Progress Report on DRIFT

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DRIFT

Directional

Recoil

Identification

From

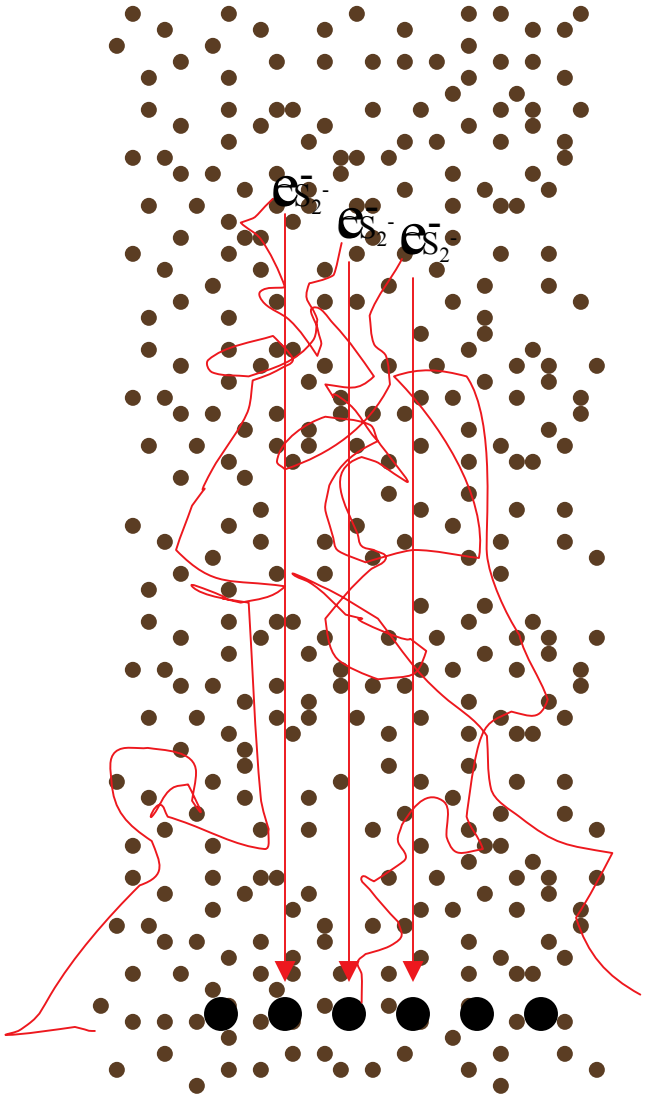
Tracks

DRIFT is a low pressure TPC

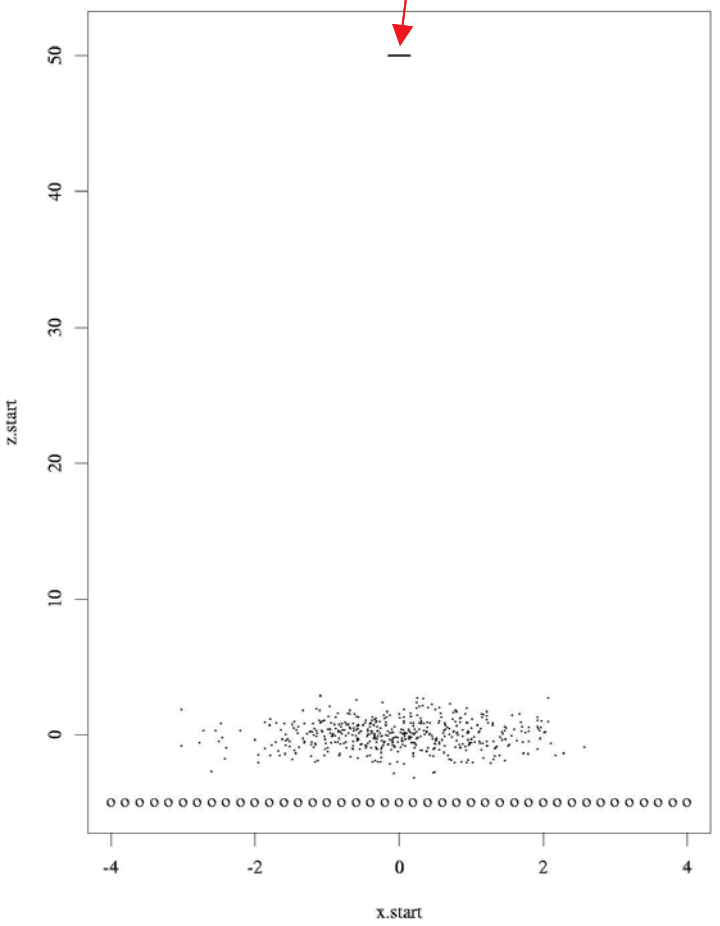
Electron Diffusion

Use an electronegative gas (CS_2 for instance) instead

Electrons diffuse in Ar



500 electron ion pairs spread over 3 mm



