R&D for Low-threshold Noble Liquid Detectors

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On behalf of LBECA and DarkSide-LowMass

Two main goals

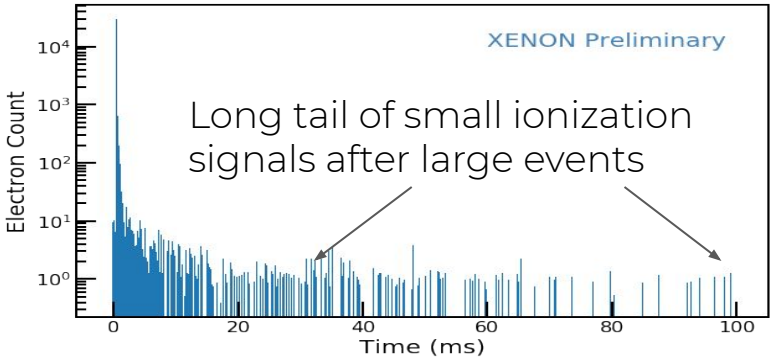
Lower backgrounds

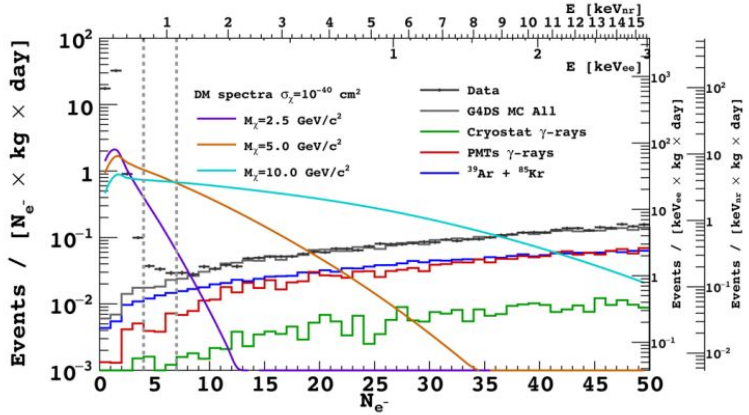
- Dominant source: Single electron backgrounds
  - Characterize SE backgrounds and develop reduction techniques
  - Improve chem. purification techniques to remove electronegative impurities
  - Optimize E-field configuration for minimizing SE backgrounds
- Electromagnetic backgrounds more important than at higher masses:
  - Design radiopure detector components, with focus on all γ-emitters
  - Develop radiopure SiPM & readout components to minimize γ-emitters
  - Improve purification of β-emitting contaminants (e.g. tritium, ^{39}Ar)

Lower energy threshold

- Calibrate detector response to O(1 keV) and below nuclear and electron recoils
- Optimize E-field configuration to maximize ionization signal
  - E.g. Higher drift field
    → less recombination
    → larger ionization signal
- Minimize low energy backgrounds
- Develop techniques for doping noble liquids:
  - Low ionization dopants to improve ionization/scintillation efficiency
  - Low A dopants for better kinematic coupling to light dark matter

Single electron backgrounds





DarkSide-50, PRL 121, 081307 (2018)

This can be improved with further study on:

- Effect of electronegative impurities on this background
- Effect of electric field

Removal of this background would significantly enhance the sensitivity of low mass dark matter searches and allow for lower energy thresholds

See also: APS talks from XENON (A. Depoian) and LUX (J. Xu)

The End

- Developing technology for low threshold LXe and LAr detectors
- Likely applications beyond our immediate plans
- Similar interests?
  Let’s talk more!