



LUX

DARK MATTER SEARCH

Carter Hall, University of Maryland

Direct detection of WIMP dark matter

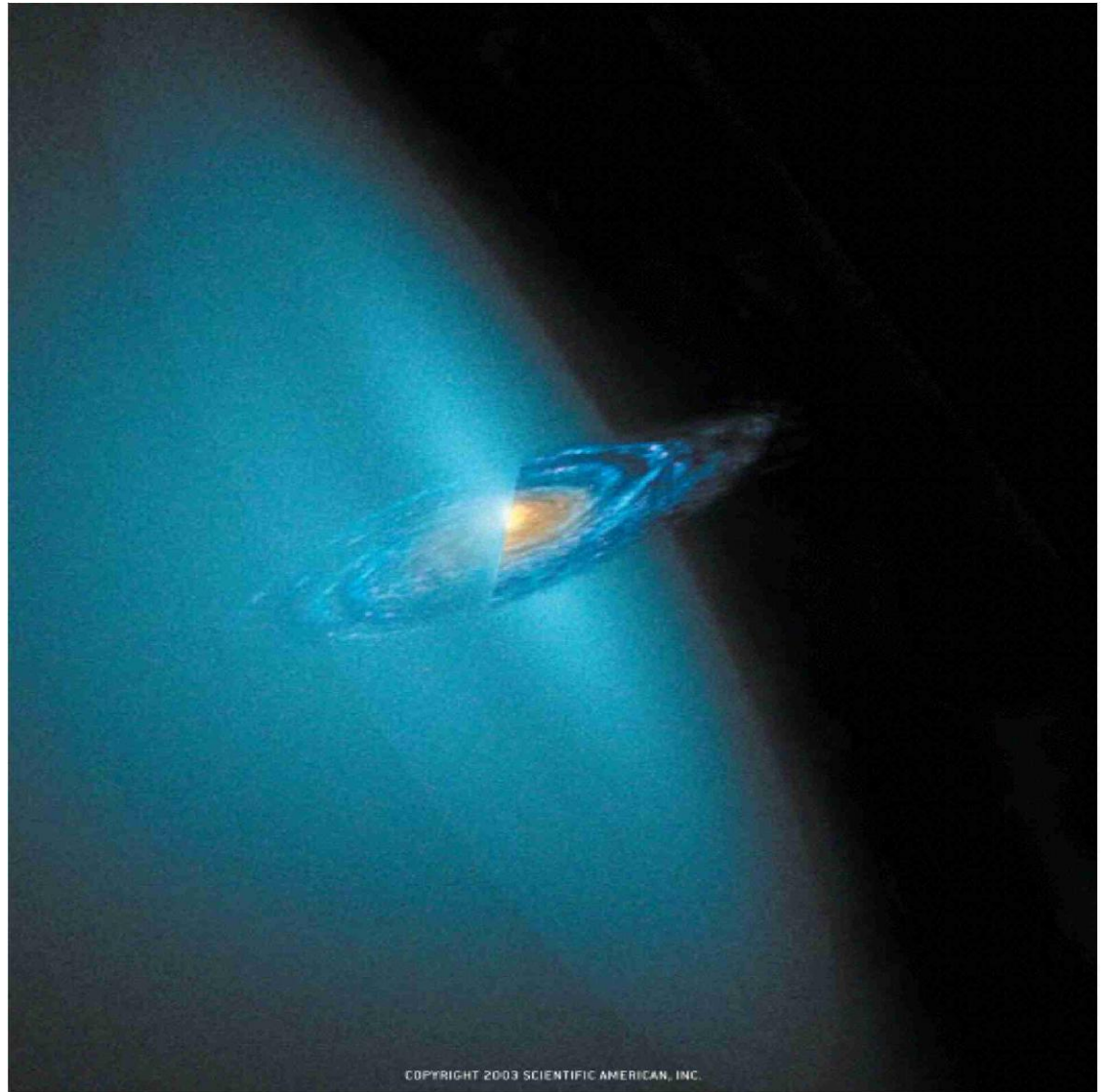
$\rho \sim 300$ proton masses
per liter of space.

If $M_{\text{WIMP}} \sim 100$ GeV,
then 3 WIMP/liter.

Typical orbital velocity
 ~ 230 km/sec,
or 0.1% speed of light.

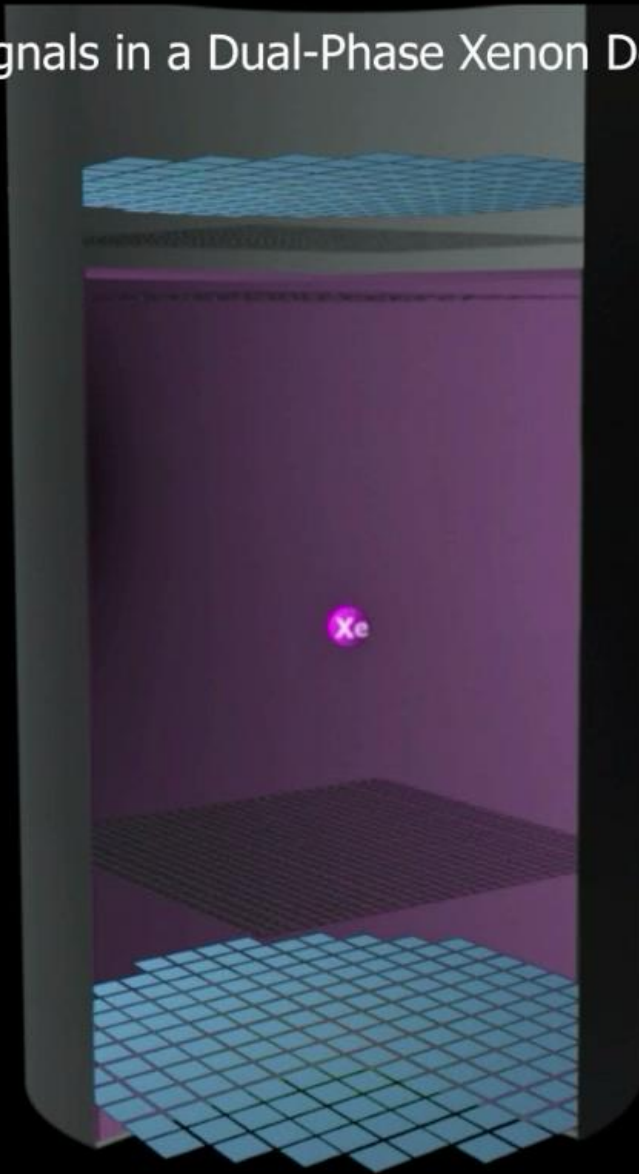
Coherent scalar
interactions:

