

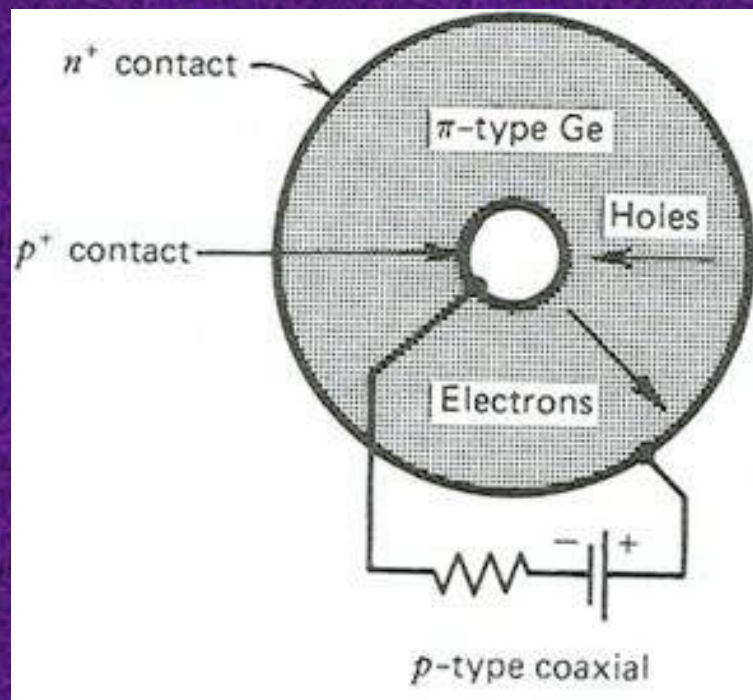
# Gamma Backgrounds in the XENON-10 Detector

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XENON Collaboration  
April 2007 APS Meeting

# Overview

- HPGe Detectors
- The Gator Detector
- Material Screening
- XENON-10 Simulations
- Future Work

