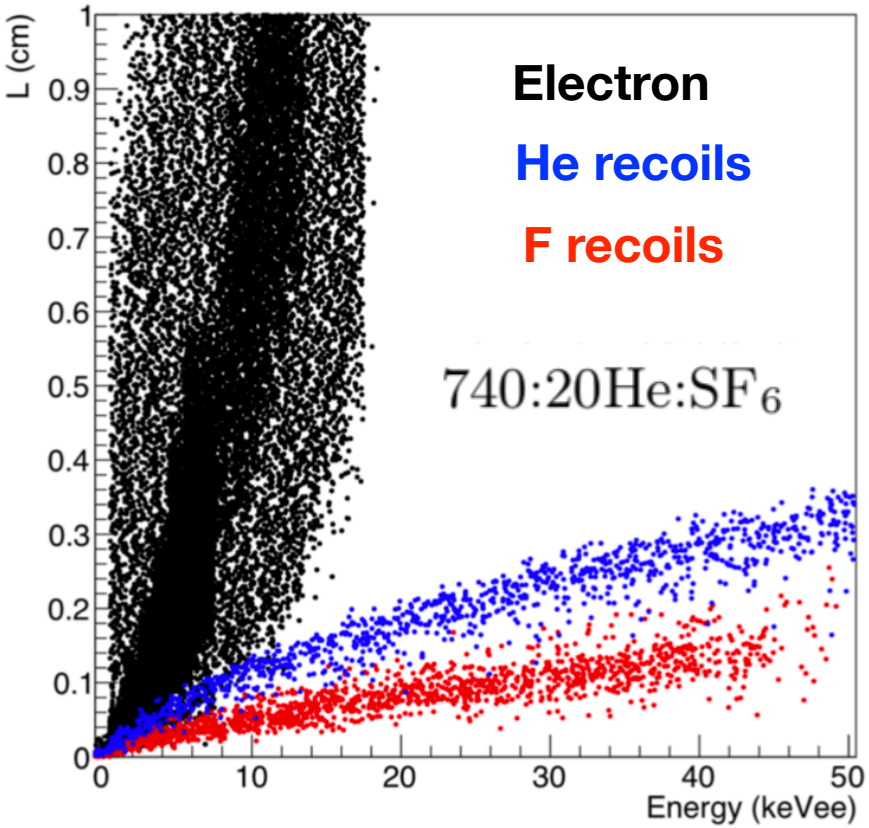
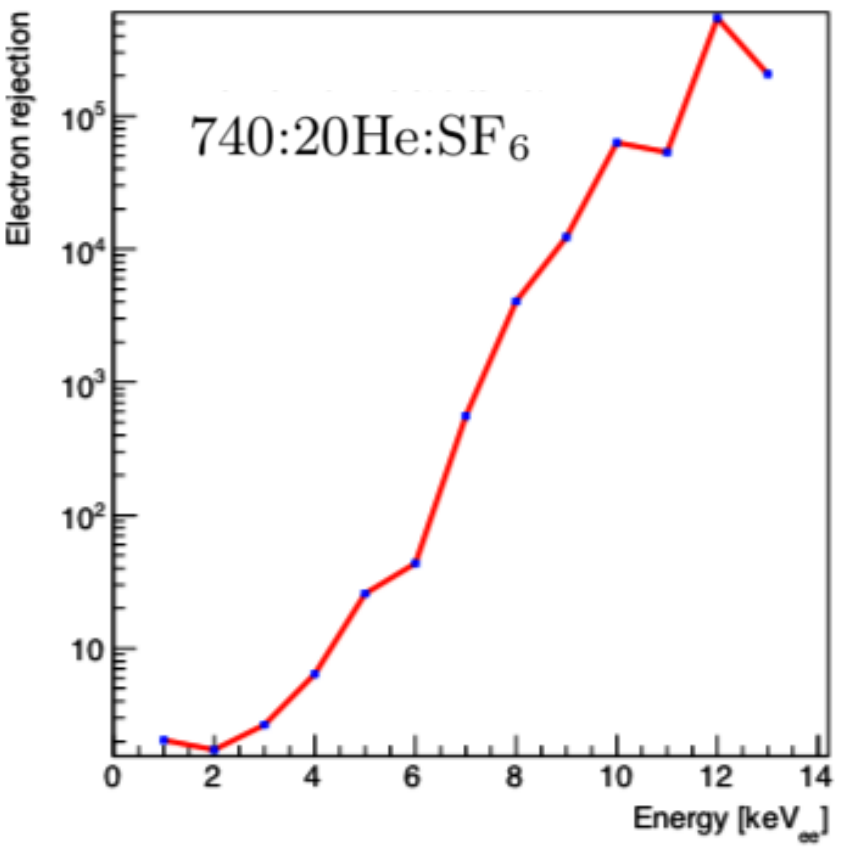
Funding strategy meeting