$$\sigma \sim A^2$$

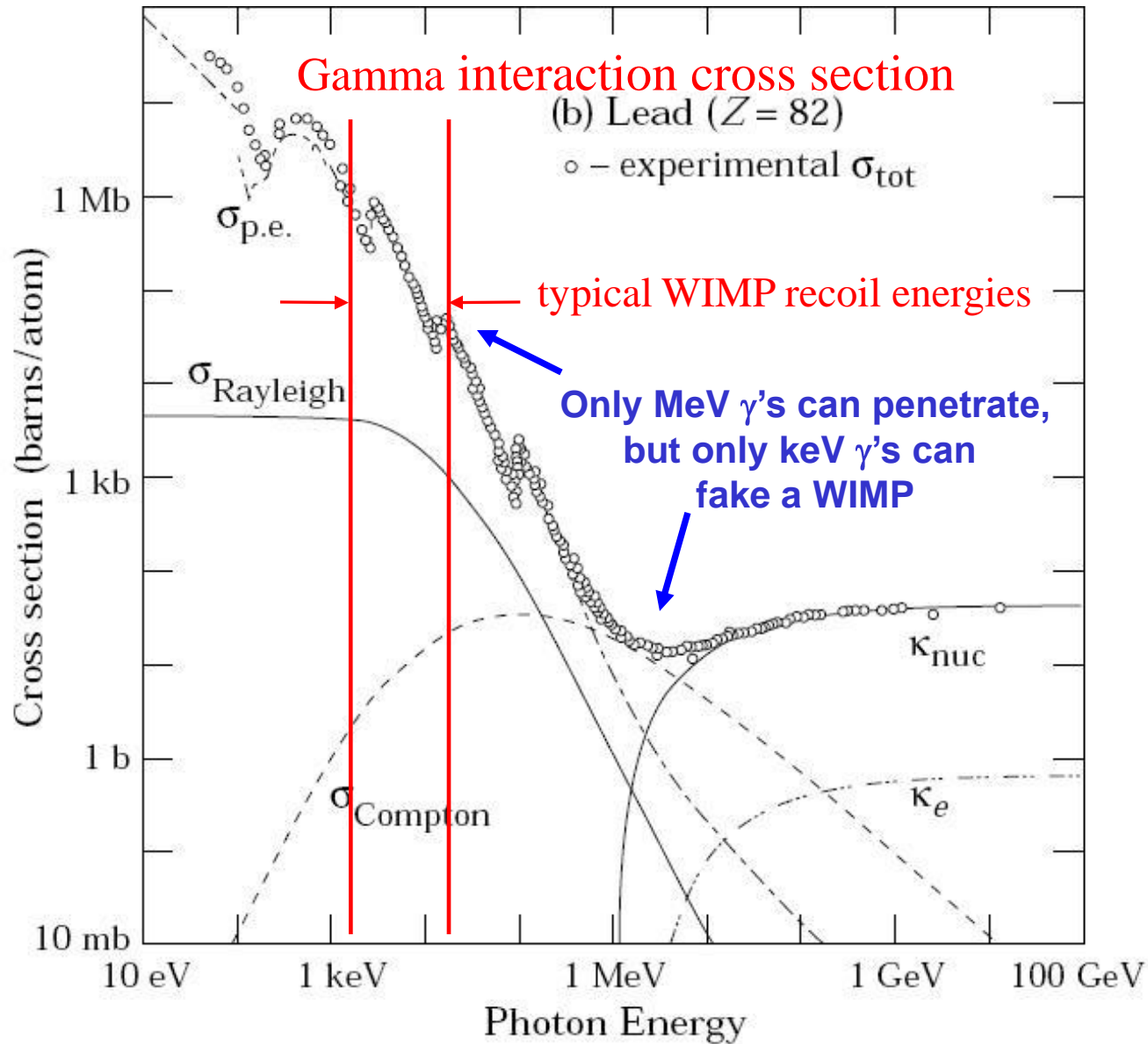


Rate < 1 event / kg / 100 days, or much, much lower

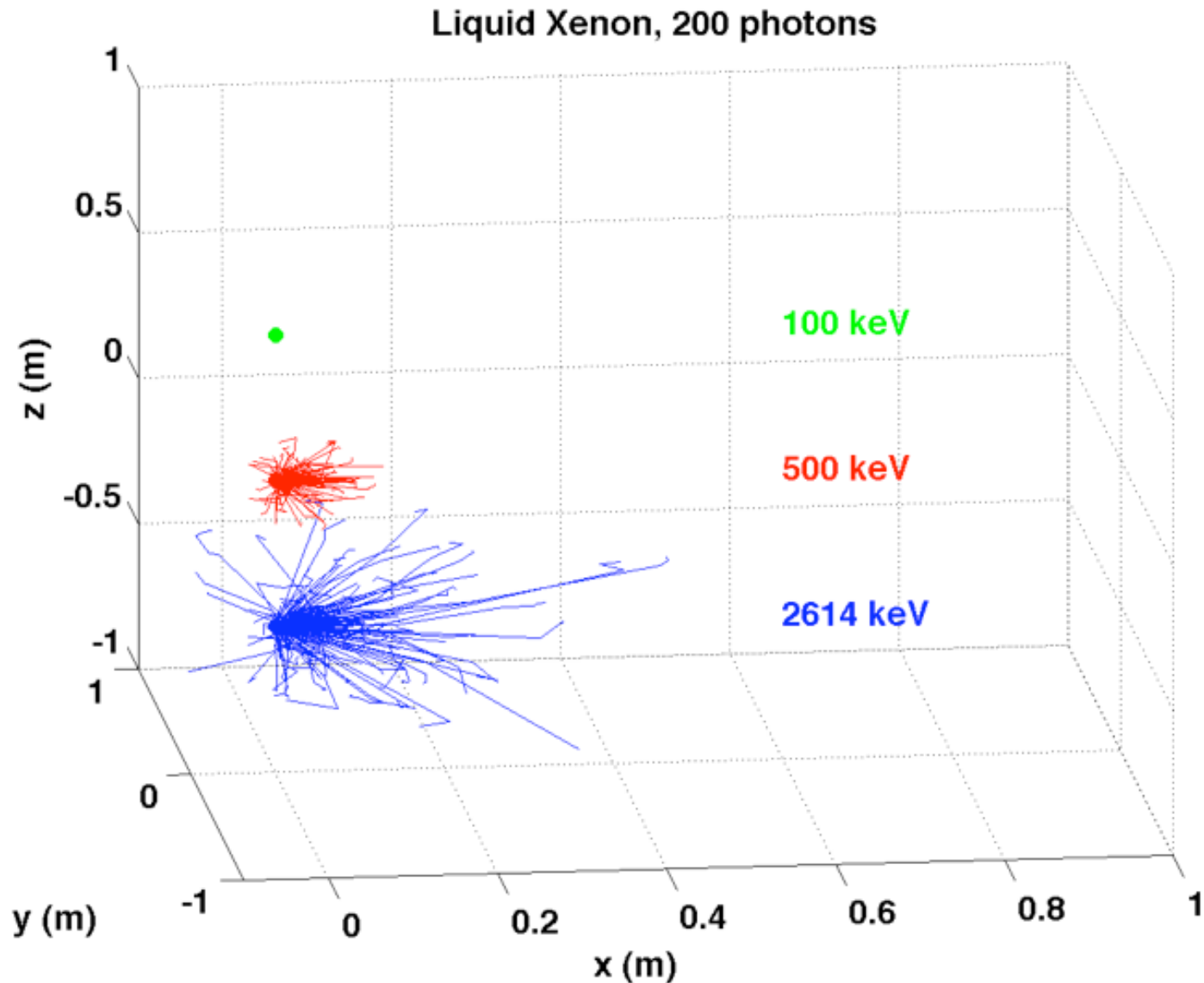
WIMP Signals in a Dual-Phase Xenon Detector



