The XENON1T TPC

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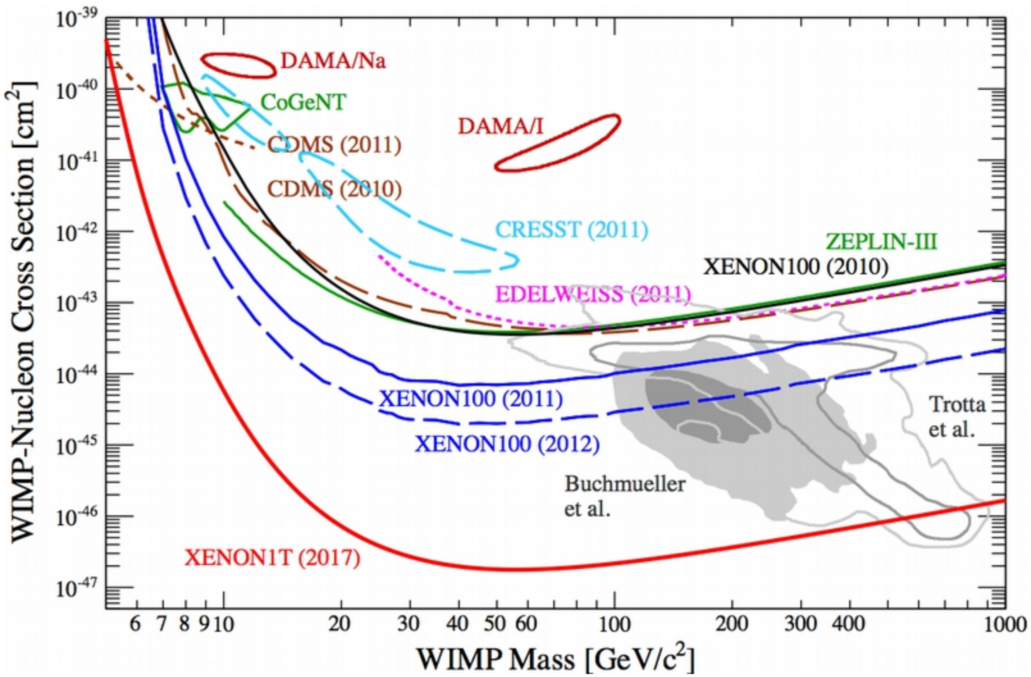
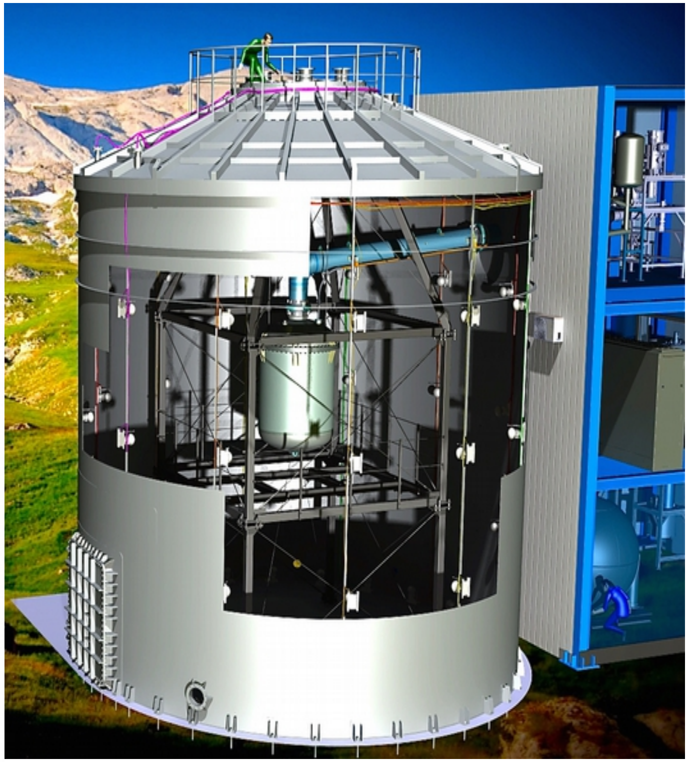
Gindelwald, Switzerland, CHIPP School, January 2015

XENON1T

- 3.2 tons (2 within TPC) of liquid xenon used as scintillator.
- Estimated WIMP-Nucleon cross section limit of 2×10^{-47} cm^2 at 100GeV.
- Construction expected to be completed in 2015.