DRIFT is a NITPC

Negative

Ion

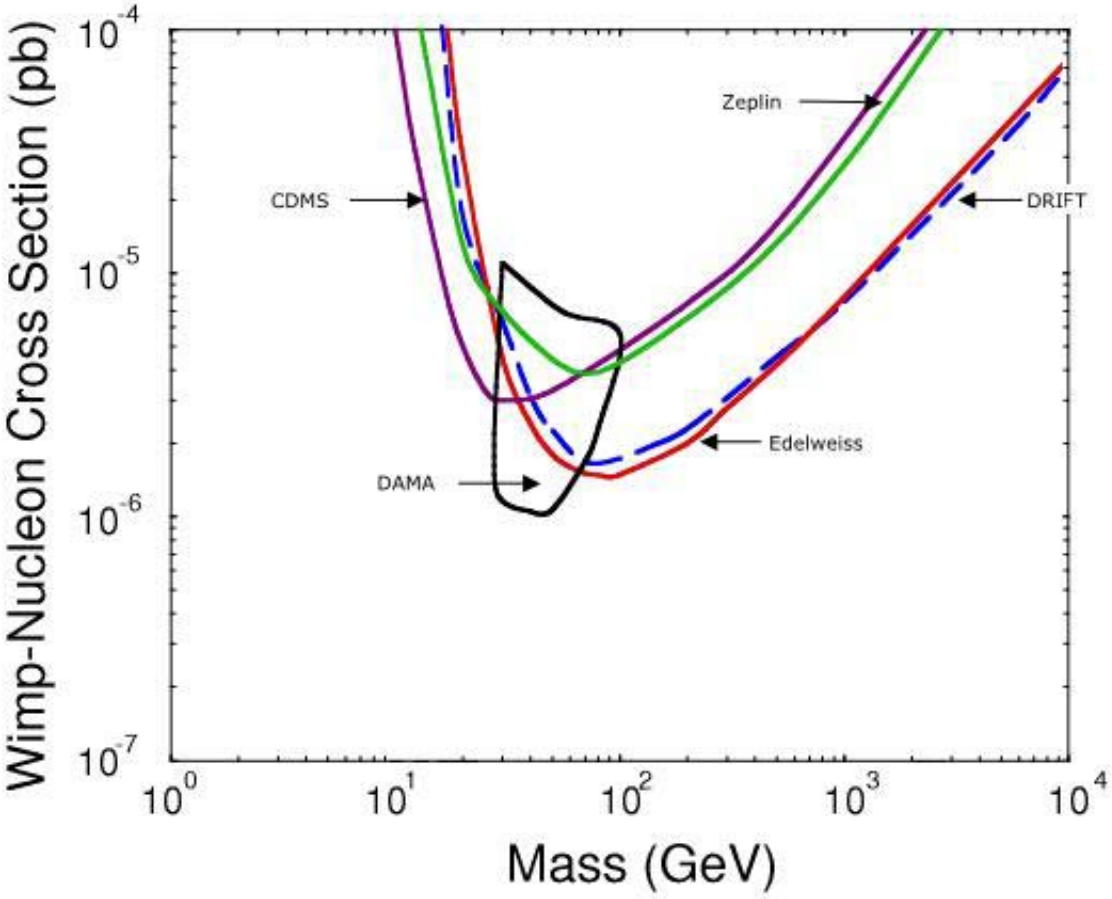
Time

Projection

Chamber

Sensitivity

DRIFT-I (1 m^3, 40 Torr CS_2, 0.16 kg)
run for 1 year could achieve the following limits…

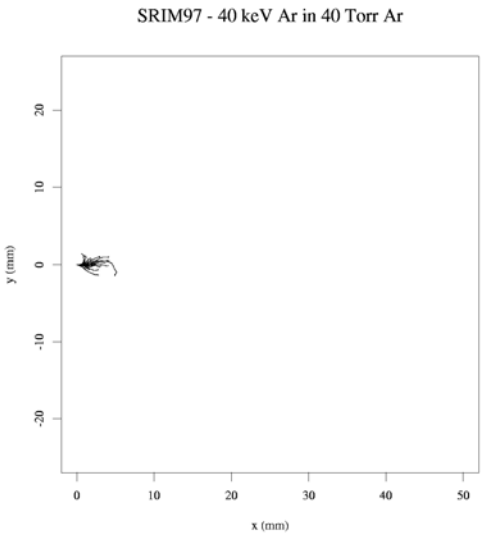


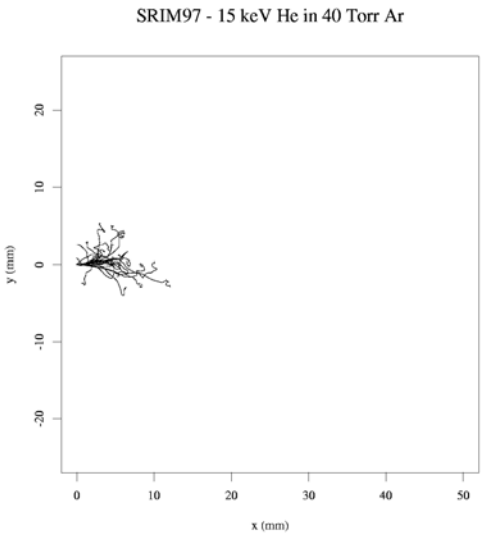
Background Rejection

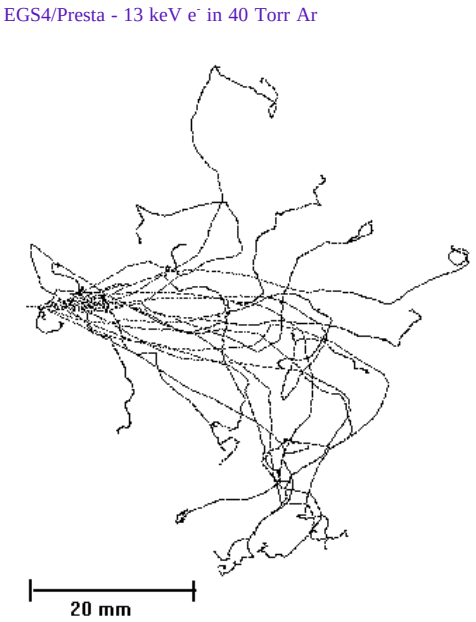
40 keV Ar recoils
500 electron-ion pairs