It's not difficult to shield at 10 keV



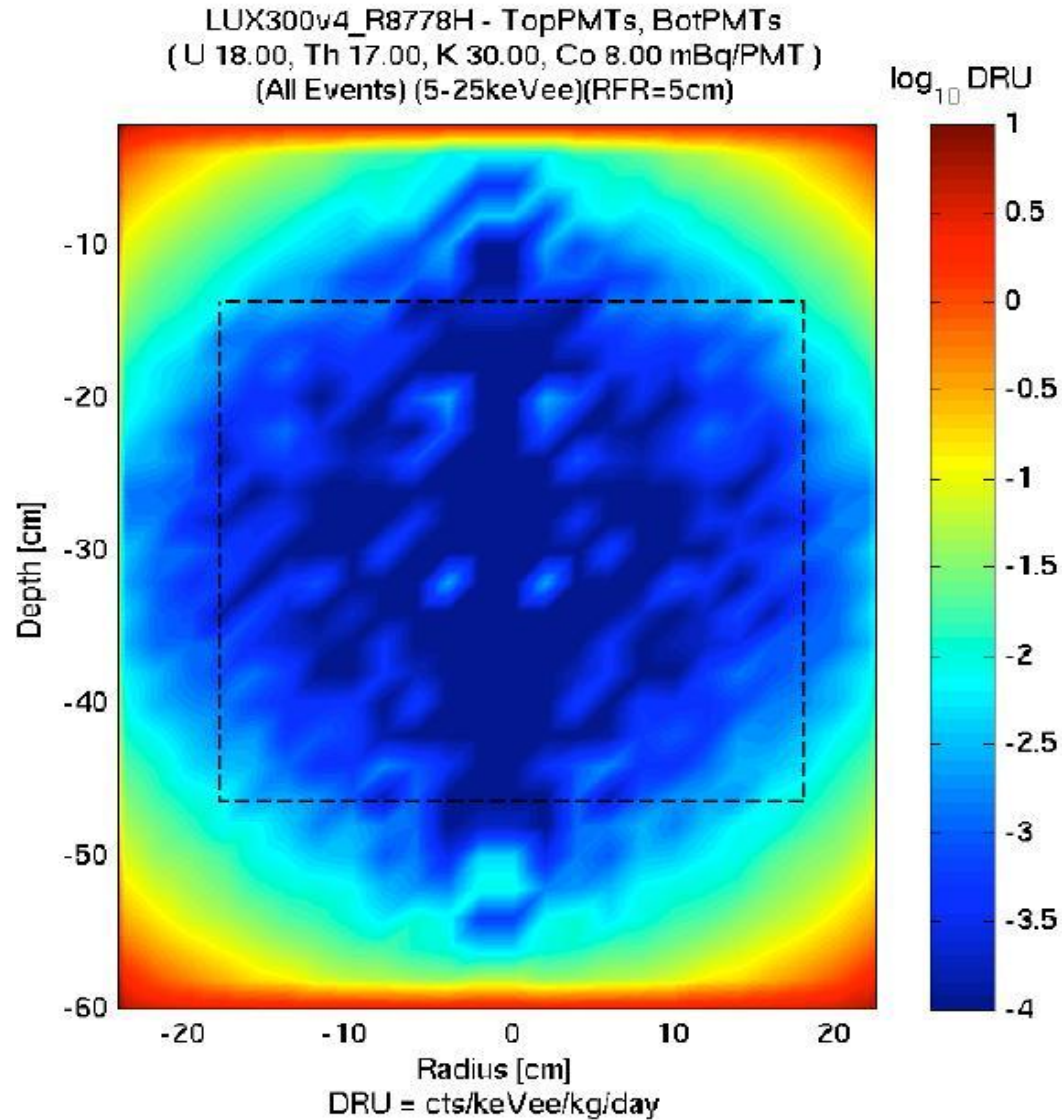
Self-shielding of liquid xenon is extremely powerful