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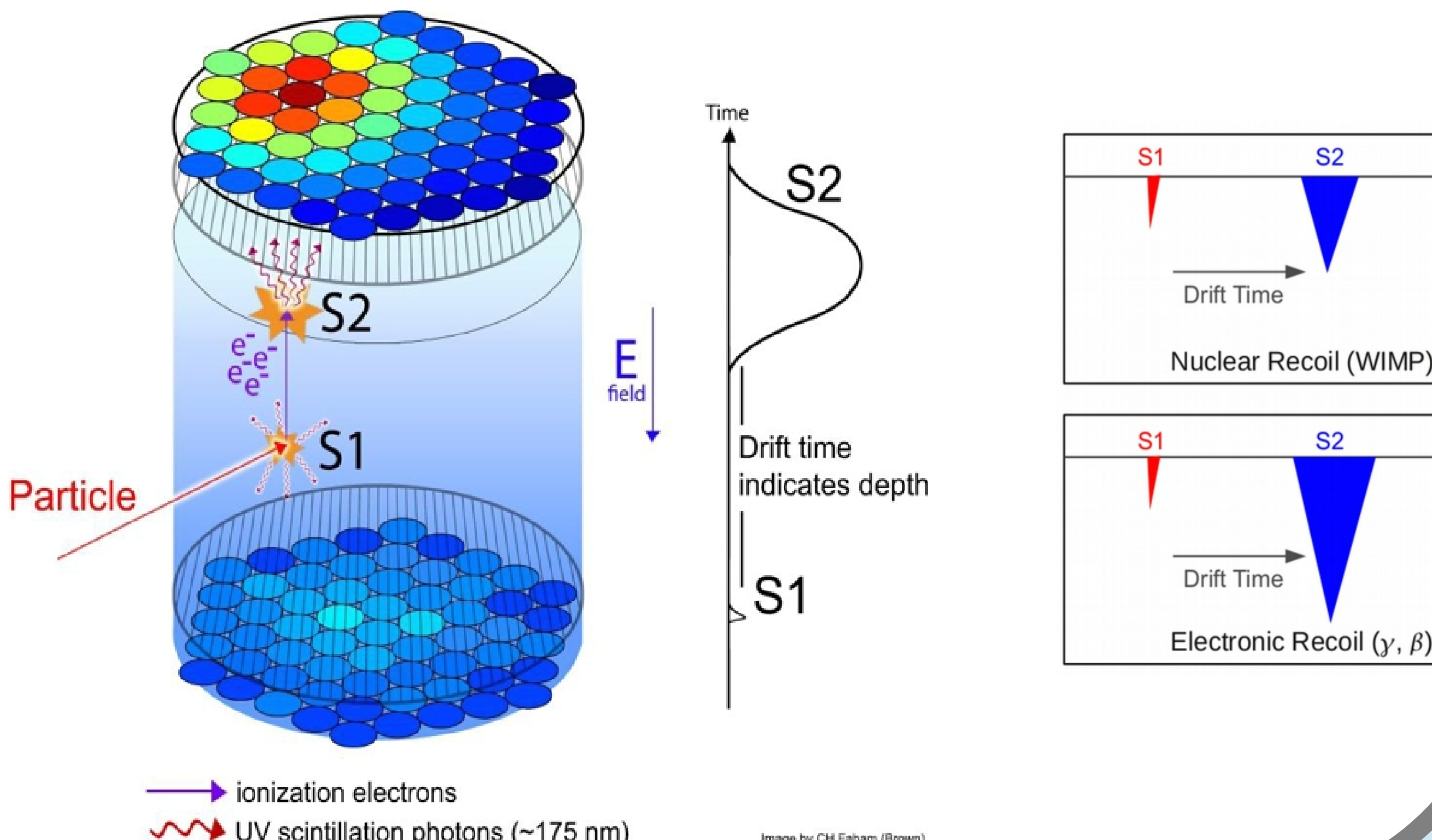
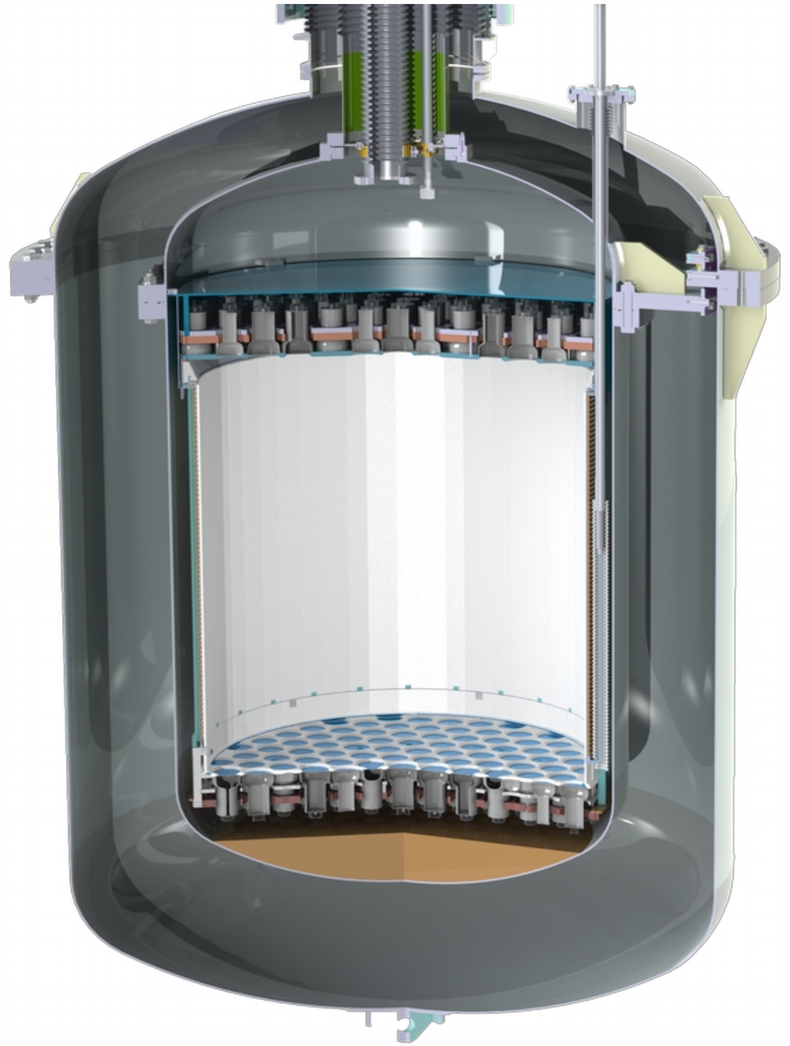
2-phase TPC Concept

