

# LA-UR-12-25942

Approved for public release; distribution is unlimited.

Title: Data Acquisition for the UCNB Experiment

Author(s): Sjue, Sky K

Intended for: APS Division of Nuclear Physics, 2012-10-24 (Newport Beach, California, United States)  
Presentation

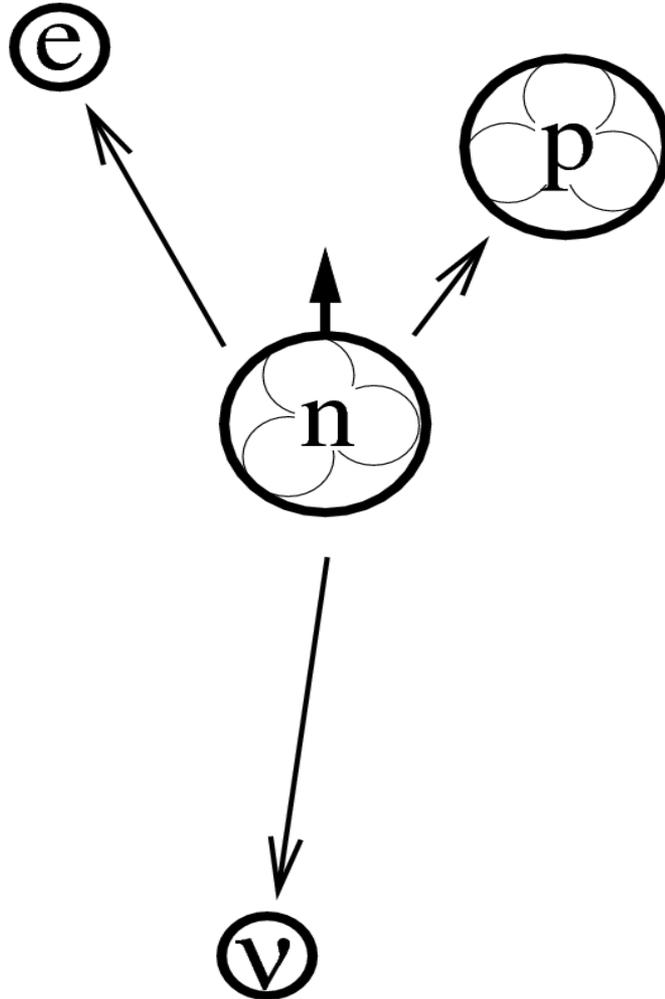


**Disclaimer:**

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the Los Alamos National Security, LLC for the National Nuclear Security Administration of the U.S. Department of Energy under contract DE-AC52-06NA25396. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