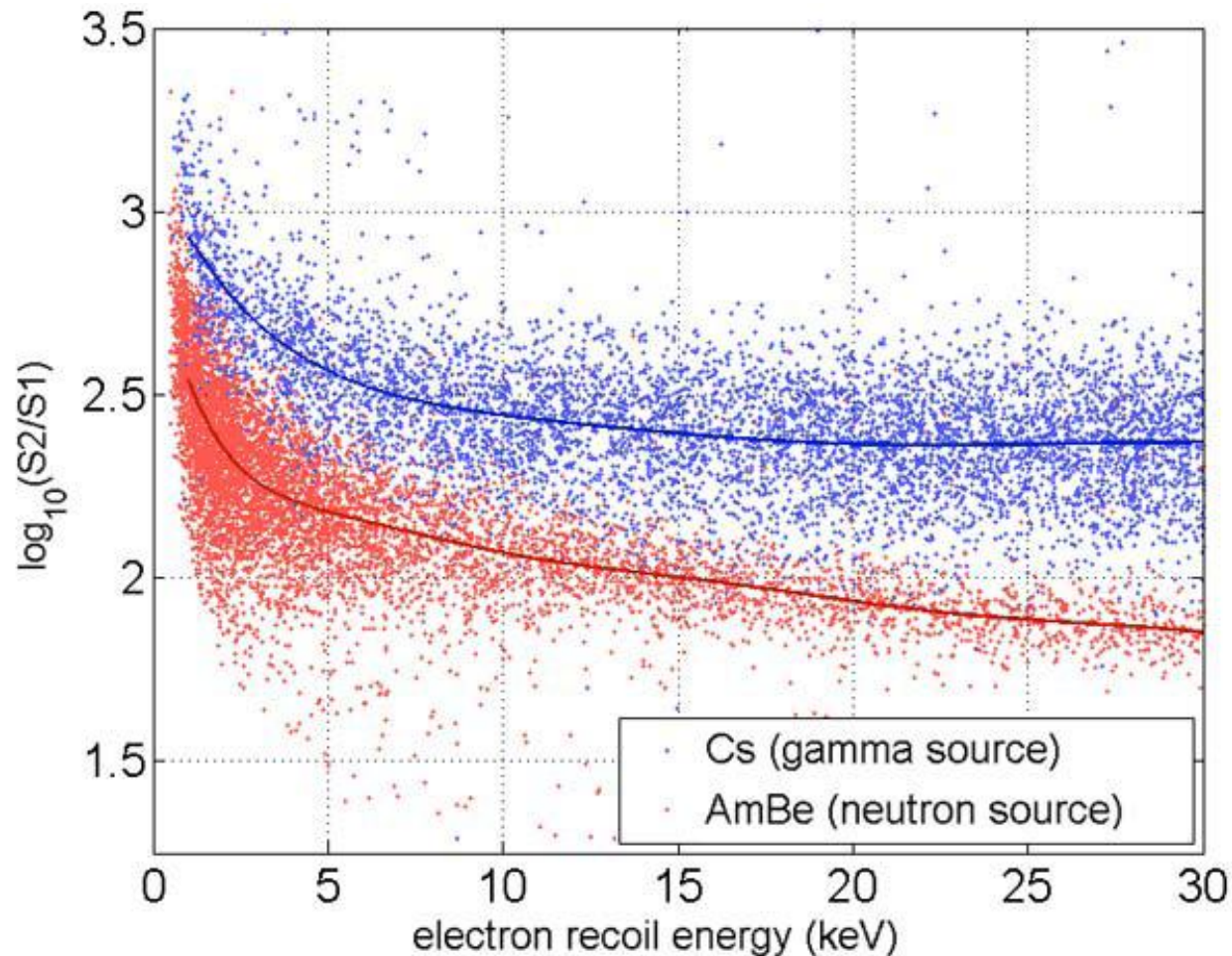
Fiducial volume cut rejects most backgrounds

Self-shielding effect

Sensitivity improves quickly as target mass increases!



Particle ID: nuclear recoil discrimination

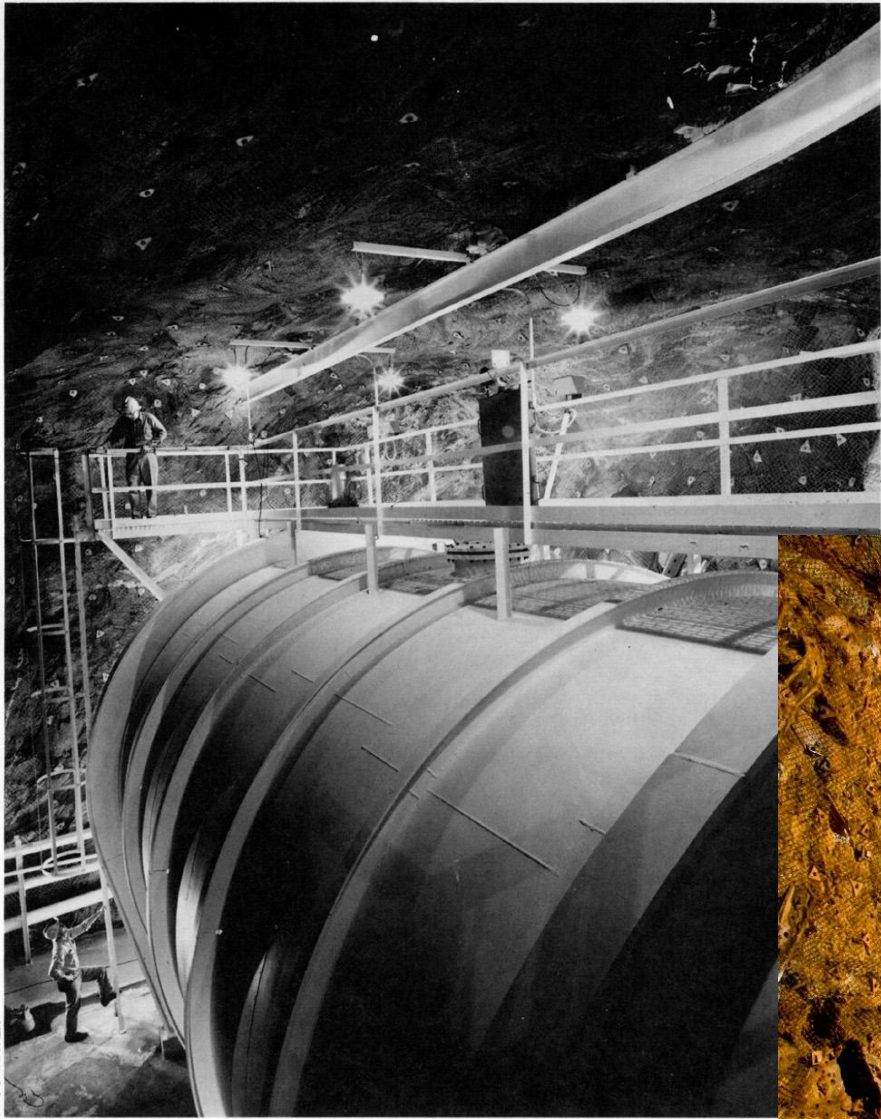


Ionization-to-scintillation ratio allows discrimination between common radioactivity and WIMP events.
Background rejection factor of ~ 180