- Purpose is to extract electrons produced by initial interaction (S1) in the liquid to then produce proportional scintillation (S2).
- Time difference between S1 and S2 enables for Z-position.
- fiducial volume of the TPC and background reduction.



XENON1T TPC



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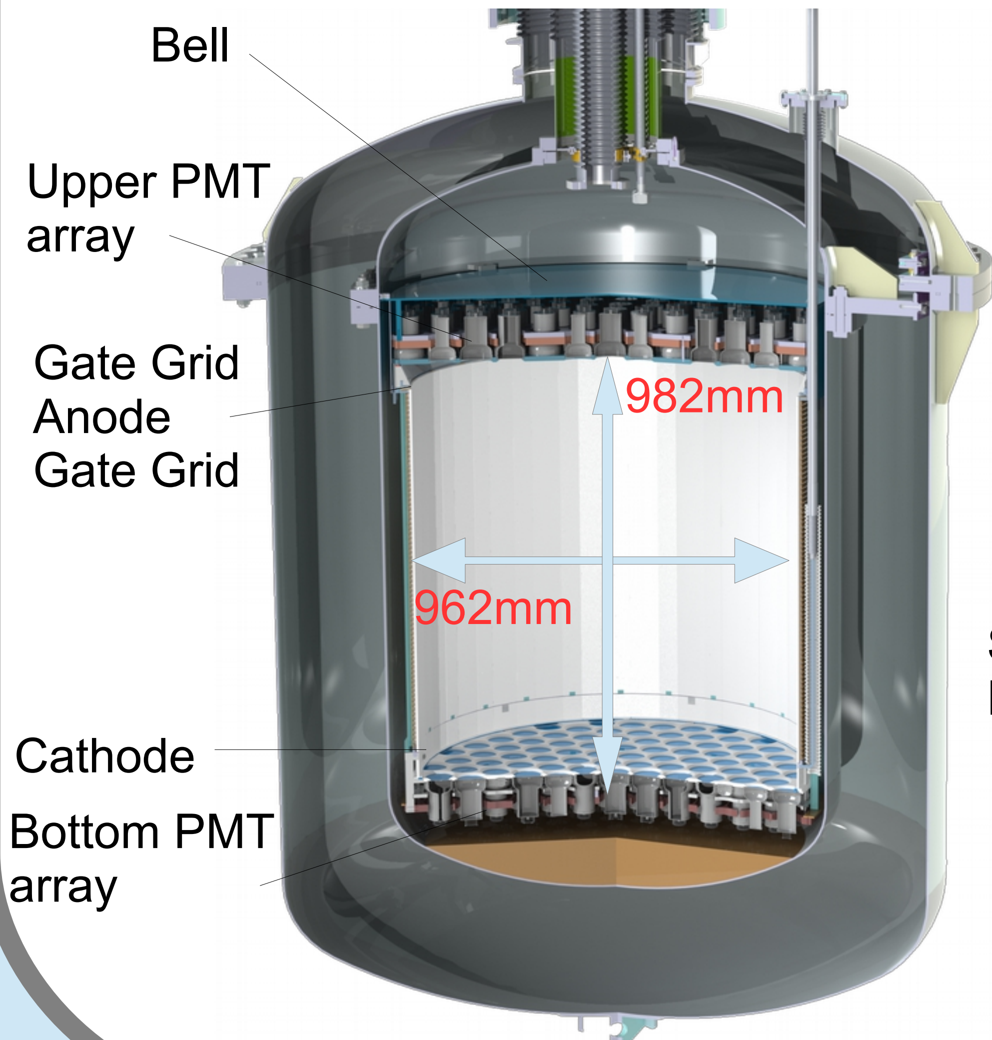
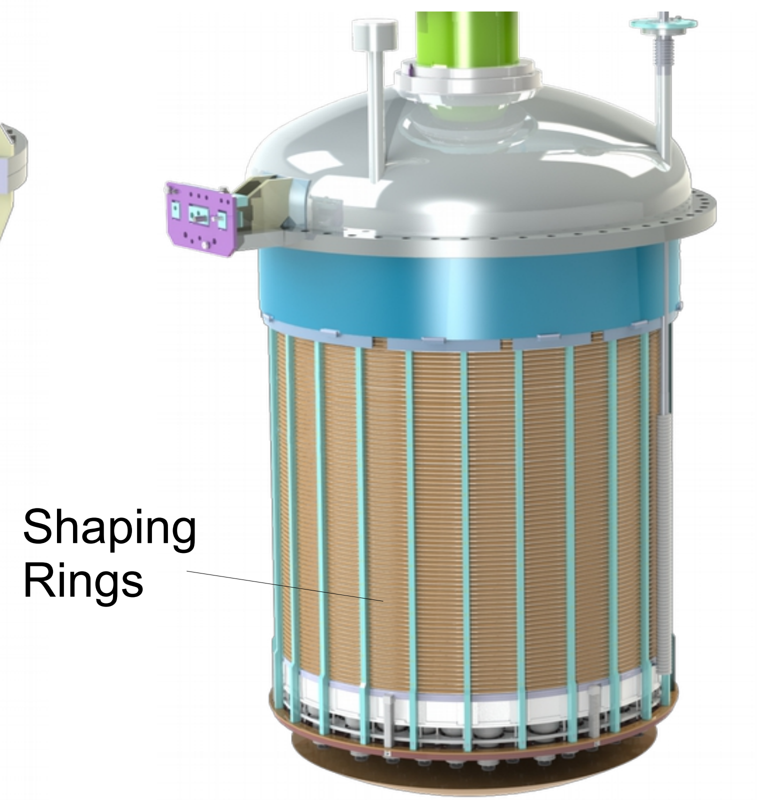
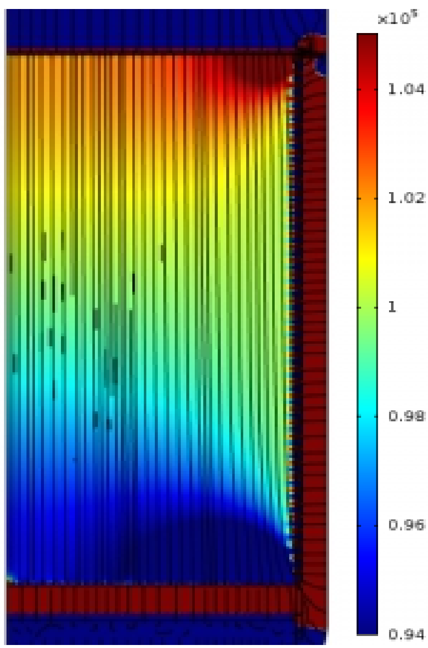
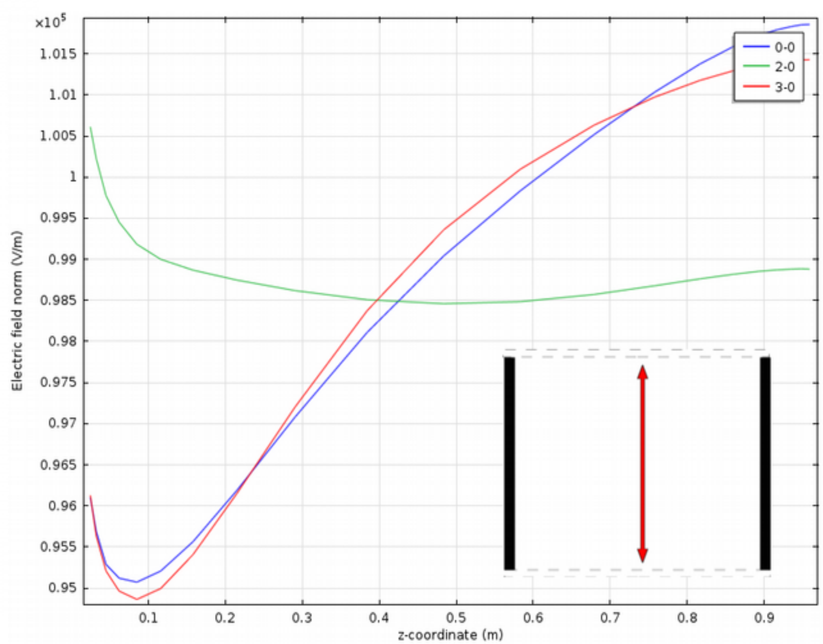

Bell
Upper PMT array
Gate Grid
Anode
Gate Grid
982mm
962mm
Cathode
Bottom PMT array

