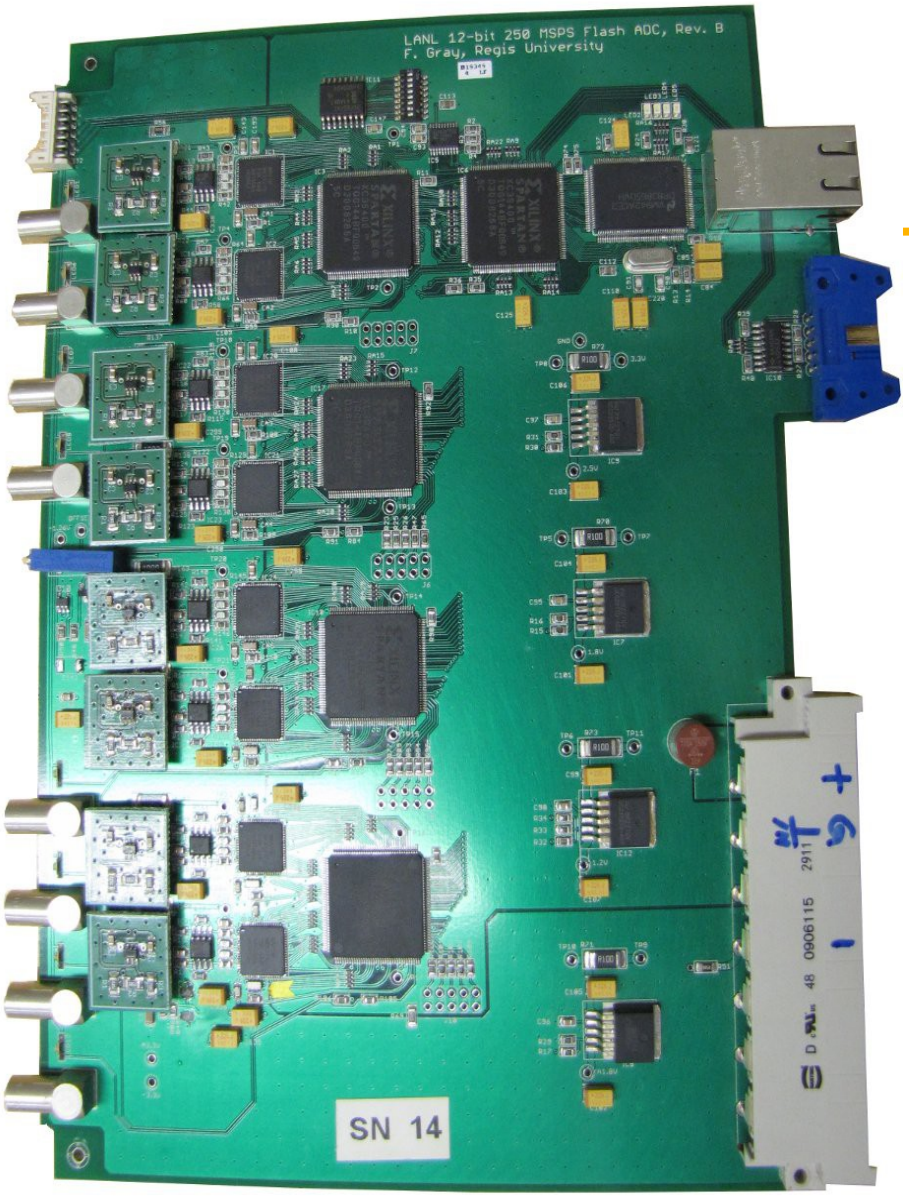
24 of these in a cylindrical array cover one detector.