15 keV αs
500 electron-ion pairs

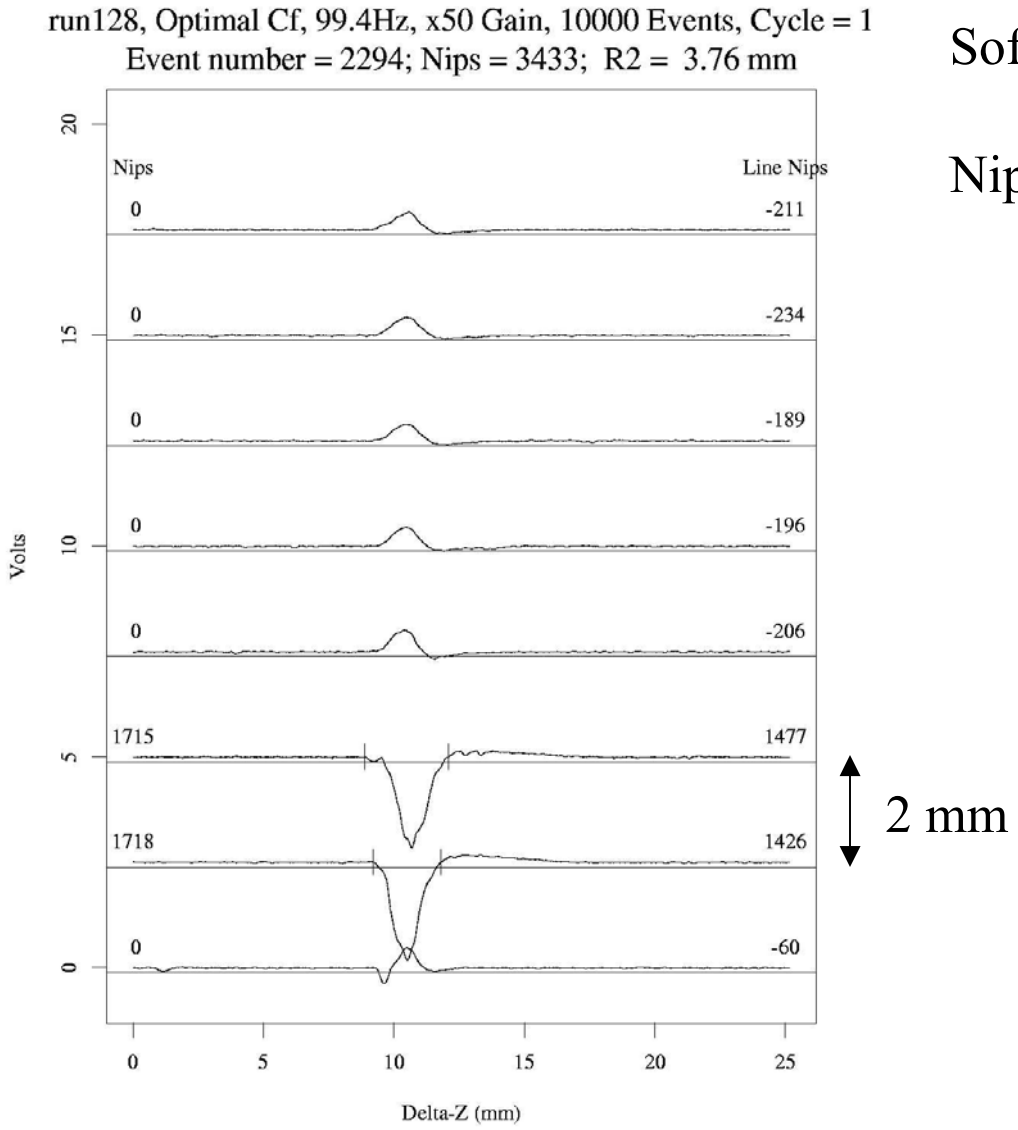
13 keV □⁻s
500 electron-ion pairs







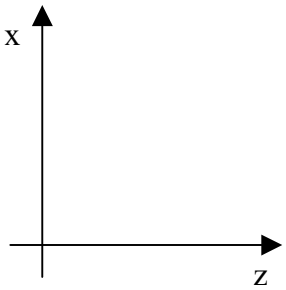
Data analysis



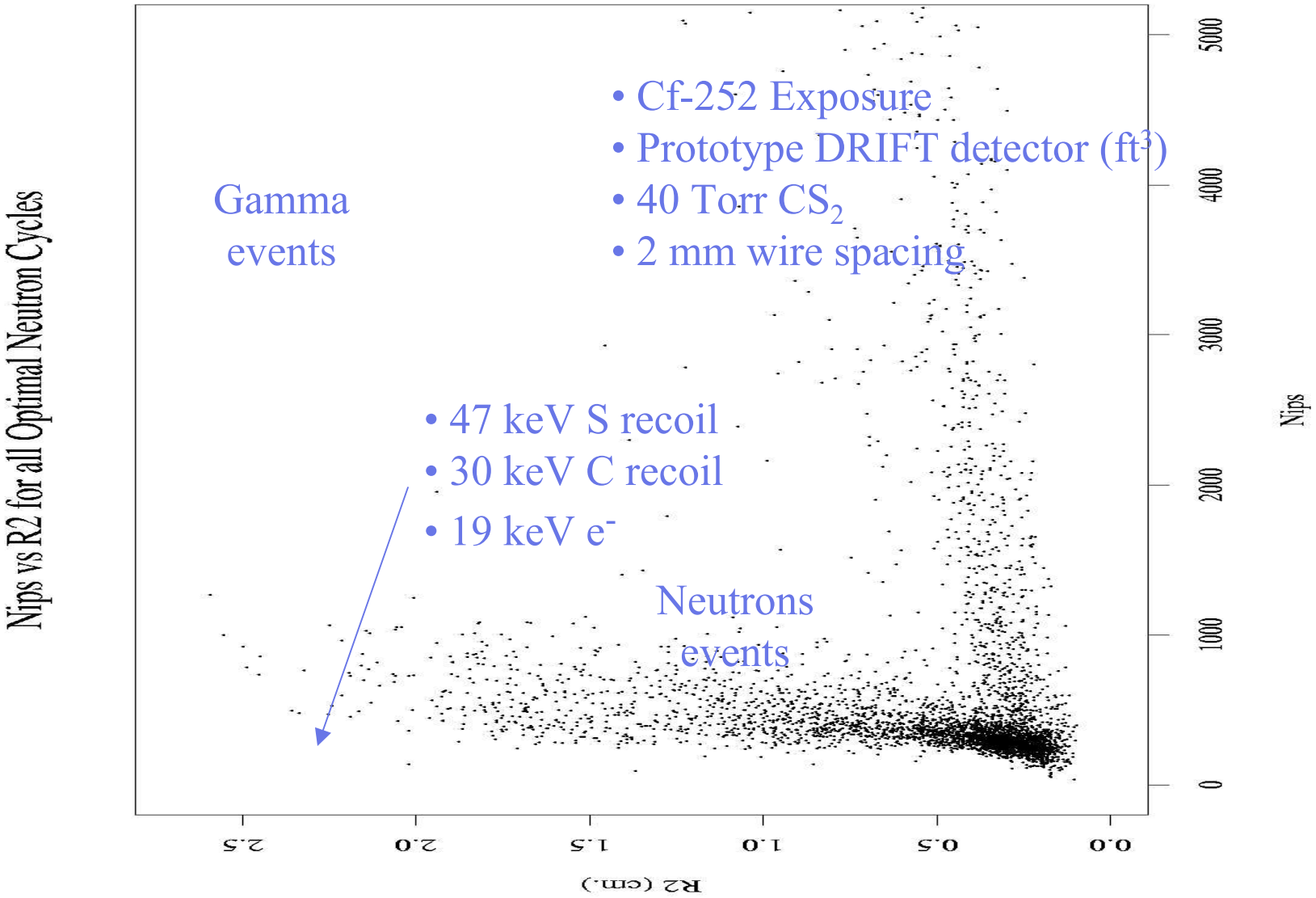
Software threshold

Nips = Number of ion pairs
= ionization

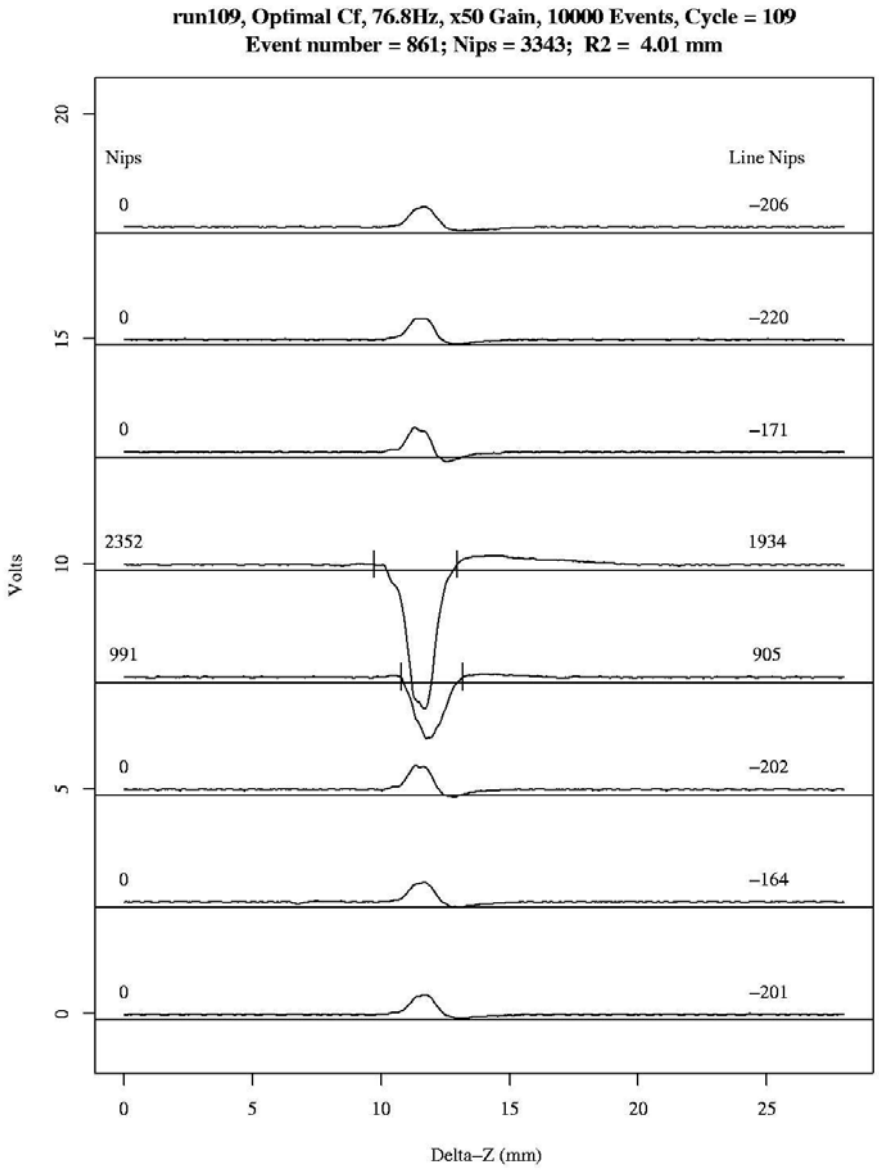
