

Alpha and Beta Counting Instrumentation

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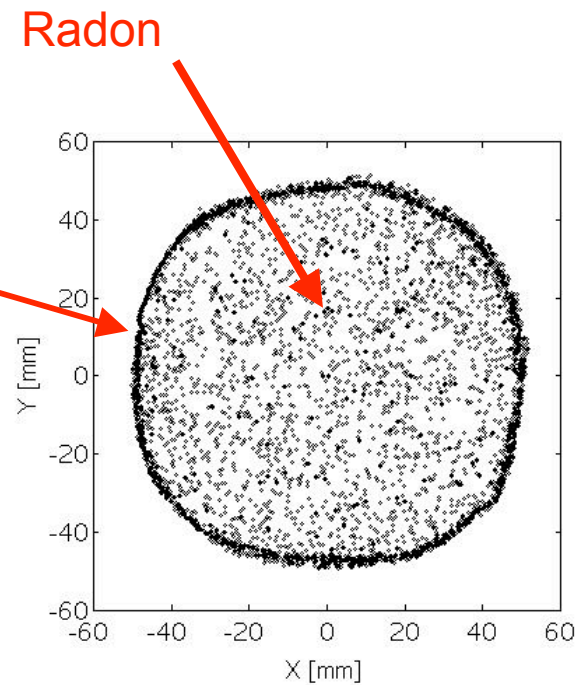
Fermilab

Alpha and Radon Screening for COUPP

- Alpha decays cause bubbles in COUPP, indistinguishable on a single-event basis from WIMP bubbles.



Uranium,
Radium,
Thorium,
Polonium



Low- Background Alpha Counting Instruments

Vendor	Type	Sample Size [cm ²]	Background [cts/cm ² -day]	System Cost [k\$]
Ortec, Canberra...	Silicon	< 12	1	10
Alpha Sciences	Gas proportional, thin Mylar window	1000	0.1	30
Ordella	Gas proportional, Windowless	1000	0.1	30-40
XIA	Drift chamber	1800	2×10^{-3} ?	40 ?
Golwala, Schnee et al.	"Beta Cage" MWPC	10^4	"Negligible"	200 ?

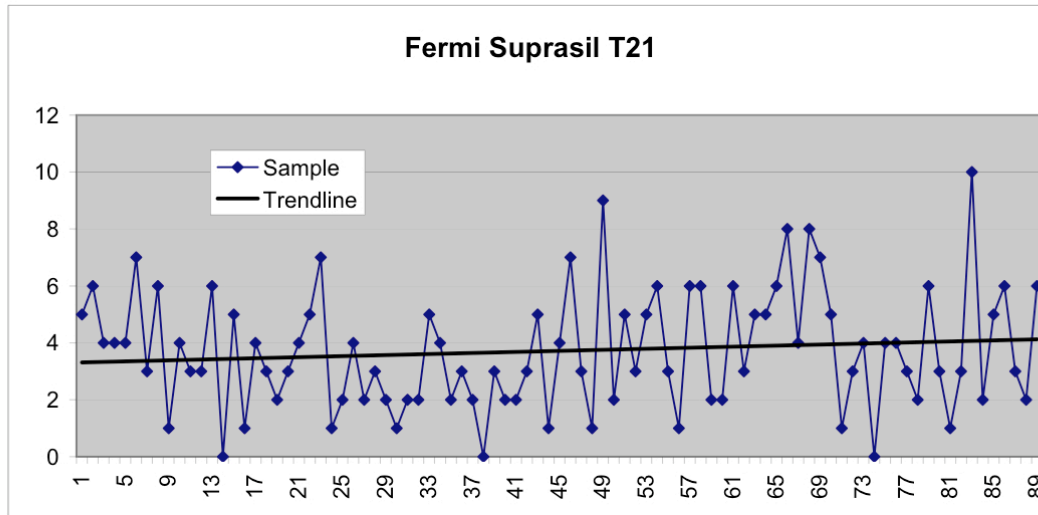


Model 8600A Sample Count

Customer: Fermi Lab
 Work Order No. 1542
 Report Date: 8/20/2007

Samples:
 CH1:
 CH2:
 CH3:
 CH4: Fermi S_T21 (53 pieces), Disc. = 3.0 MeV
 Date Data Logged: 08/16/2007
 Time Data Logged Started: 12:32:17 PM

- Background is unstable
- Still very useful for COUPP
- Could tease better performance out of this instrument with some effort?