Flash ADC boards

-8 channels

-250 MHz

-12 bits



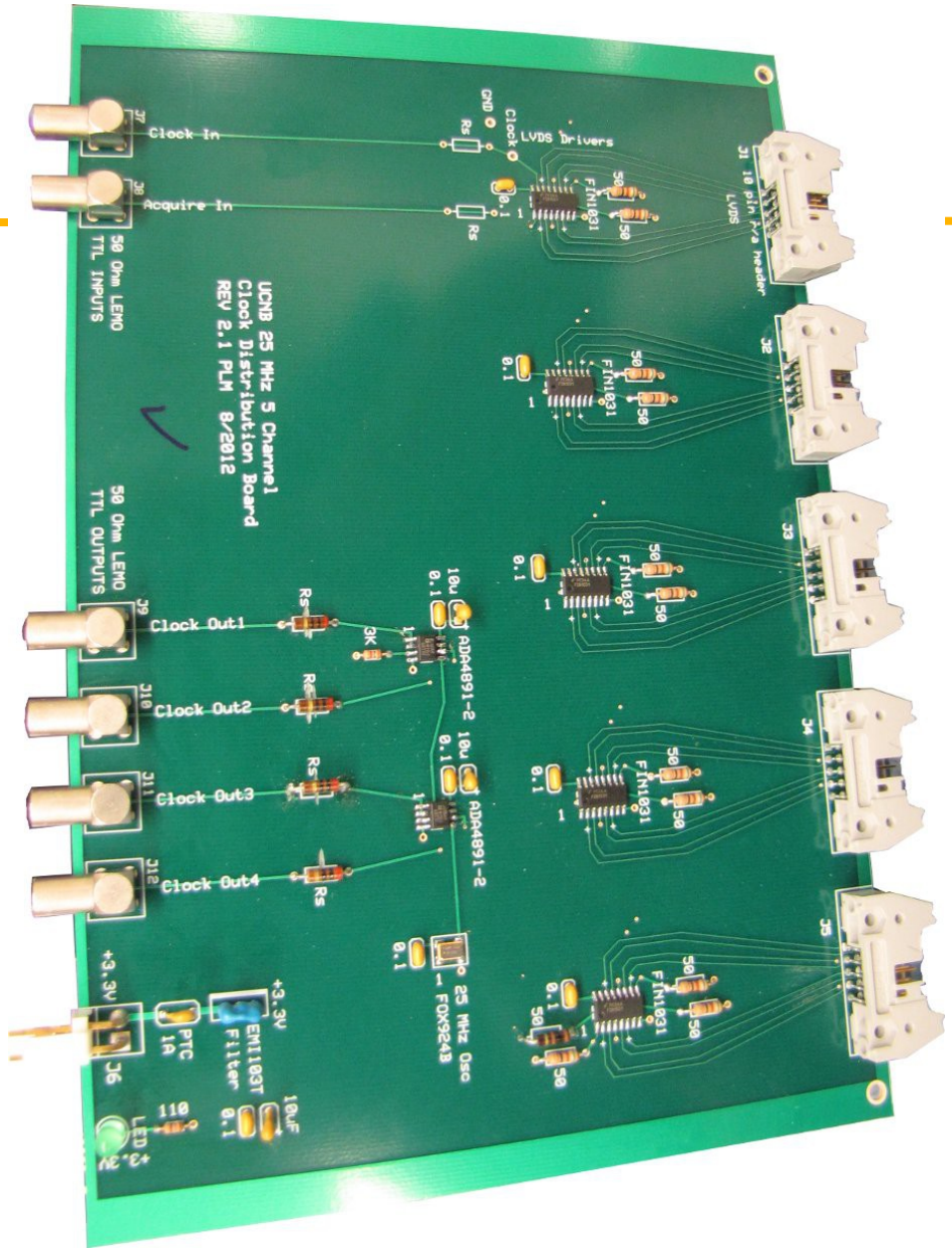
Clock board

-25 MHz oscillator

-Synchronizes boards

-2x2 driving amplifiers

-Fiber optic link? (HV)

