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# First SD WIMP limits from DRIFT with full z-fiducialisation

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On behalf of the DRIFT collaboration

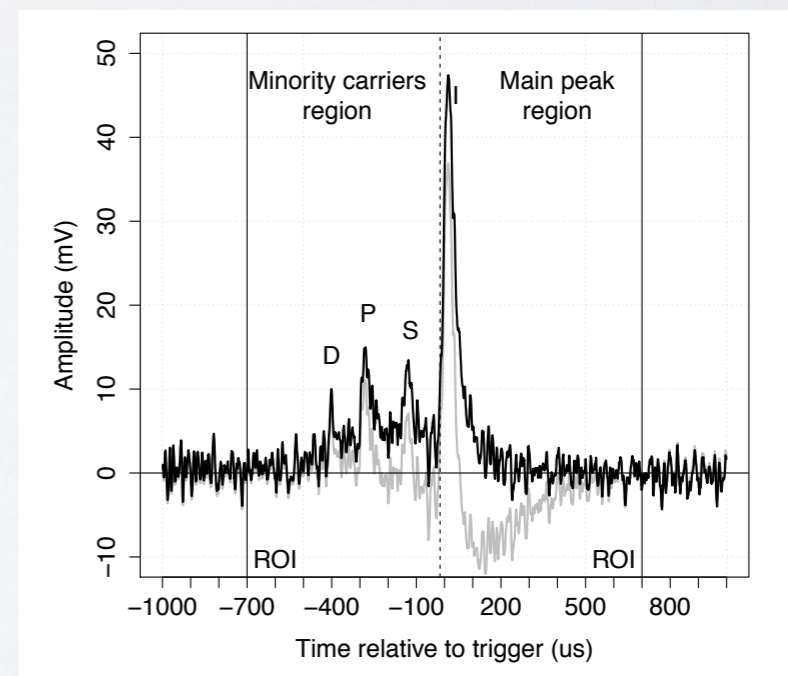
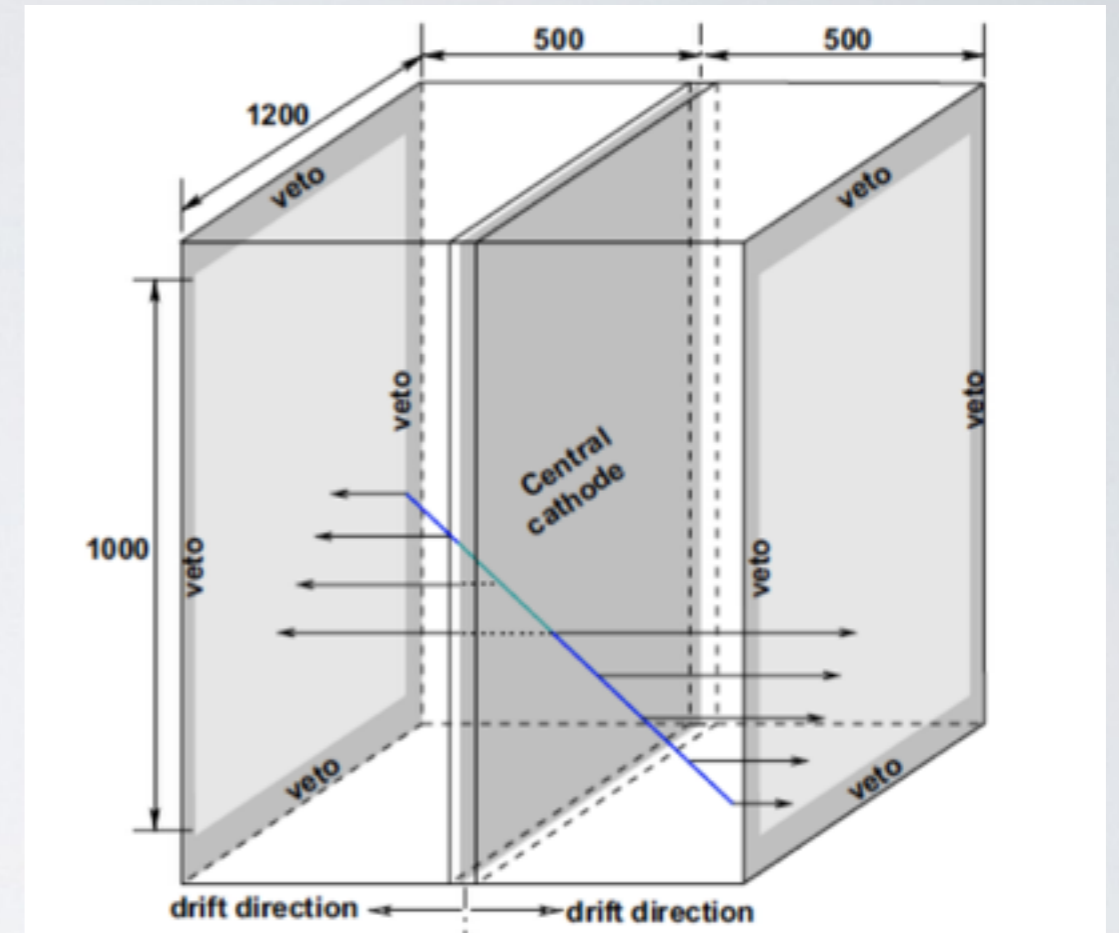


