An Update on DRIFT Backgrounds

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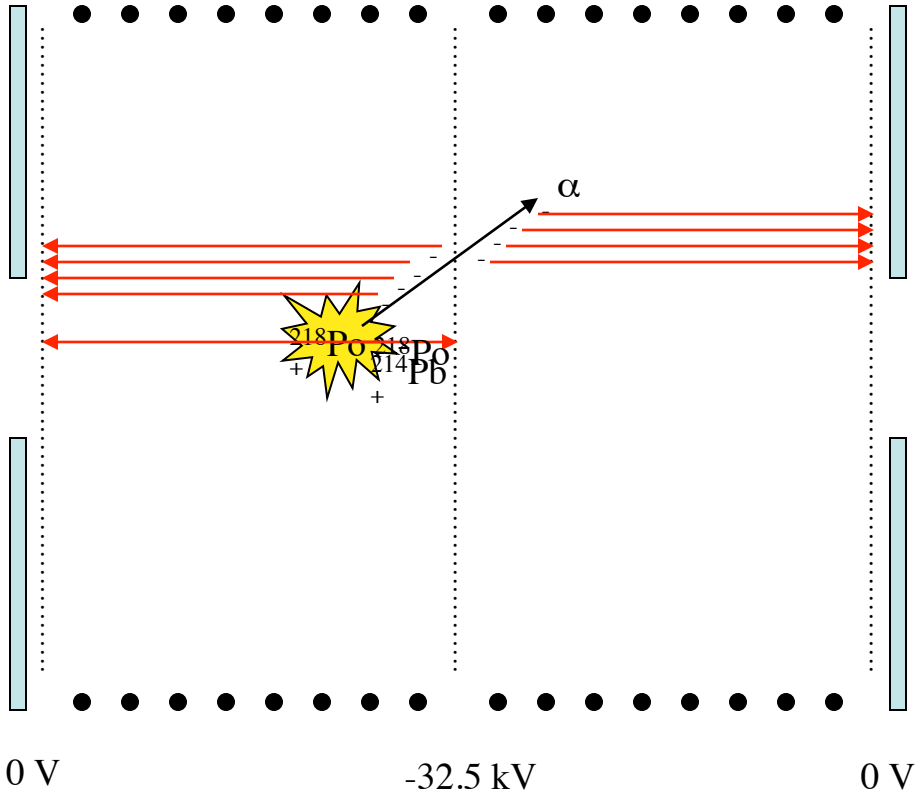
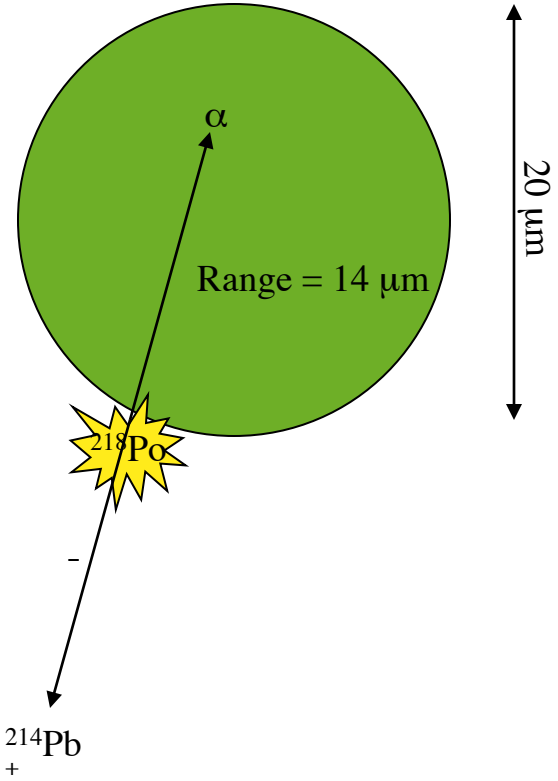
For the DRIFT collaboration
CYGNUS 2013 Toyama

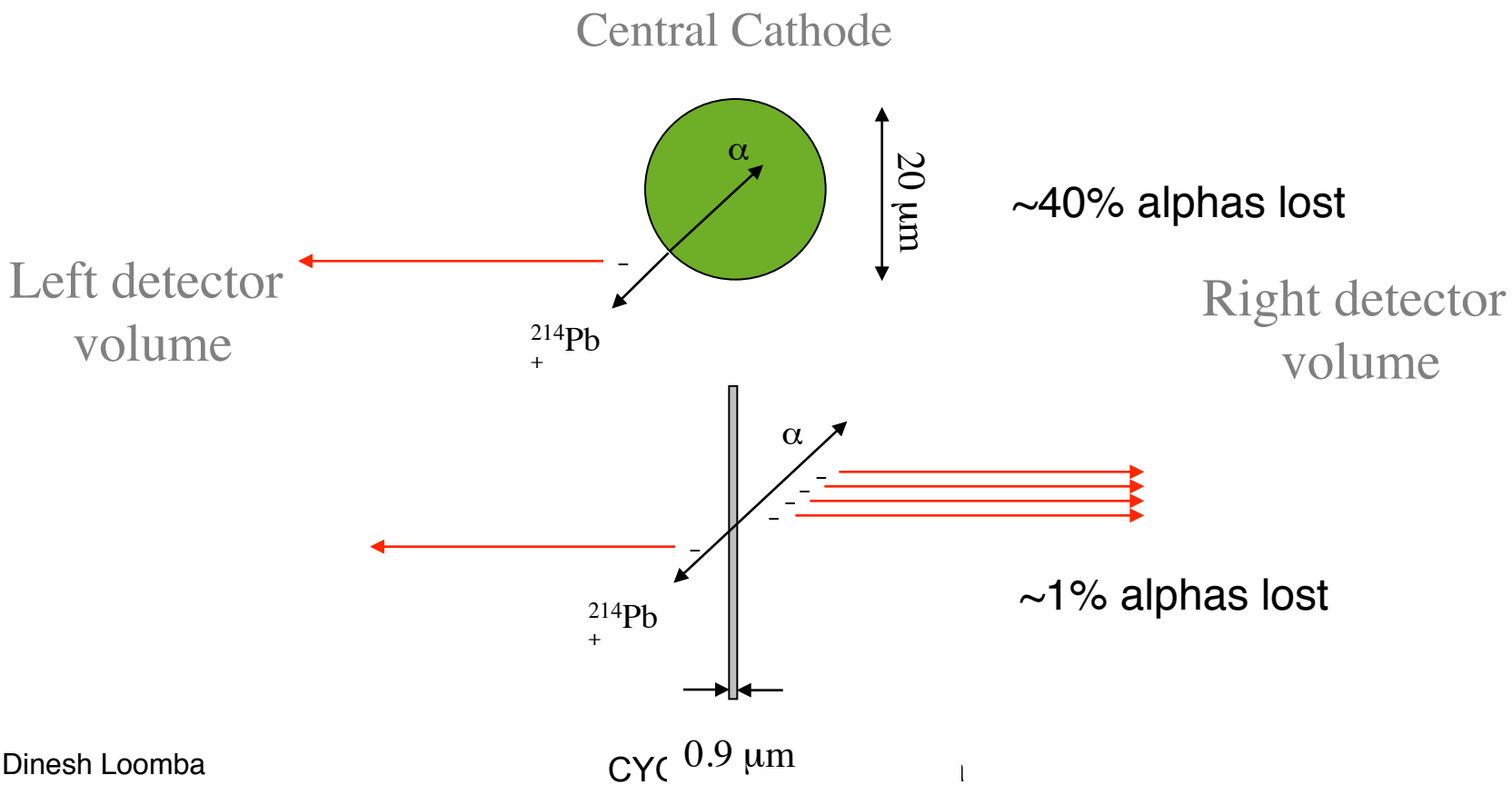
DRIFT's backgrounds are dominated by Radon Progeny Recoils (RPRs):