# HPGe Spectrometers

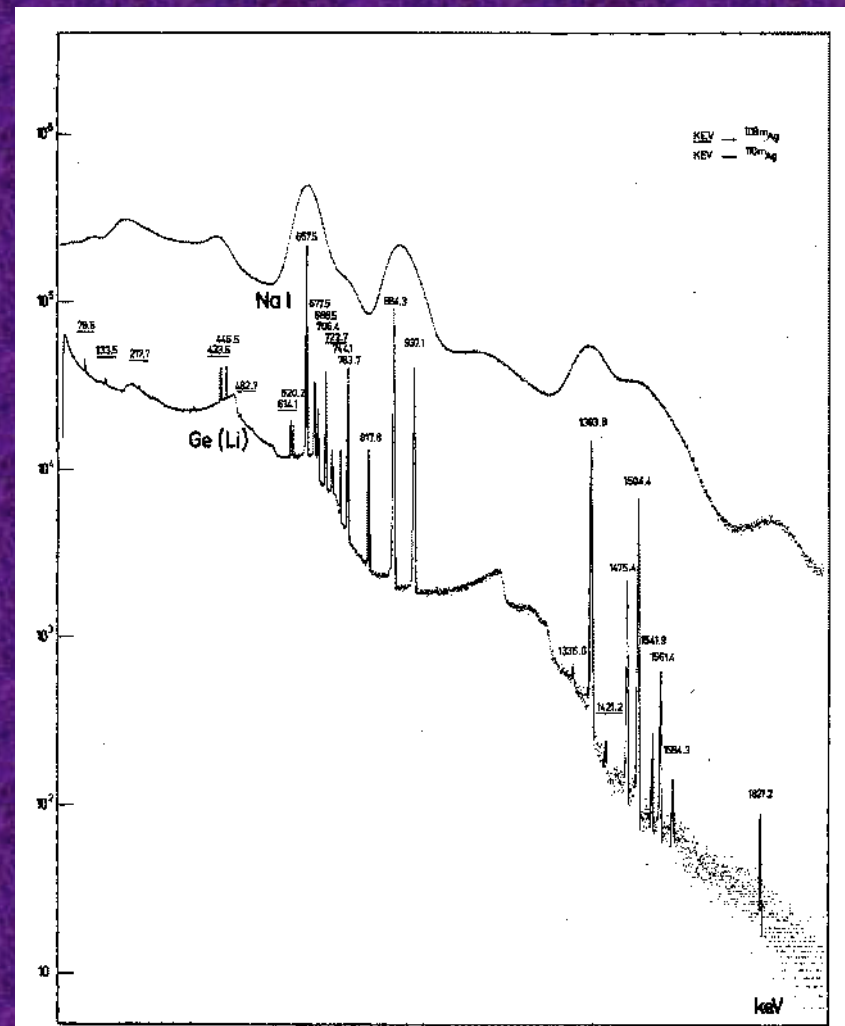


- Small bandgap between valence and conduction bands
- Incoming gamma ray excites electrons to conduction band creating electron-hole pairs
- Cool via liquid  $N_2$  to reduce leak current

# HPGe Spectrometers

- Advantages

- Easy cryogenics
- Excellent energy resolution
  - 1.891 keV @ 1173.2 keV
  - 2.170 keV @ 1332.5 keV
- Able to measure all energies of interest for our background studies
  - (0-3000 keV)



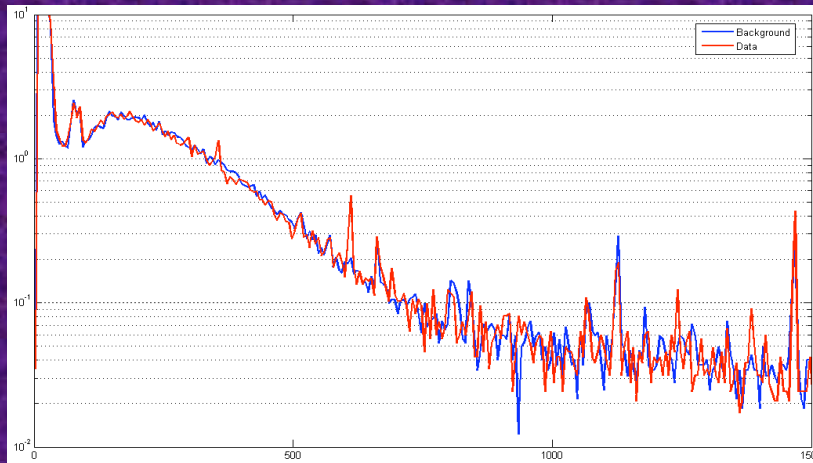
# The Gator Detector

- 2.2 kg HPGe crystal
- ULB Cu housing
- 12"-16" of Pb shielding
  - $^{210}\text{Pb}$  ~50 Bq/kg
- 2" of old Pb additionally
  - $^{210}\text{Pb}$  ~50 mBq/kg
- N<sub>2</sub> Atmosphere
- Located at the SOLO facility in the Soudan Underground Lab



# Material Screening

P  
O  
L  
Y

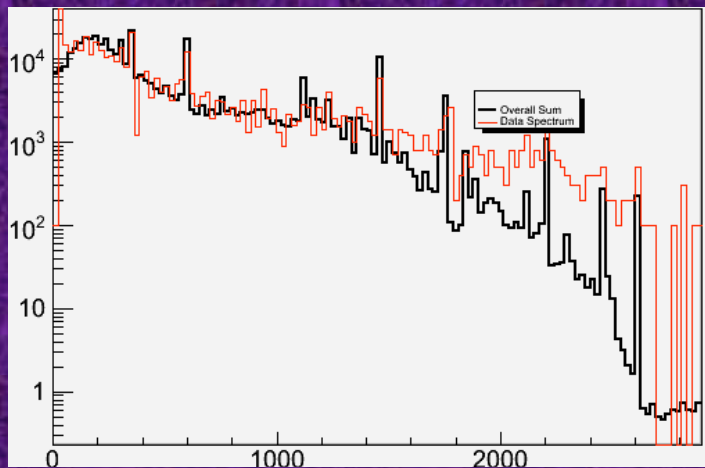


$U^{238}$  |  $Th^{232}$  |  $K^{40}$  |  $Co^{60}$   
26.7 | 2.92 | 49.7 | <0.7  
( mBq / kg )