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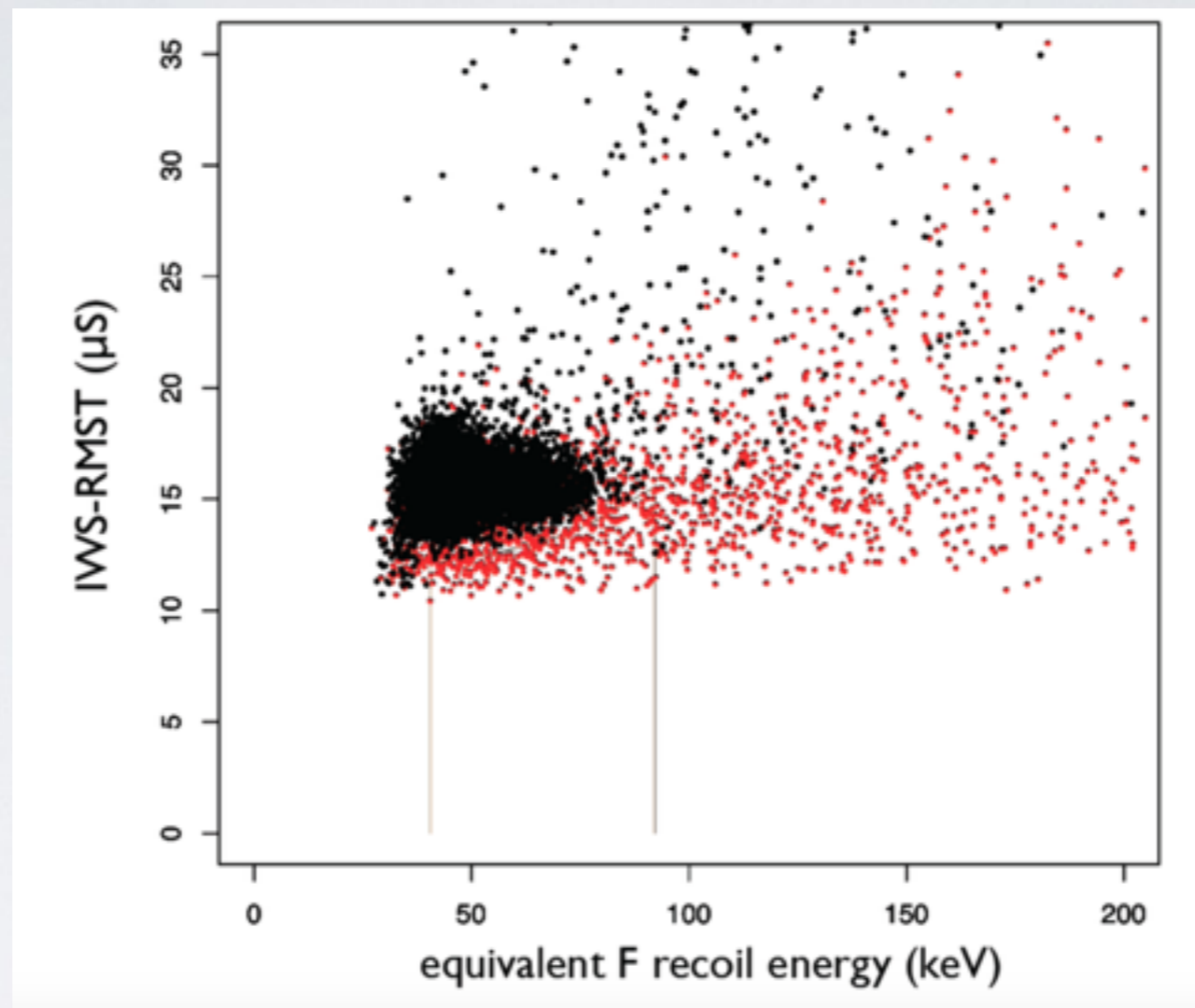