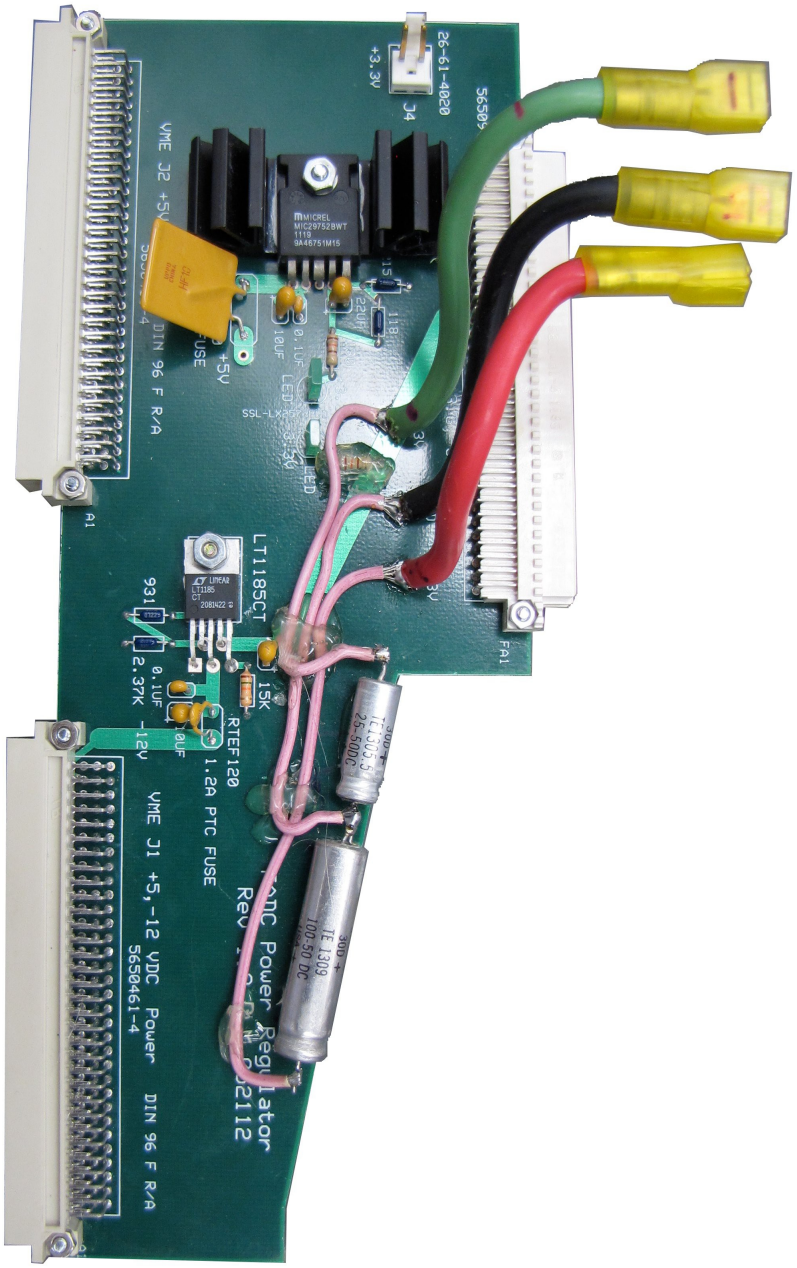


Voltage regulator

-Powers FADC cards