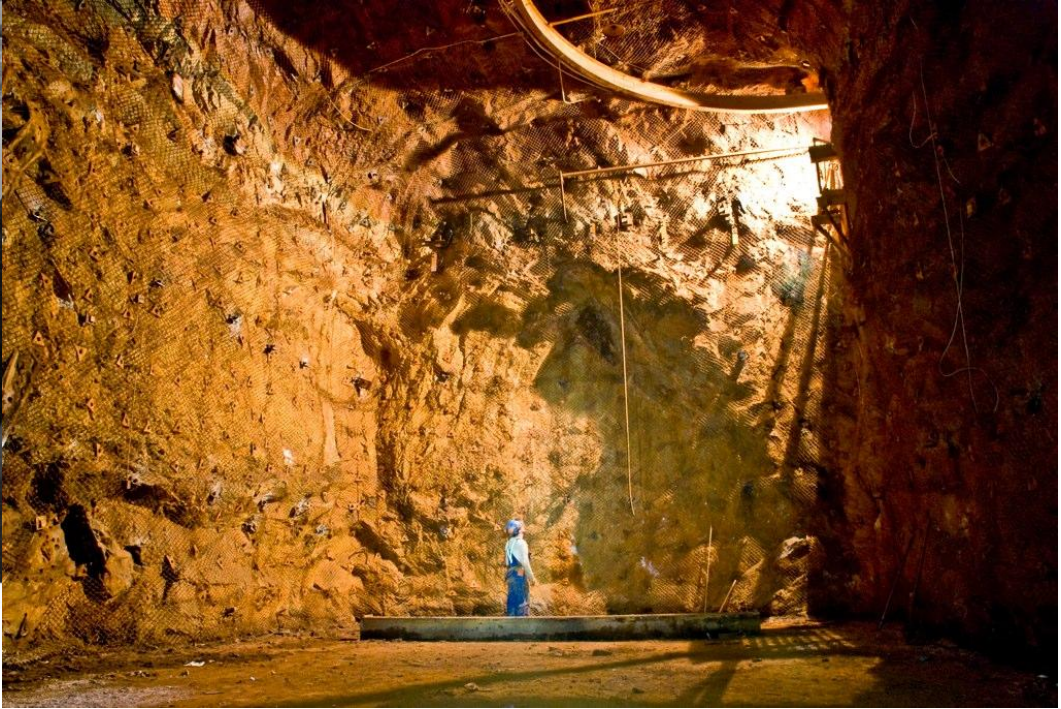
The Hunters Hut

Homestake (SD)





Raymond Davis

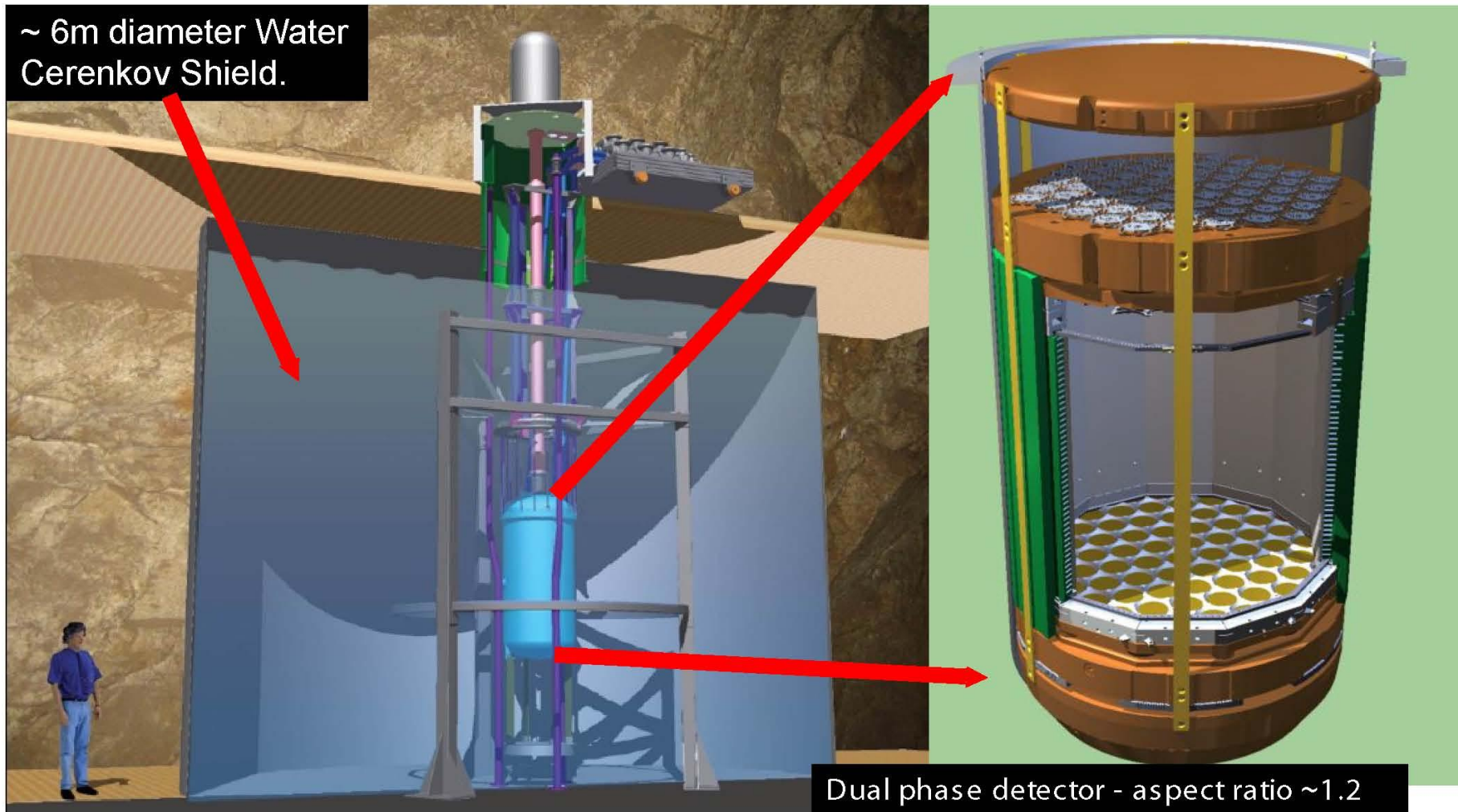


Davis' neutrino detection apparatus one kilometer underground in the Homestake Gold Mine, Lead, South Dakota. The tank contains 400,000 liters of perchloroethylene.