Activity = Counts per second / Efficiency / Sample Mass  
(Bq / kg)

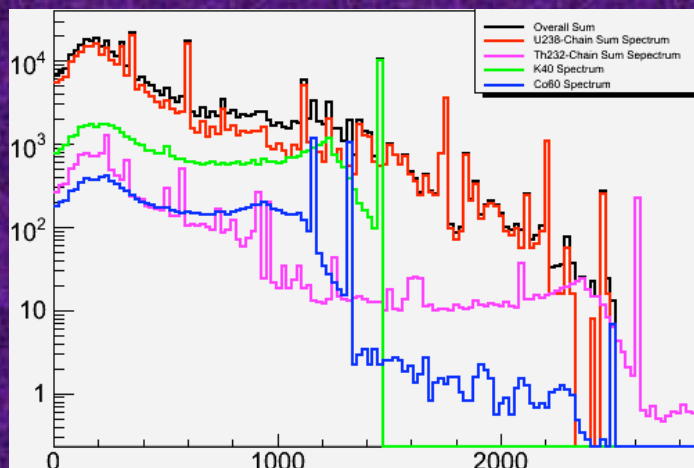
# Material Screening

P  
O  
L  
Y



$U^{238}$  |  $Th^{232}$  |  $K^{40}$  |  $Co^{60}$

29.5 | 1.11 | 112 | 1.27  
( mBq / kg )



Activity = Events Simulated \* Detector Mass \* Bin Width \* Scale / Sample Mass  
(events / kg / day)

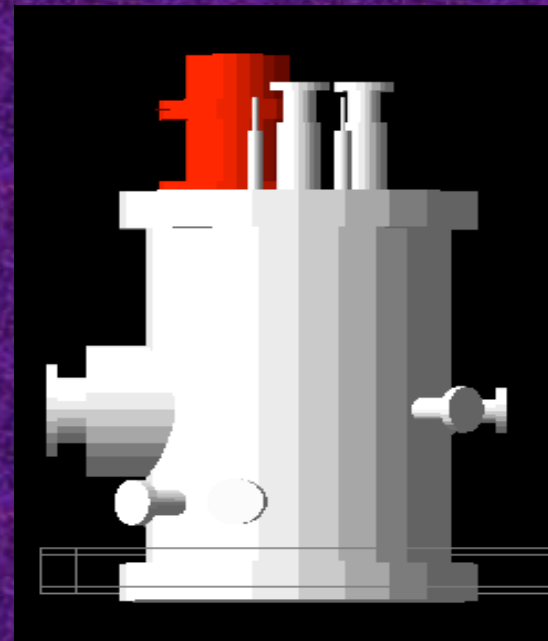
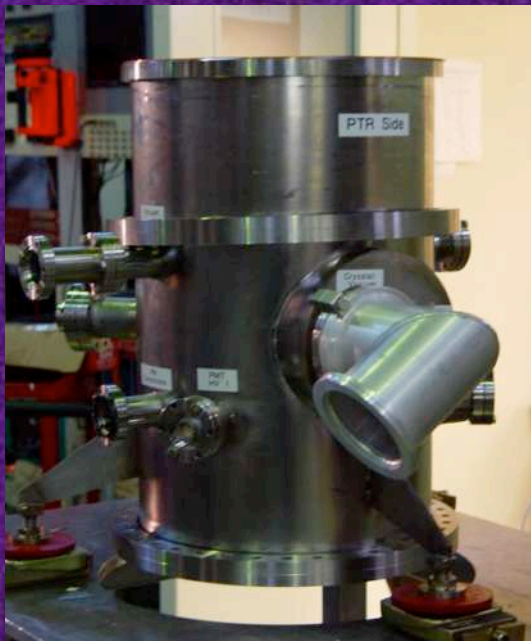
# Material Screening