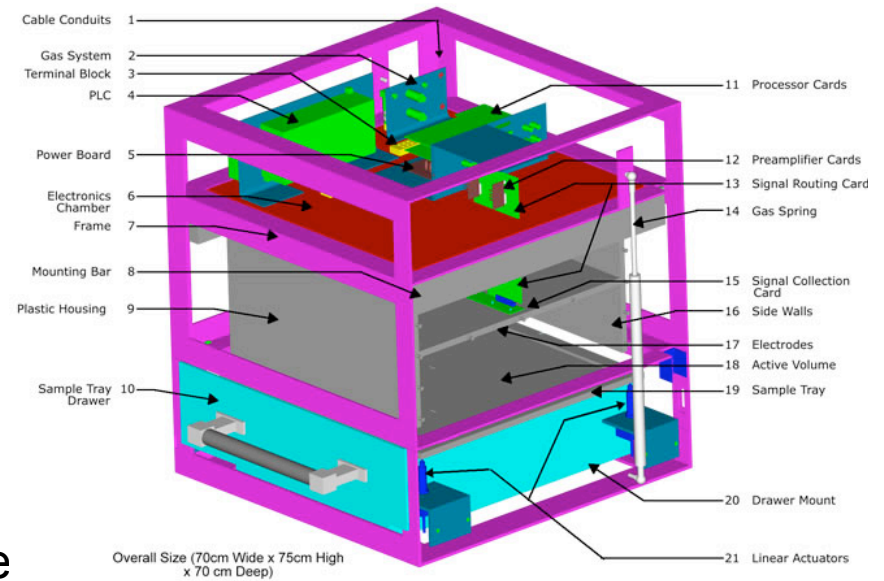


Sample measurement from hour:	4 To 96 = 93 hrs	371 cnts =	3.9892 CPH	+/-	0.21 CPH
Tool Background	7/12/2007 1 To 144 = 144 hrs	629 cnts =	4.3681 CPH	+/-	0.17 CPH
		NET cnts =	-0.3788 CPH	+/-	0.22 CPH
Area of Sample		=	1000 cm*2		

NET Counts/Area	=	-0.00038 CPH/cm*2 +/- 0.00022 CPH/cm*2
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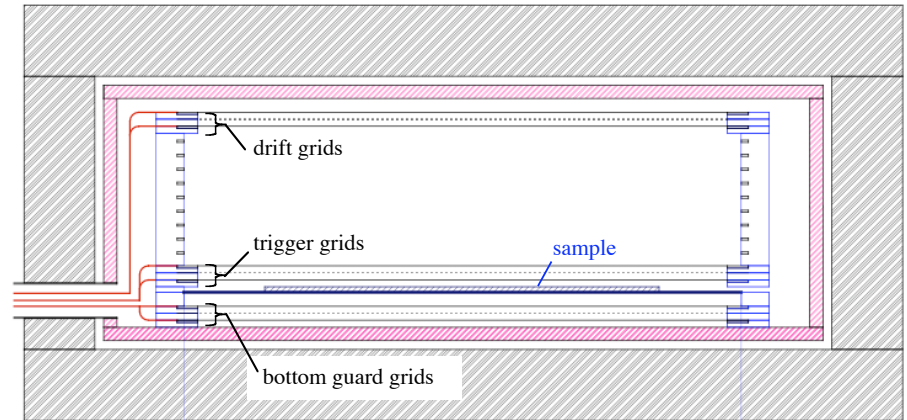
XIA Device

- X-ray Instrumentation Associates (XIA), Hayward, CA. www.xia.com
- Drift chamber with pulse shape analysis to reject surface backgrounds.
- Developed using NIST SBIR grant.
- Should have 1-2 orders of magnitude lower background than Ordella.
- Not clear what limiting background will be. Low background counting community may be able to push sensitivity even higher.
- Stanford CDMS group will be one of six “beta test” sites, beginning early 2008.
- Testing at SUF shallow underground site and possibly Soudan, Fermilab.



BetaCage

- Multiwire proportional counter
 - ◆ 100 cm x 100 cm x 50 cm high
 - ◆ Funded DUSEL R&D FY2008-9
 - ◆ To be installed at Soudan LBCF in 2009
 - ◆ Dirty prototype almost done



- Would be world's most sensitive screener for a's, b's
 - ◆ Expect b background $3 \times 10^{-5} \text{ keV}^{-1} \text{ cm}^{-2} \text{ day}^{-1}$ so screen to 60-cm samples for 3 days to $10^{-5} \text{ keV}^{-1} \text{ cm}^{-2} \text{ day}^{-1}$ w/ bkgd subtraction
 - ◆ Expect negligible backgrounds for a's
- Applications for rare-event searches and beyond
 - ◆ Industry: a emitters that cause single-event upsets in Si chips
 - ◆ Radioisotope dating with β sources competitive with AMS
 - $^{14}\text{C}/^{12}\text{C}$ to 10^{-18} , $^3\text{H}/\text{H}$ to 10^{-20} also ^{10}Be , ^{210}Pb , ^{36}Cl
 - ◆ Detect tracers used in uptake and transport in biology studies

Radon Emanation Measurements