Ideas for sensitivity optimisation & comparison with other directional experiments

CYGNUS: Feasibility of a nuclear recoil observatory with directional sensitivity to dark matter and neutrinos



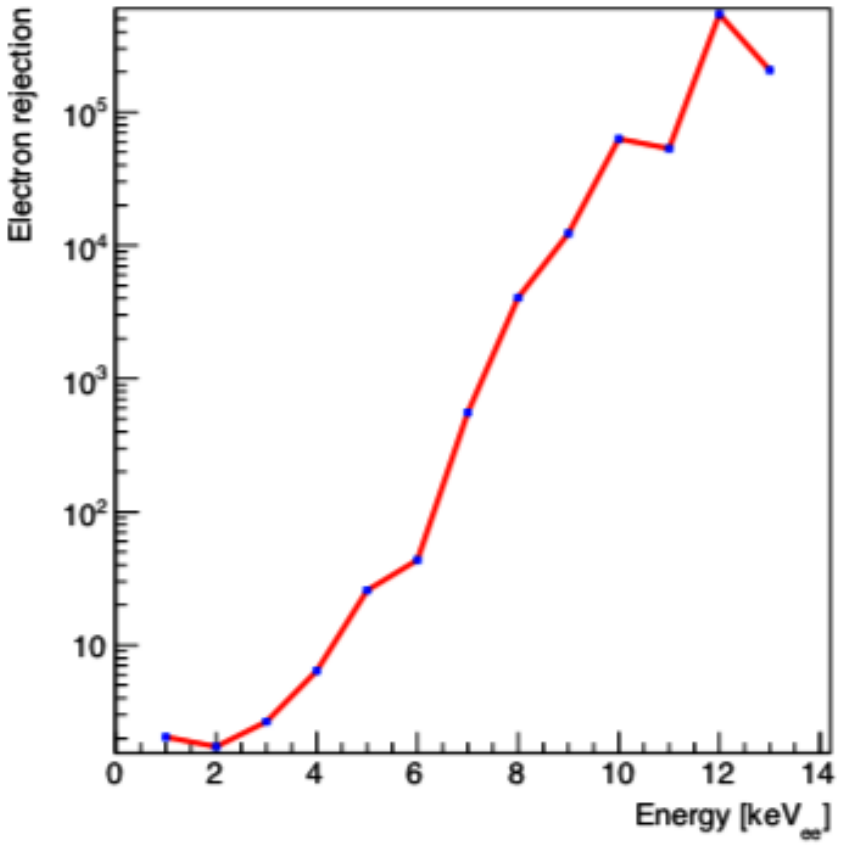
Electron rejection after 25 cm drift



Gas mixture	SF_6	$He:SF_6$	$He:SF_6$	$He:CF_4$
Gas pressure [Torr]	20	740:20	755:5	740:20
W [eV/ion pair]	35.5	38.0	35.6	38.0
Transverse diffusion, σ_T [$\mu m/\sqrt{cm}$]	116.2	78.6	78.6	213.0
Longitudinal diffusion, σ_z [$\mu m/\sqrt{cm}$]	116.2	78.6	78.6	148.0
Drift velocity [mm/µs]	0.140	0.140	140	24.45
Mean avalanche gain	9×10^3	9×10^3	9×10^3	10^6