SAMPLE	ACTIVITY (U / Th / K / Co)
SS from UF OC	mBq/kg (NA / NA / 7.13 +- 3.11 / 67.57 +- 1.59)
R8520 PMT's	mBq/PMT (15.79 +- 5.34 / <6.40 / 110.3 +- 41.4 / <0.0825)
Cirlex PMT	mBq/Base (1.21 +- 0.293 / <2.97 / 6.68 +- 1.24 / <0.0932)
Bases Poly Shield	mBq/kg (26.70 +- 3.72 / 2.92 +- 2.67 / 49.68 +- 13.56 / <0.738)
Bricks Teflon	mBq/kg (<4.79 / <7.89 / 60.69 +- 24.12 / <1.19)
XENON IC SS	mBq/kg (13.43 +- 5.22 / 44.07 +- 6.66 / 116.9 +- 24.3 / <3.40)



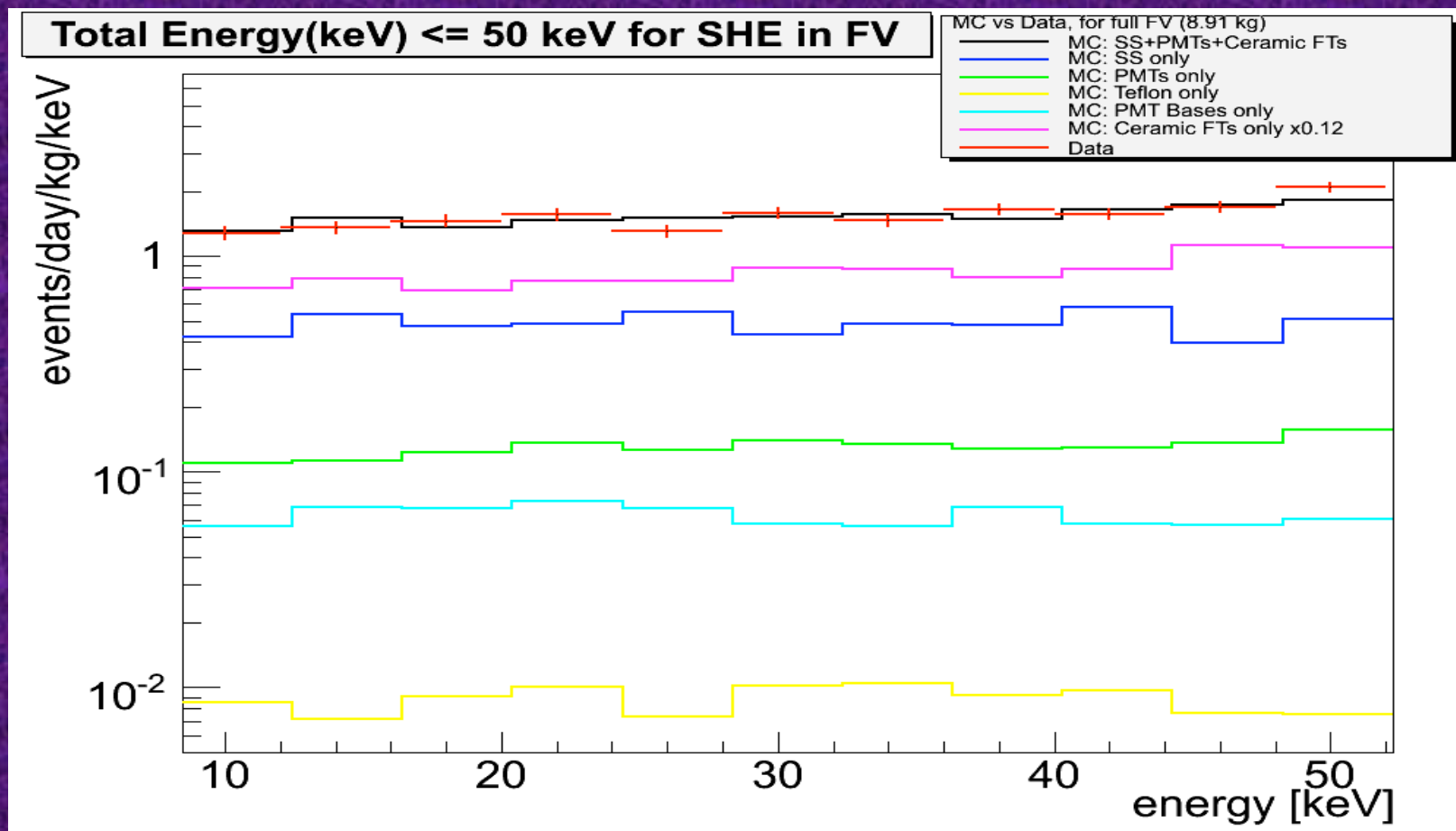
# XENON-10 Simulations

- Simulations done with Geant4 by CERN