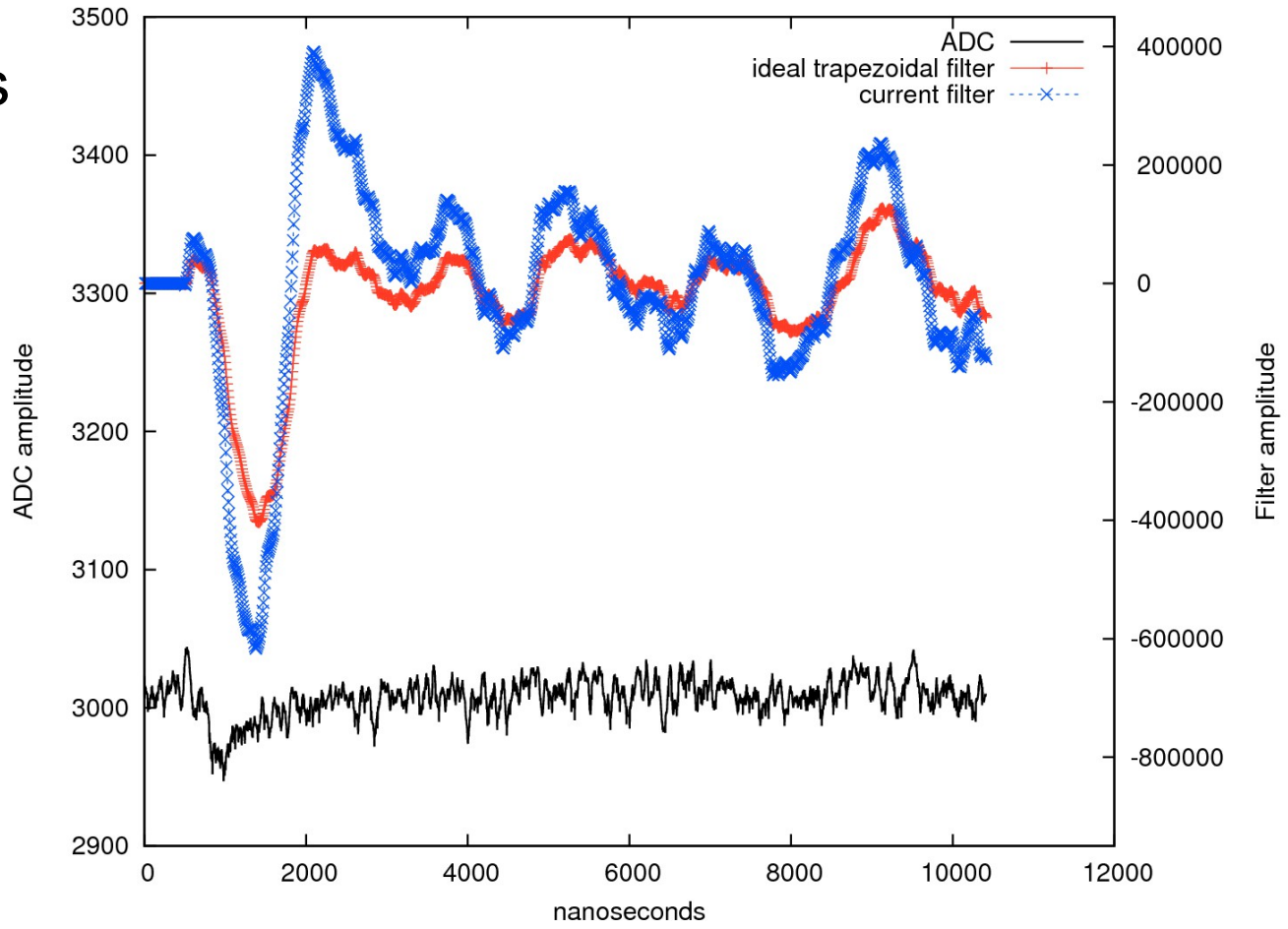
-Uses VME crate supply

-Generates +3.3 V DC



Trapezoidal Filter Trigger

