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The LUX WIMP Detector

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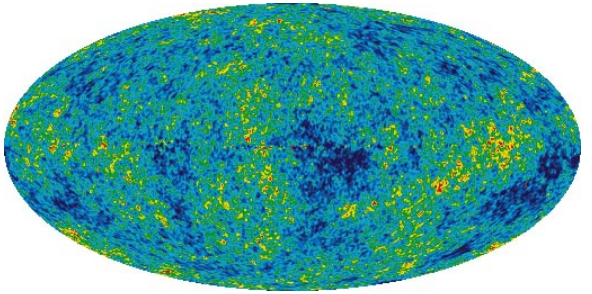
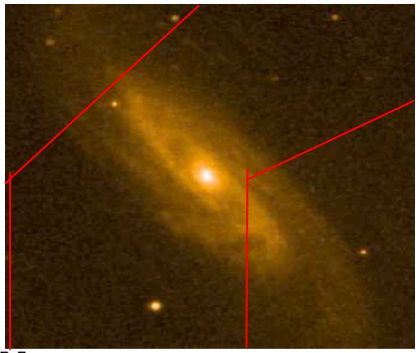
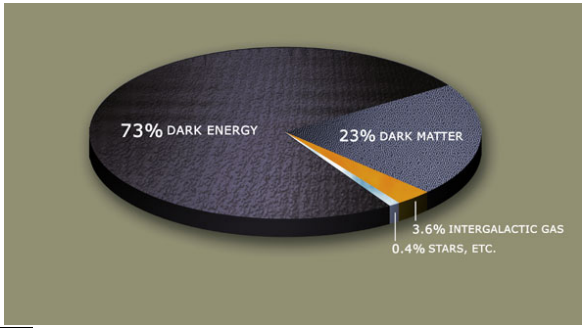
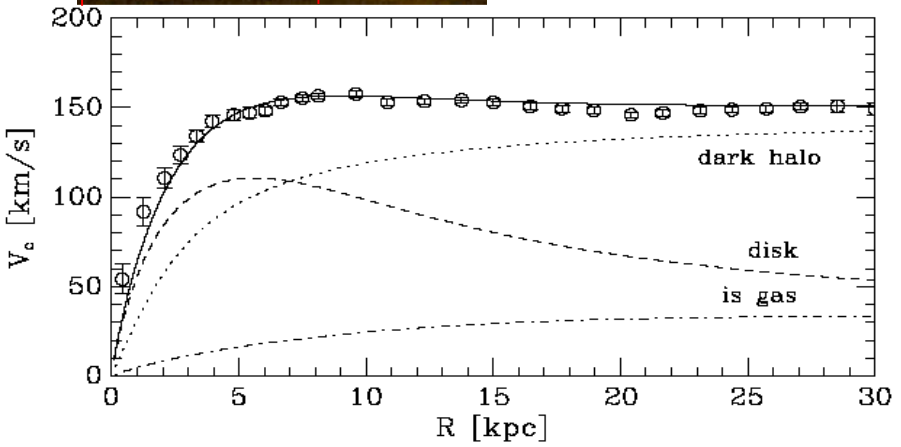
Dark Matter

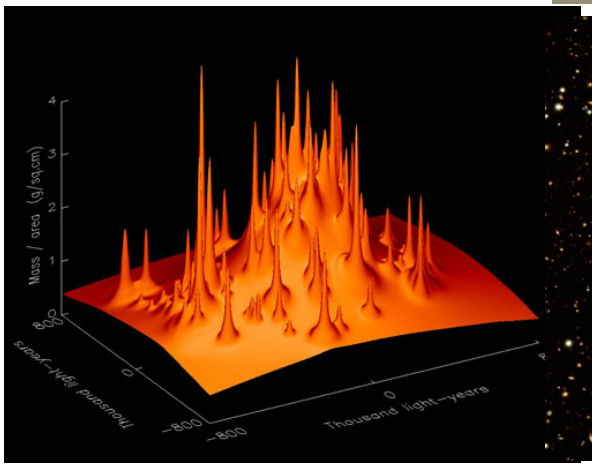
- Galactic rotation curves
- Galaxy clusters
  - Galaxy velocities
  - X-ray Temperature
  - S-Z effect
  - Lensing
- Big bang nucleosynthesis
- CMB anisotropy
- Large-scale structure growth