Davis Cavern @ Homestake, 9/21/09

BROOKHAVEN

The LUX Detector

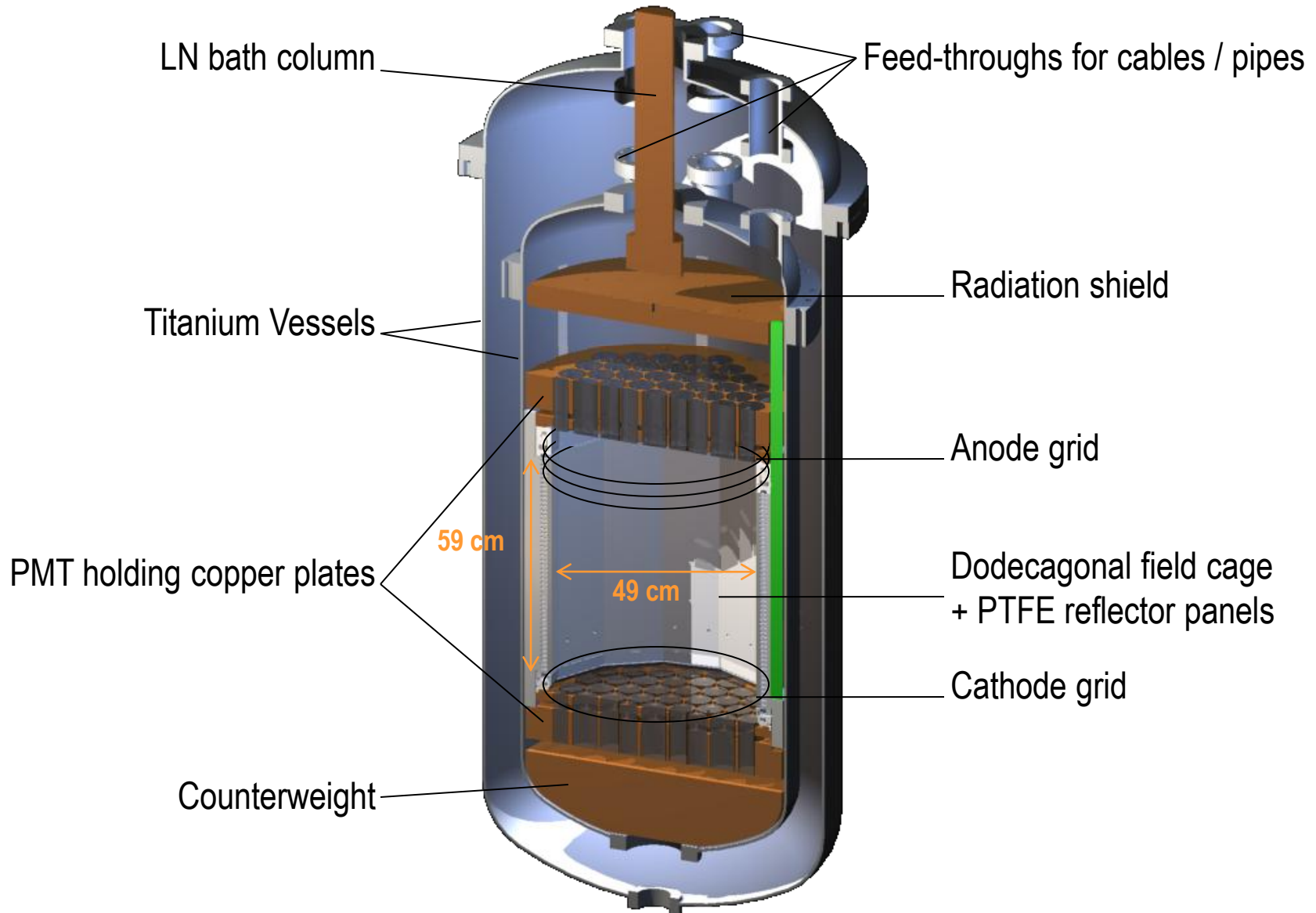


350 kg Dual Phase Liquid Xenon Time Projection Chamber, fully funded by NSF and DOE
2 kV/cm drift field in liquid, 5 kV/cm for extraction, and 10 kV/cm in gas phase.

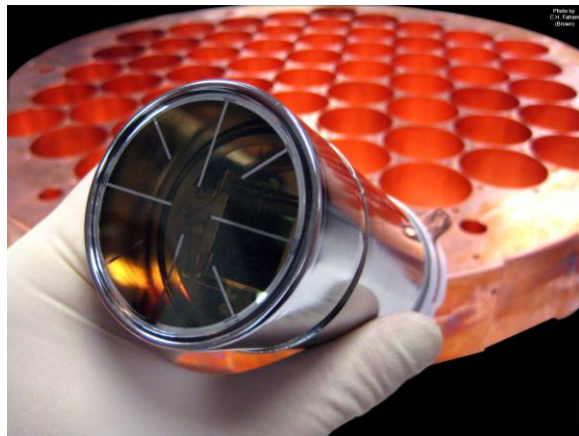
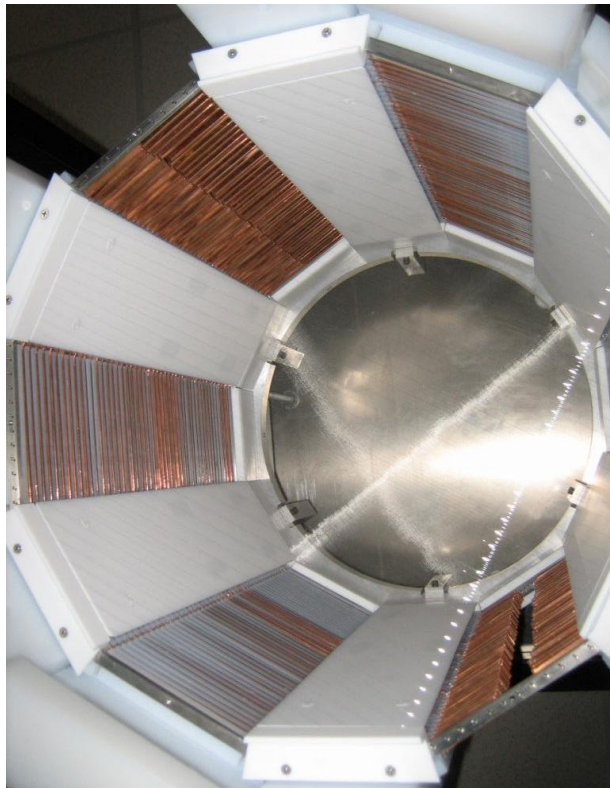
122 PMTs (Hamamatsu R8778) in two arrays