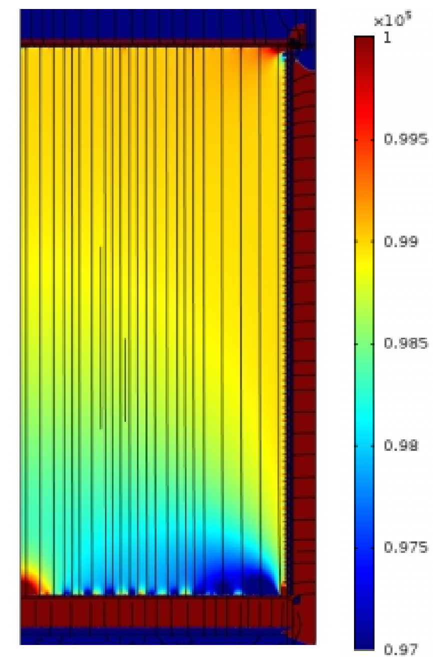

Shaping Rings

Electric Field Simulations

- Position reconstruction dependent on uniformity of E-field.
- Simulations necessary for determination of design of the field cage.
- COMSOL Electric Field Simulation of TPC cross section.
- Uniformity achieved through alteration of shaping rings and resistor chain alone.





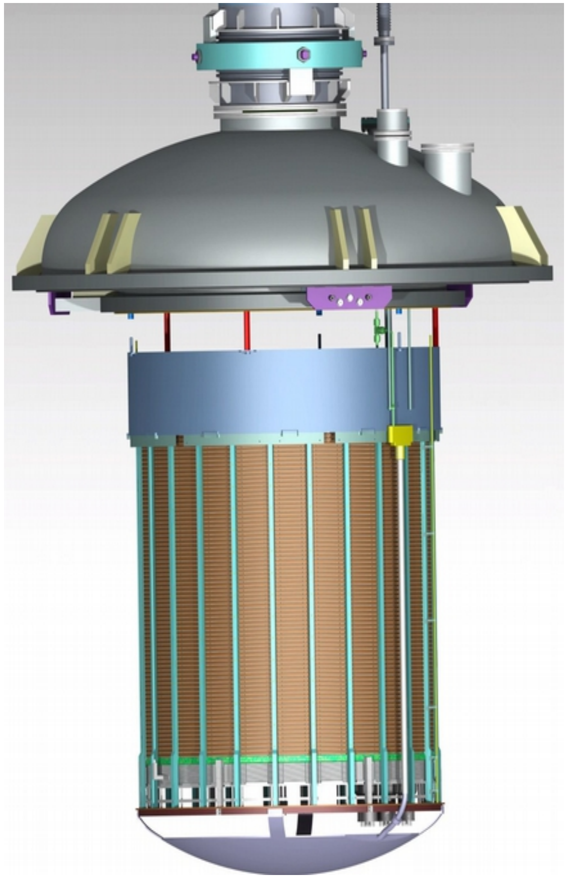


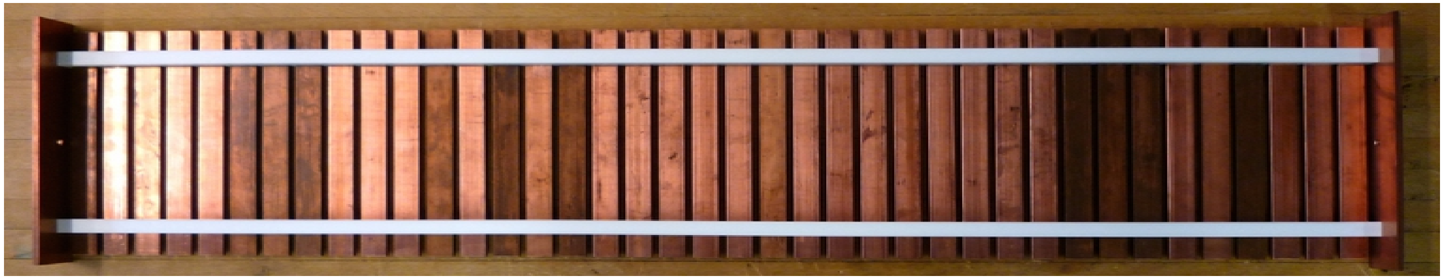
7% variation.
10mm shaping rings
5 mm separation