$$R2 = \sqrt{\Delta x^2 + \Delta z^2}$$

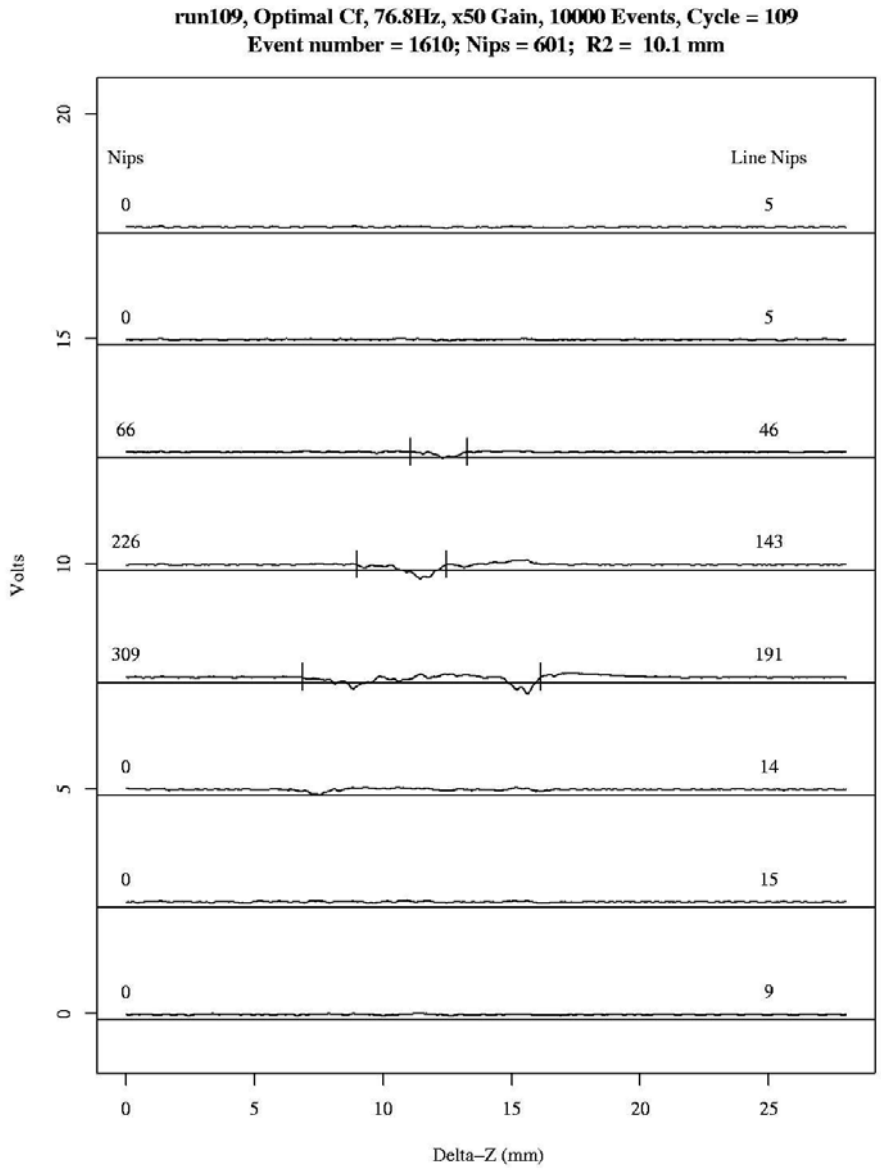


Gamma Discrimination Data

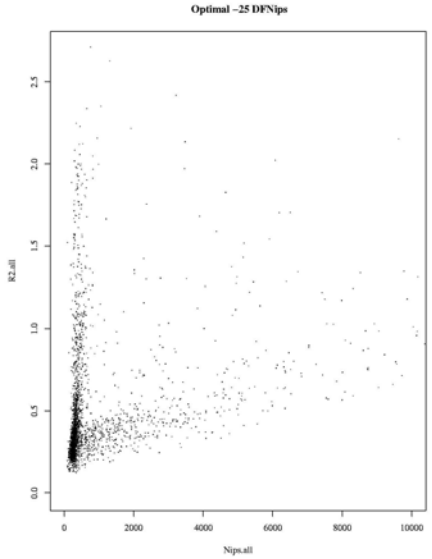


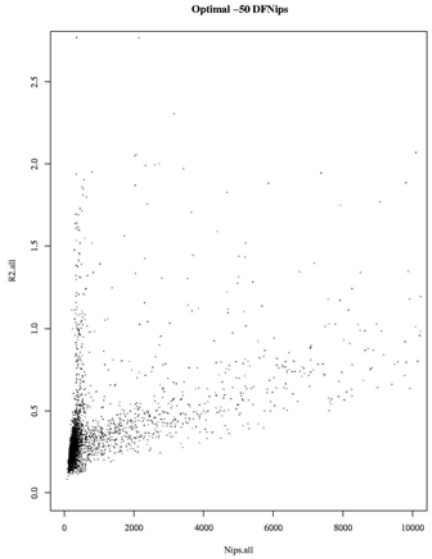
Neutrons and Gammas

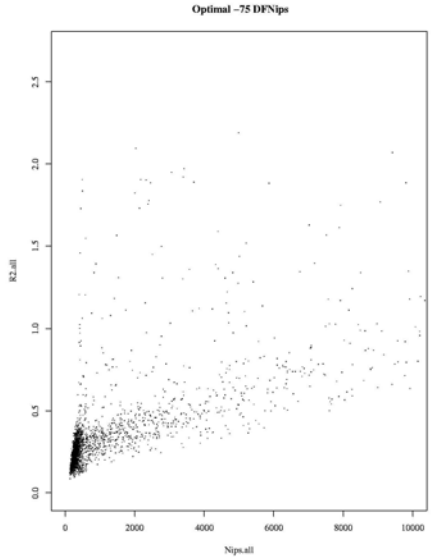


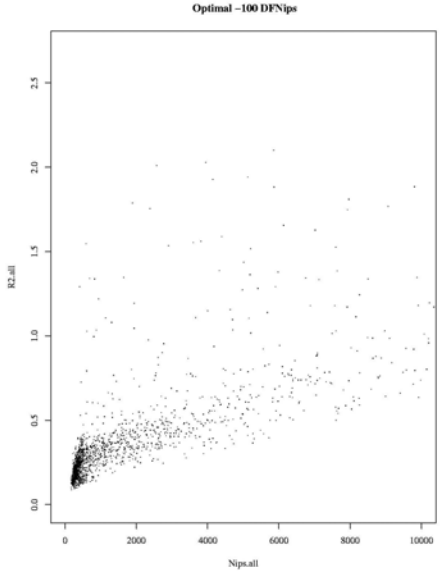


