FCAL R&D in SiD

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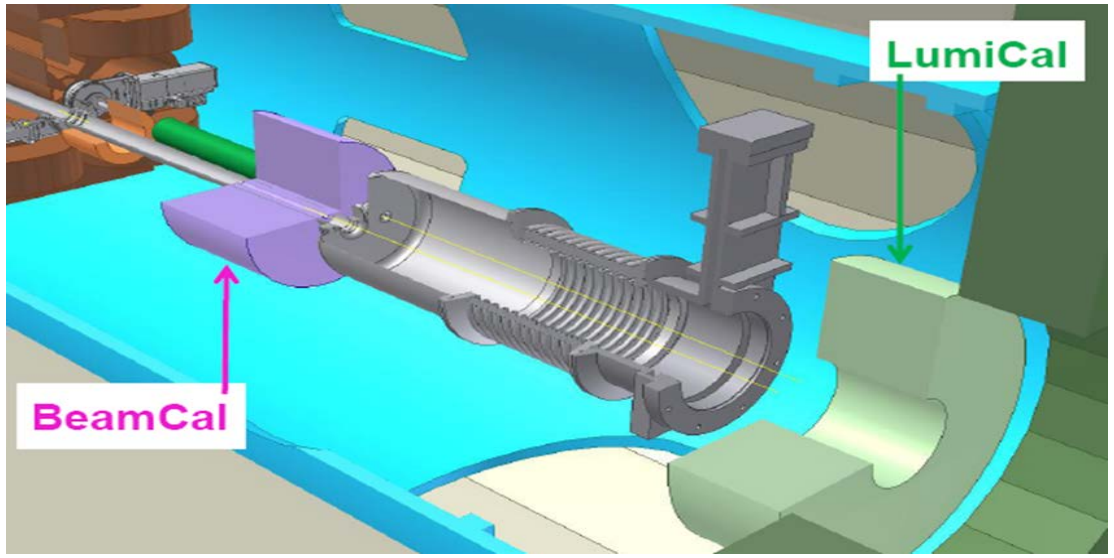
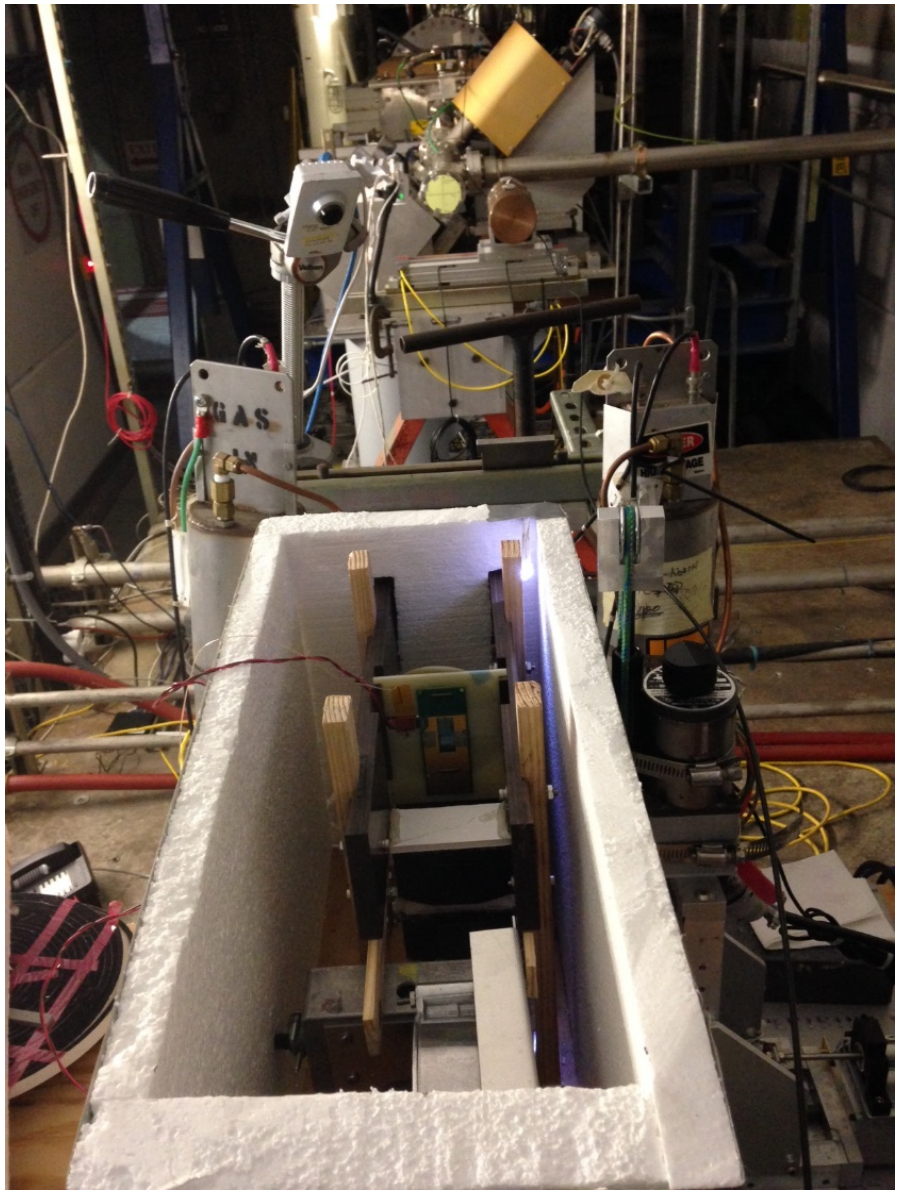
FCAL-Oriented R&D I: Electromagnetic Radiation Damage Studies