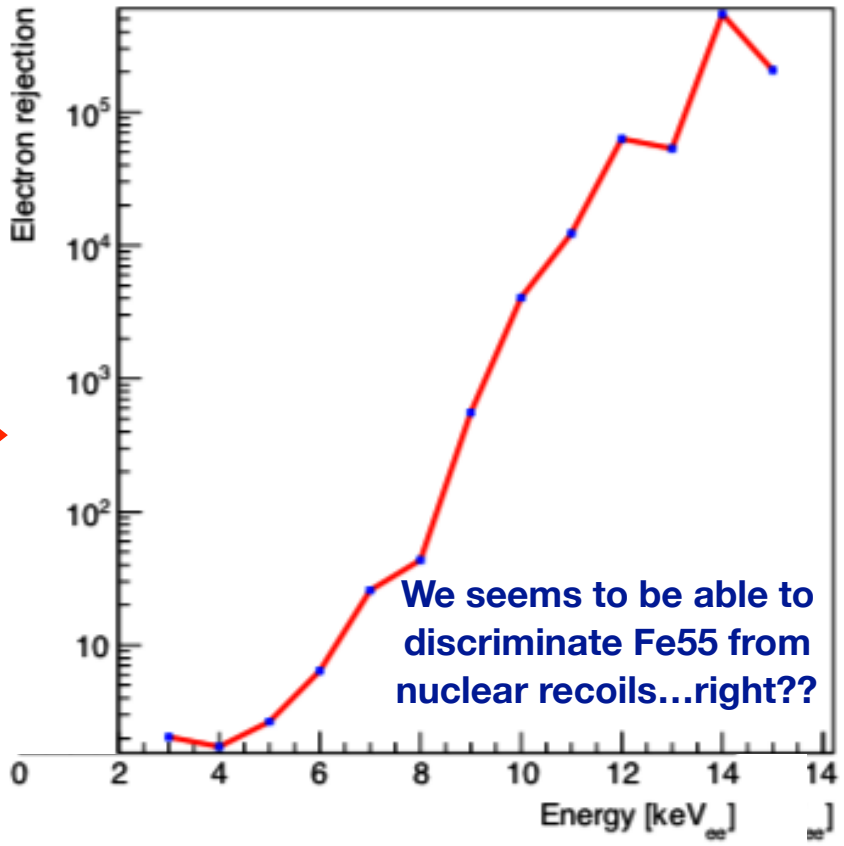
Proposal

CYGNUS paper



He:SF_6 740:20 Torr
0.33 kg/m^3
79 um/sqrt(cm)