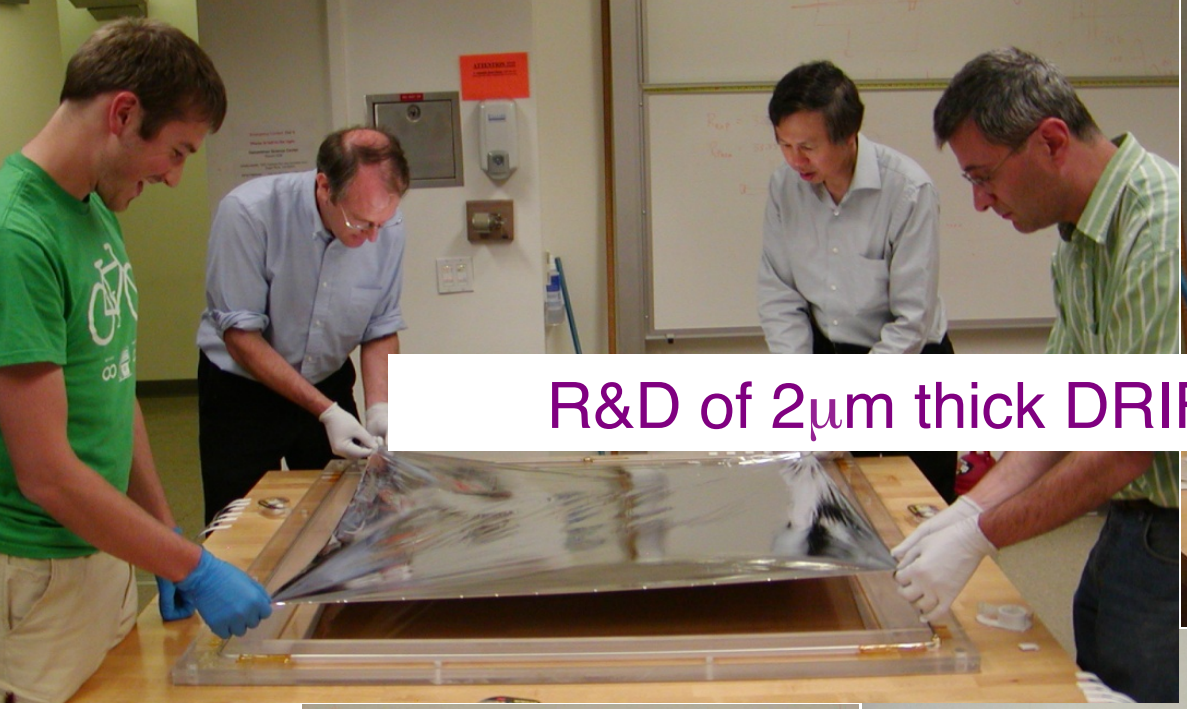


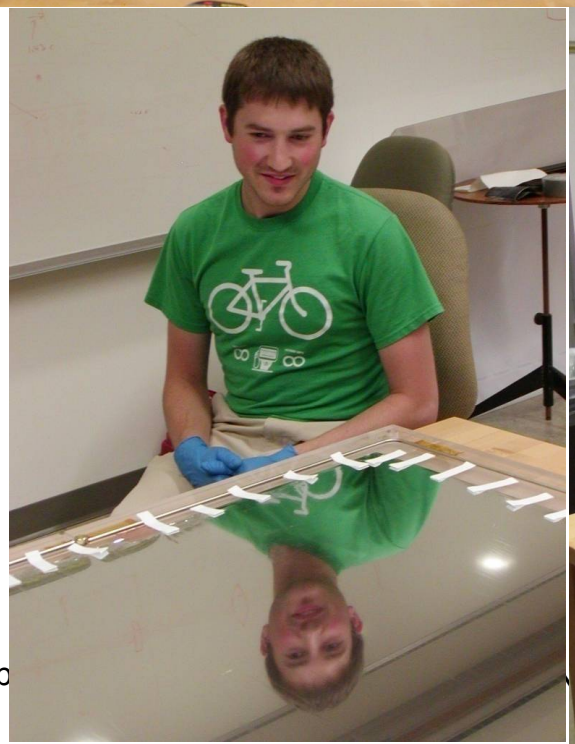
Techniques for reducing RPR background

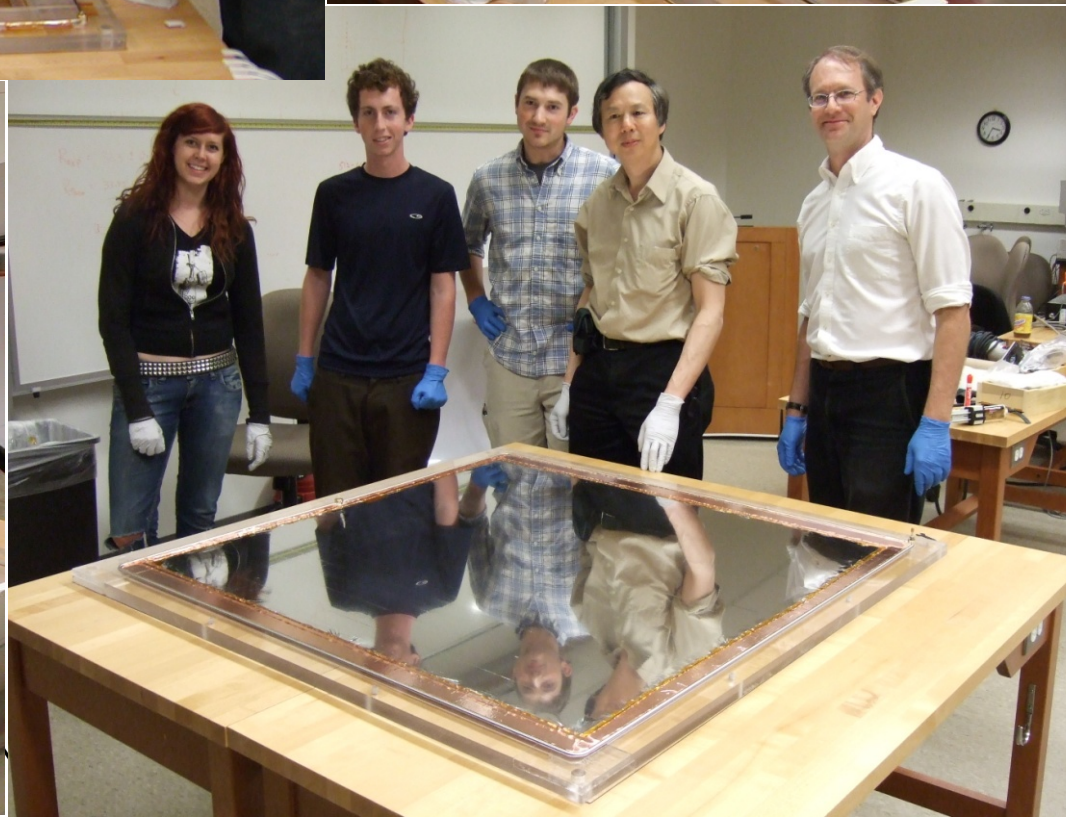
A cathode transparent to α's from RPRs will provide a tag to veto these events:



