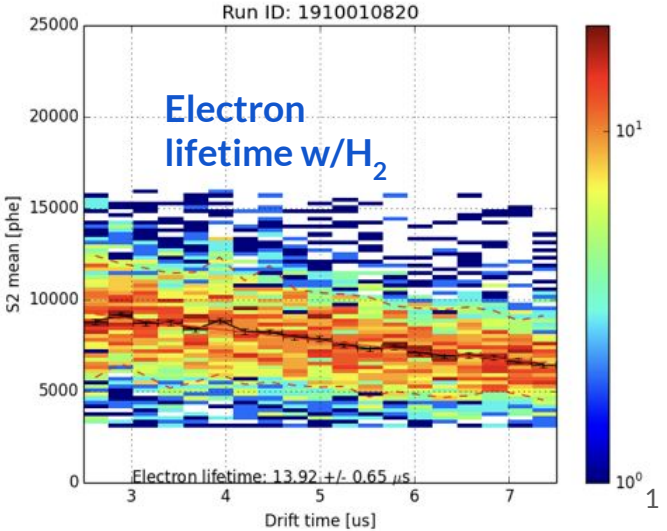
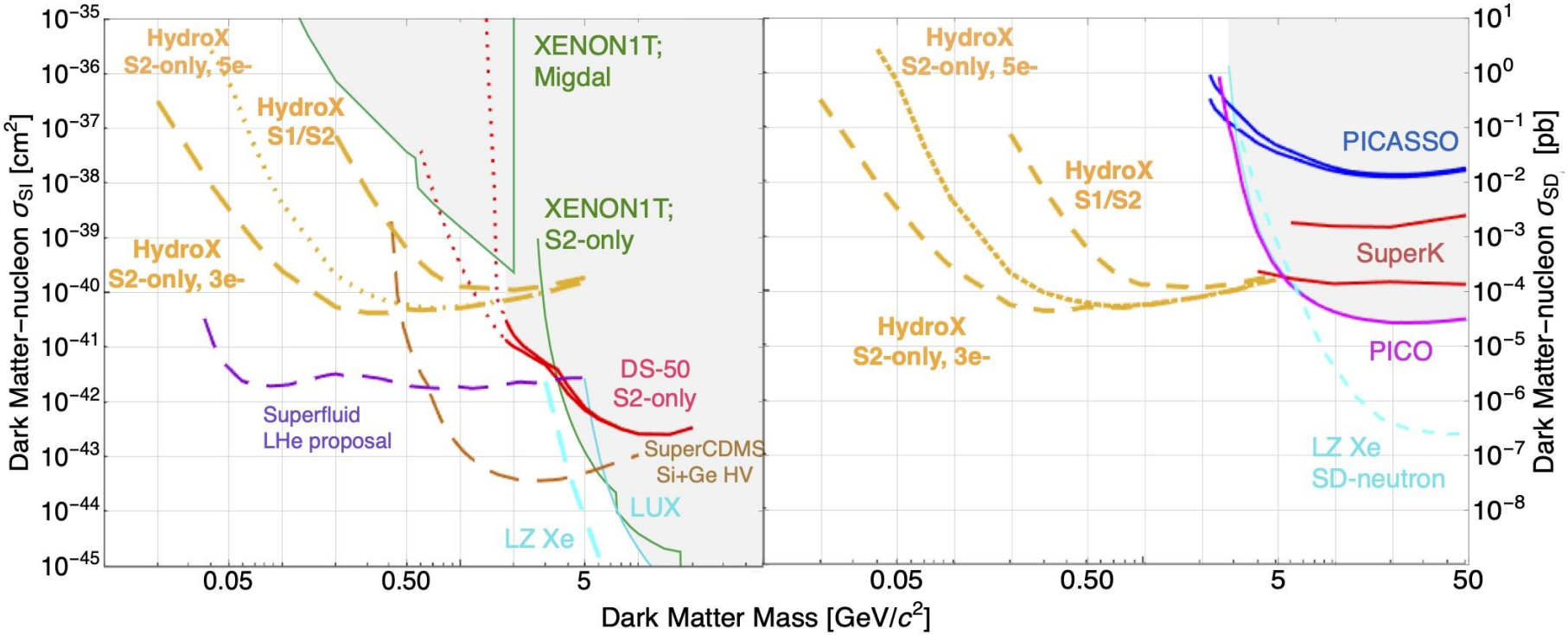
Upgrade to LXe TPC for low mass dark matter

- Hydrogen is the lightest nuclei available to probe light dark matter
  - Sensitive to both spin-independent and spin-dependent
  - H_2-proton; D_2-neutron
- Run in LZ after main WIMP search - Extremely well characterized low background environment
- First steps at Fermilab (PAB):
  - TPC still works with H_2!
- Major R&D still needed
  - Potential increase in signal from H-recoils
  - Potential losses from quenching on H_2
  - How much H_2 can be loaded into LXe?
  - Cryogenic implications



HydroX sensitivity



Spin independent

Spin dependent

Content of a White Paper (very preliminary)

- R&D Program: Answers needed to quantitatively validate HydroX physics reach
  - How much H_2 can we put in LZ? Need to understand:
    - H_2 solubility in xenon
    - H_2 + Xe cryogenics
    - TPC performance of H_2 + Xe
  - What is XeTPC response to proton / deuteron recoils?
    - S1 + S2 response (keV-scale calibrations)
    - S2-only response (10eV-scale calibrations)
- Cosmic Program:
  - Physics case for HydroX
  - What does it take (time and money) to make HydroX happen in LZ

- HydroX institutions (from last year's New Initiatives proposal):
  - UCSB (lead), Fermilab, Northwestern, SLAC, LBNL, SDSTA (SURF), Michigan, Penn St, Wisconsin
  - ^ includes current LZ spokesperson, 2 past LZ spokespeople, and LZ lead lab (LBNL)