What to apply to CYGNO background estimation

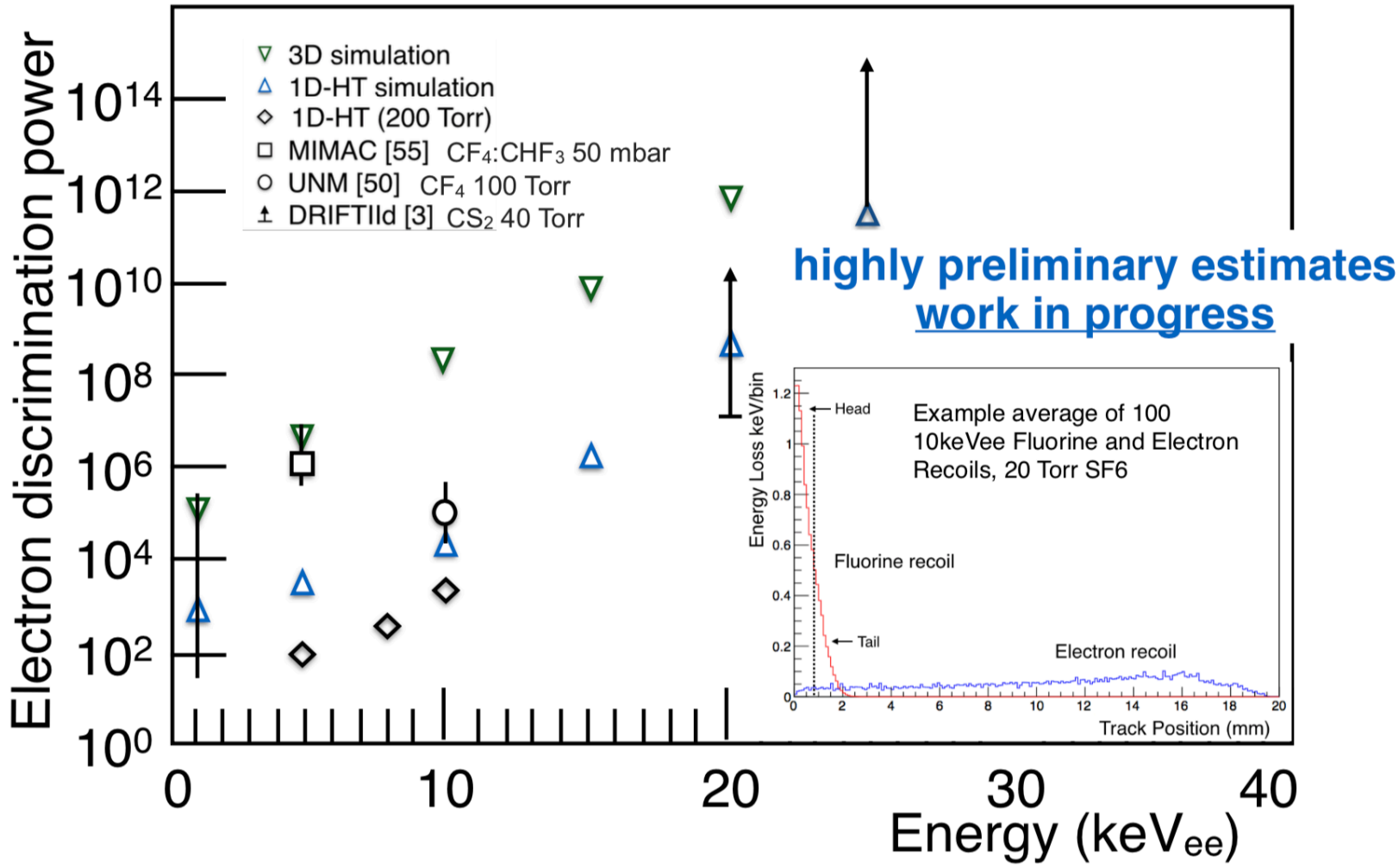


He:CF_4 60:40
1.6 kg/m^3
130 um/sqrt(cm)

Notice: from 10^5 to 10^3 at 10 keV
Might be pessimistic….or optimistic since density is 5 times? Opinions?