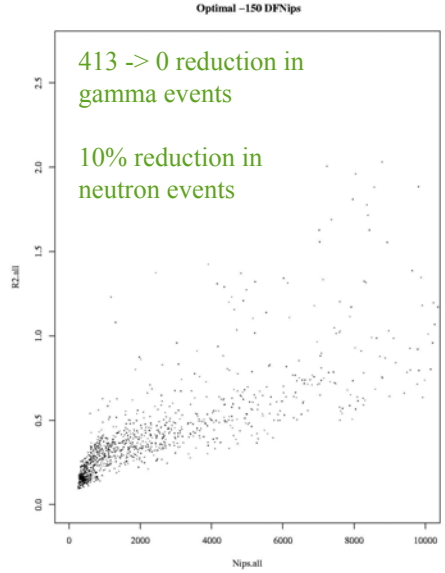
Changing the software threshold





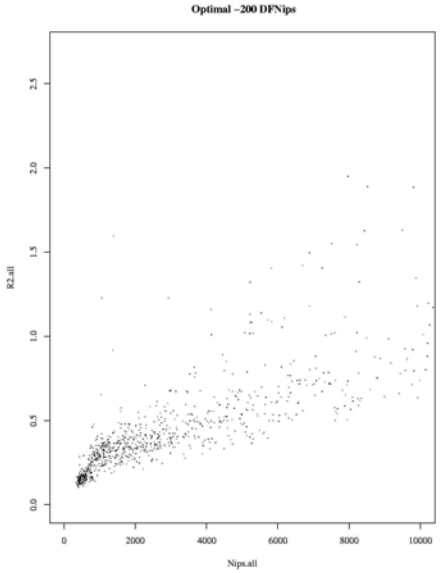






413 -> 0 reduction in gamma events

10% reduction in neutron events



A timeline

People
- 3 PIs going up
- Several Post-Docs
- Several Grad students
- Many undergrads