R&D of 2μm thick DRIFT cathode







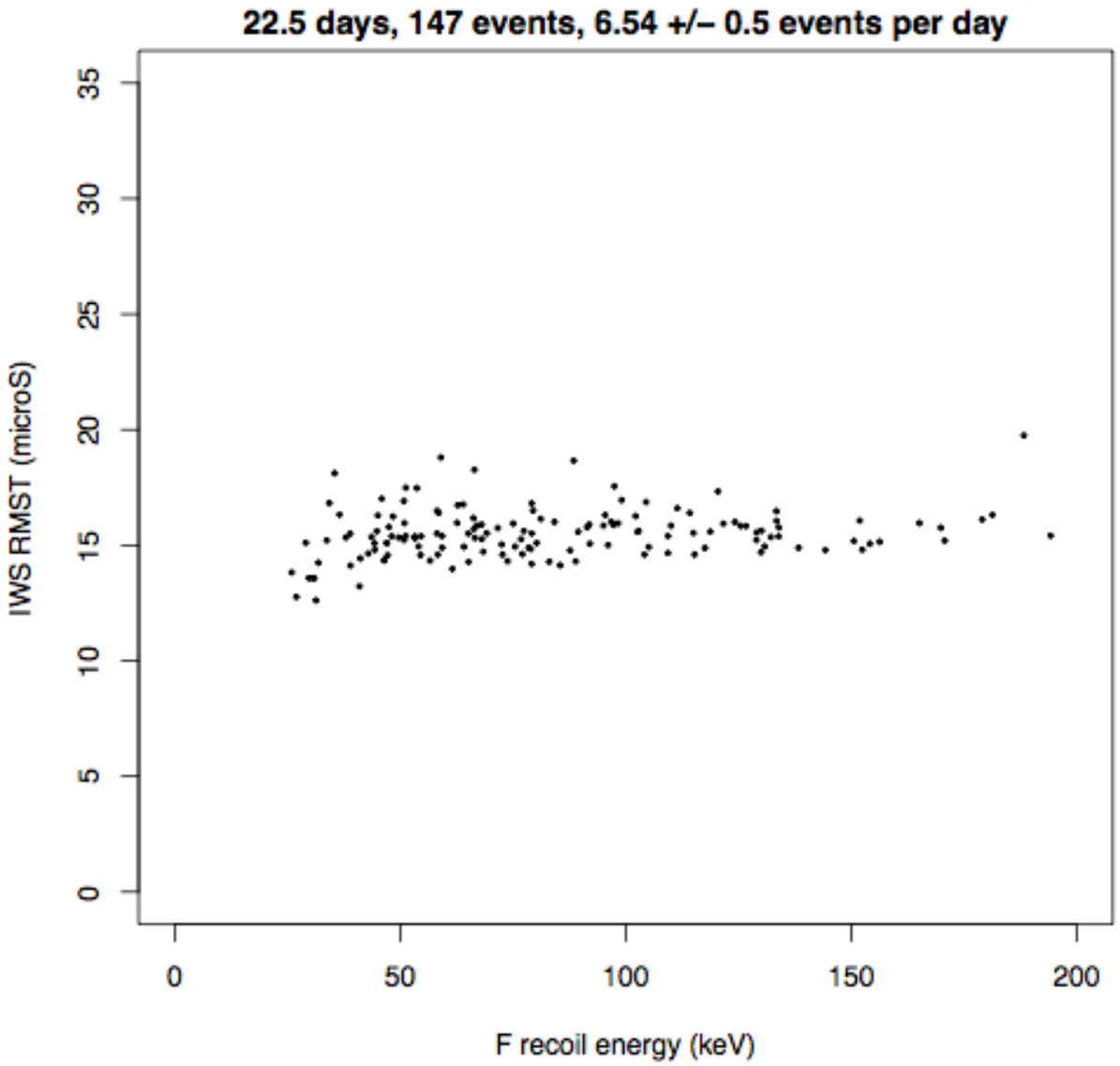
Multi-panel **0.9μm** thick DRIFT cathode constructed underground at Boulby and installed in DRIFT-IId

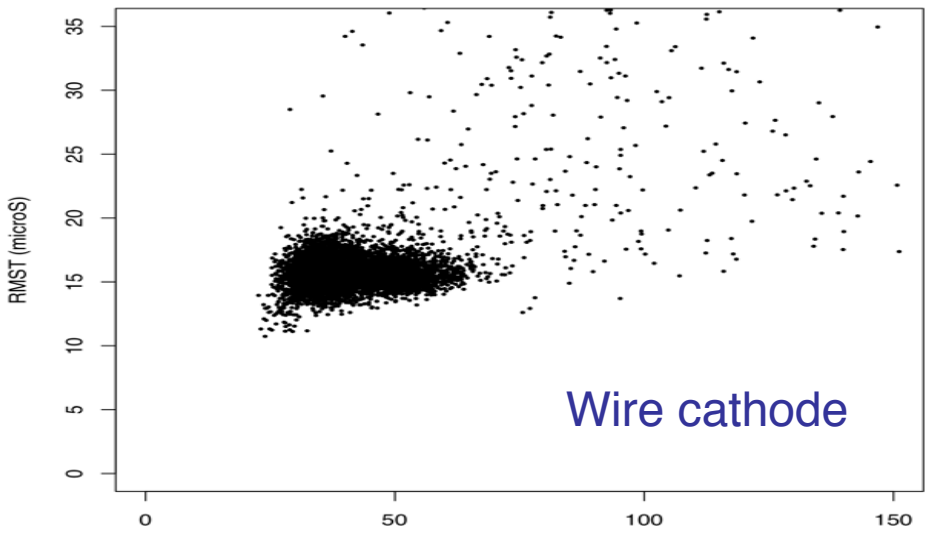
With 0.9 micron thick cathode the projected RPR rate was expected to drop from 130/day, from wire cathode, to ~3/day

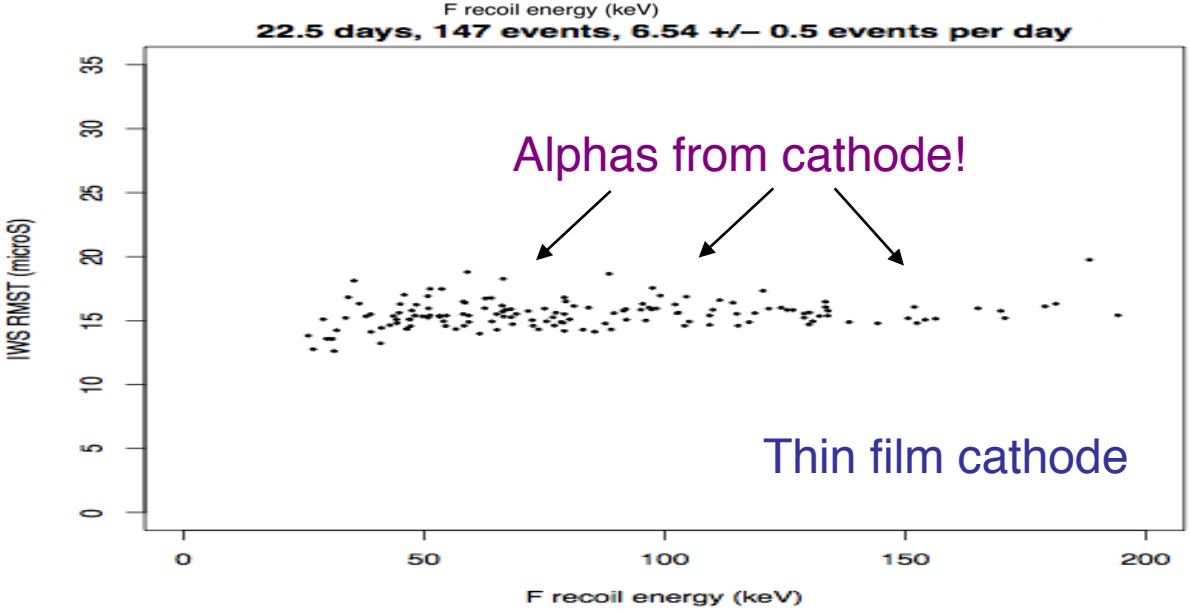
0.9 micron cathode was installed in DRIFT-IId and 65 days of live-time data taken. We performed a blind analysis of 53 days.

Here is a look at the level of background in this data…

…thin film worked, but reduction was closer to ×20




RMST (microS)
0
5
10
15
20
25
30
35
0
50
100
150
F recoil energy (keV)
Wire cathode


22.5 days, 147 events, 6.54 +/− 0.5 events per day
IWS RMST (microS)
0
5
10
15
20
25
30
35
0
50
100
150
200
F recoil energy (keV)
Alphas from cathode!
Thin film cathode

These alphas are a clue as to why we only got a factor 20 reduction in RPRs from the thin film

Alphas Classification in DRIFT

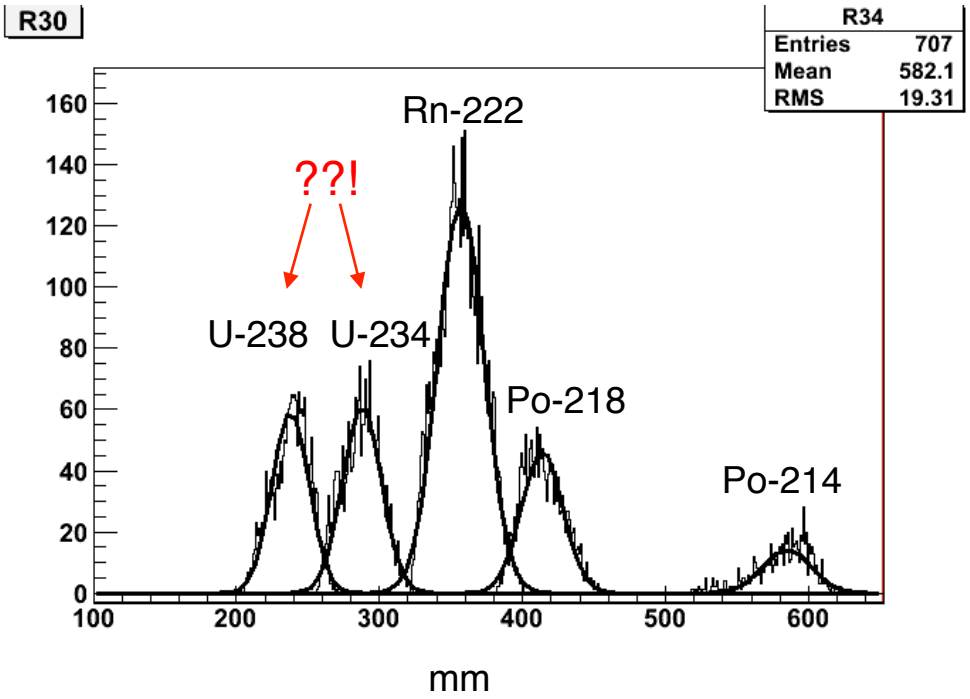
Fully contained alphas:

- Alphas crossing the central thin film cathode
- Alphas originating at the cathode as determined by a tagged recoil on the other side
- Alphas contained in left/right detector volume:
  - Alphas moving towards the cathode
  - Alphas moving away from the cathode

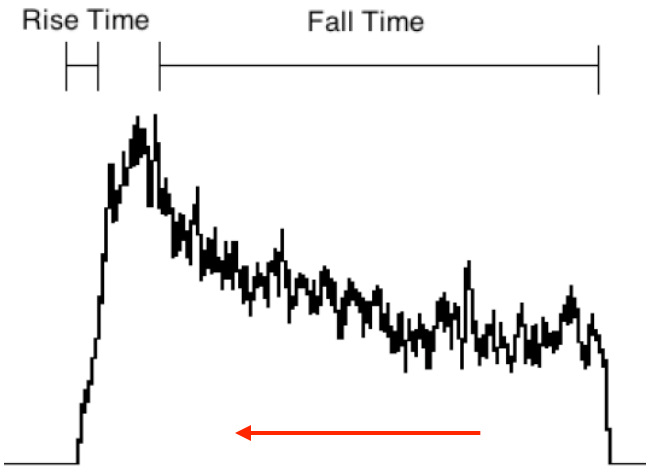
Lots of information! Lets look at the data …

Spectroscopy using Alpha Ranges

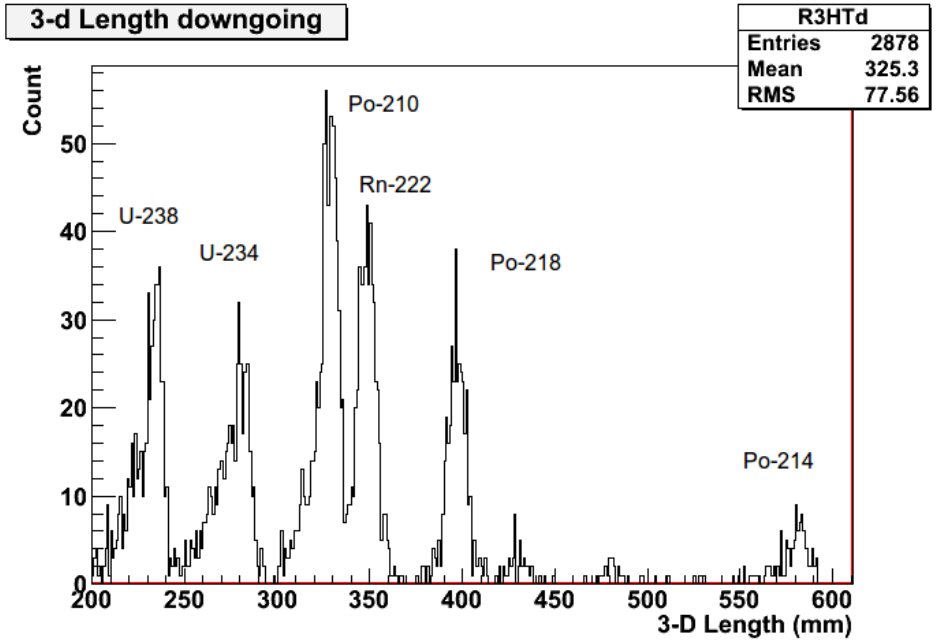
The 3D range of *all* fully contained alphas:



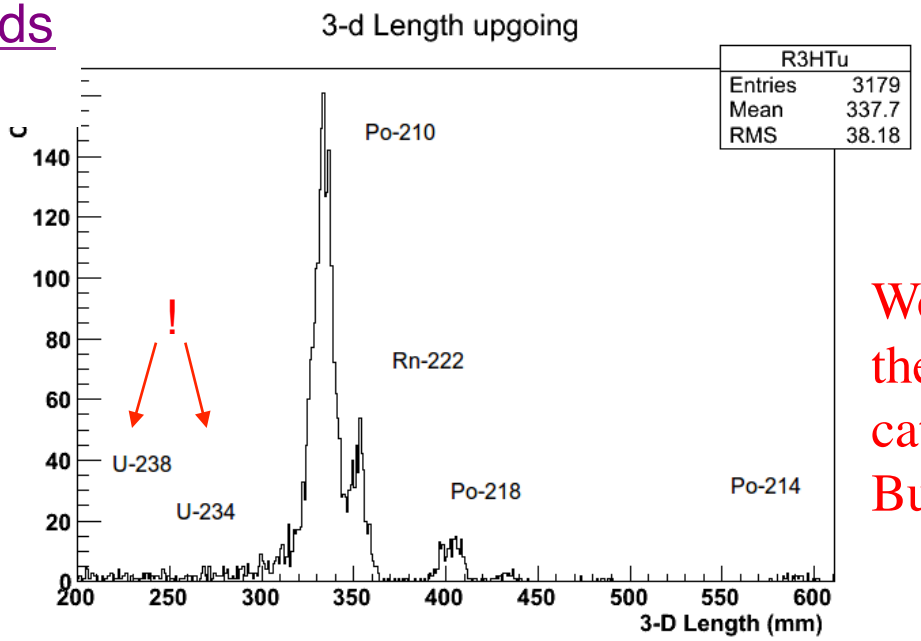
Bragg curve used to determine alpha direction:



Alphas directed away from cathode) :

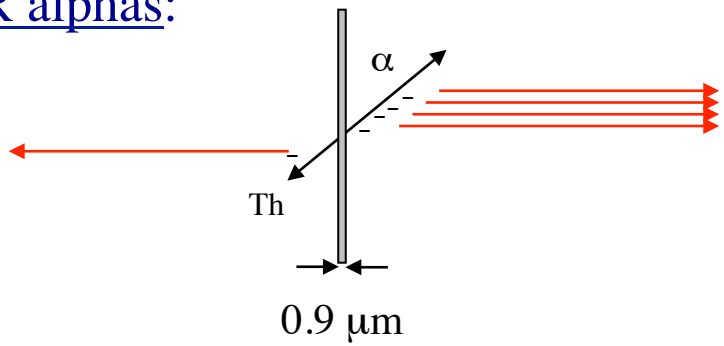


Alphas directed towards the cathode:

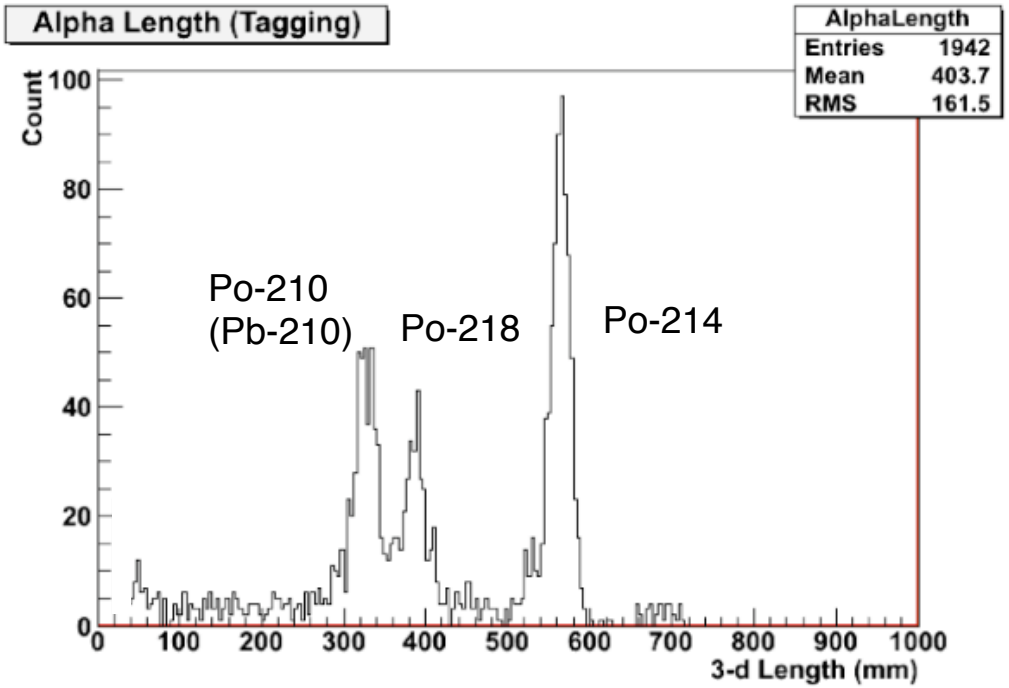


We can say that all of the U is in the thin cathode!…
But WHERE exactly?