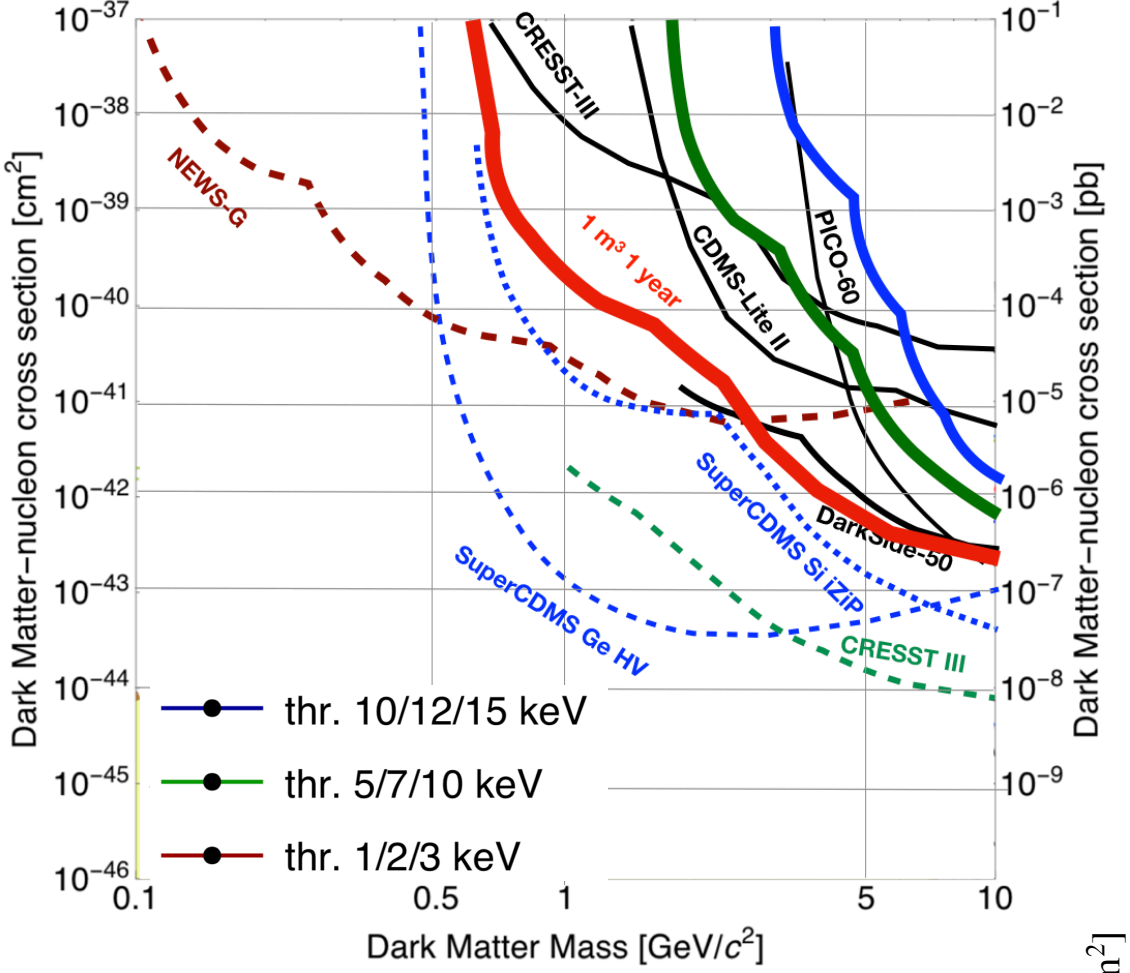
What about above 15 keV?

From an old (and optimistic!) CYGNUS study



Can either rescale 10^8 to 10^3, or assume a linear dependence from previous plot

Opinions?