# Data acquisition for the UCNB experiment

---



Sky Sjue

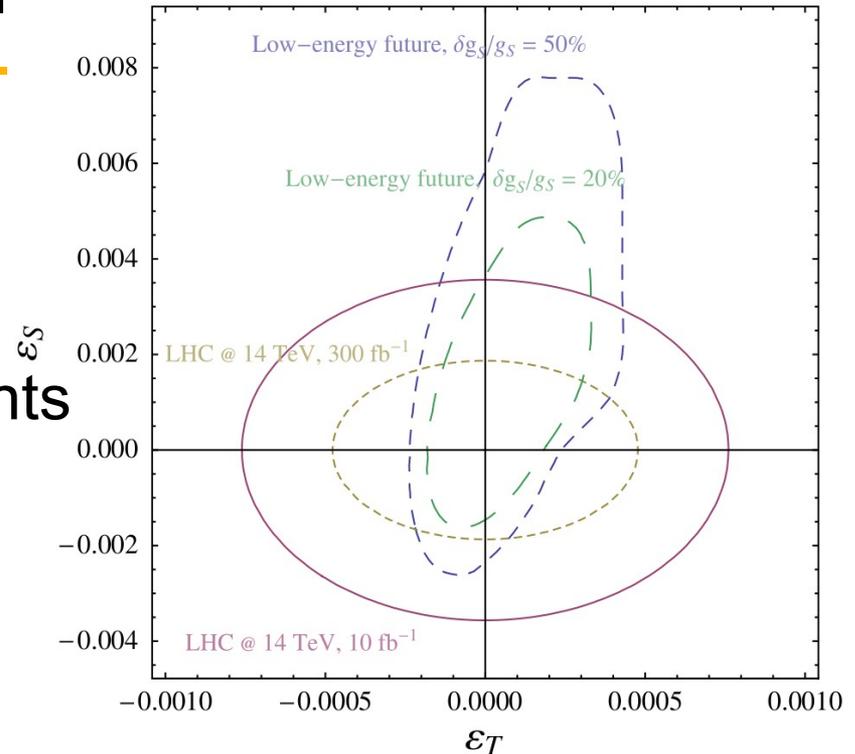
APS DNP 2012

Newport Beach, CA

27 October 2012

# Physics motivation

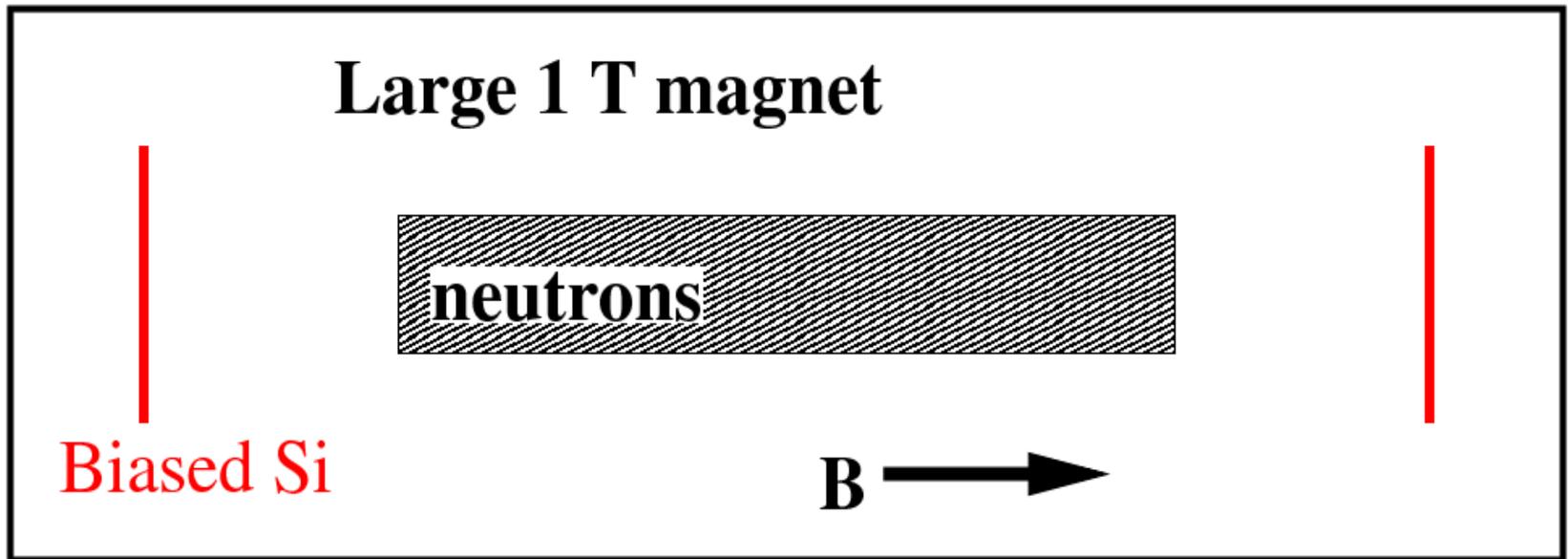
Precision measurements of neutron beta decay can provide limits on scalar and tensor currents complementary to the LHC.



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

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

# Experimental strategy

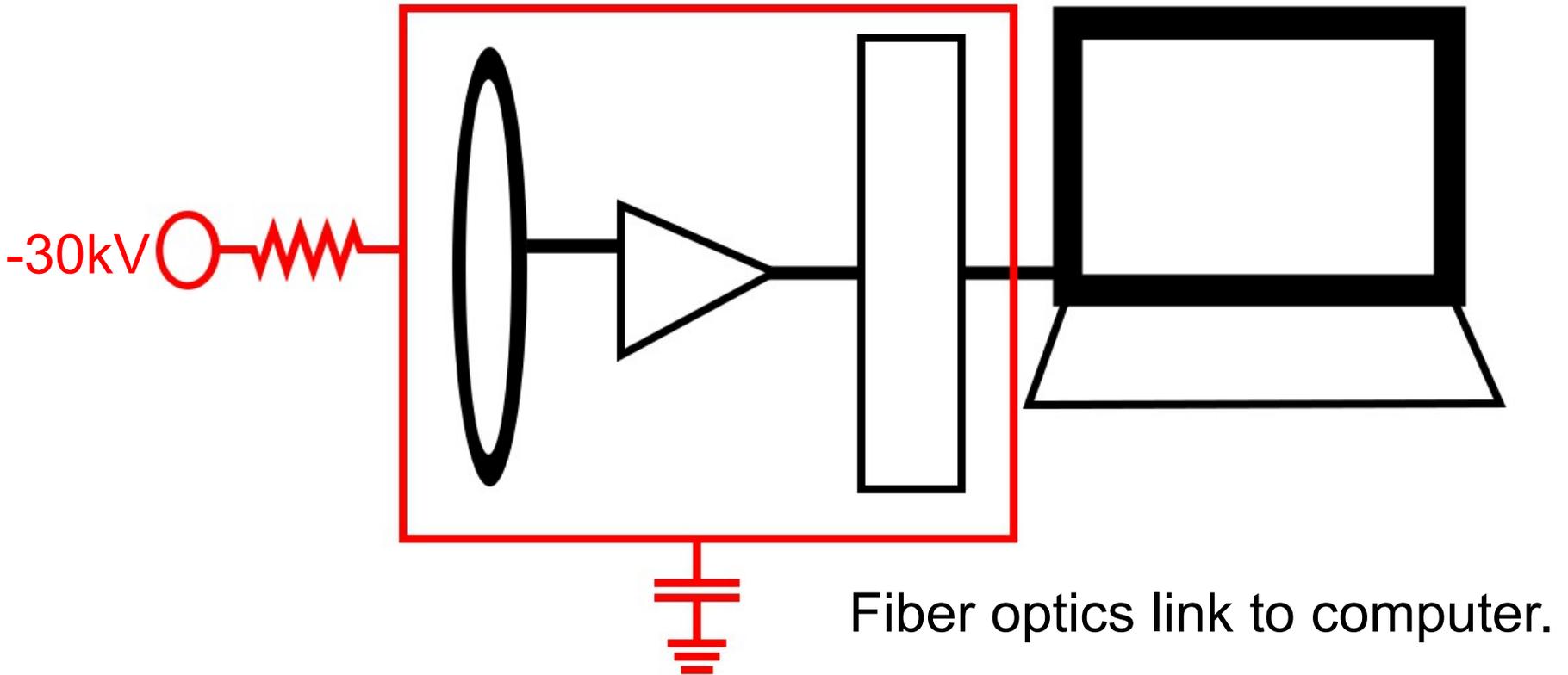


Bias voltage of -30 kV accelerates protons.