2% variation.
8mm shaping rings
3mm separation

Building the TPC

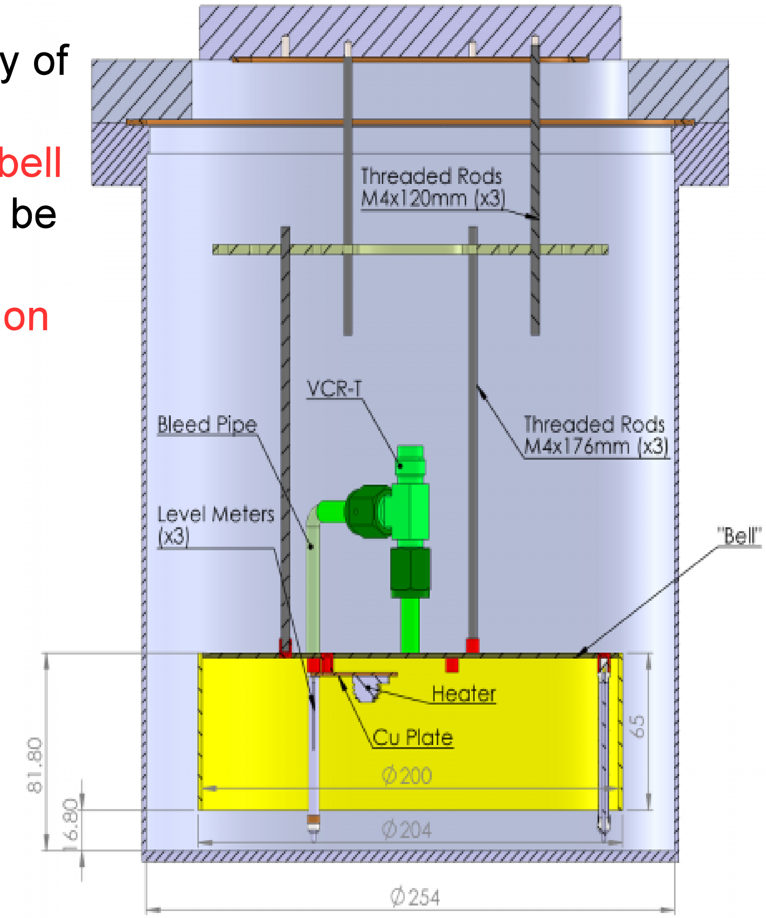
- Small 1/16 segment of TPC have been built and tested.
- Structural integrity of field cage confirmed by cryogenic testing
- Full scale TPC design being refined
- Installation of the TPC in 2015.
- A Prototype shaping ring has been produced.





Bell Tests

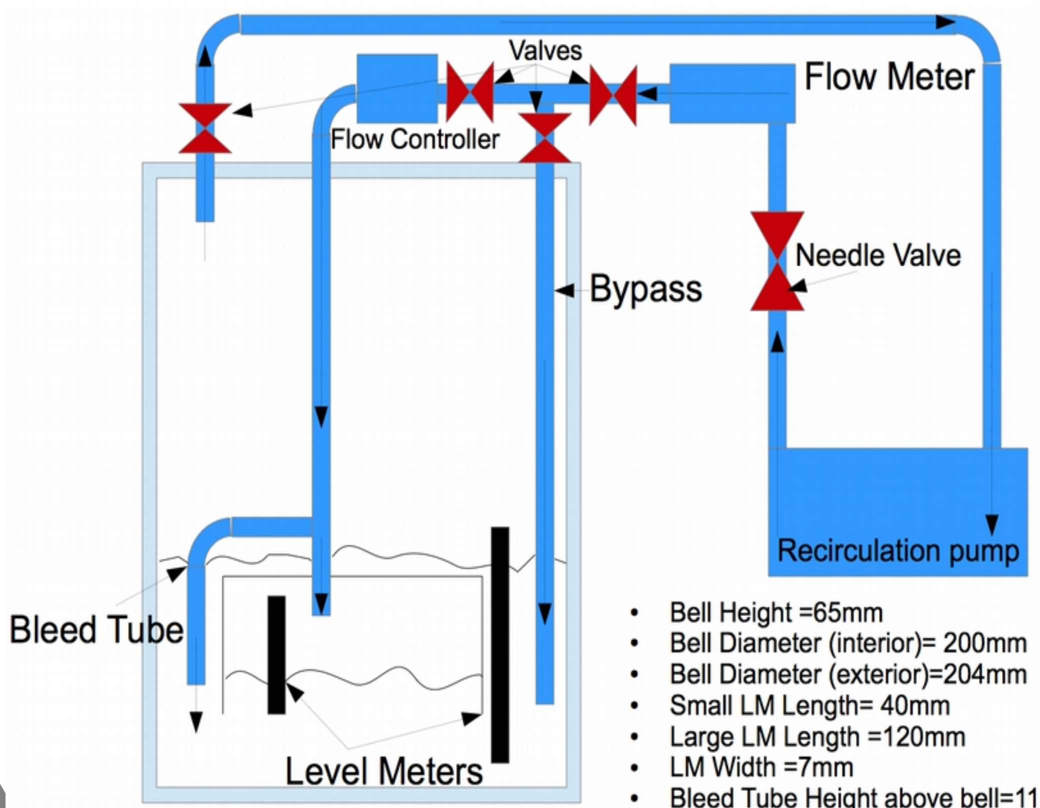
- Liquid level control highly important for S2 signal production.
- Need sub-mm accuracy in determination and stability of liquid-gas boundary.
- Liquid level control by over-pressure inside a diving bell
- Small model of full bell can be tests, and results can be extrapolated to XENON1T
- Tests being performed inside specially designed xenon chamber at UZH.