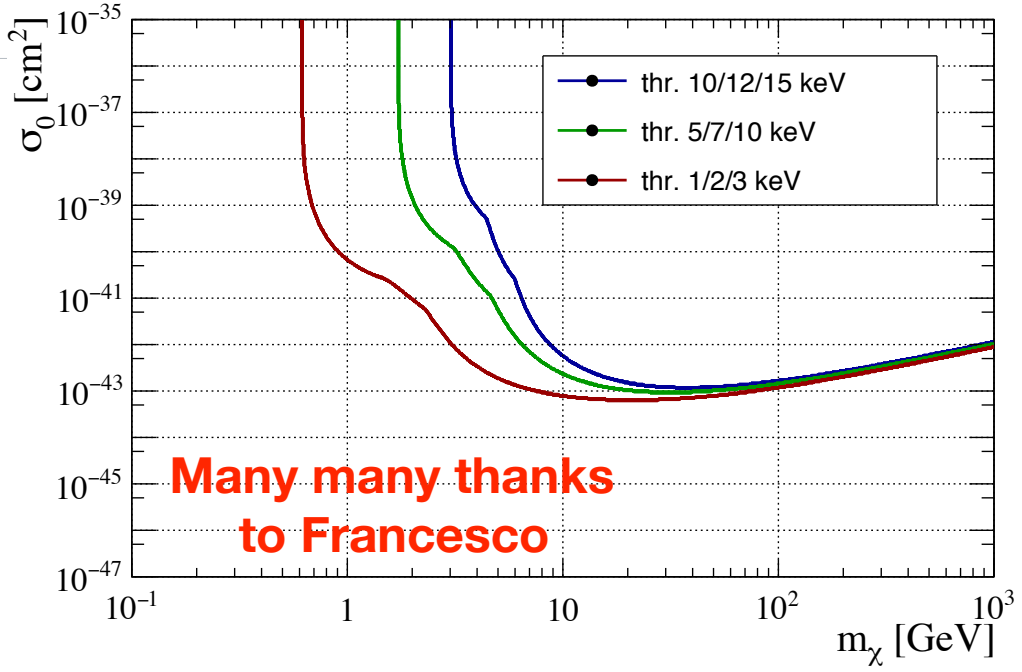


What if we raise the threshold in order to stay background free?

1.6 kg x 365 days of He:CF_4 80:20

=

584 kg days of He:CF_4 80:20



Comparison with other directional experiments

Spoiler alert: typically, no background events from environmental radioactivity in neither directional nor non-directional experiments

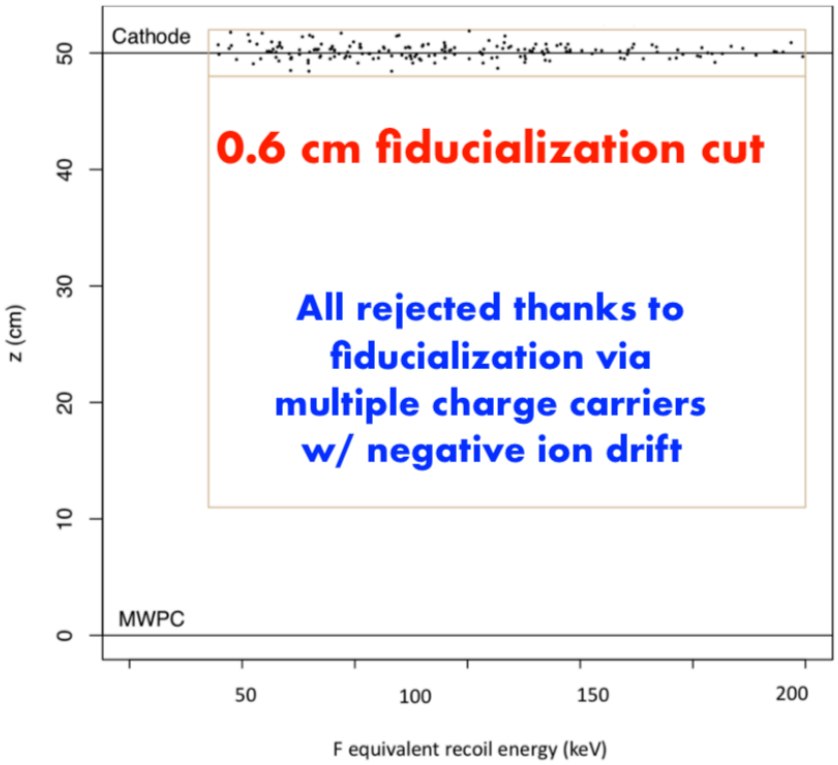
Typically, background is only internal (ie. detector material) background