- All major components simulated



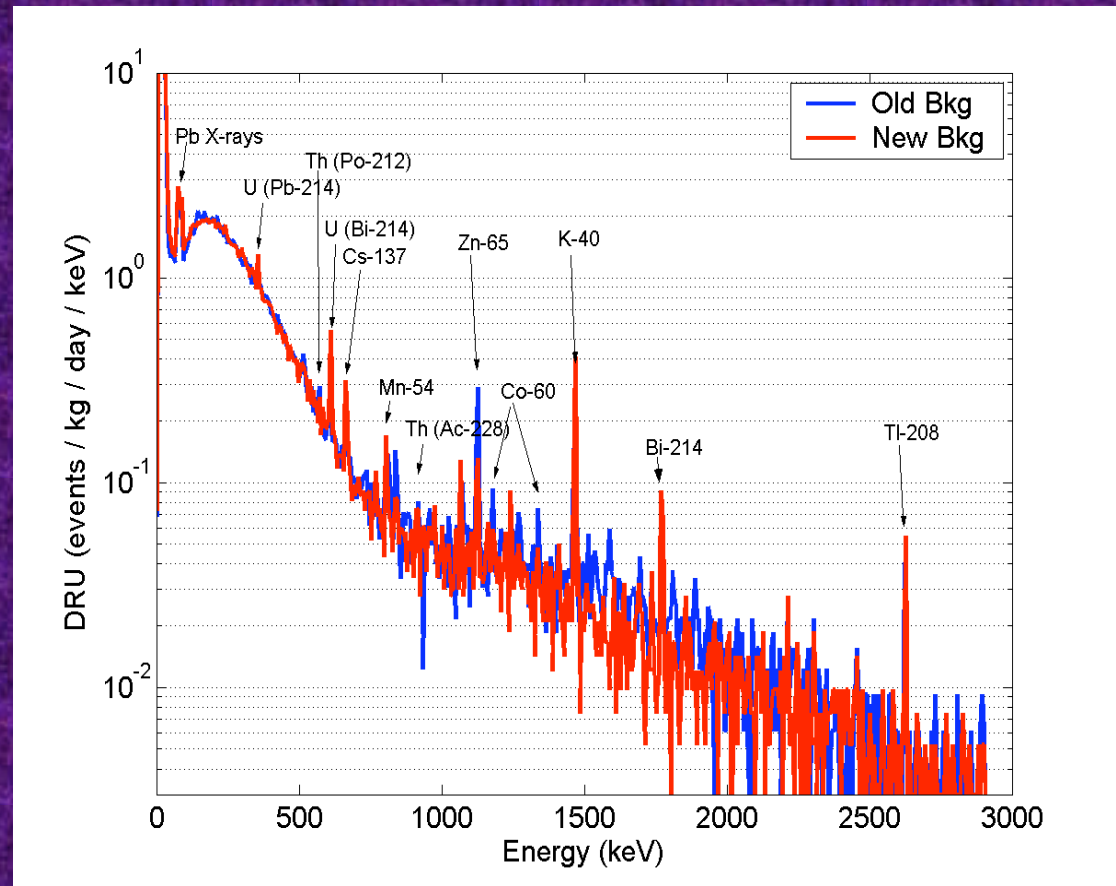
# XENON-10 Simulations

- Compare simulations to background data



# Future Work

- Relocate Gator to LNGS
  - Lower background
  - Better shield design



# Future Work

- Future Screening
  - Different Feed throughs
  - Individual PMT Components
    - Allows for better PMT's to be constructed
- Future simulations
  - Simulate background for all detector components
  - Compare to latest data
    - Allows for improvements to future XENON design