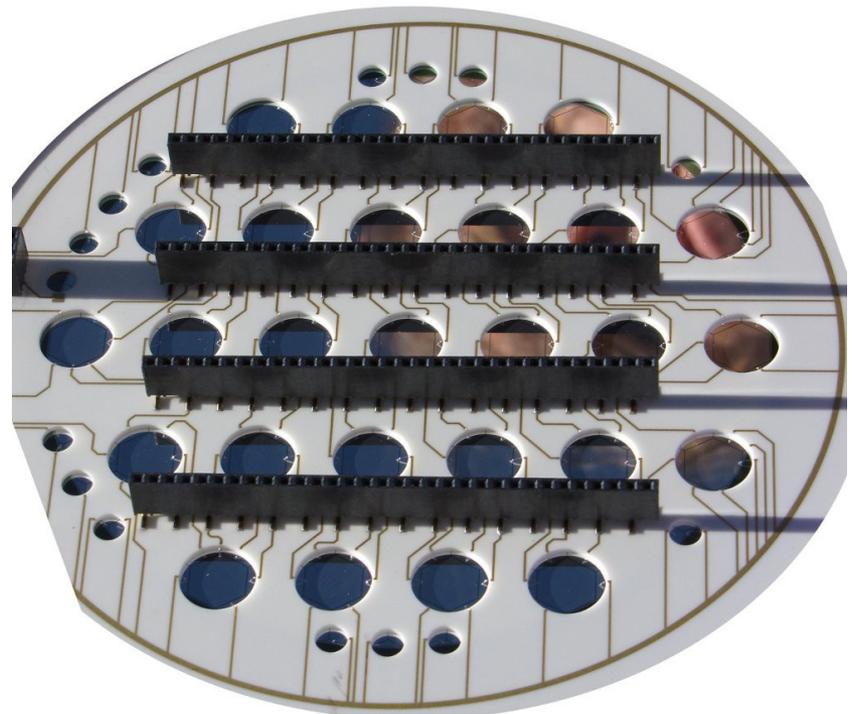
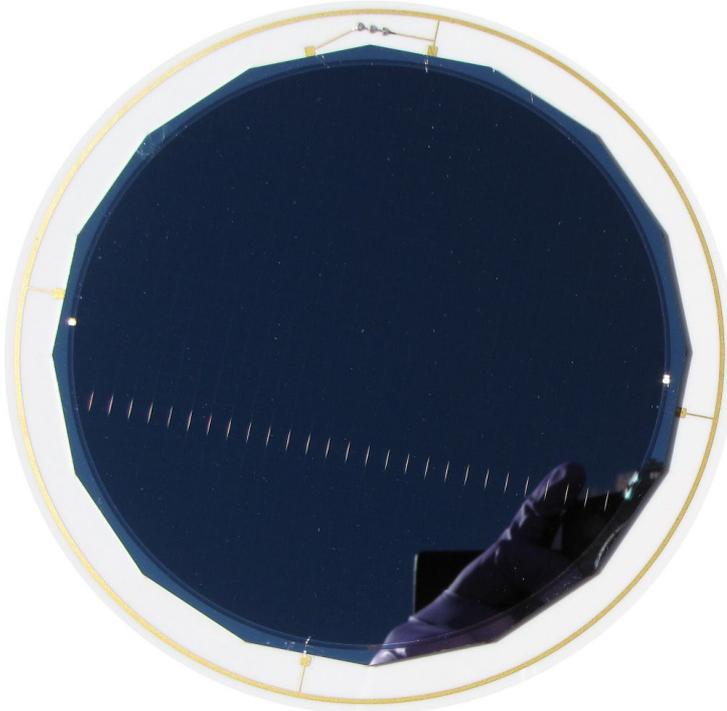
Simultaneous detection of protons and electrons allows inference of neutrino's momentum.

# Bias scheme

Detector, preamps and FADCs are at high voltage.