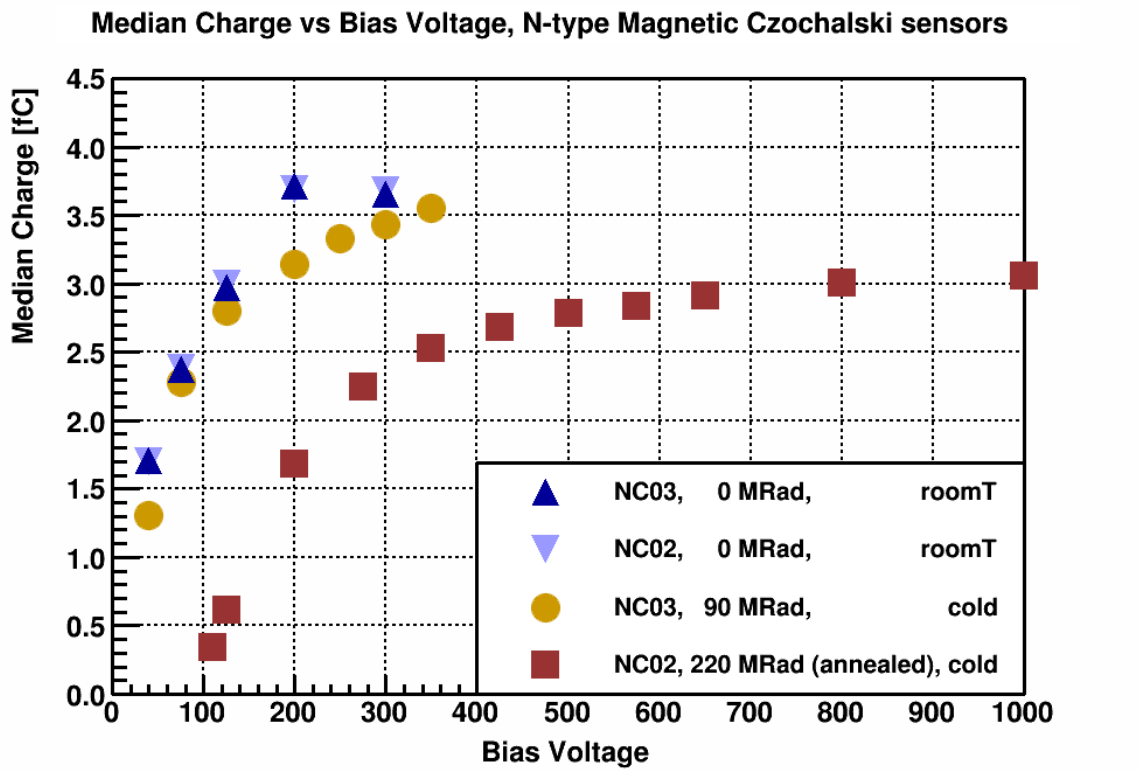
BeamCal instrument expected to receive up to 100 Mrad per year of electromagnetically-induced radiation