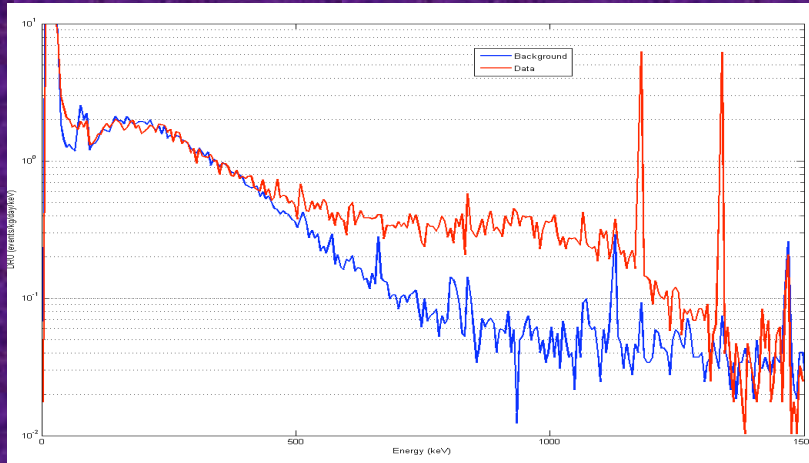
# Summary

- Gator detector screens samples for XENON-10 and improvements to the system will make these measurements more accurate.
- Geant4 simulations and comparison with data helps to better our understanding of XENON-10 backgrounds and provide information needed for future upgrades.

# Acknowledgments

- University of FL and the XENON Collaboration
- Angel and Guillaume for assistance with Root and Geant4.
- And Jurgen Flurgen...

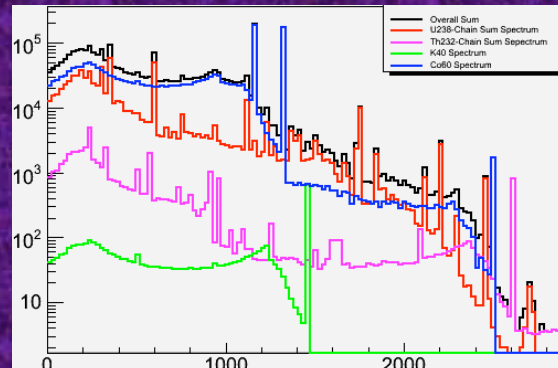
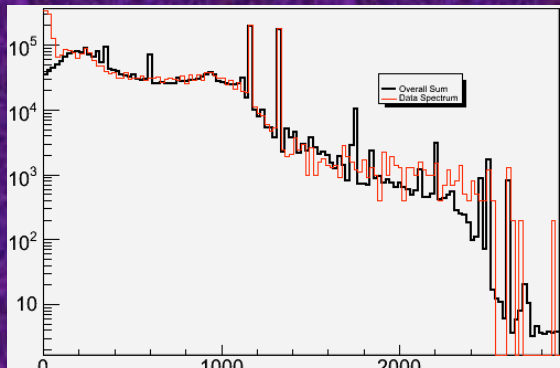
S  
T  
E  
E  
L



$U^{238}$  |  $Th^{232}$  |  $K^{40}$  |  $Co^{60}$

NA | NA | 7.13 | 67.7  
( mBq / kg )

S  
T  
E  
E  
L



$U^{238}$  |  $Th^{232}$  |  $K^{40}$  |  $Co^{60}$

2.70 | 0.14 | 2.30 | 65.7  
( mBq / kg )