Look at Tagged RPR alphas:



The range of tagged RPR alphas:



Note: No Uranium!

Its NOT on the surface, but inside the aluminum where the recoils can't come out.

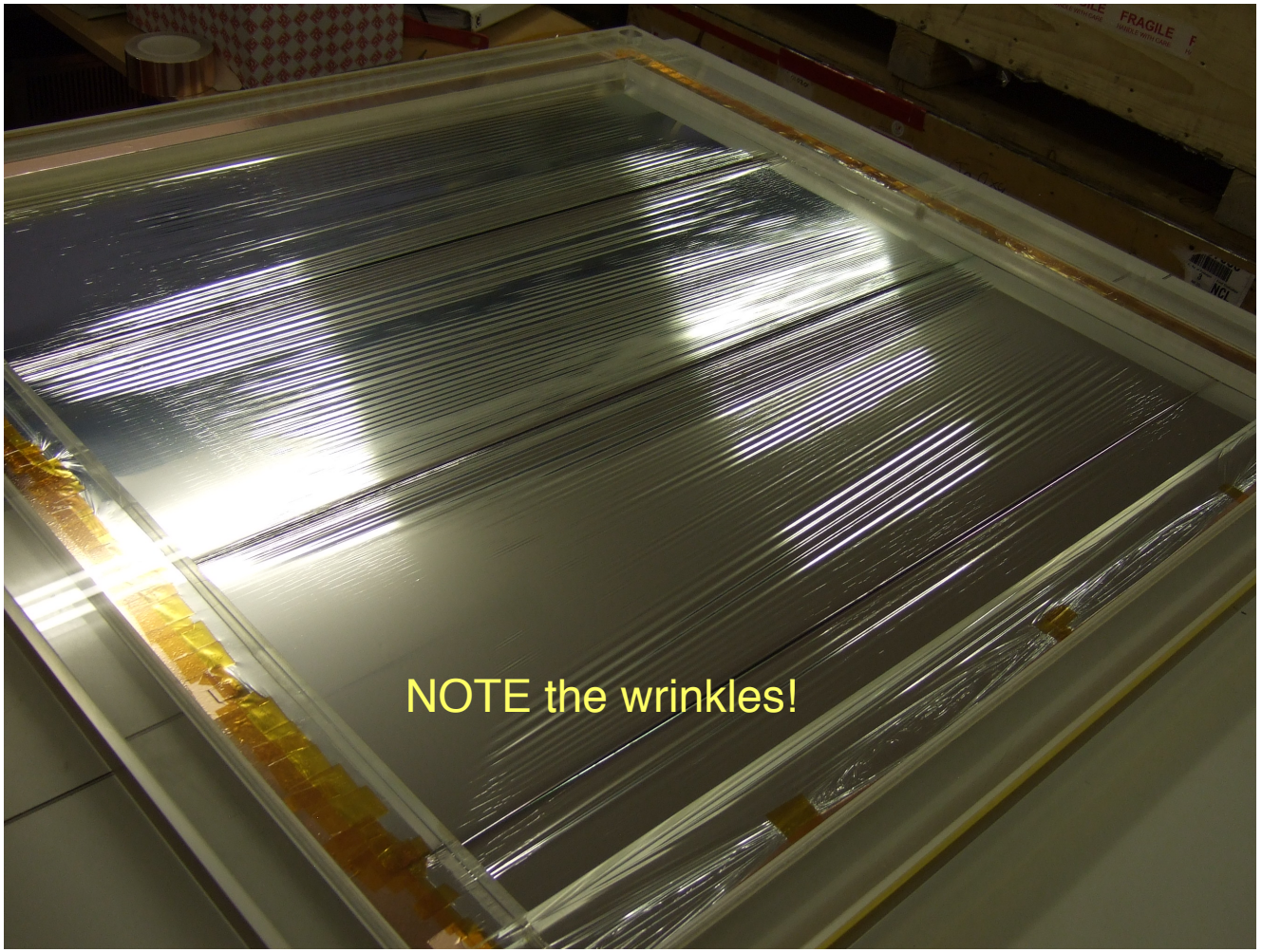
The Pb and Po ARE mostly on the surface.

Summary of backgrounds from central cathode

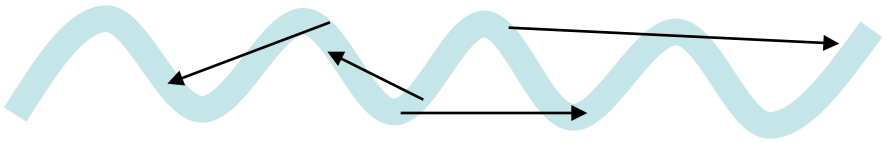
- Uranium isotopes in aluminum --> untagged lower energy alphas
- Pb-210 at surface of thin film --> RPRs
- Rn-222 in gas --> radon progeny that can plate out on cathode
- Polonium isotopes (Radon progeny) mostly plated out on surface of thin film --> RPRs

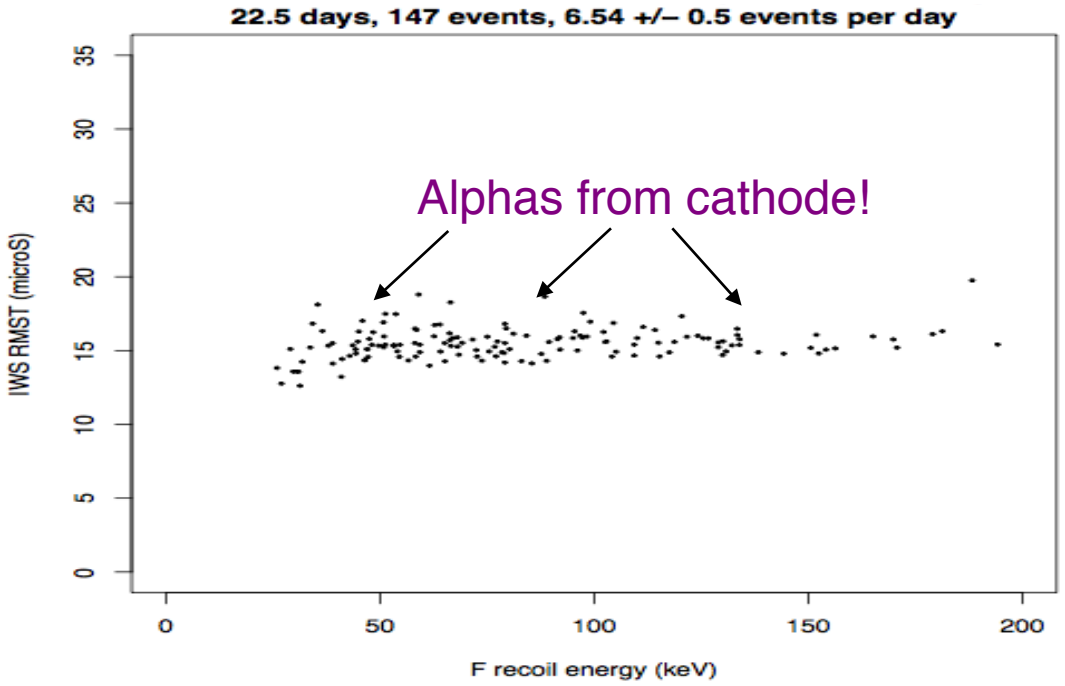
Extra source of alpha related backgrounds from cathode…how do they produce our backgrounds??