SLAC Experiment T506 uses End Station Test Beam directed on 7 X_0 of Tungsten radiator to generate EM showers

Doses of up to 220 Mrad absorbed by various types of Si diode sensors as well as GaAs bulk sensors



Electromagnetic Radiation Damage Studies: Selected Results

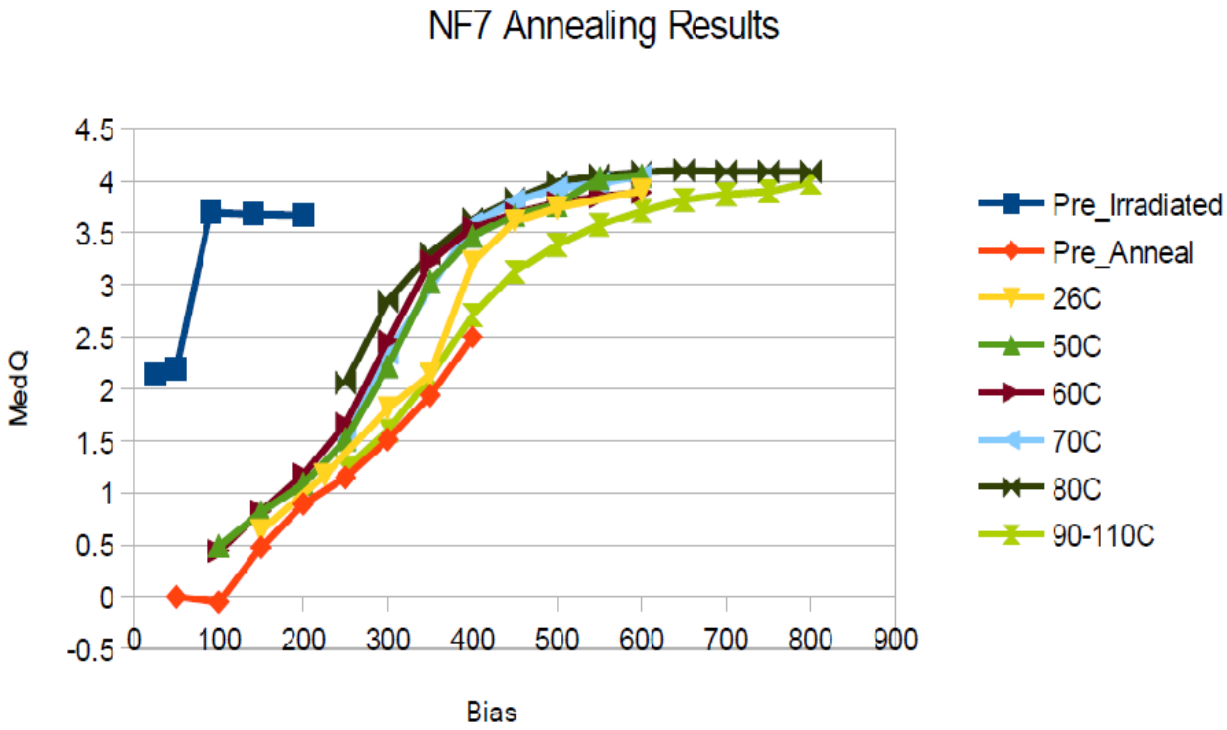


N-type magnetic Czochralski bulk Si diode detector irradiated to 220 Mrad

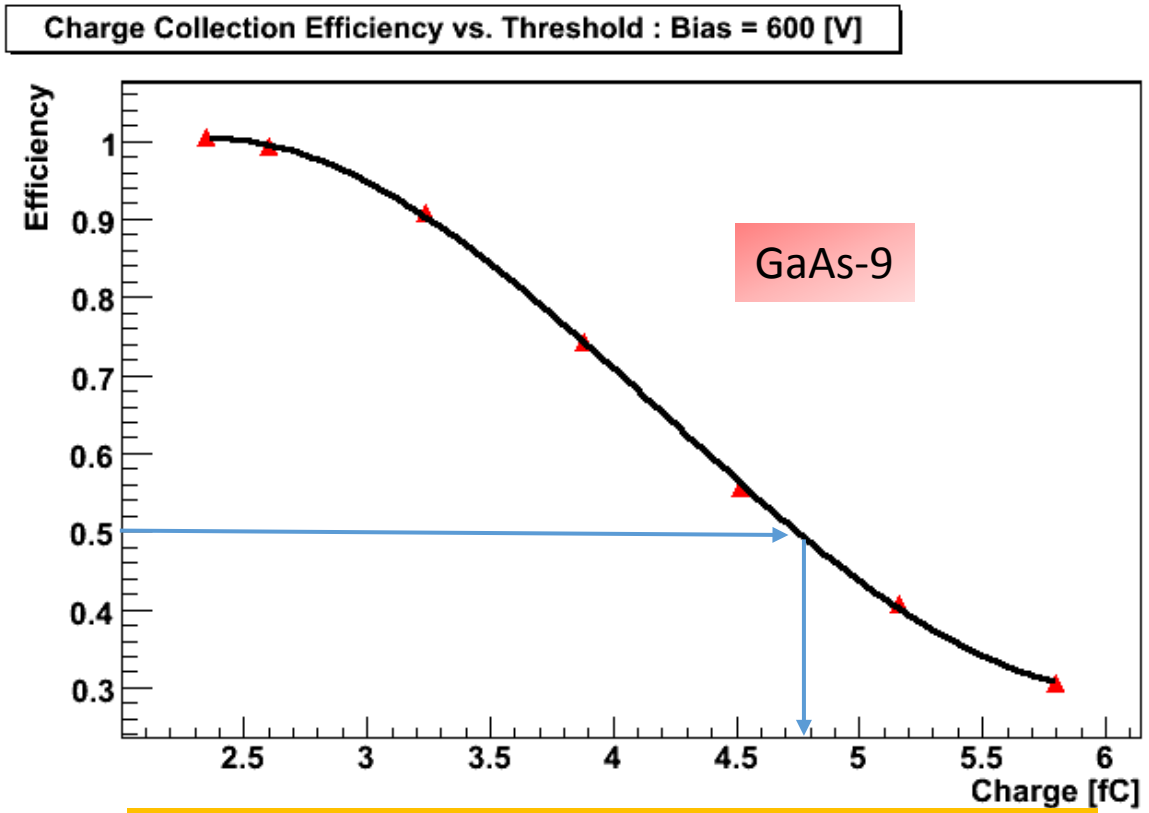
Increase in depletion voltage and decrease in charge-collection observed, but performance still adequate for calorimetry

N-type float-zone bulk Si diode detector irradiated to 90 Mrad

Increase in depletion voltage but no decrease in charge-collection observed; some improvement in depletion voltage obtained with controlled annealing



Electromagnetic Radiation Damage Studies: Outlook and Plans



GaAs sensor response: pre-irradiation

At 600 V bias, see about 4.8 fC of collected charge (one of two GaAs sensors from JINR/Tomsk that was irradiated in the second run of T506)

Near-Term Plans:

- Complete annealing studies for Si diode sensors
- Perform charge collection evaluation of two GaAs sensors, which were irradiated to 5 and 20 Mrad, respectively
- Perform GaAs annealing studies, as warranted

Longer-Term Plans:

- Further running of T506 in spring/summer 2015
- GaAs to 100 Mrad, as warranted
- NC sensor to 500 Mrad
- NF, PC, PF sensors to 200 Mrad
- More controlled annealing studies