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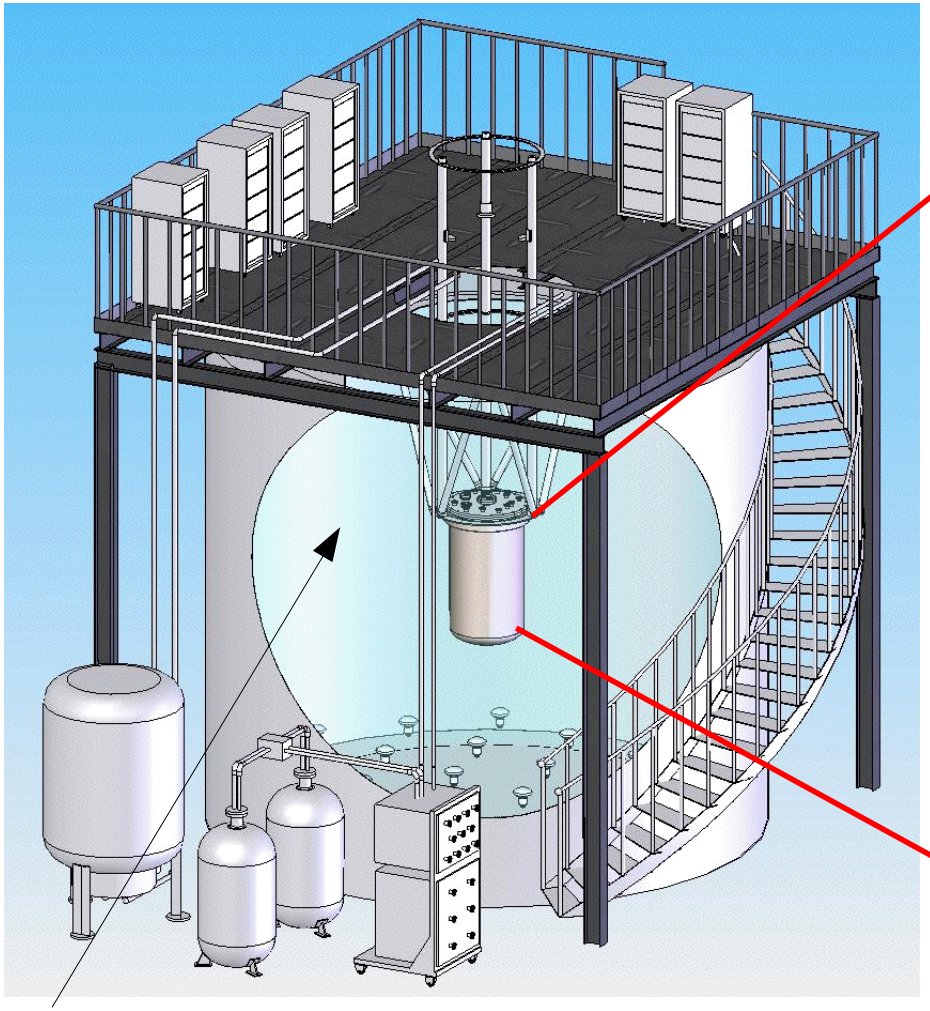
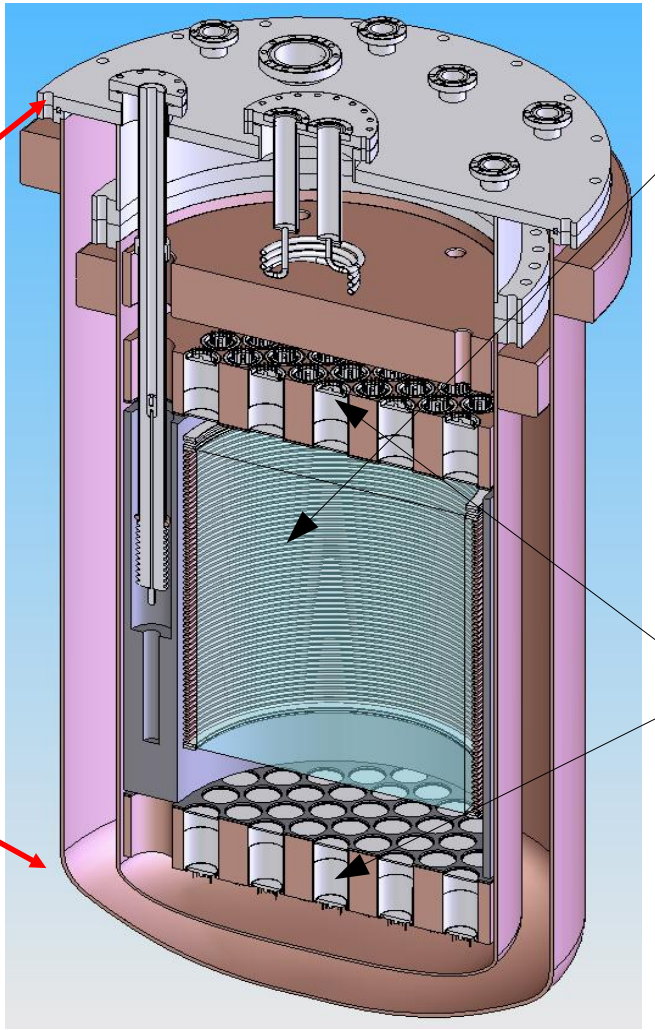
WIMPs
Weakly Interacting Massive Particles