# Overview of DRIFT

- Directional DM detector.
- Current detector (DRIFT-IIId) running at Boulby Underground Laboratory.
- $1\text{ m}^3$  NI-TPC using two MWPCs for readout.
- Full fiducialisation of the detector allowed by using minority carriers.
- Target gas:
  - $\text{CS}_2$  (30 Torr) - Negative-ion to lower diffusion.
  - $\text{CF}_4$  (10 Torr) - Target gas ( $j=1/2$ ) for SD WIMP search.
  - $\text{O}_2$  (1 Torr) - Adds minority carriers used for fiducialisation of detector.

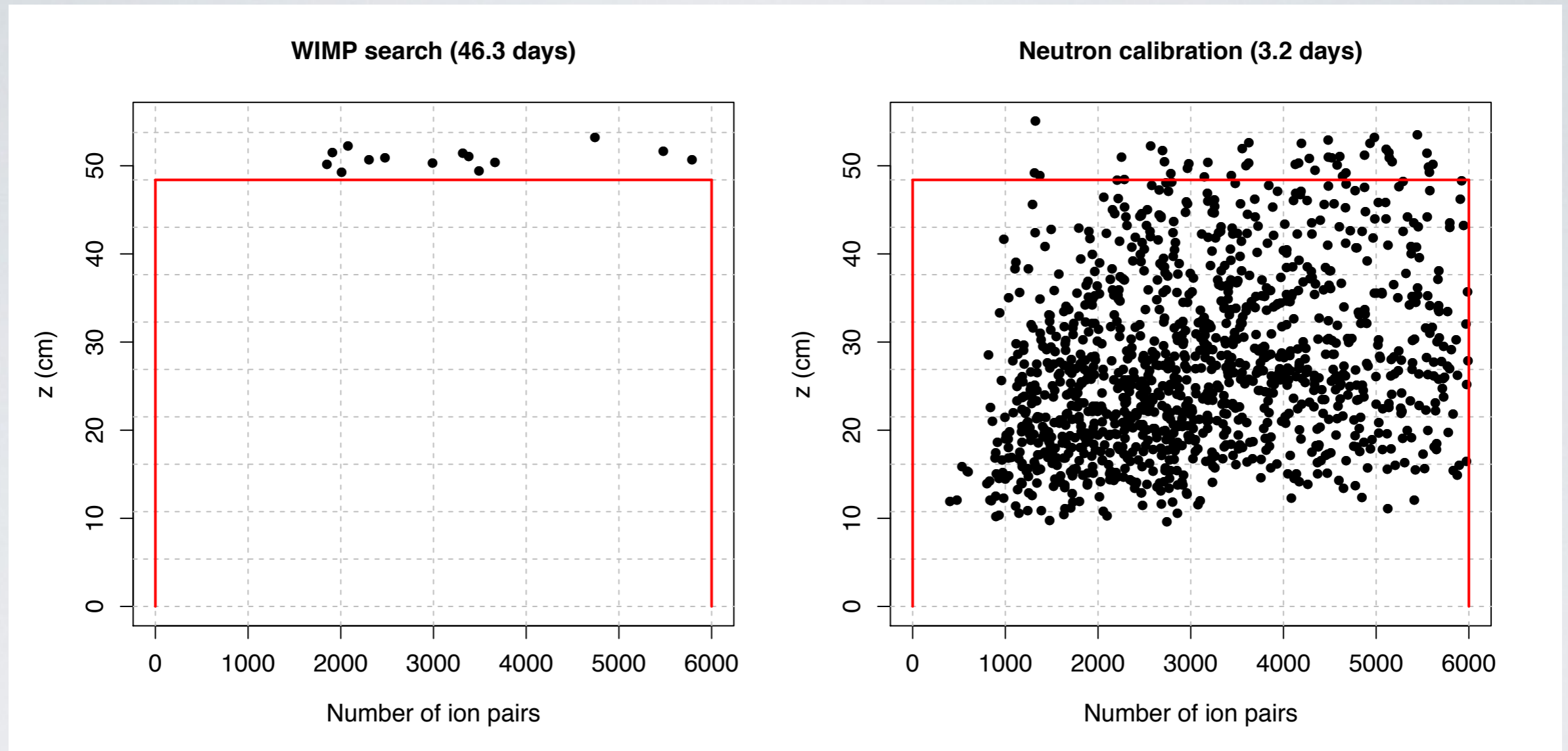


# Comparison of signal regions



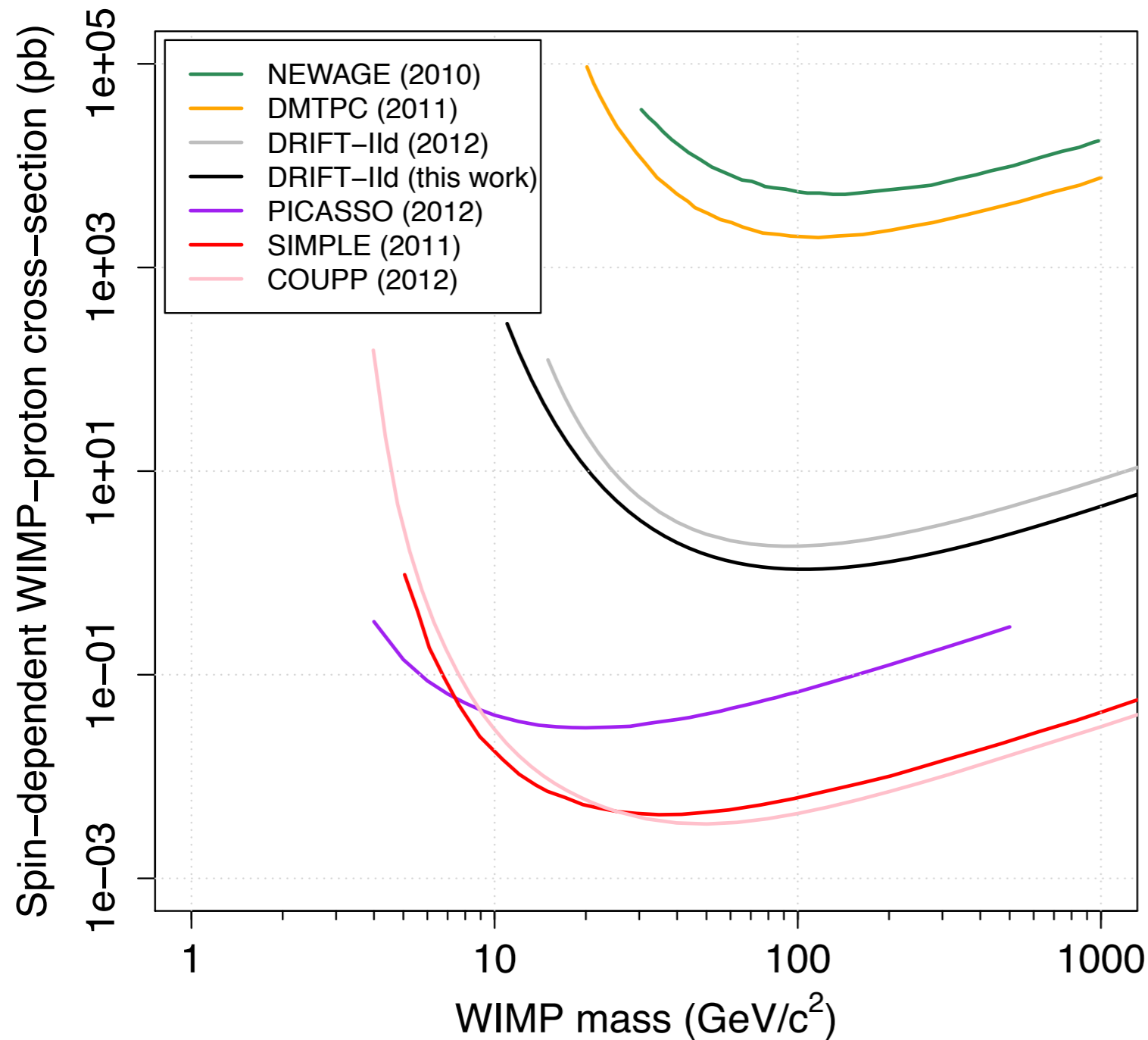
- $\sim 3x$  more neutron events accepted into signal region without accepting any background events.
- Limit at high  $z$  due to BG events from cathode.
- Limit at low  $z$  due to overlapping peaks.

# Comparison of signal regions



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- Limit at high z due to BG events from cathode.
- Limit at low z due to overlapping peaks.