1.5 D charge readout

DRIFT @ Boulby: background free limit

0 events in the ROI
Background free limit
Energy thr. 40 keV

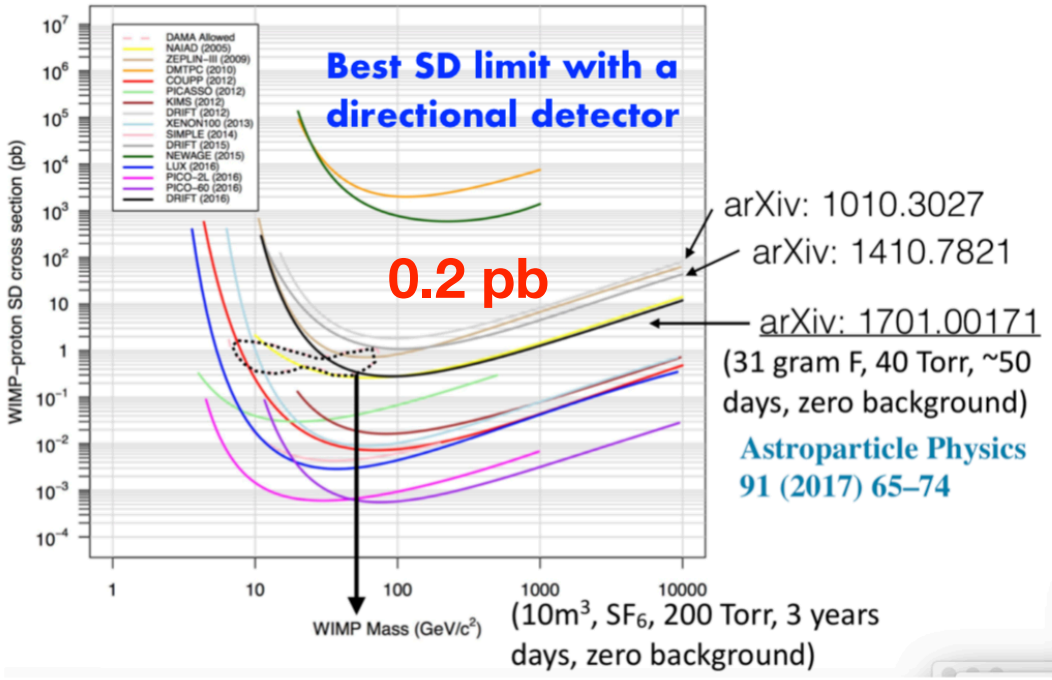
Nuclear recoil events energy vs z



gamma rejection > 1.98 x 10^7 @ 90% C.L.
zero gamma-like events observed

NOTICE: all background events from cathode

First result in "DAMA Region" with directional sensitivity"

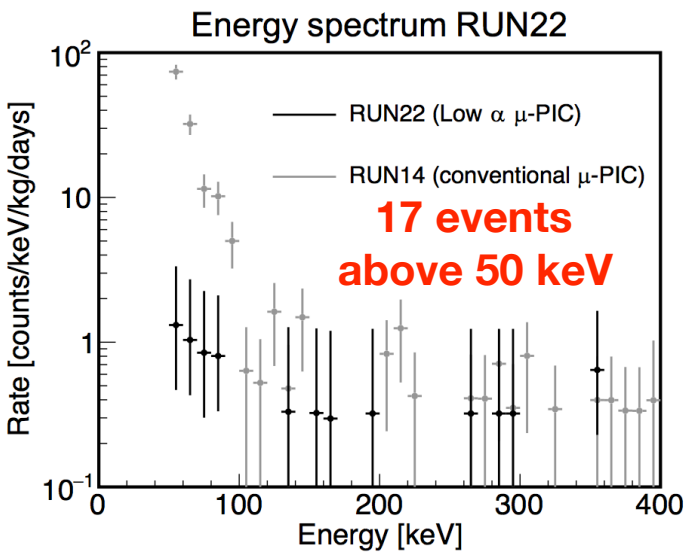


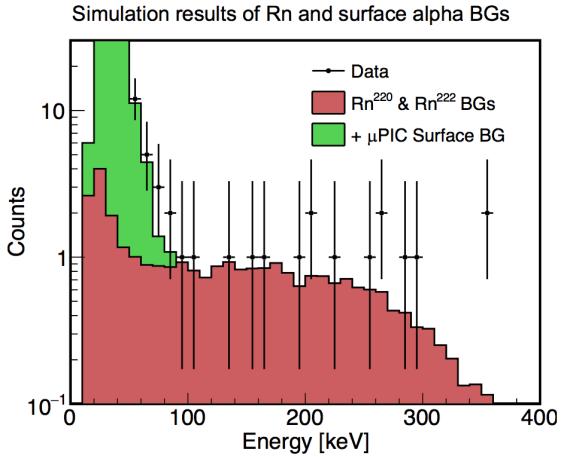
- 54.7 days of data analyzed
- 185 events found but as expected all were located at 50 cm away from the detector, i.e. on the central cathode.