- Dark matter particles must interact weakly (or not at all) otherwise they would have been detected.
- Supersymmetry provides possible WIMP candidates
  - The lightest supersymmetric particle (LSP) is usually taken to be stable
  - Supersymmetric particles created during the big bang would decay to the stable LSP
- WIMP detection means new physics beyond the standard model

The LUX Detector



Water Shield/Muon Veto



300 kg Xenon (100 Kg fiducial)

PMTs

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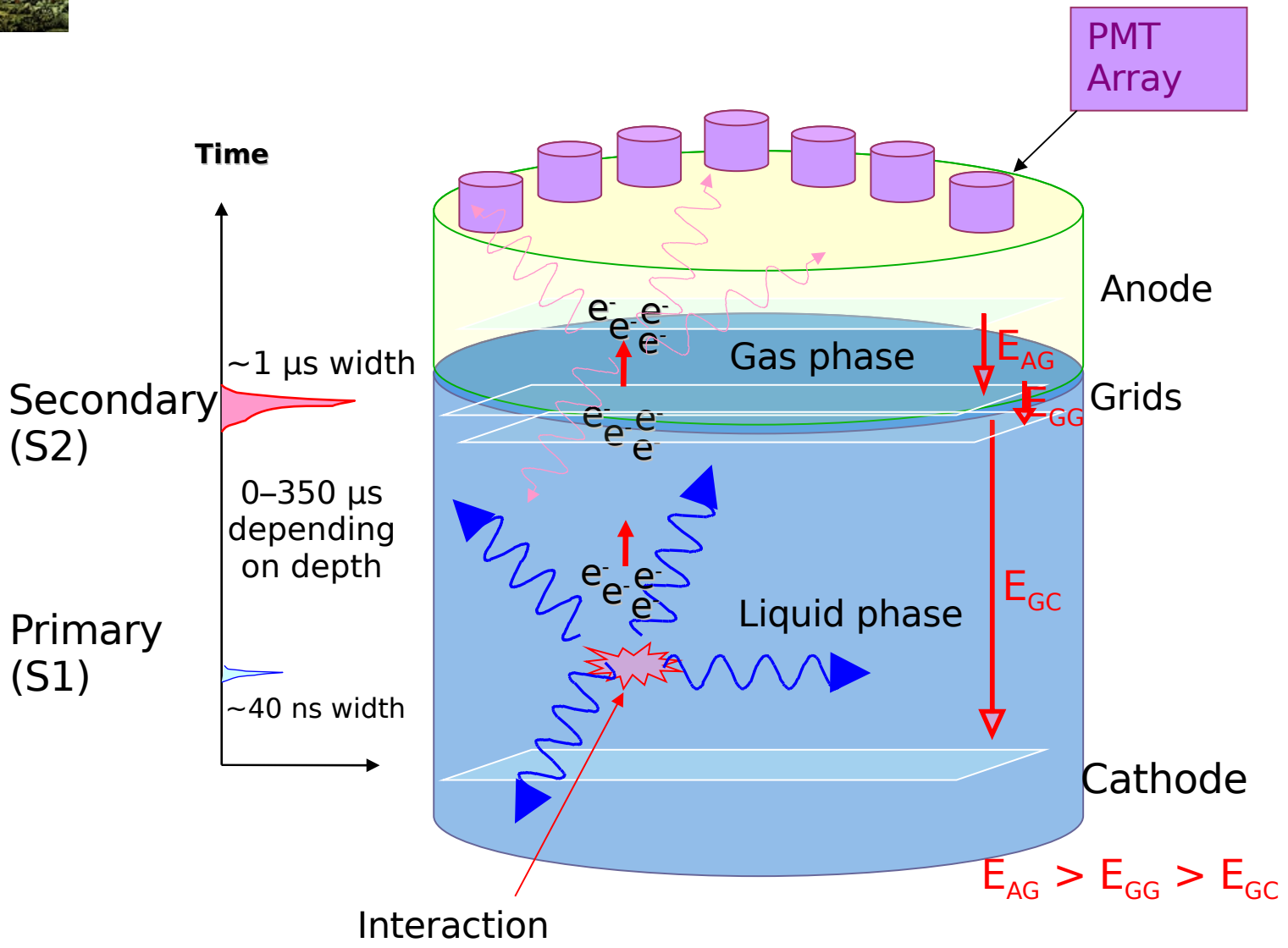
LUX