3D imaging via TPC eliminates surface events, defines 100 kg fiducial mass

LUX Detector - Overview



LUX 350 kg detector under construction



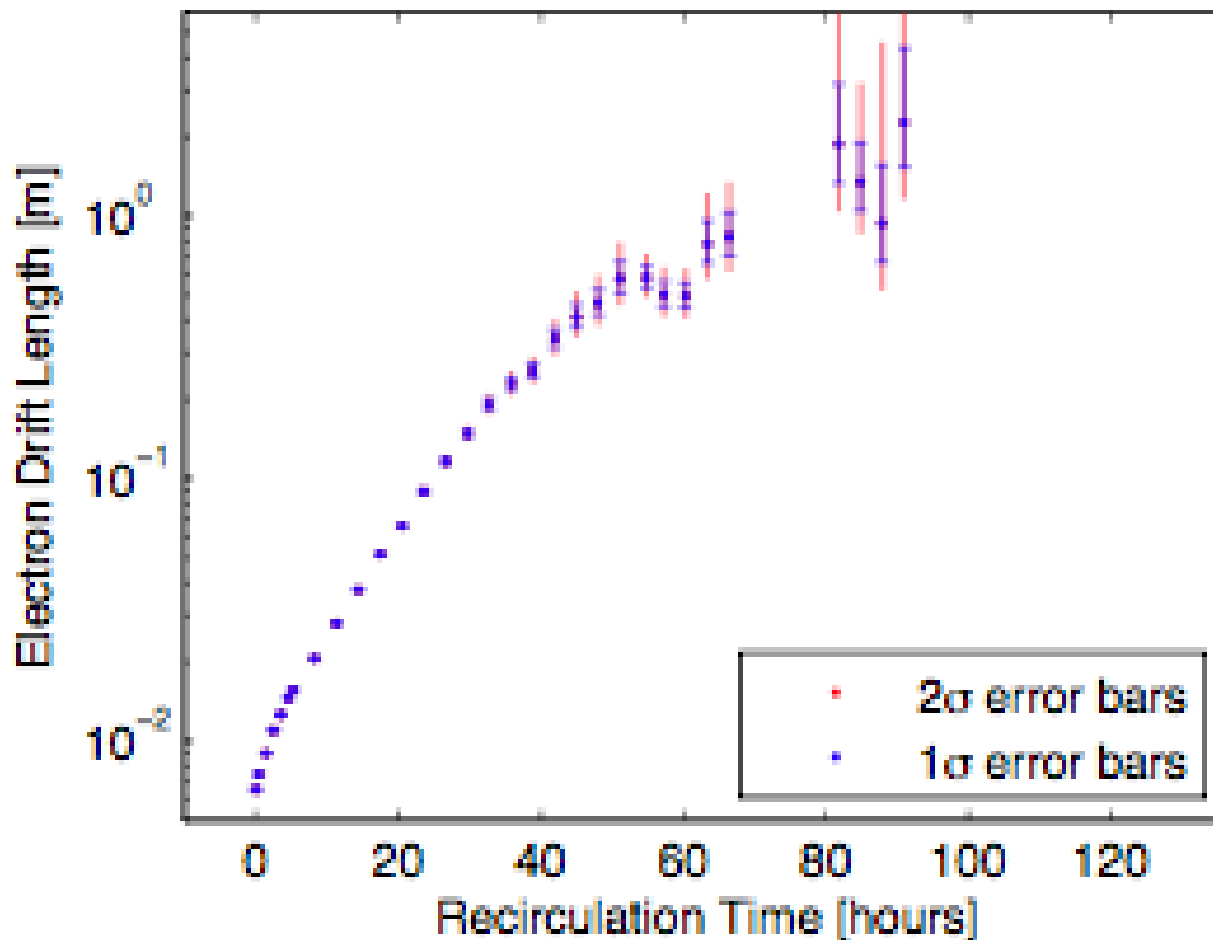
Test fit of detector inside the titanium cryostat



Assembly & commissioning in a new laboratory on the surface at Homestake

Xenon Purity measured in a 60 kg test run

Purification vs. Time, Run009



0.2 tonnes
circulation per day

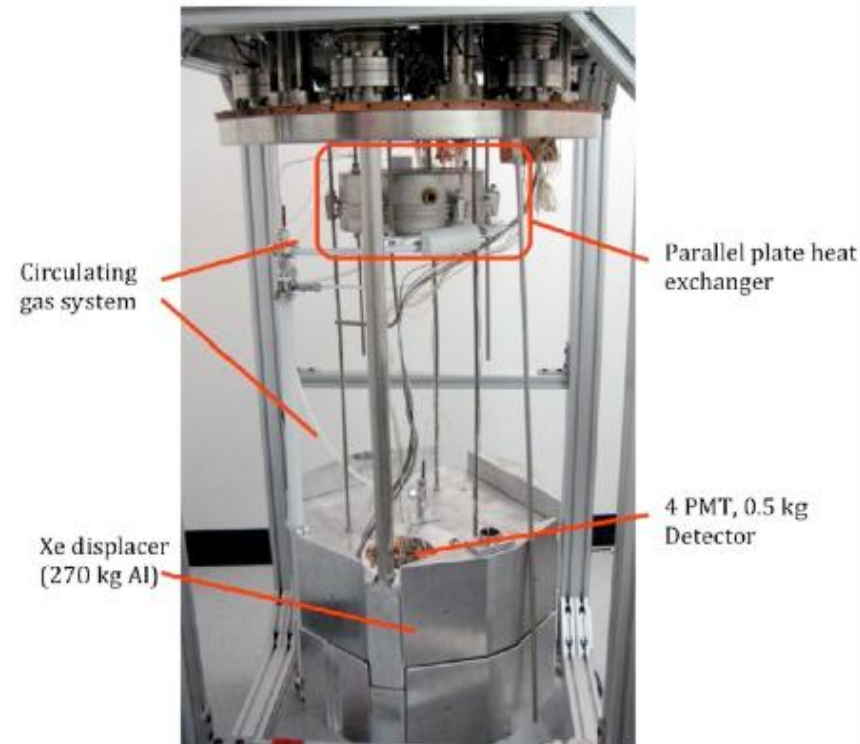
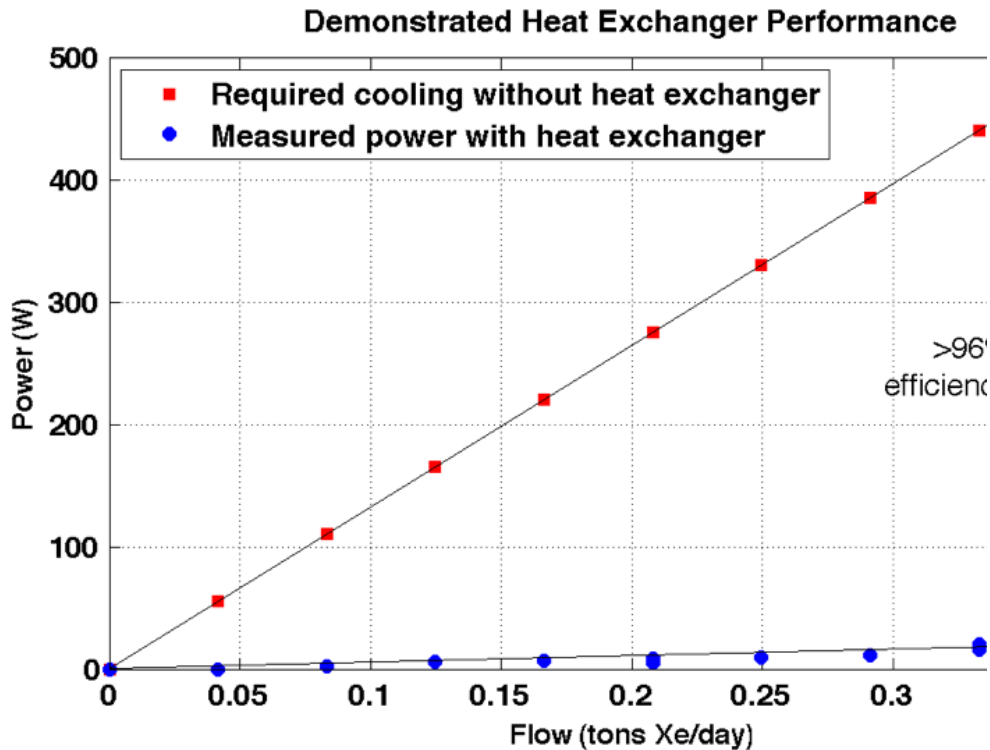
- ~9 hr time constant for purification