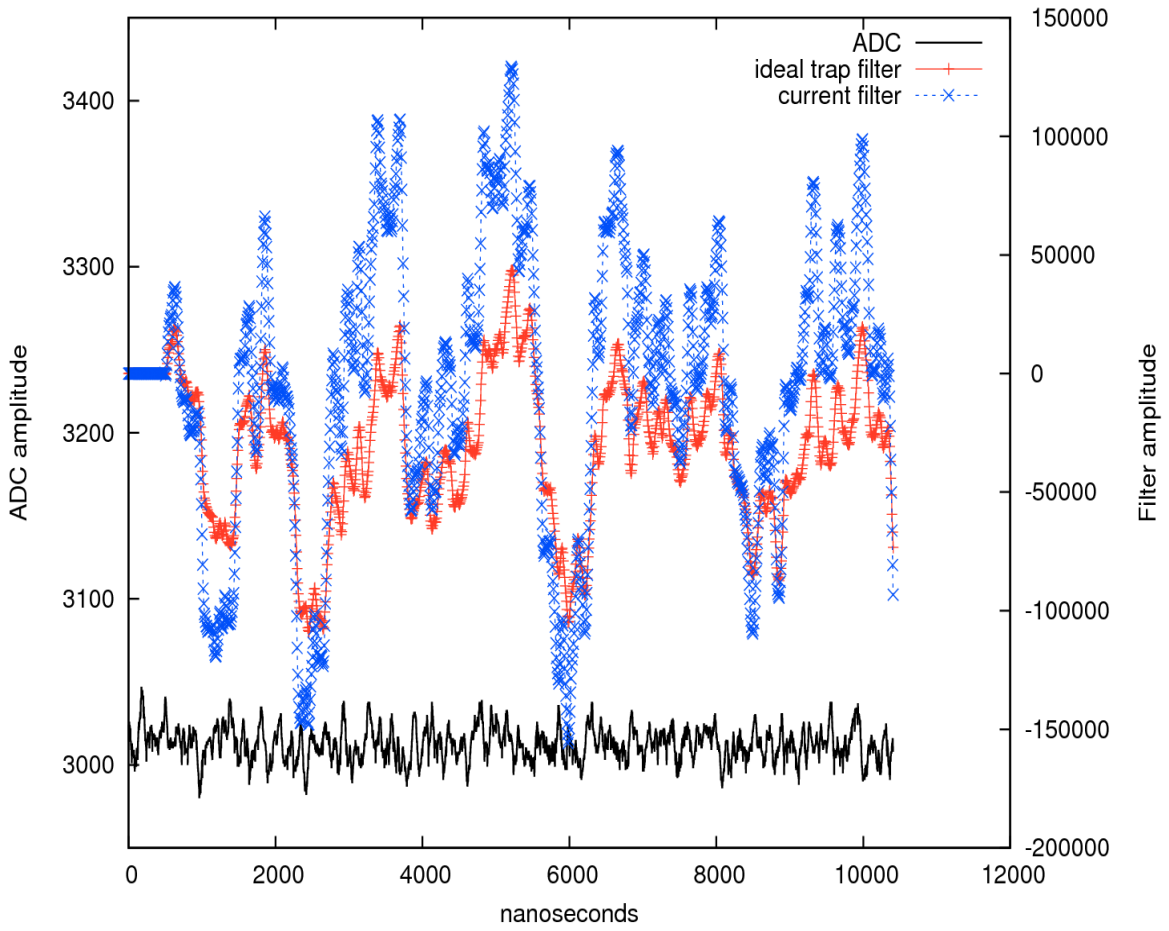
Current filter has dampening with less than ideal response.