Detection Method



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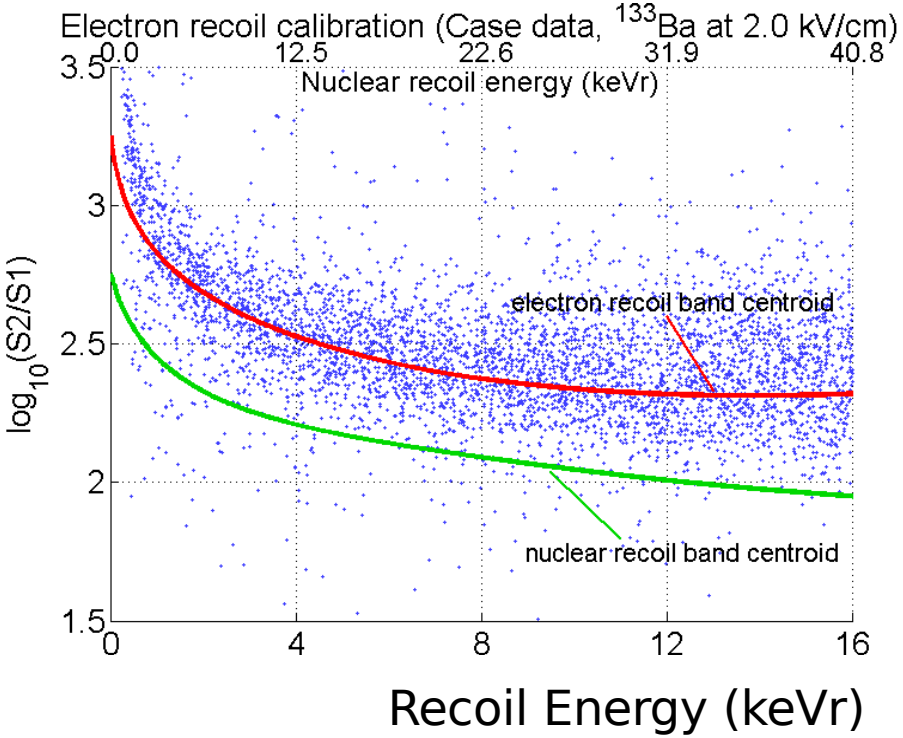
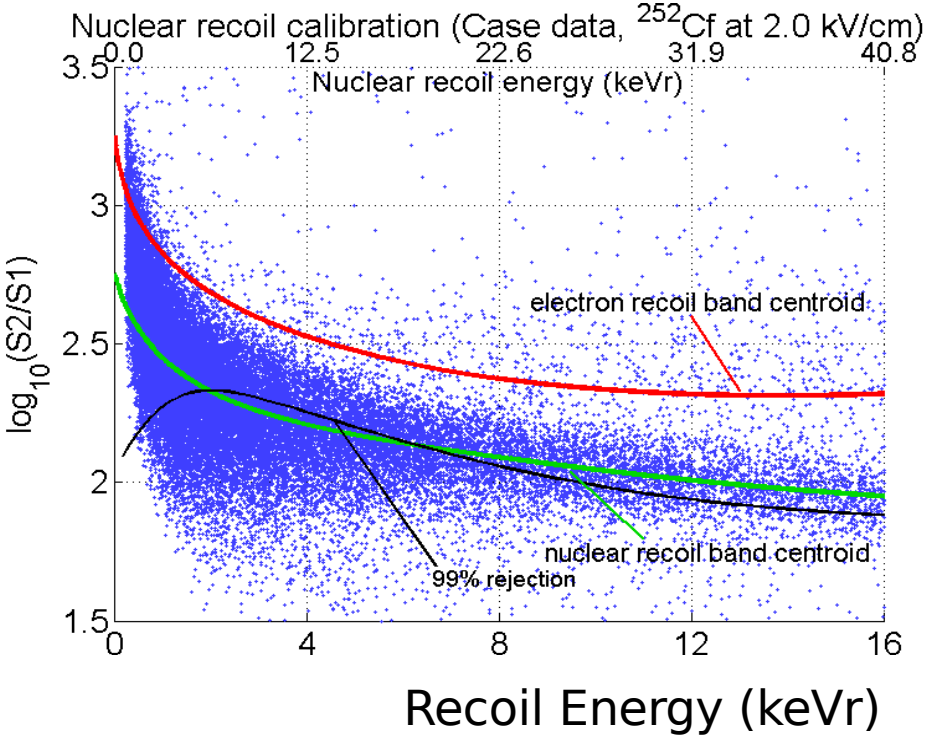
Background Discrimination