Publications
- 6 journal pubs
- Many conf. proc.
- Even more internal memos

		R&D	Funding	Detector
1996	Spring			
	Summer			
	Fall	Emails between Jeff and Dan		
1997	Spring	First simulations of DRIFT		
	Summer			
	Fall			
1998	Spring	Diffusion and gain measurements in CS_2 + Xe made: DD-neutron beam exposures		
	Summer	Diffusion measurements made on CS_2 at Oxy		
	Fall		Applied for NSF Funding	
1999	Spring	32-channel VME transient digitizer design developed with SLAC	SAGENAP	
	Summer	Neutron and alpha runs at Oxy		
	Fall		NSF Funding for DRIFT-I starts	
2000	Spring			DRIFT-I planning
	Summer	WIMP, alpha, and neutron simulations developed		MWPCs constructed at Oxy
	Fall			Gas circulation system, electronics, DAQ s/w
2001	Spring			Dan and Jeff on sabbatical in Sheffield. Integration.
	Summer	Electron simulation developed		
	Fall			Installed in Boulby
2002	Spring			Engineering data; Data analysis started
	Summer	Grid readout studied		
	Fall		Applied for DRIFT-II funding	Many problems with detector.
2003	Spring	Helium-CS_2 mixtures	NSF funding for DRIFT-I renewed	Data analysis
	Summer	Vetoes studied		
	Fall	GEMs studied		
2004	Spring			Problems solved, vetoes working and data taking and analysis resumed
	Summer			
	Fall			

Construction

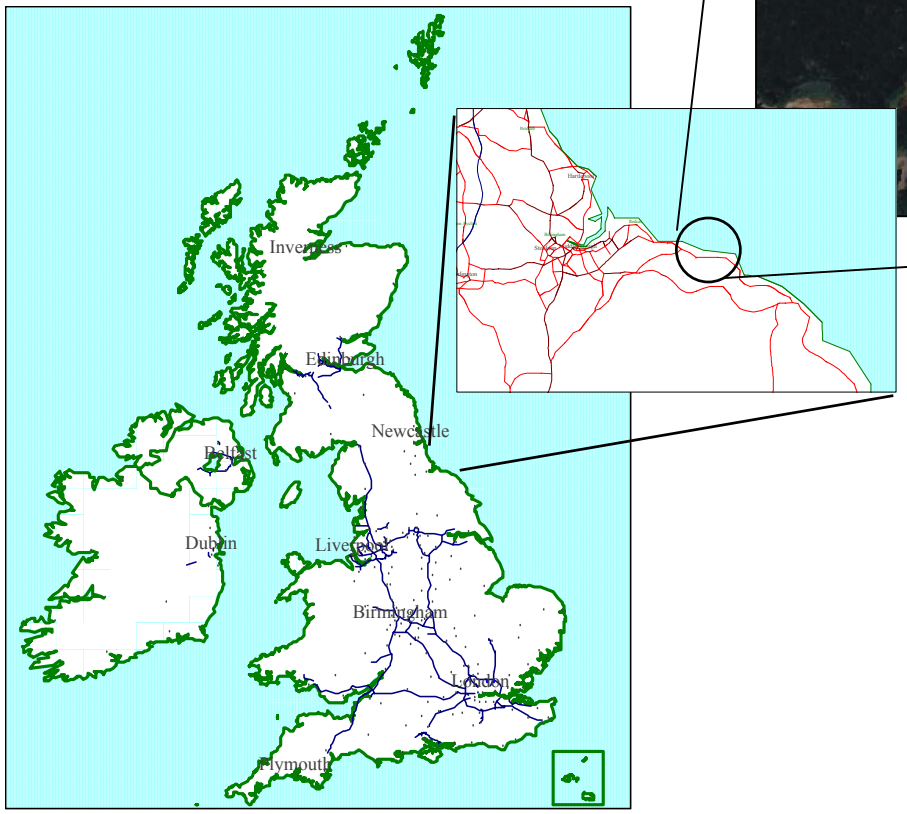
The full detector

DRIFT-I specifications

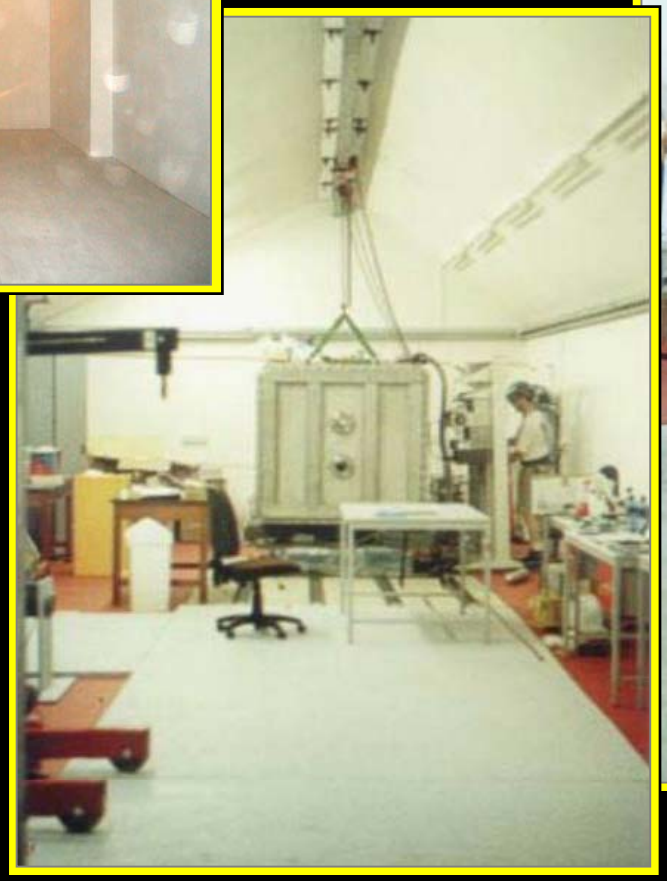
- 1 m^3 active volume
- 2 mm pitch anode wires top and bottom
- Central cathode made from 20 micron diameter wires at 2 mm pitch
- Veto regions around outside
- Gas fill 40 Torr CS_2 => 167 g of target gas