# 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

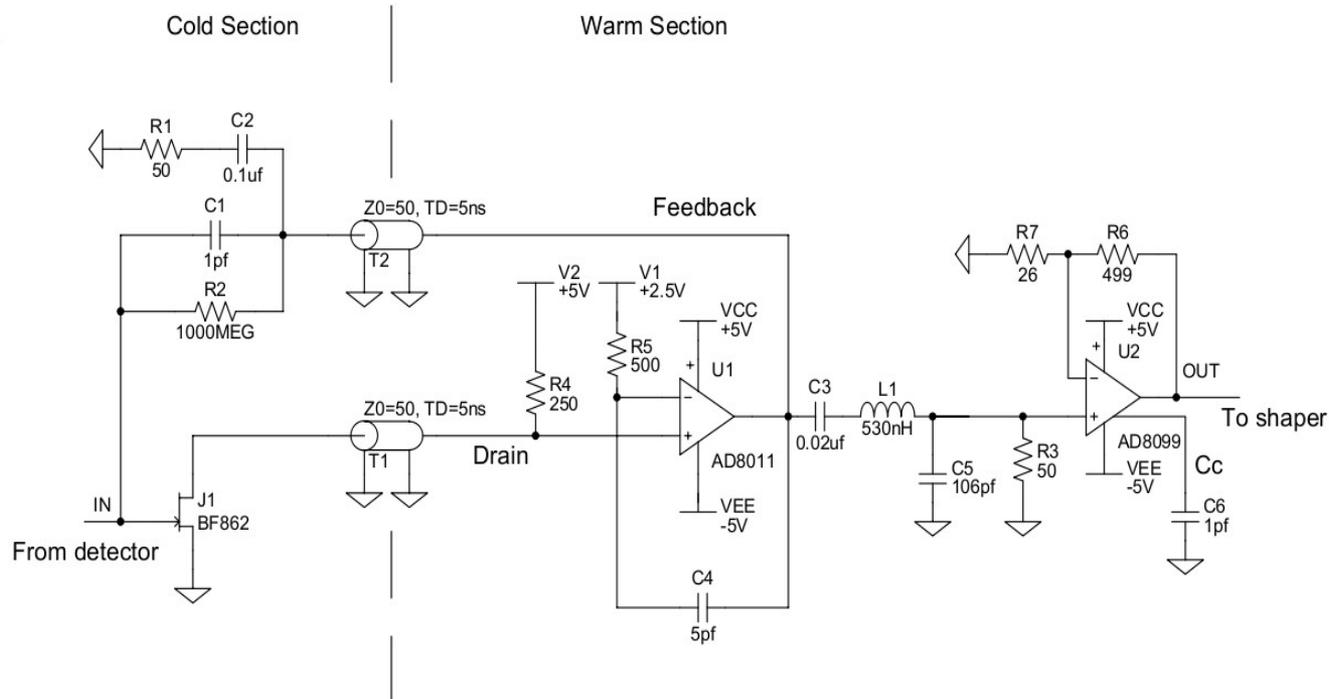
---

- Maximum Larmor radius is  $\sim 4$  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

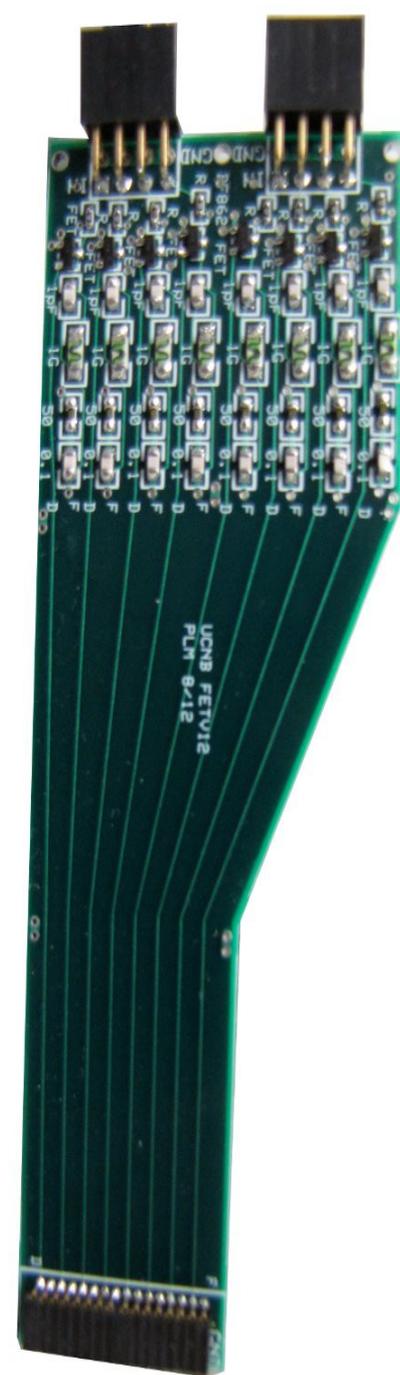
# Preamplifier



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.