These measurements were made above ground, but agree well with Xenon10 experience.

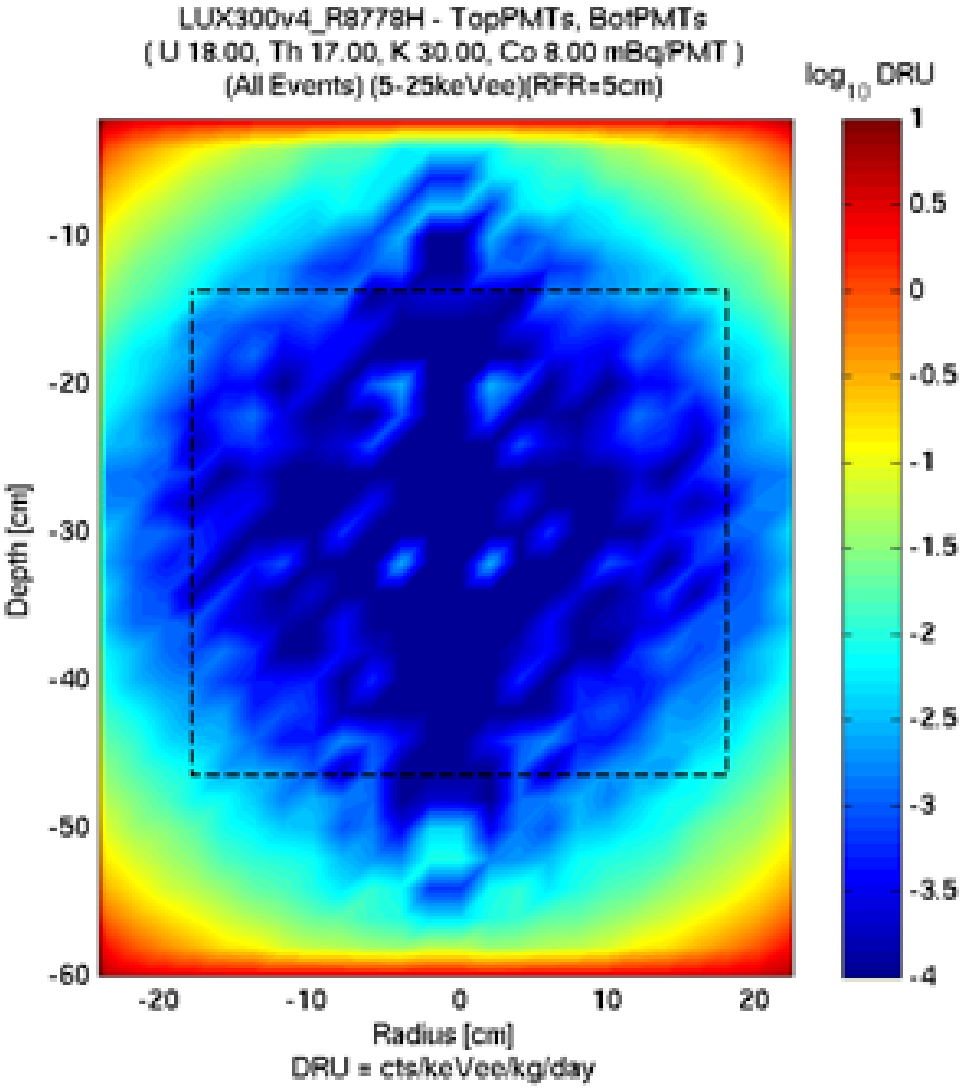
Background

Gammas

Internal strong self-shielding against PMT activity (main source of background events). Double Compton scatters are rejected.

External large water shield with muon veto.