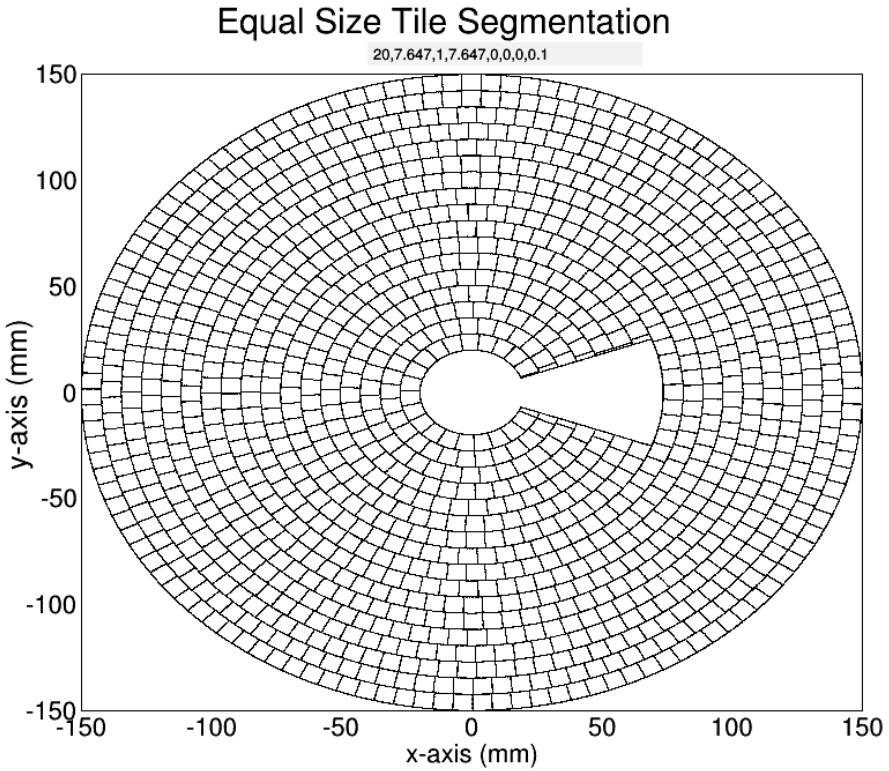
➔ **Very much at mercy of LCLS beam conditions unless a 2nd kicker magnet is installed in the ESTB!!!**

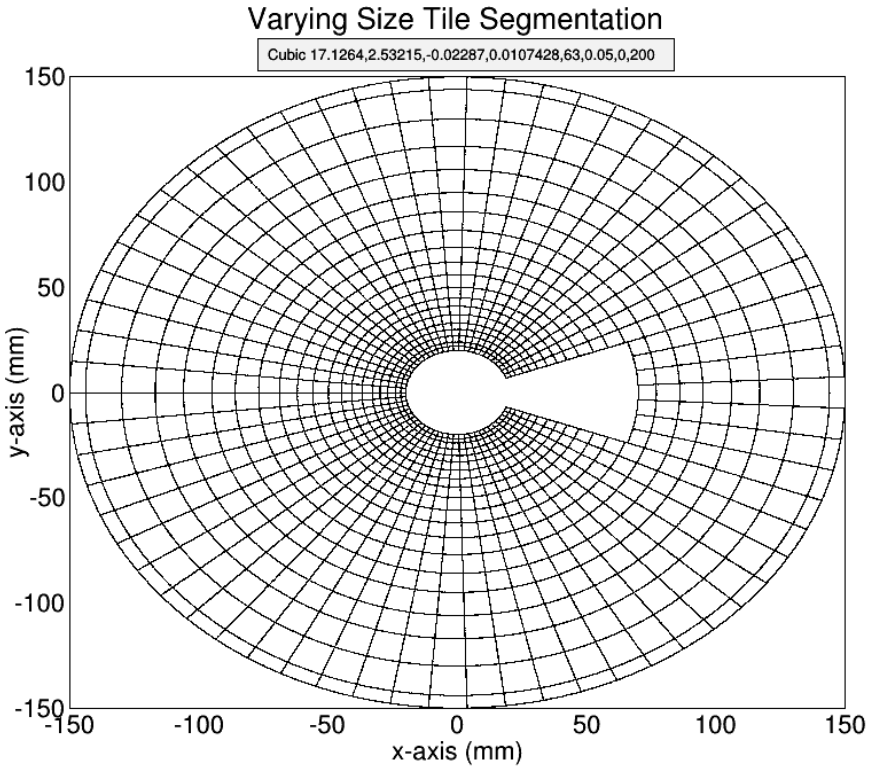
FCAL-Oriented R&D II: BeamCal Design and Performance Simulations

Have developed local computer system to analyze simulated BeamCal background and signal (physics major Christopher Milke)