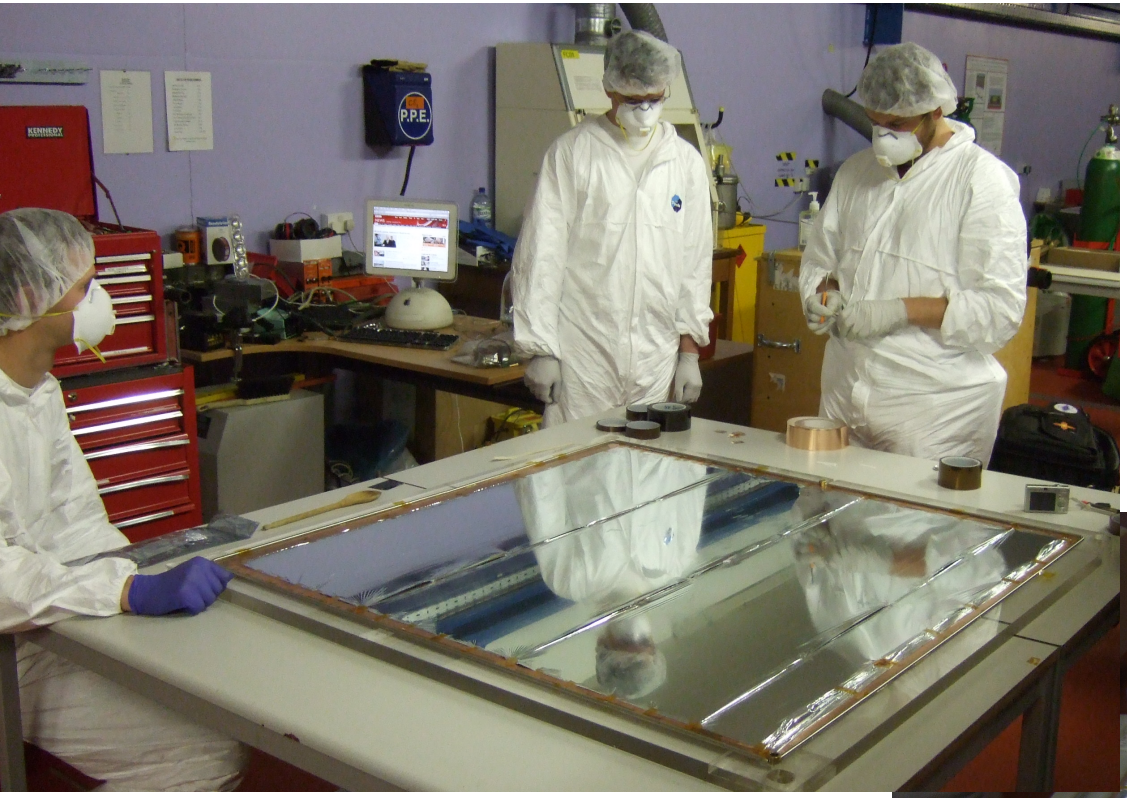
Multi-panel 0.9μm thick DRIFT cathode in DRIFT-IId



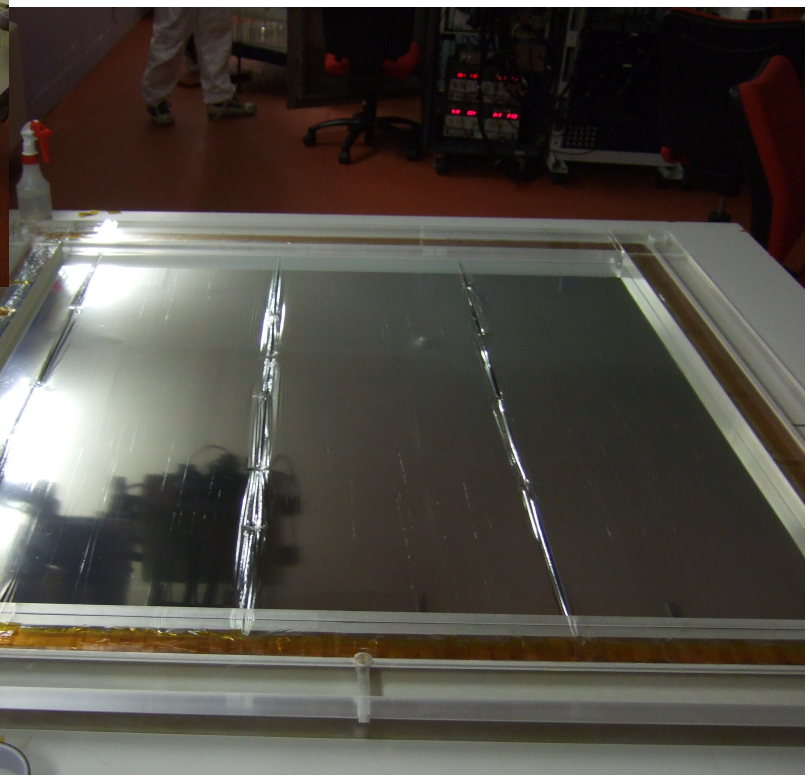
Dirty + wrinkled cathode





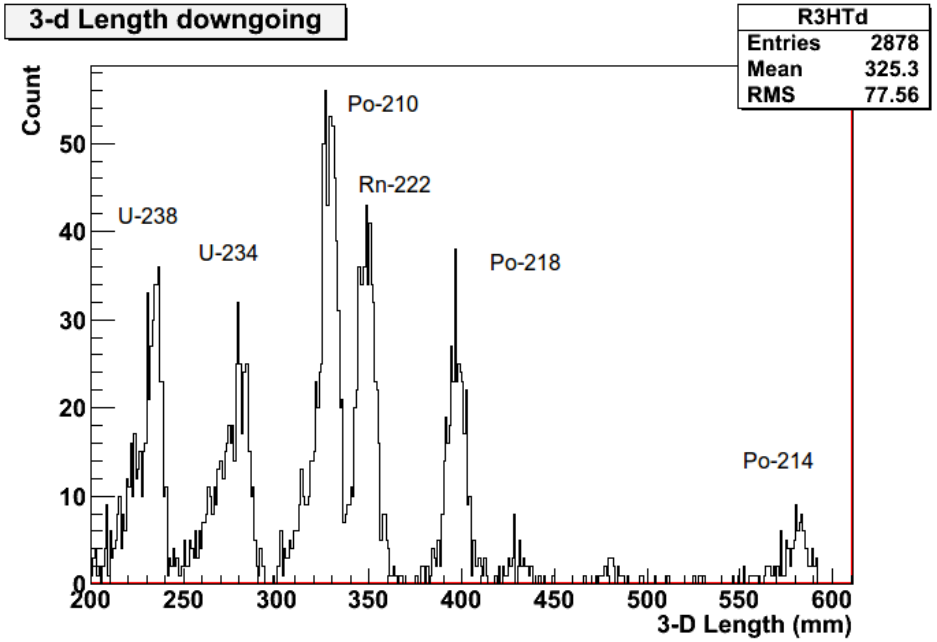


Radiopure flat cathode installed in DRIFT-IId in June 2012 and data taking has started.

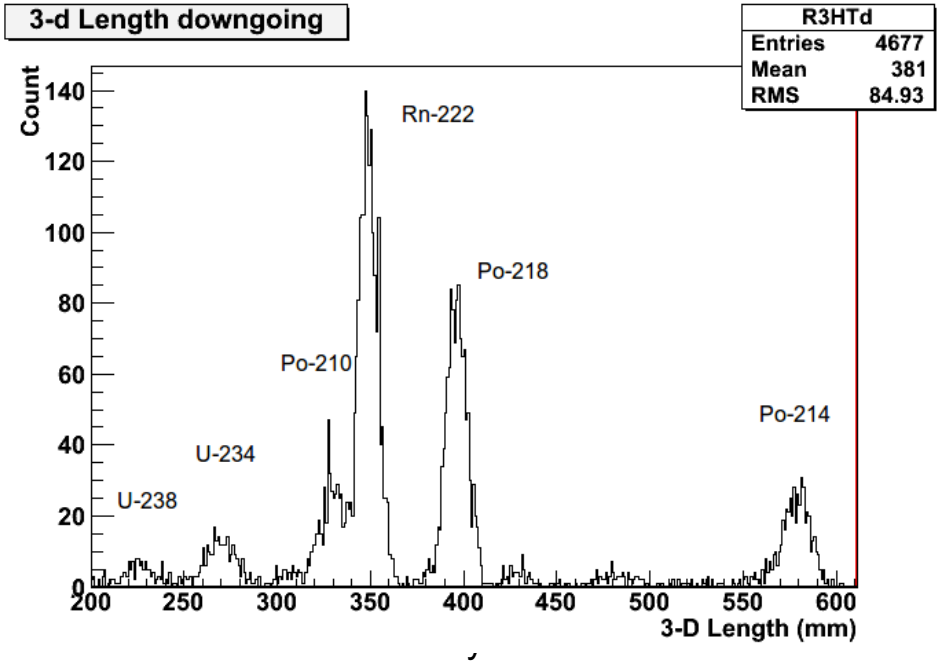


Preliminary analysis of unshielded data indicates that the background events from cathode are down to ~2/day (lower by ×60 from wire cathode)