Very effective for cavern γ -- Very low gamma backgrounds with readily achievable $<10^{-11}$ g/g purity for water.



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Background

Neutrons

Internal

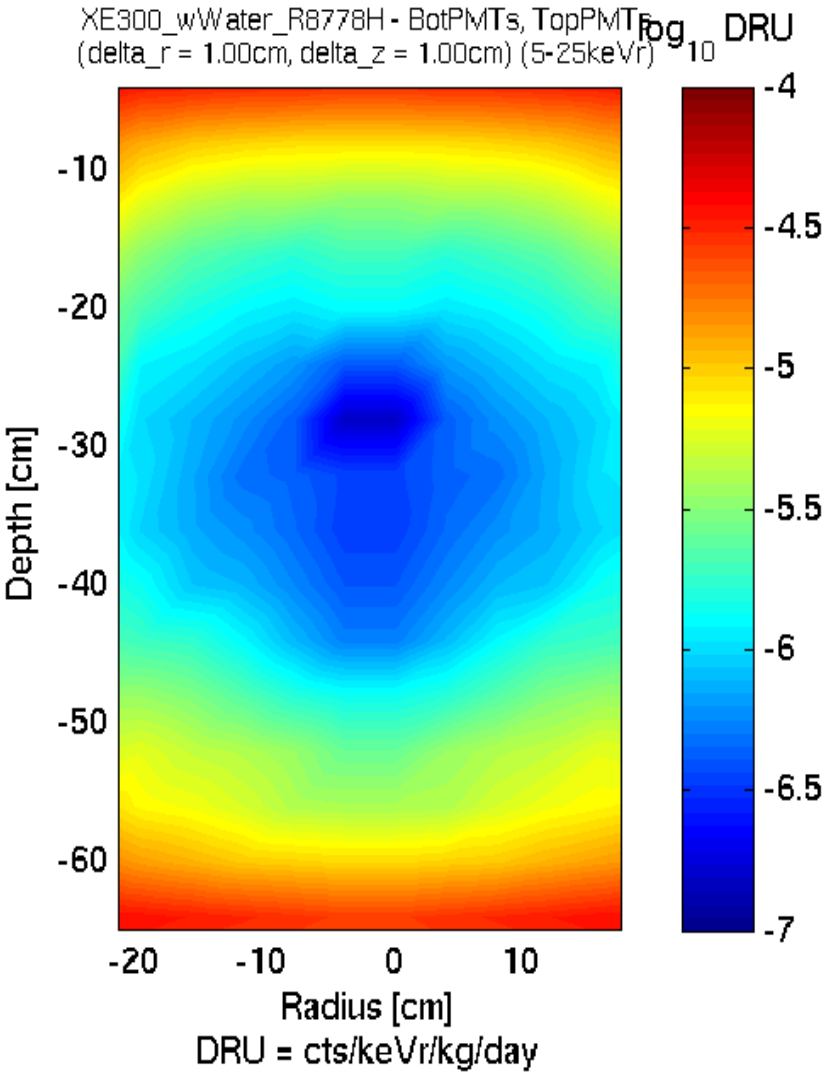
Neutrons (α,n) & fission << $\gamma + \beta$.