The Boulby Mine

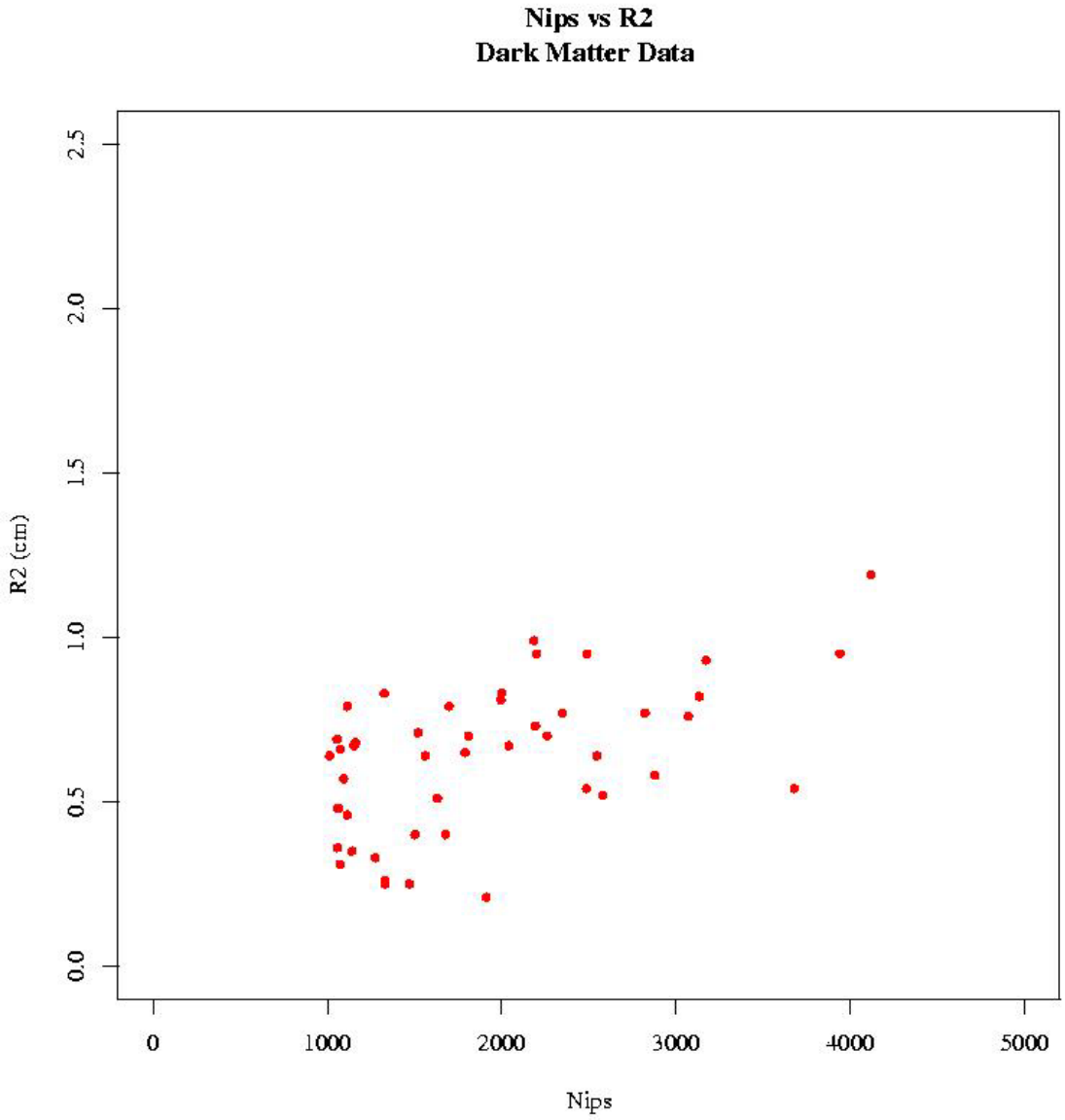
- Working potash / rock salt mine
- 1100m Deep (~3000 MWE)