- > 2 m electron drift length achieved (> 1000 us) with 60kg target

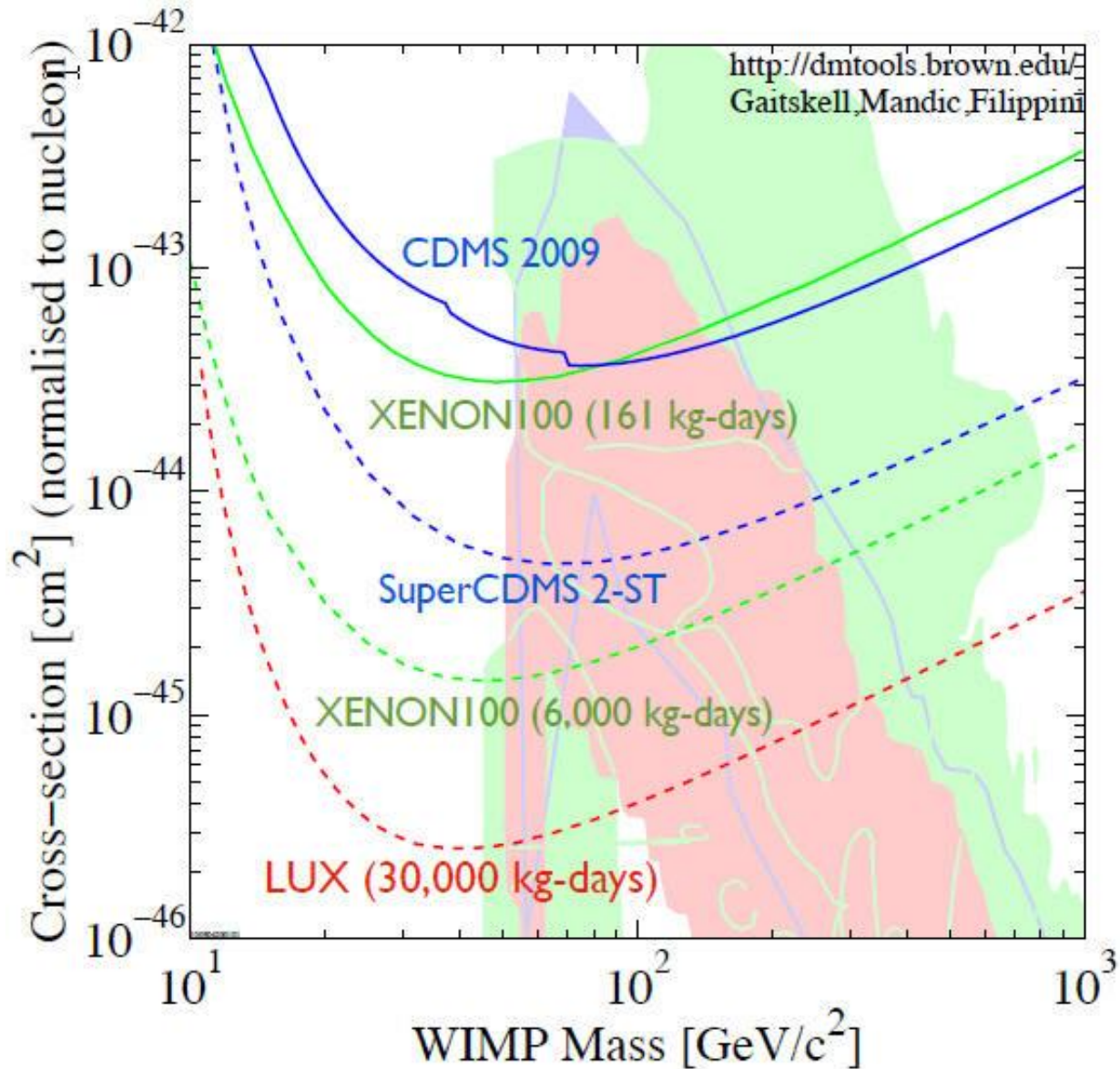
- Errors dominated by use of 5 cm test cell drift within large cryostat

Heat Exchanger Operates >96% Efficient

Demonstrated - 18 W required to circulate 0.4 tonnes of Xe a day
Evaporate Liquid > Gas / Purification -> Re-condense Liquid



LUX dark matter sensitivity

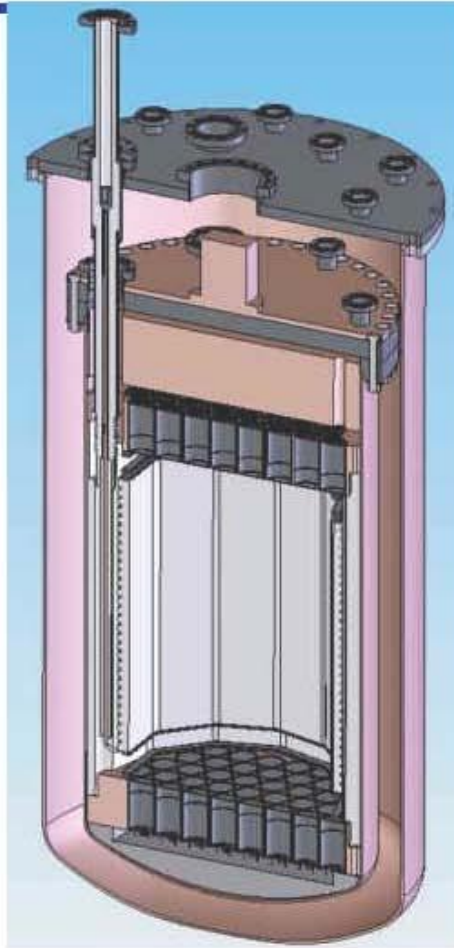


**Status: LUX is being now being assembled on the surface at Homestake.
Expect to move underground in December 2010.**

Evolution



XENON10
22 kg / Fiducial 5.4 kg



LUX
350 kg / Fiducial 100 kg



LZ20
20000 kg / Fiducial 16000 kg



Collaboration meeting @ Homestake mine, March 1, 2009