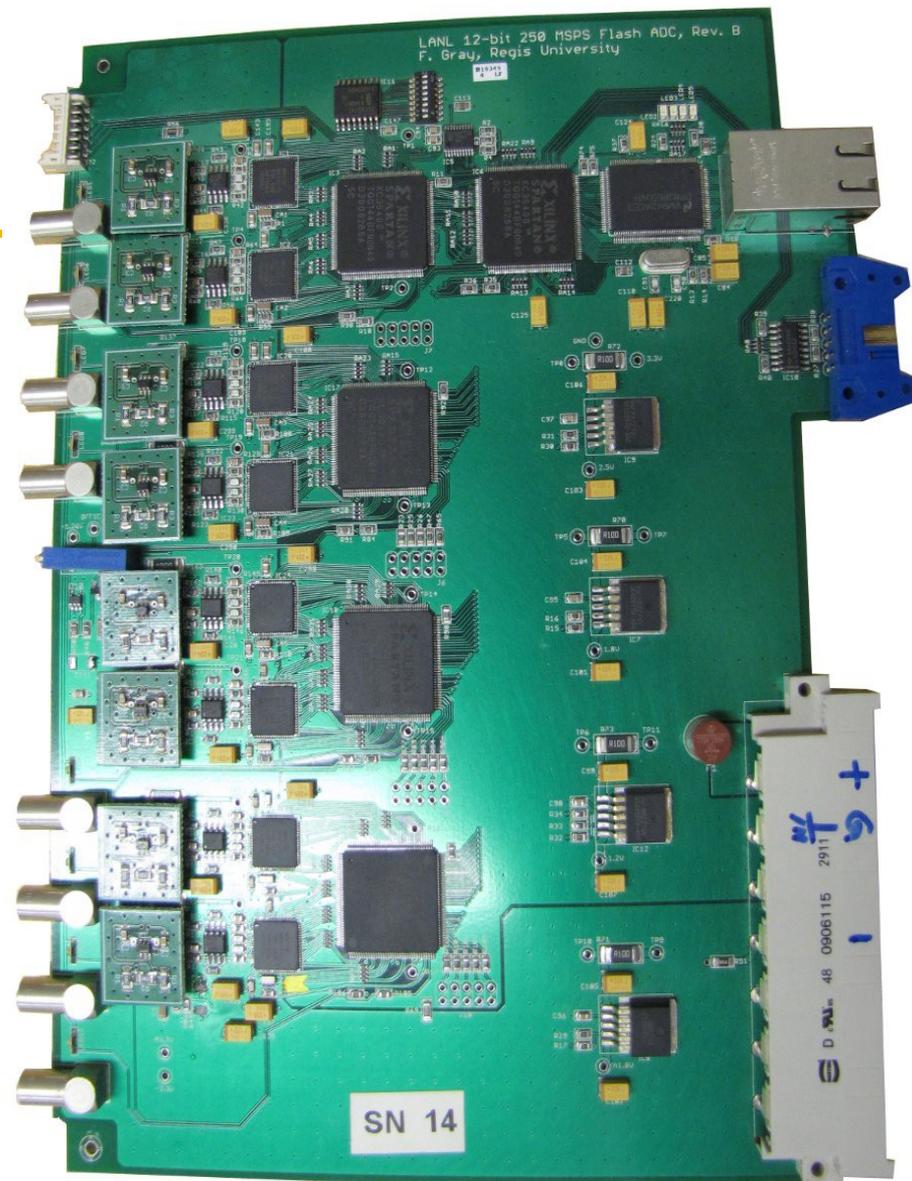


# Flash ADC boards

-8 channels

-250 MHz

-12 bits

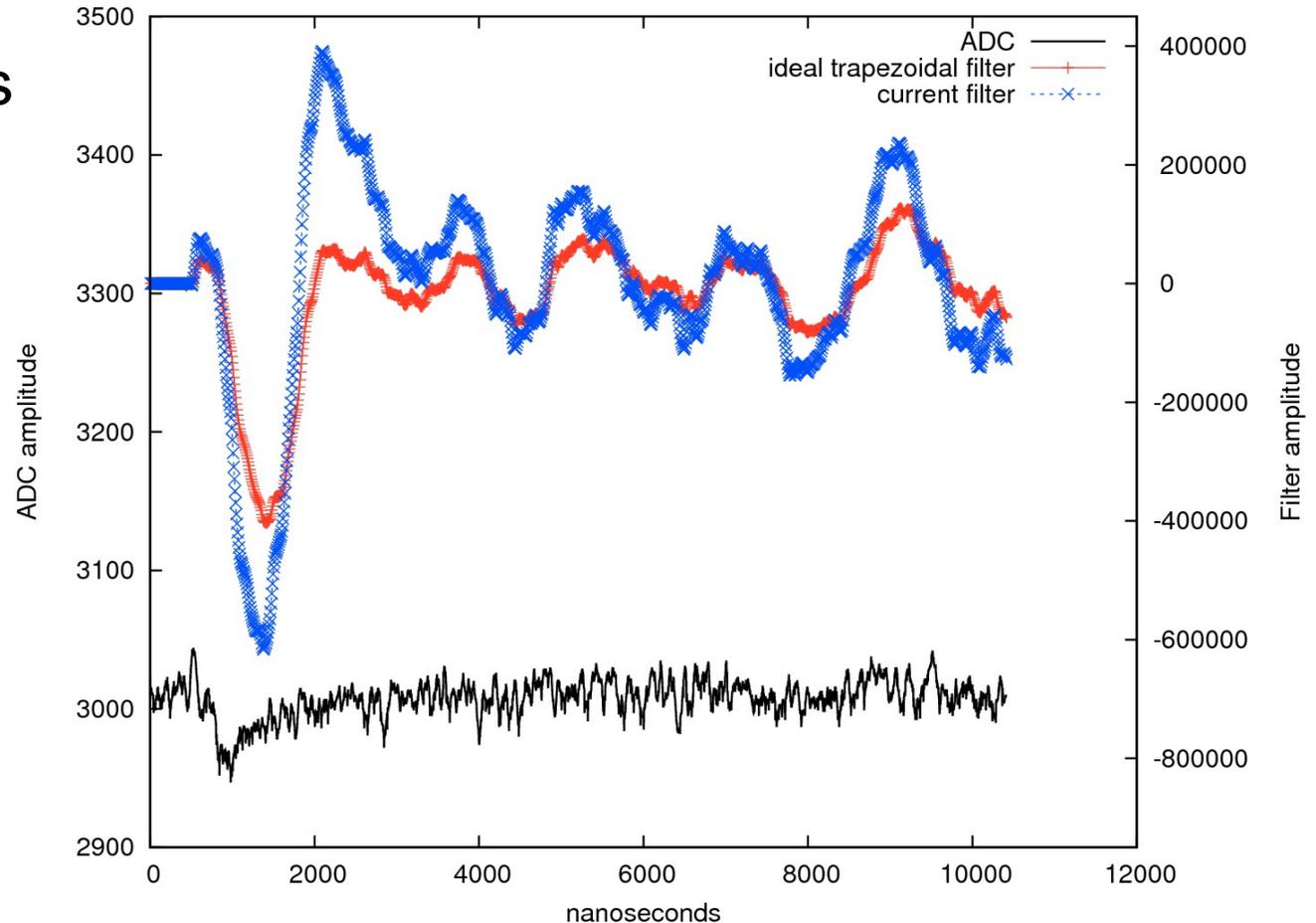