Installation of the DRIFT-I Detector

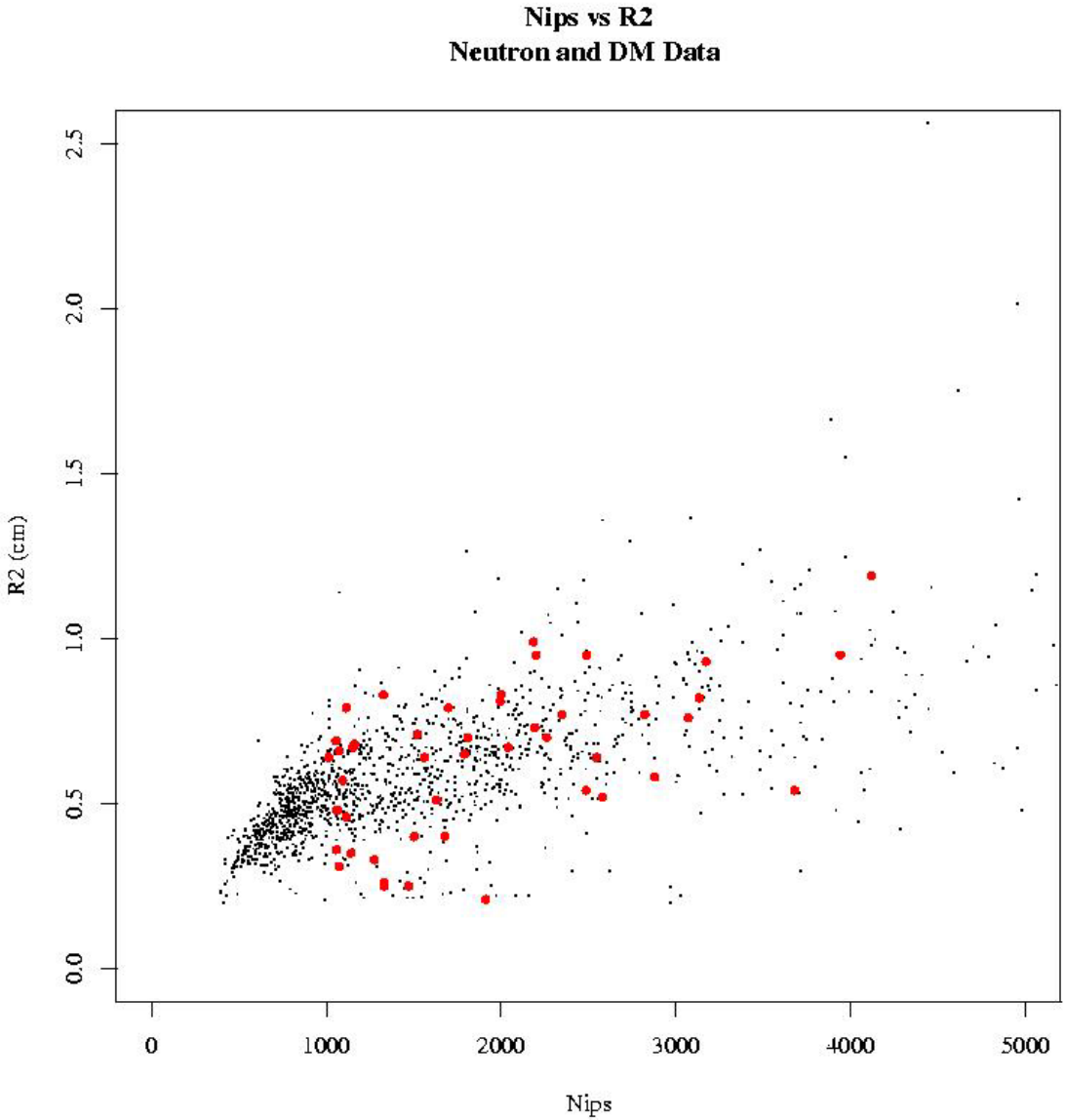


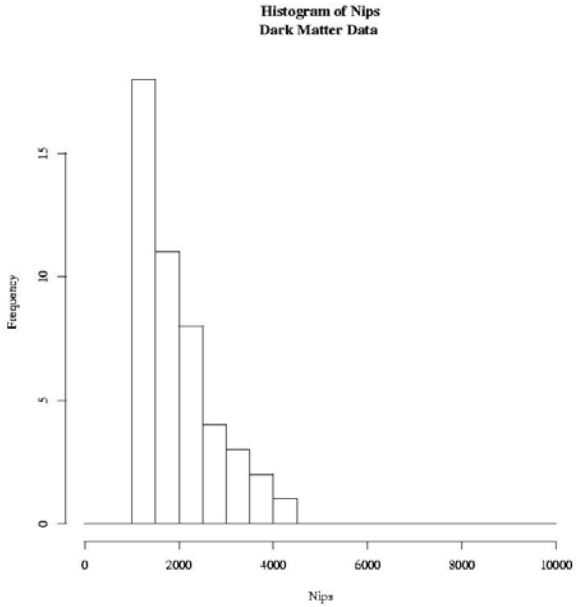
2002 Results

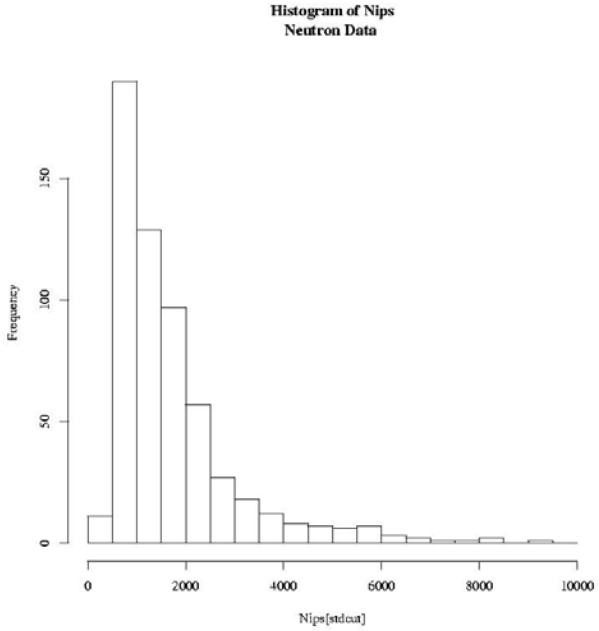


- 37.25 days of live time
- 1.67 kg-days
- 47 events
- Rate = 28 events / kg / day
- Unshielded!

Comparison with Cf-252 exposure







Predictions

- U and Th levels measured in the DRIFT lab using an unshielded Ge detector.

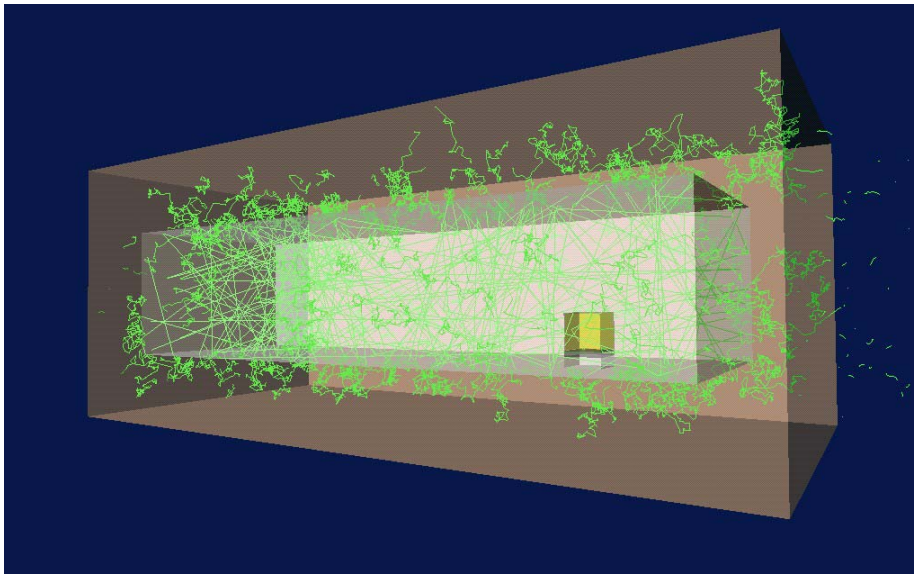
- Two neutron MCs agree on rate in detector.

- Detector MC used to predict detector response to software cuts and analysis procedure

- Predicted rate = 12.6 events / kg / day compared to observed rate = 28 events / kg / day

- Gamma simulation => rejection factor of > 99.998%

GEANT



New Collaborators

Boston University:

- Steve Ahlen

University of New Mexico:

- Bernd Bassalleck
- Steve Boyd
- Mike Gold
- Cy Hoffman
- Dinesh Loomba
- John Matthews