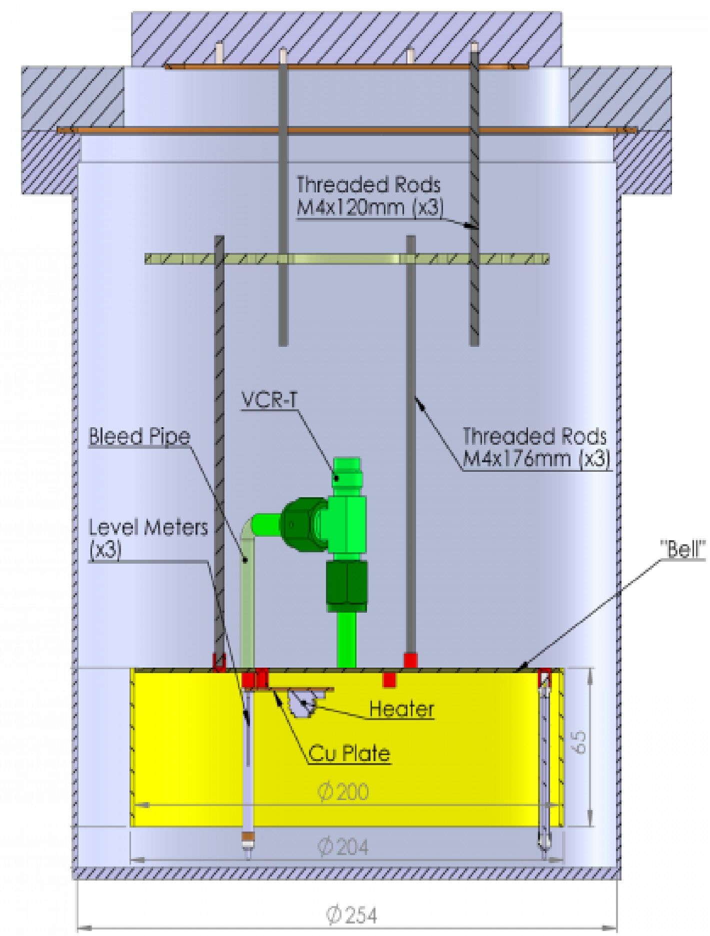
MarmotXL

Bell Tests

- Goal is to accurately disconnect recirculation flow from that into the bell.
- Flow controller with a bypass pipe enables control of flow into the bell without affecting recirculation flow.

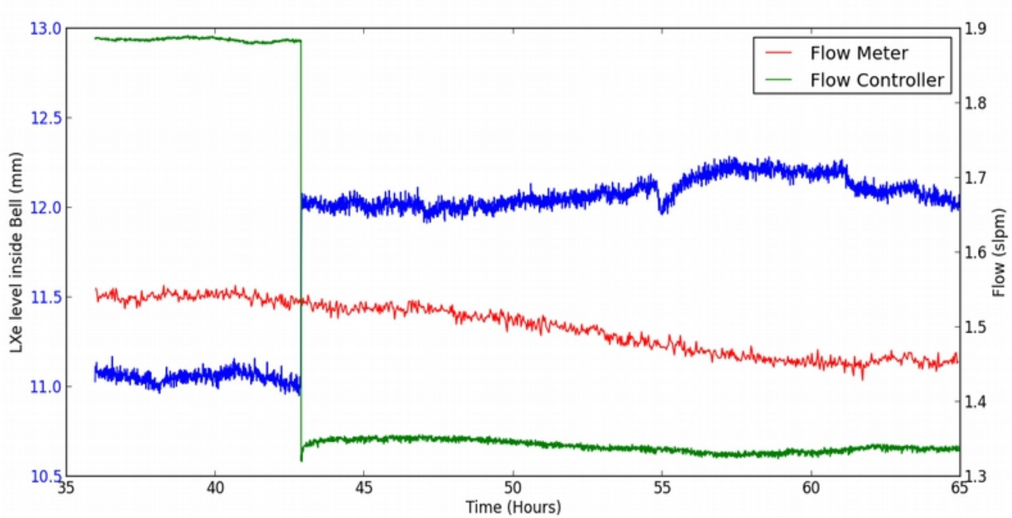


- Bell Height =65mm
- Bell Diameter (interior)= 200mm
- Bell Diameter (exterior)=204mm
- Small LM Length= 40mm
- Large LM Length =120mm
- LM Width =7mm
- Bleed Tube Height above bell=11mm