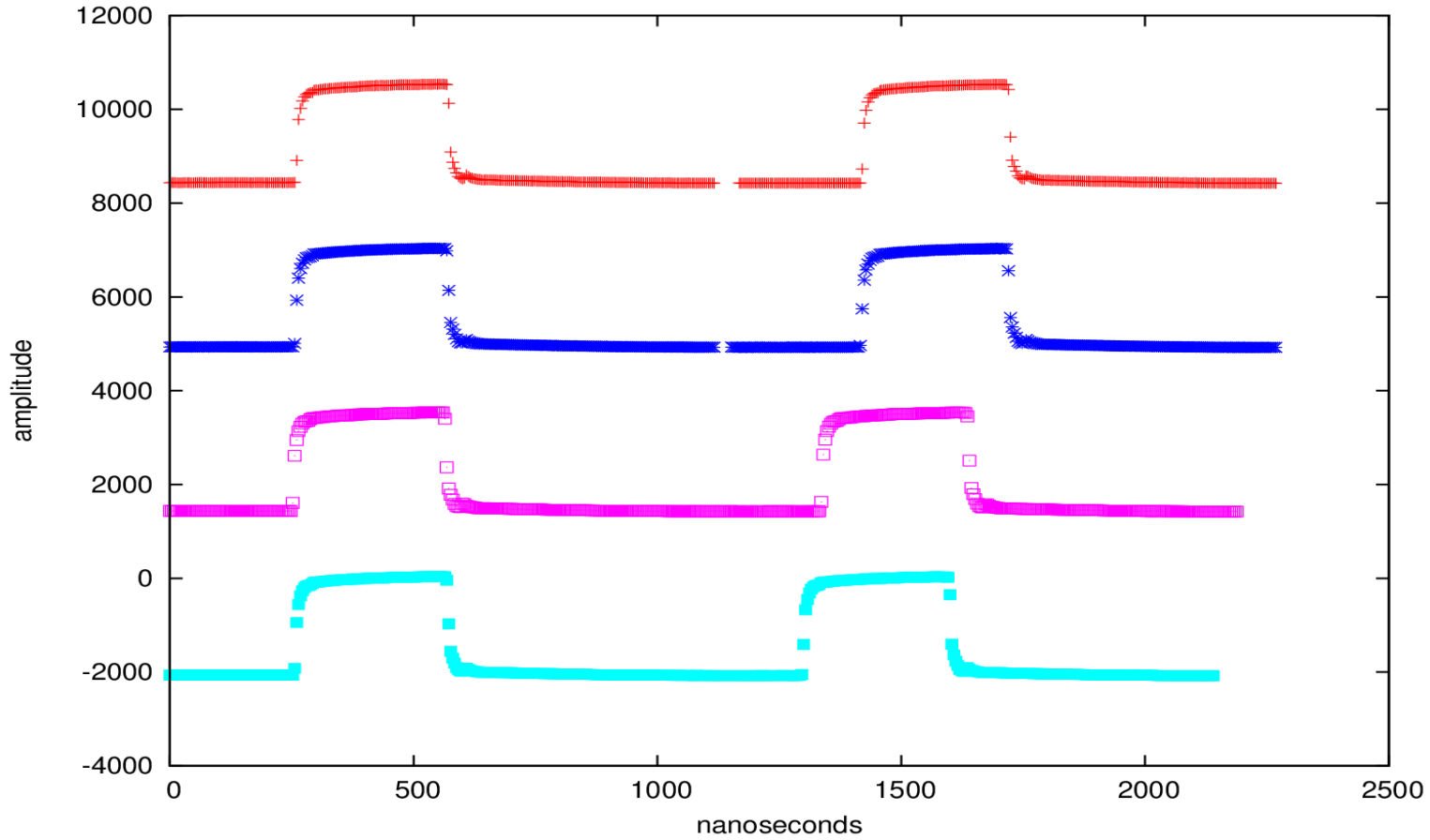
Trapezoidal Filter Trigger

This limits noise rejection.

Work in progress....