# Spin-dependant WIMP limit

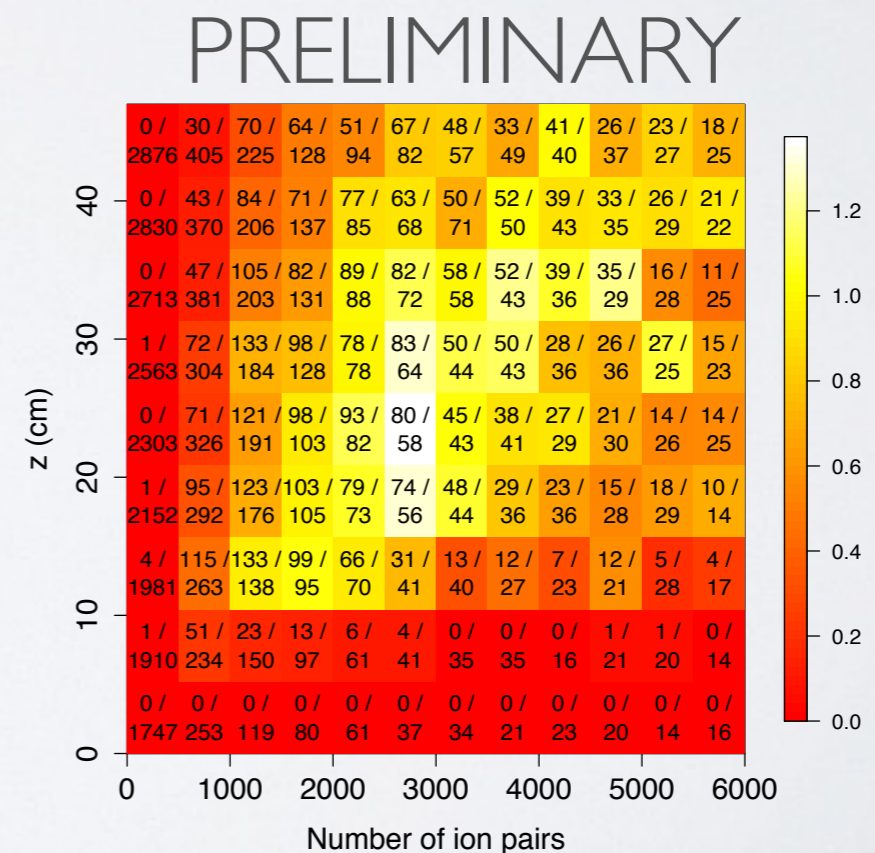
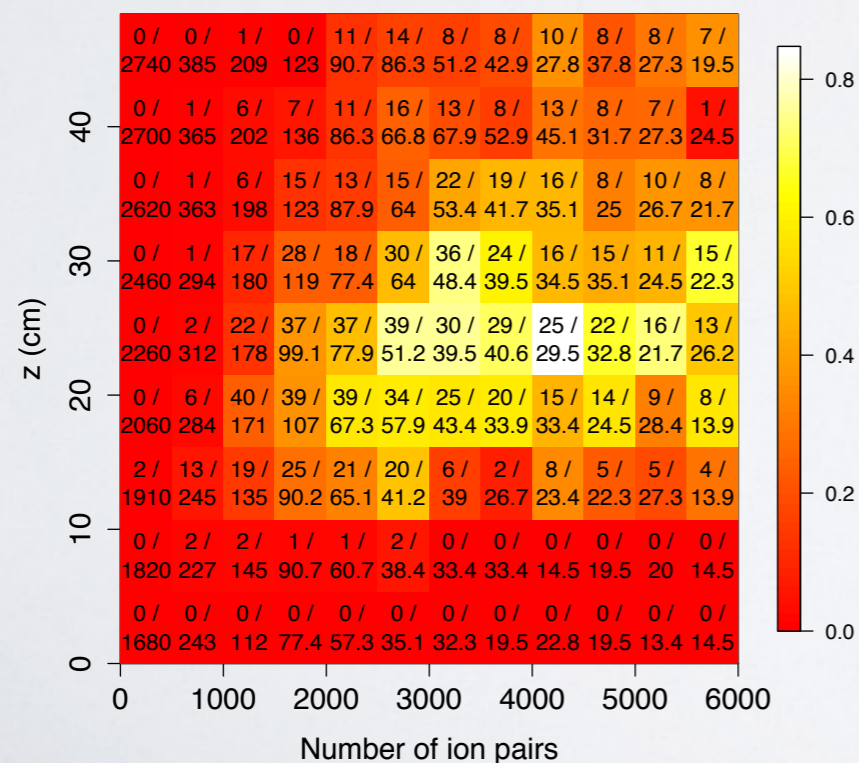


arXiv:1410.7821

- Minimum at 1.1 pb at 100 GeV.
- Matches prediction presented at DMUK earlier this year.
- 2x better than 2012 limit. (arXiv:1110.0222)
- Factor of  $10^3$  lower than other directional detectors.
- Further improvements to come shortly.