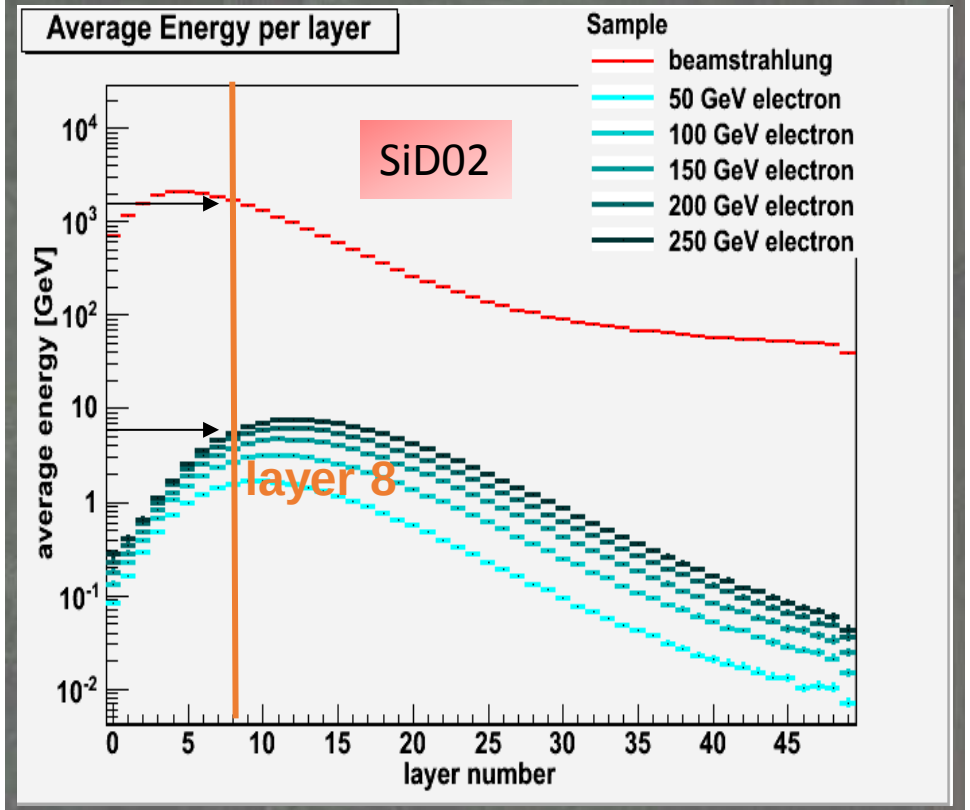
Have implemented flexible tiling scheme for BeamCal sensors

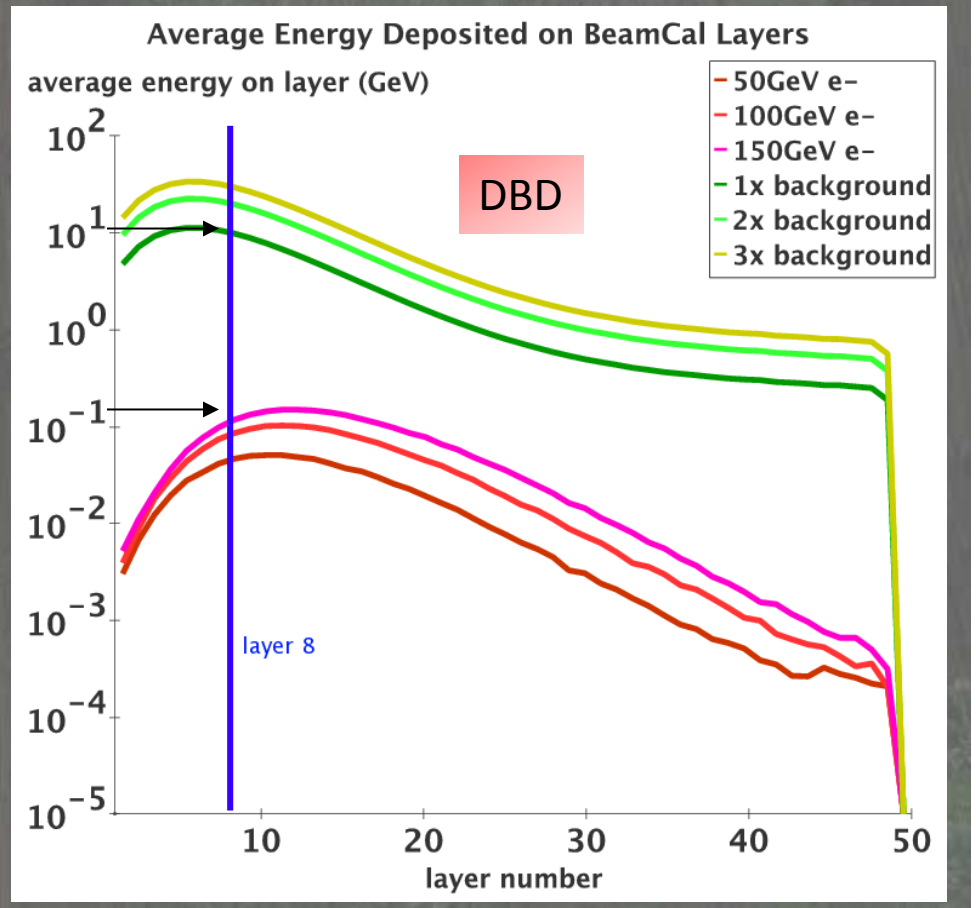
Will explore performance vs. tiling scheme and granularity; also will compare “competing” reconstruction algorithms