# Trapezoidal Filter Trigger

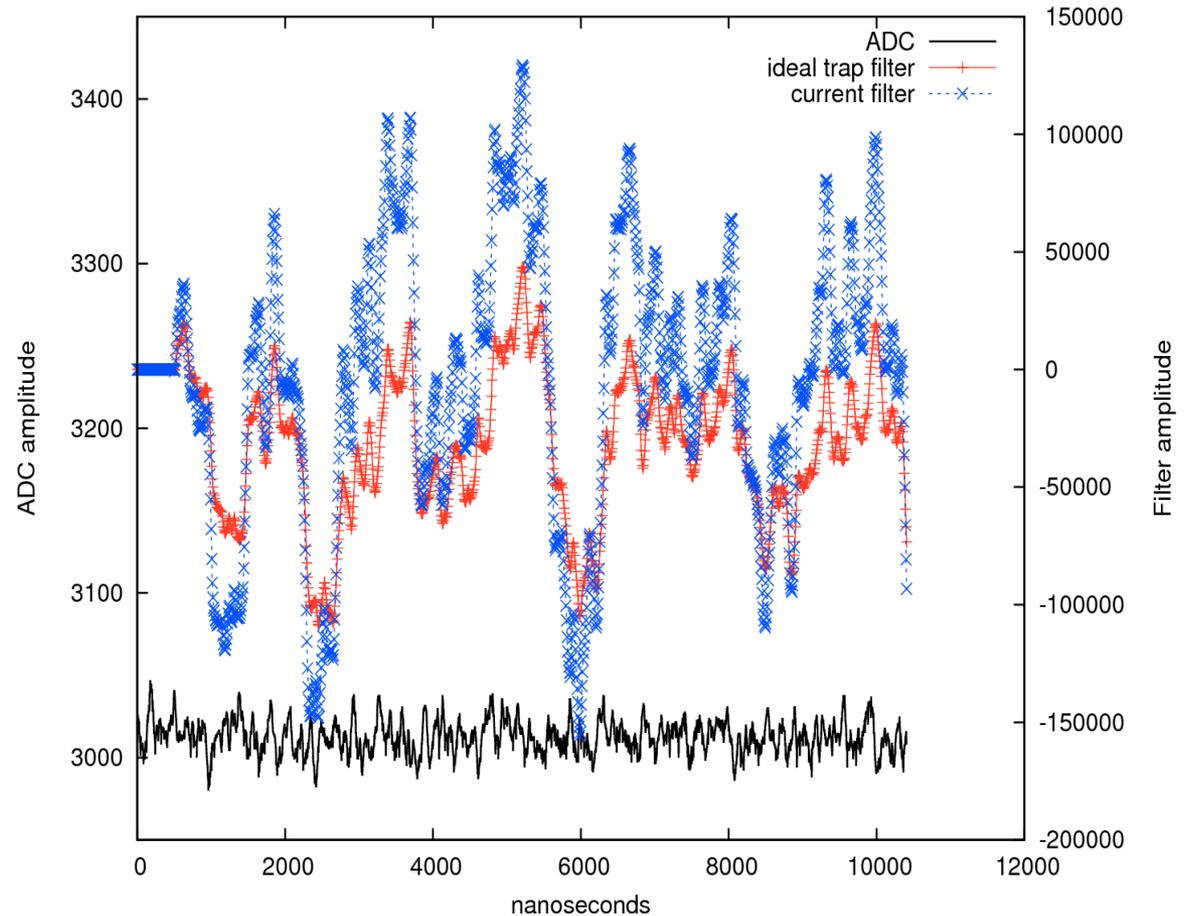
Current filter has dampening with less than ideal response.