~65% double scatter.

(PMTs are the main source)

External large water shield with muon veto.

- Very effective for cavern n, and HE neutrons from muons
- Possible upgrade of adding Gd to the water.



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LUX Goals

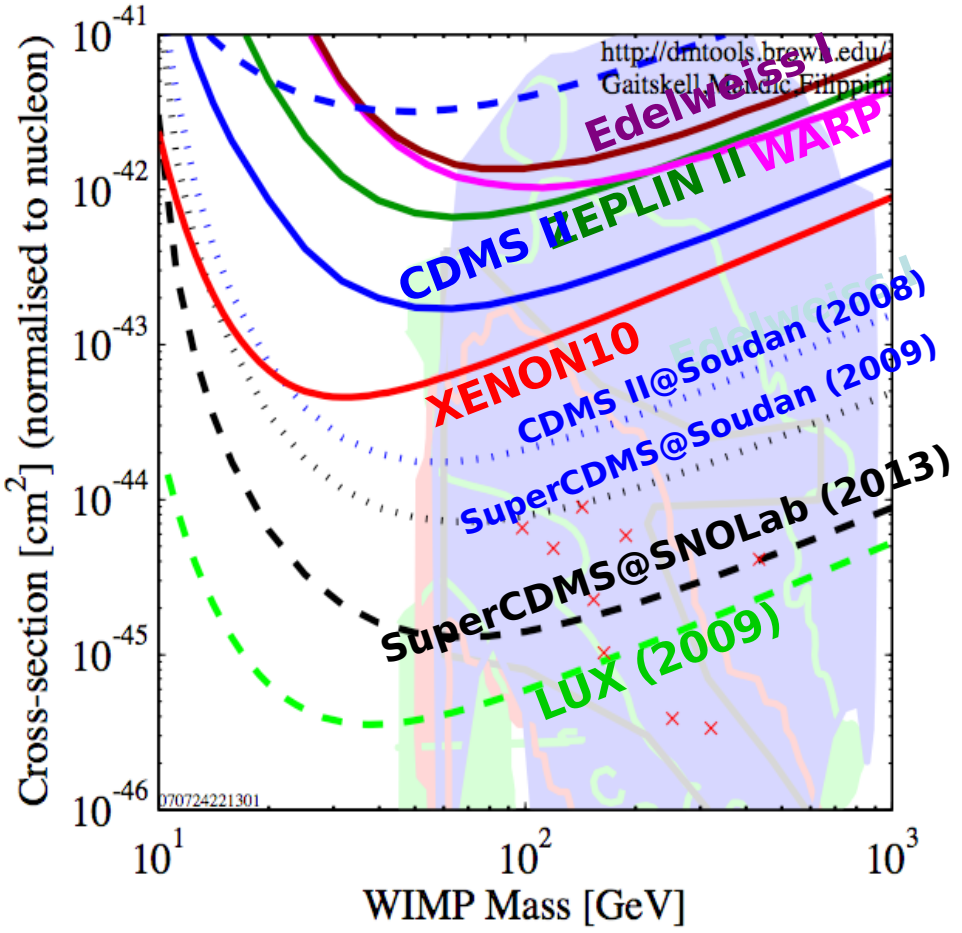
- 99.3 – 99.9% Electron Recoil background rejection for 50% Neutron Recoil acceptance, in the range 5 keVr < E < 25 keV

$\gamma + \beta$ rate < 8 x 10^{-4} events/kg/keVee/day with 99.4% rejection (conservative)

10 month run w/ 50% NR acceptance (net 15,000 kg-days)

<u>DM reach</u> $\sigma \sim 4 \times 10^{-46}$ cm^2

(Equivalent to an event rate of ~0.4/100kg/month in 100kg fiducial)



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Status

- Detector R&D has been ongoing
- Fabrication of many detector components has begun
- Full funding for the experiment has been secured
- Installation at the 4850 level of Homestake will begin later this year
- First results from LUX in 2009
- Following the 300 kg phase, the detector will be scaled to 1 ton

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Conclusion

- LUX will probe for WIMPs with sensitivity orders of magnitude better than current experiments.

- This increased sensitivity will begin to probe the region of WIMP parameter space interesting to theory