Before: (~15 days)



After (~50 days):



In summary, after correcting for efficiencies we obtain the following contamination numbers:

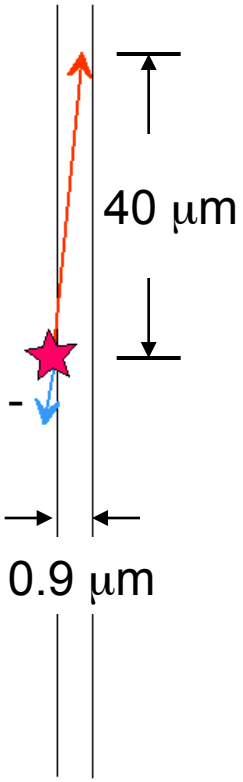
Isotope	Dirty	Clean
^{234}U	14 ± 1.2ppt	2.5 ± 0.24ppt
^{238}U	284 ± 22ppb	20 ± 2.4ppb

DRIFT has amazing sensitivity to measure backgrounds in-situ from detector materials!

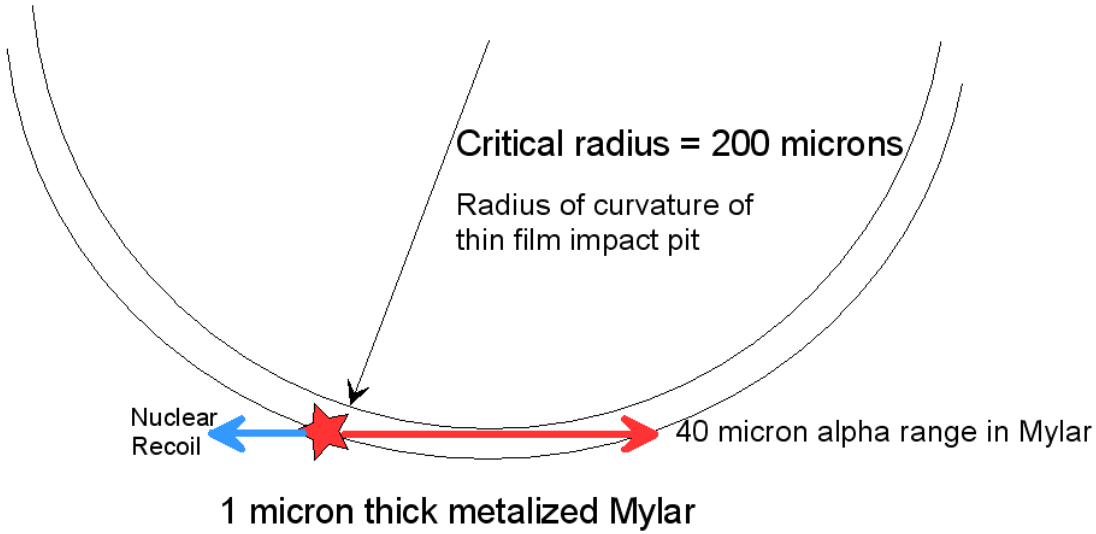
The Erics

Next step: Micro-textured Thin Film

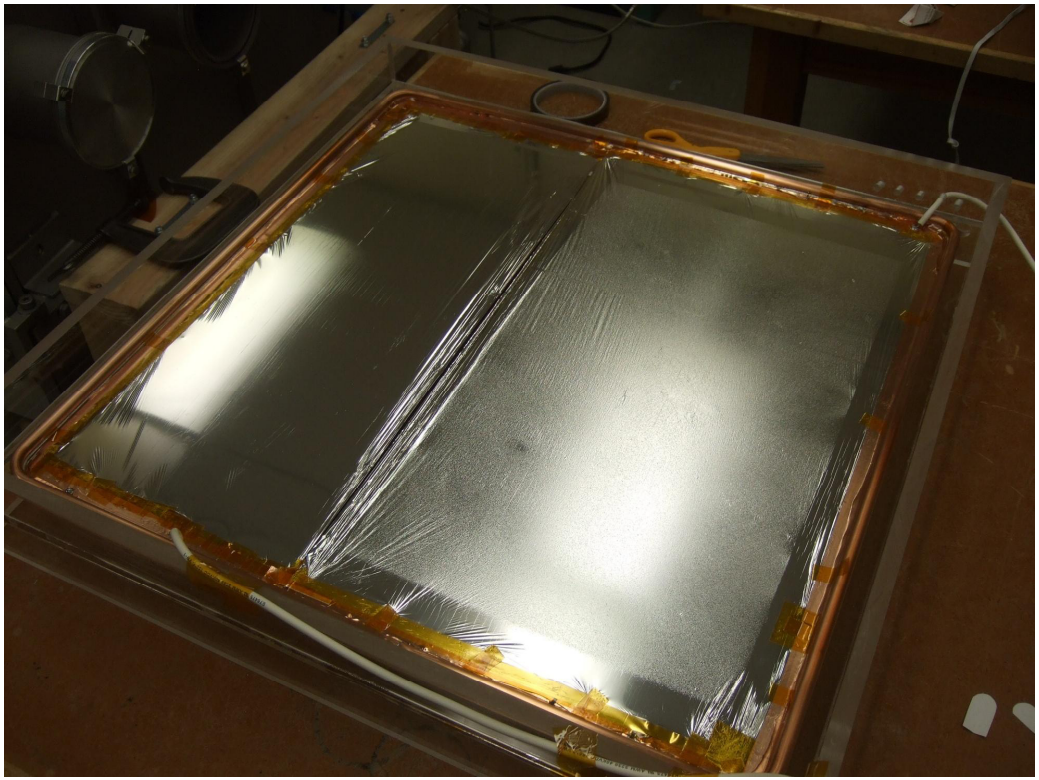
The problem: thin film cathode reduces but does not eliminate untagged RPRs

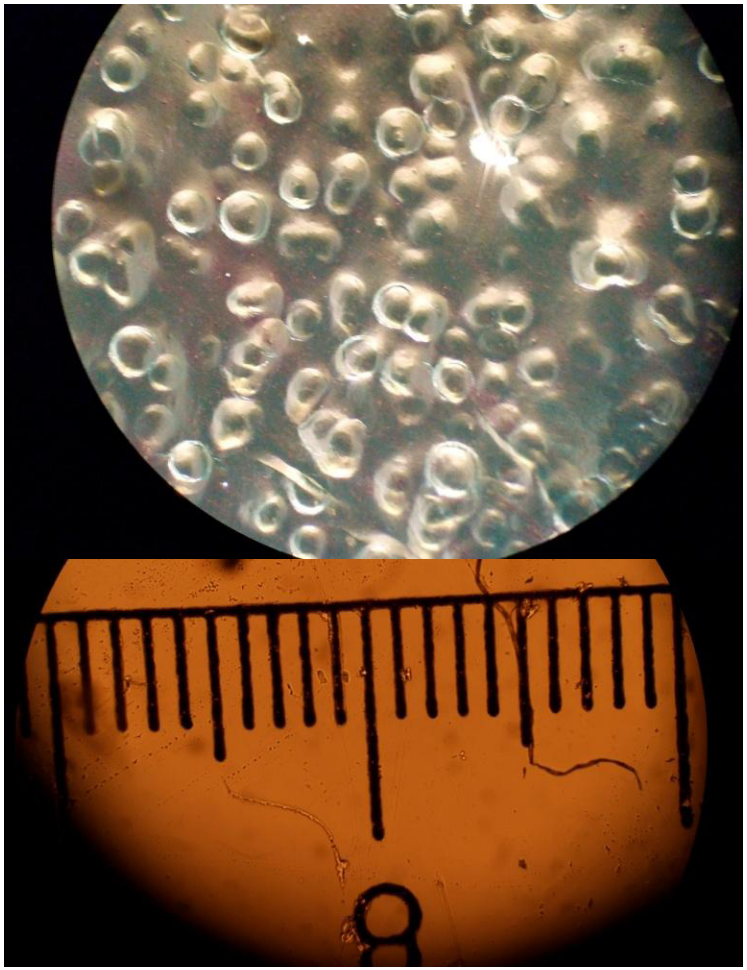


Possible solution: texturize the thin film with hemi-spherical features with scale size ~100 microns