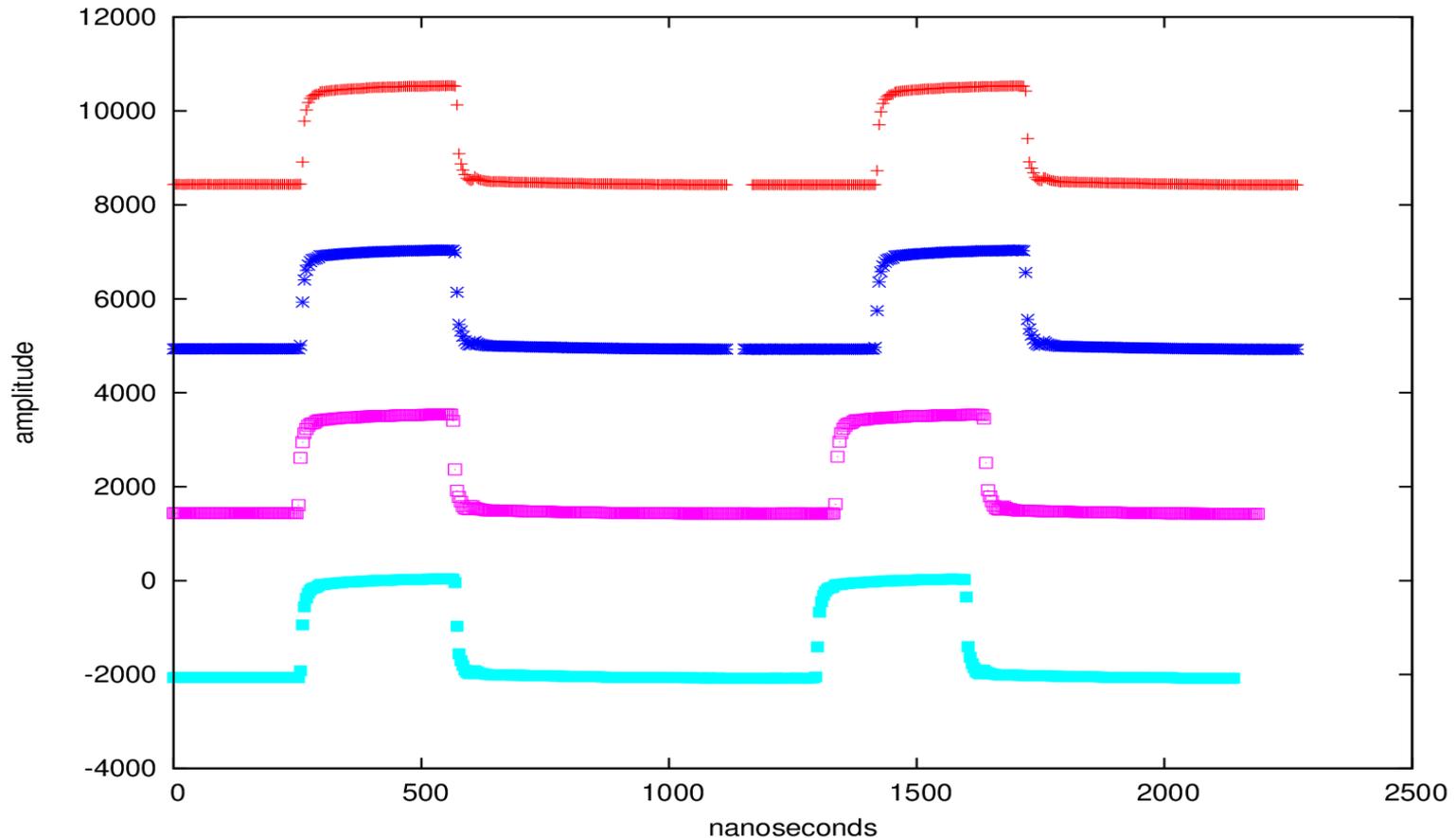
# Trapezoidal Filter Trigger

This limits noise rejection.

Work in progress....