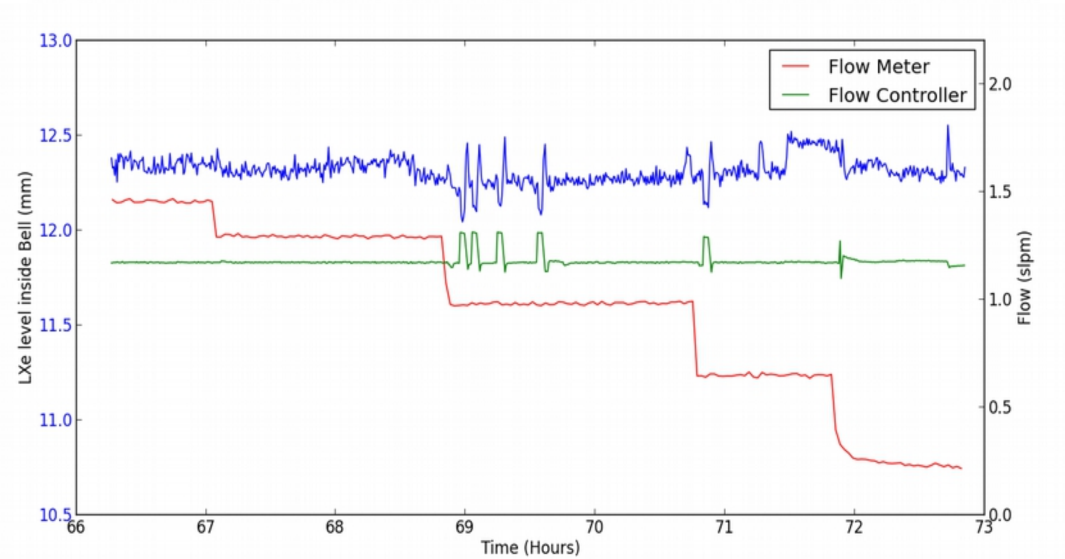


MarmotXL

Bell Tests

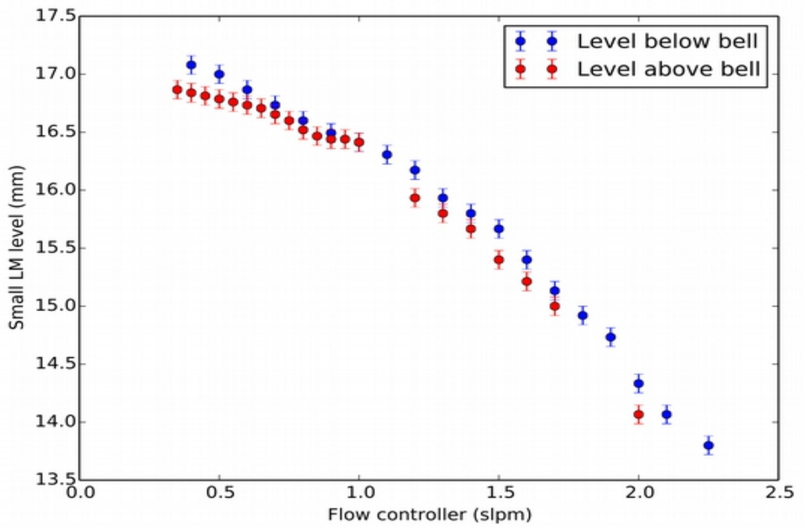


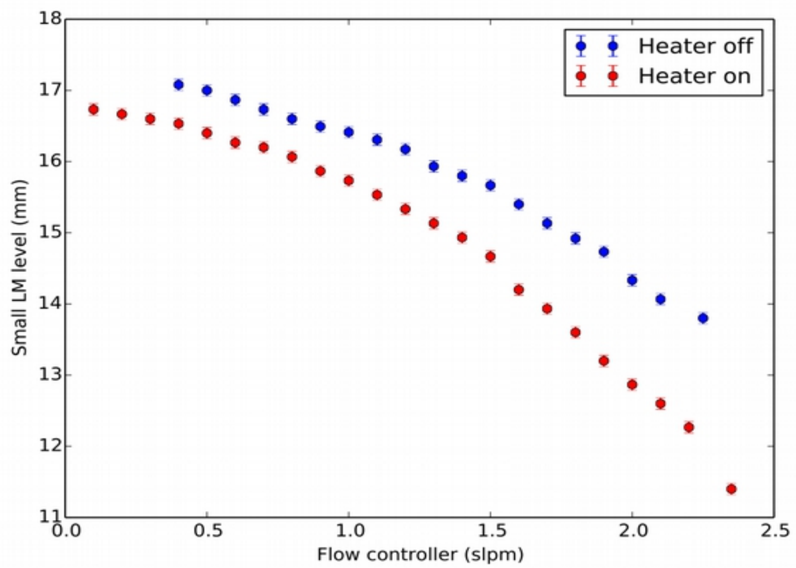
- Stability of level while altering flow into the bell.
- Rapid change of flow into bell results in rapid change, and stabilisation of liquid level



- Altering circulation flow while controller flow into the bell.
- Flow remains stable within 0.1mm with no correlation to recirculation flow.

Bell Tests





- Effects of LXe above the bell.
- Concluded that no effects could be seen, and that liquefaction from the top place does not occur on a significant level

- Study of contribution to liquid level from heater
- For a given level, approximately 0.5slpm less is needed with use of heater

Outlook

- Most R&D finished within 2014.
- Installation of TPC begins in the coming months.
- Integration of TPC to DAQ and slow control by mid-2015.
- Results in 2016.