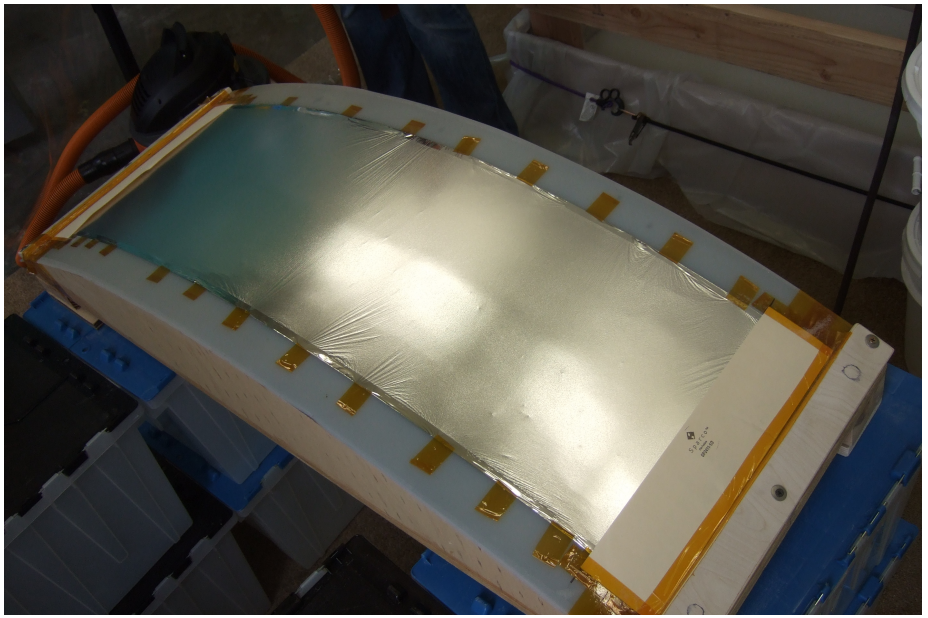


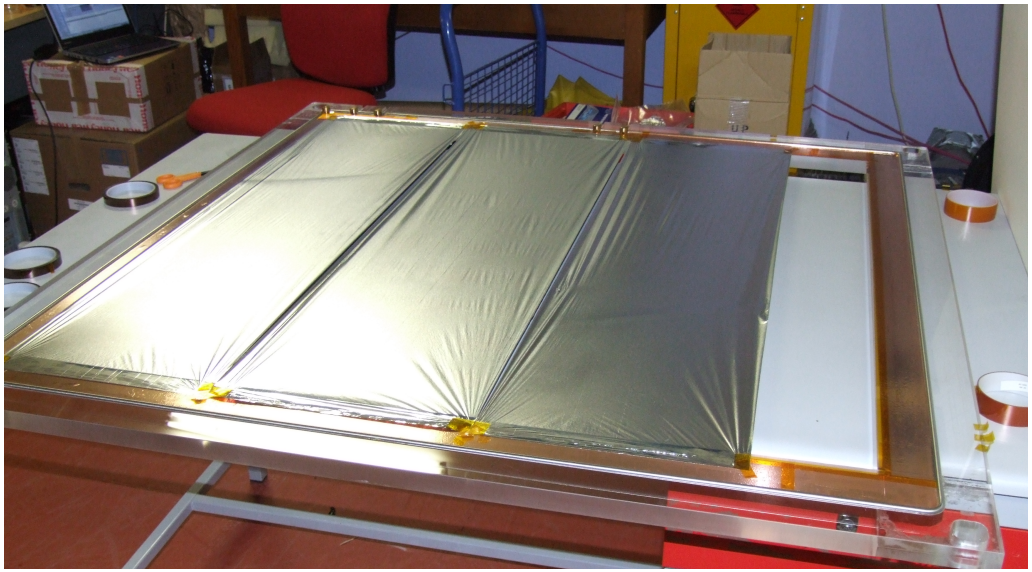
Micro-textured thin film for real!





Final panels constructed and installed in DRIFT-IId few weeks ago





Dinesh Loomba

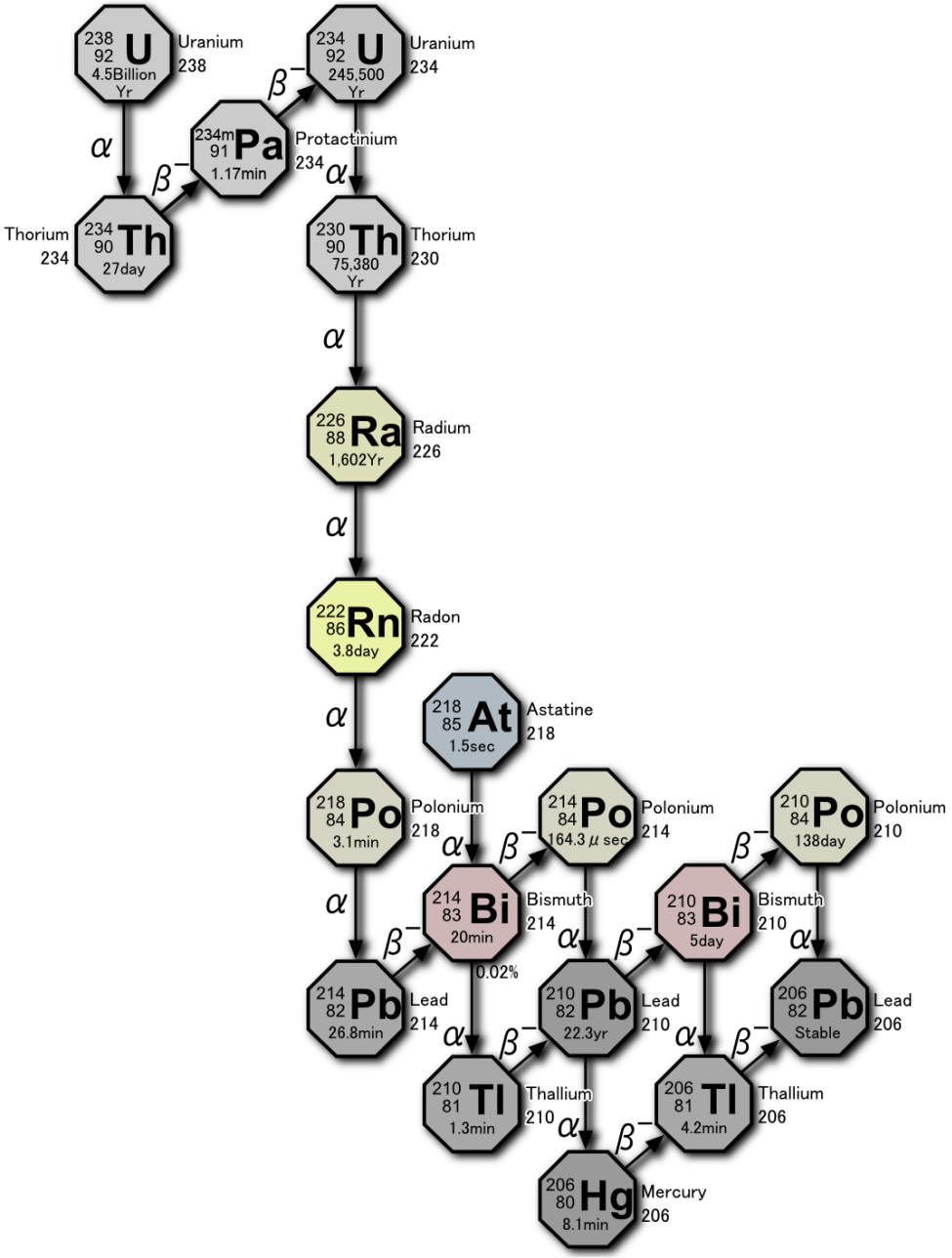
Texturization and Fiducialization:

Coup de Grace

(とどめ)

for RPRs?


RPR
(1901-2013)



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