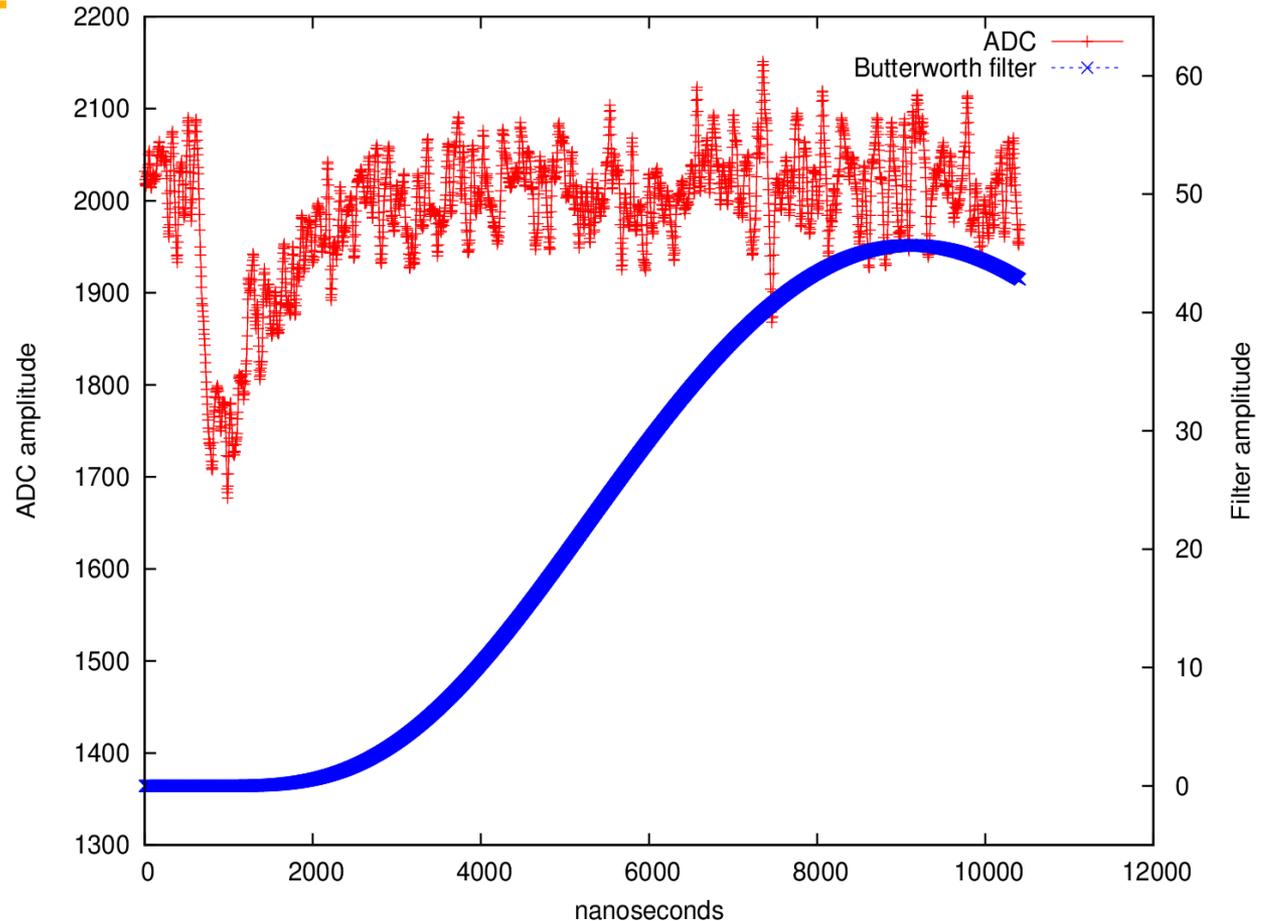
# FADC: coincidence, no dead time



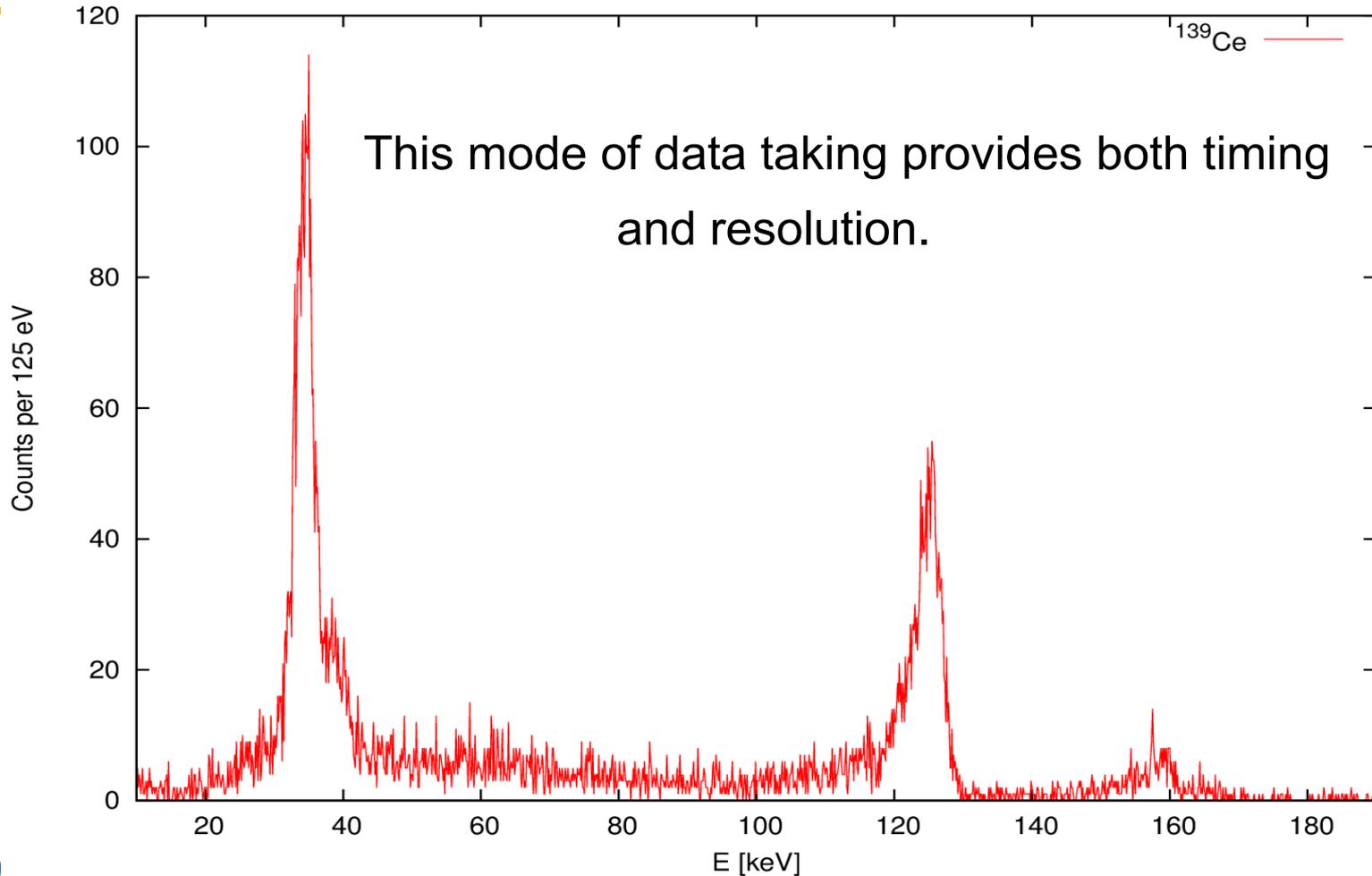
This is two events seamlessly recorded as one.

# 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.