Total: 1.7 kg x days of F

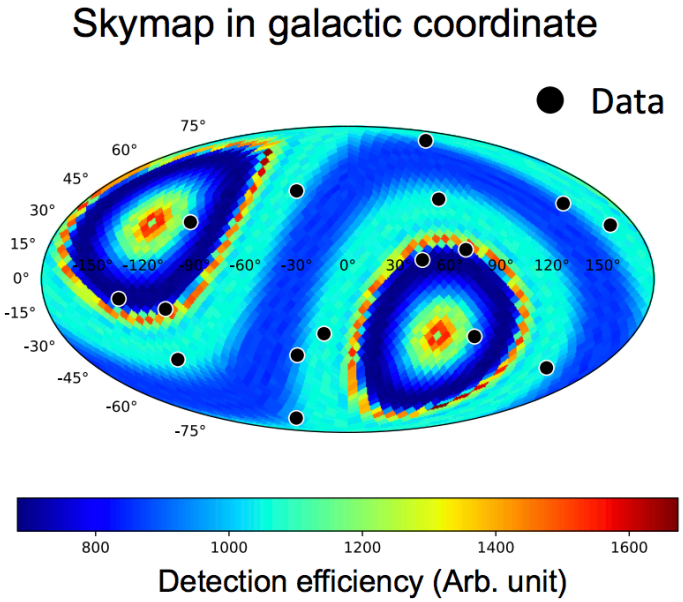
3D charge readout

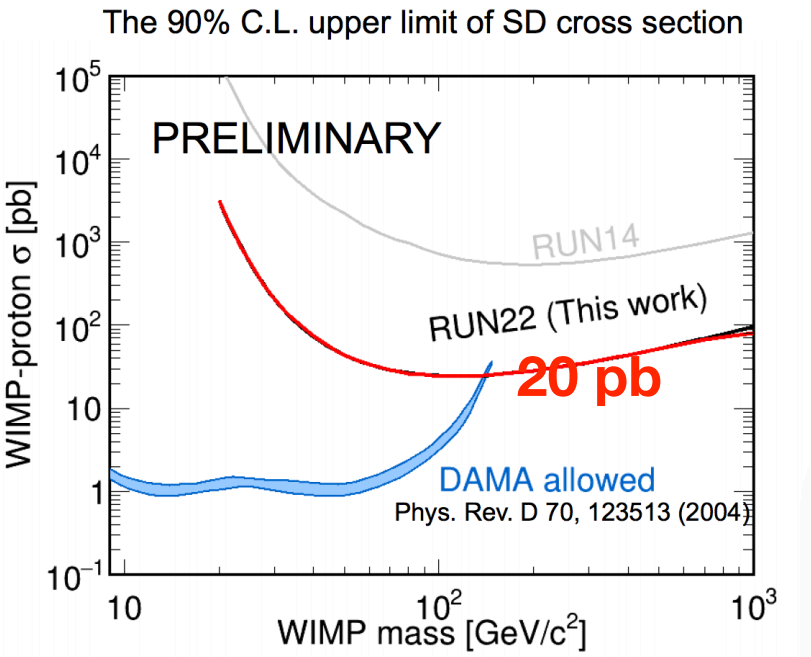
NEWAGE @ Kamioka: GEMs+μPIC





- **Main background in 50-100 keV region : a surface alpha of Low-α μ-PIC**





Total: 1.12 kg x days of F

- **Detection Volume: 31×31×41cm³**
- **Gas: CF4 at 0.1atm (50keVee threshold)**

== 0.015 kg of CF4

Notice: NO FIDUCIALIZATION!!!

ROI defined as [50,60] keV —> 2 bkg events

- Nuclear detection efficiency: 14% @50-60keV
- Electron detection efficiency: 5.9×10^{-6} @50-60keV

NOTICE: all background events from readout