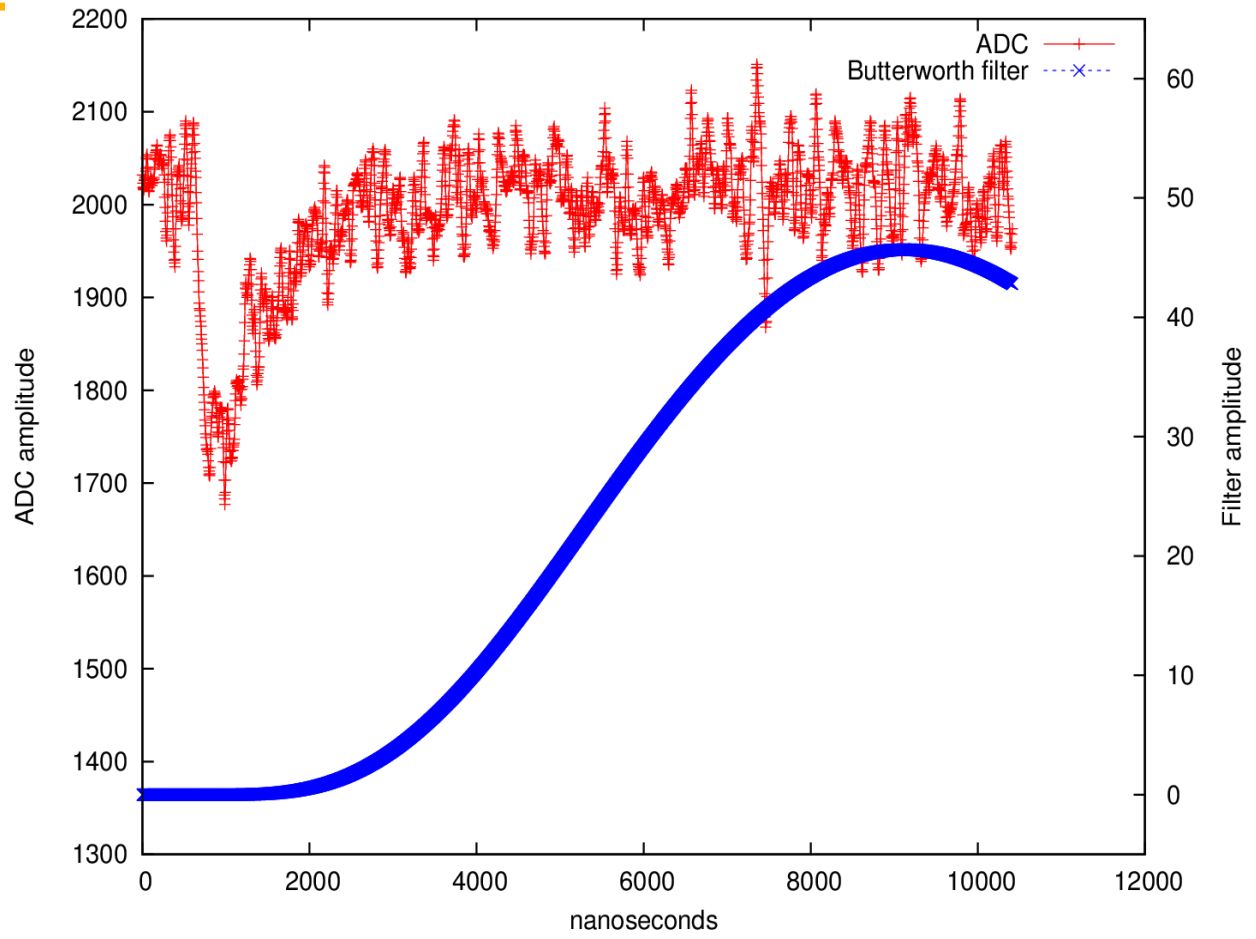
FADC: coincidence, no dead time



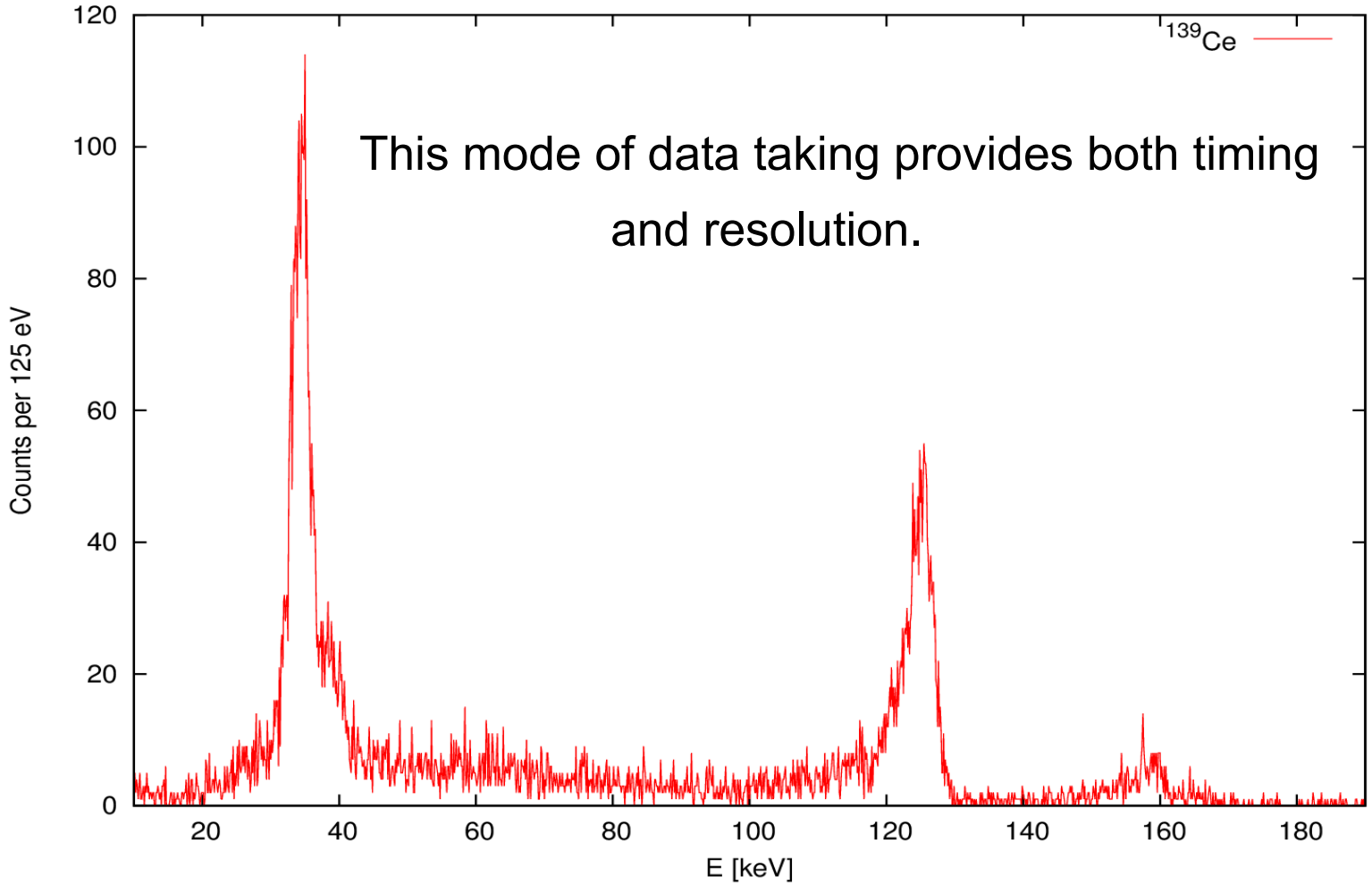
This is two events seamlessly recorded as one.

Digital shaping amplifier

Butterworth (low-pass), four-pole filter



Calibration source spectra



Status and outlook

-FADCs have all the capabilities we need but there is still work to be done, particularly on the firmware.

-Full hardware for 256 channels is on the way.
The voltage regulators are back-ordered for now.

-High voltage data is on the way soon.