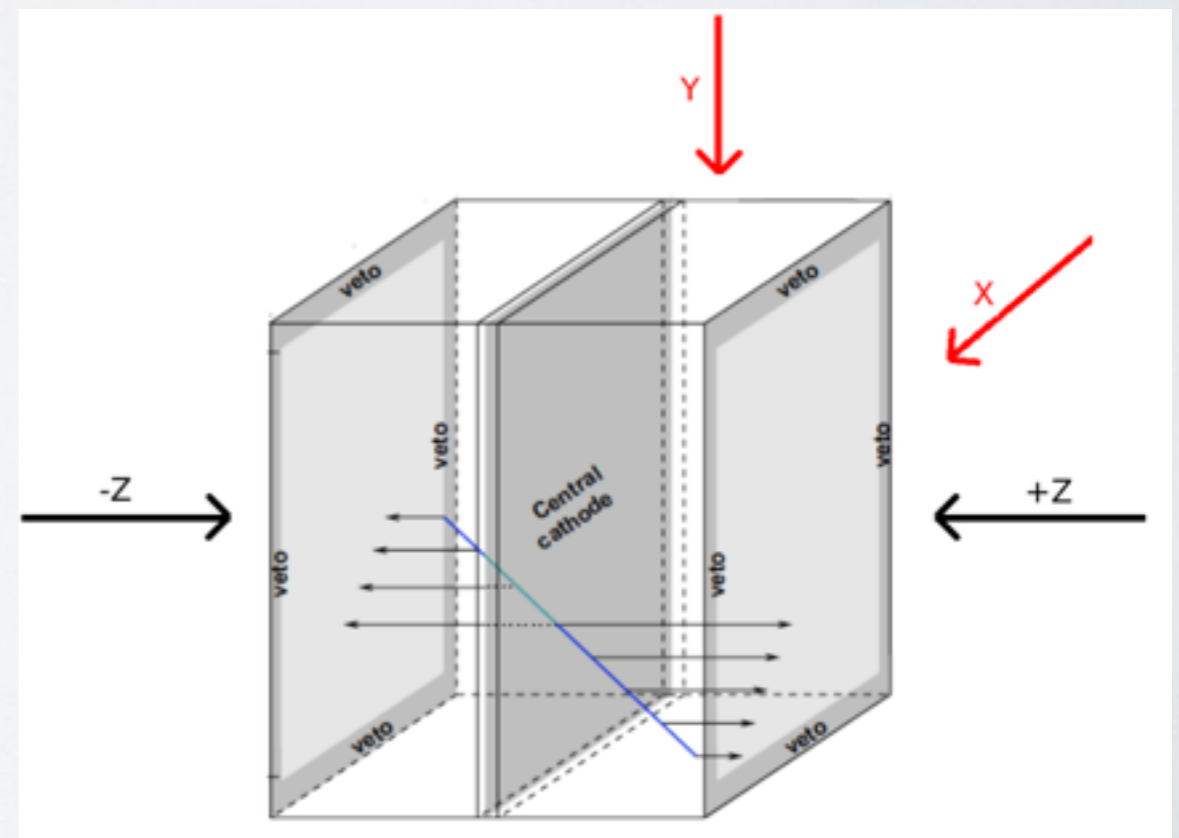
# Future improvements

- Threshold can be halved due to ionisation lost to minority peaks and a new method of smoothing the triggered waveforms.
- Improvements are being made to the peak-finding algorithm used.
- Latest runs have had the gas mixture flowing which improves the gas quality.



# Other areas of improvement

- We have recently made some neutron runs to test the directional sensitivity of the detector (using a new Cf-252 source with a higher rate than the previous).
  - The measurement of  $z$  should allow us to see the directional sensitivity as a function of  $z$ .
  - The new  $z$  information will enable us to measure diffusion as a function of  $z$ , leading to improvements in the accuracy of the recoil range  $z$  component measurement.
- We have published two new papers in JINST on backgrounds in DRIFT:
  - 2014 JINST 9 P07021 & 2014 JINST 9 P11004
- As of Nov 2014 we have installed a new cooling system on DRIFT IId.
  - Cools the detector using the Peltier effect.
  - Keeps detector  $4^{\circ}\text{C}$  below the lab temperature



# Summary

- Using new minority carrier data we have set an improved SD WIMP limit with a minimum at 1.1 pb at 100 GeV.
- Improvements in the threshold, analysis and gas quality have brought a higher efficiency for future analyses.
- Initial data from flowing background runs is currently being analysed, with results to come shortly.
- We have just started a new science run at Boulby.
- New neutron directional data has been taken with analysis to come soon.