Cautionary Note: Signal to Noise Much worse than DBD

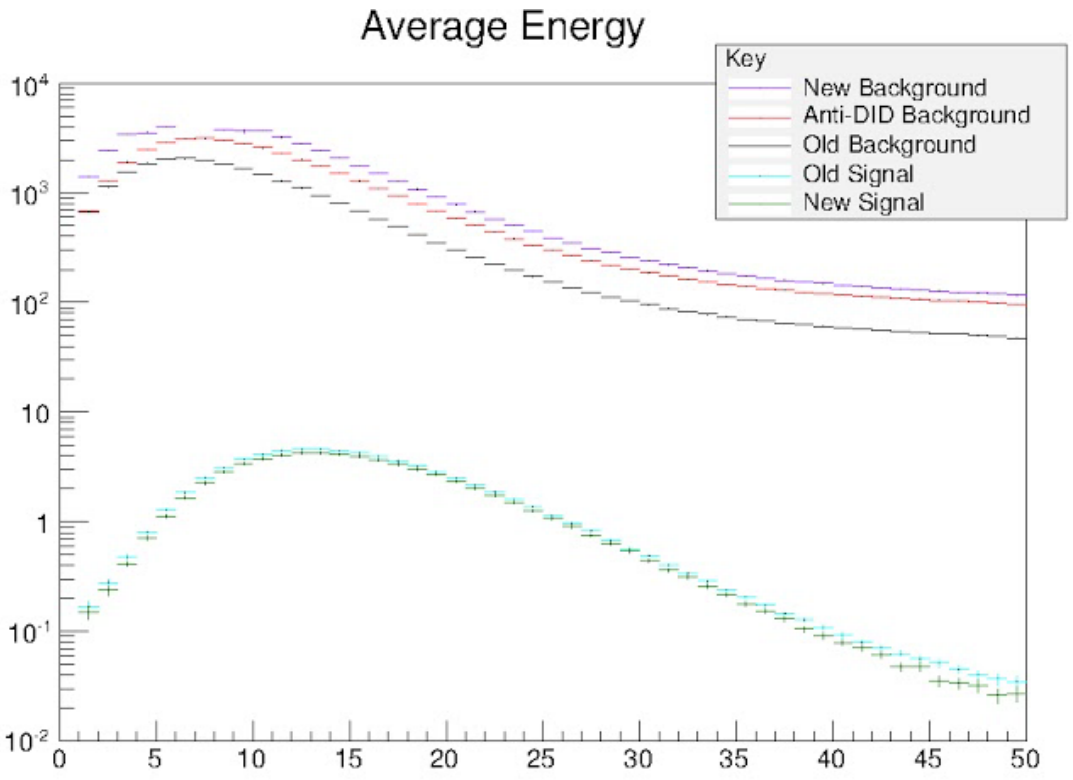




Colorado (DBD): Mean background x100 mean signal

SiD02: Mean background x500 mean signal

But even worse…



"OLD" = SiD02 "NEW" = SidLoi3

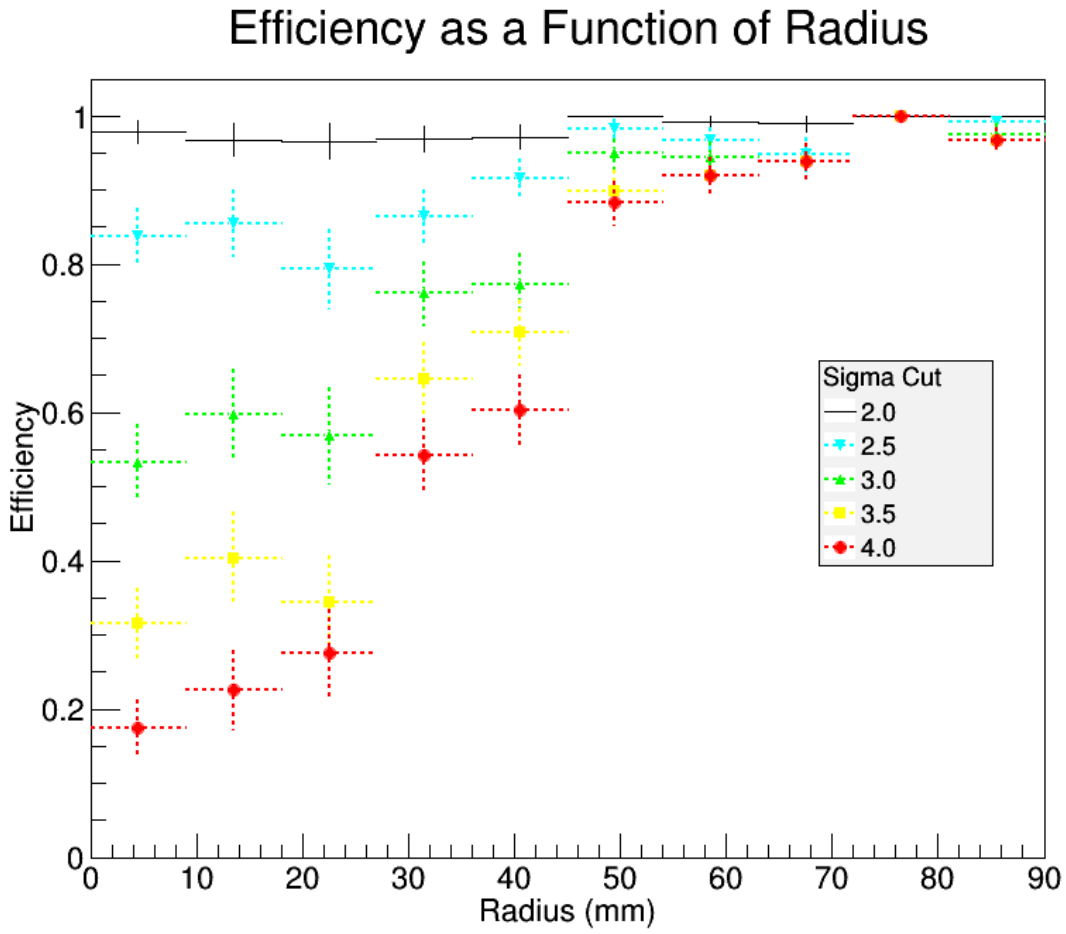
- For SiDLoi3 model, which we currently believe to be the accurate representation, signal is about the same as for SiD02 but background **another x2 worse**
- See expected improvement with inclusion of Anti-DID field but starting point is worse

FCAL-Oriented R&D II: BeamCal Design and Performance Simulations

At right: BeamCal signal reconstruction efficiency (SCIPP algorithm) as a function of radius from nominal beam trajectory, but with SiD02 model.

"Sigma Cut" of 4.0 required to ensure that less than 10% of background-only events give false positives

Looking also at energy, position resolution of reconstruction algorithms; comparative performance studies expected by October LCWS meeting (Belgrade)



Summary

- Forward Calorimetry is active area of R&D
  - Well embedded in global FCAL effort
- Lots of further interesting studies needed
  - Impact of Anti-DiD
  - Beam backgrounds
  - Improving Signal
- Interested groups always welcome
  - If you have further questions, please get in touch