



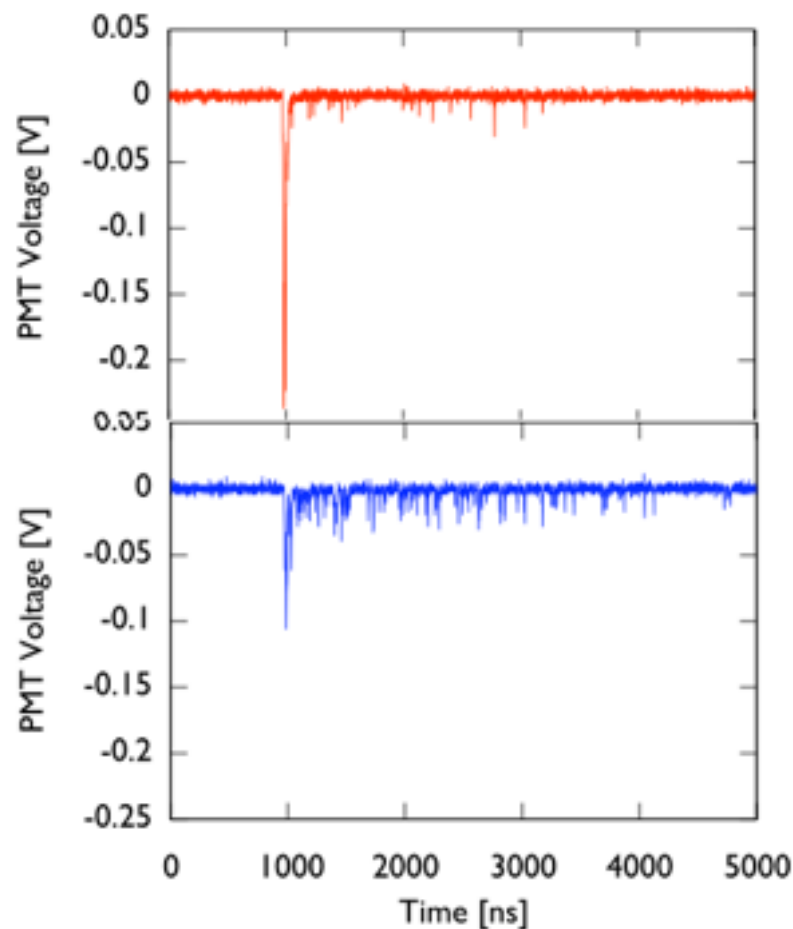
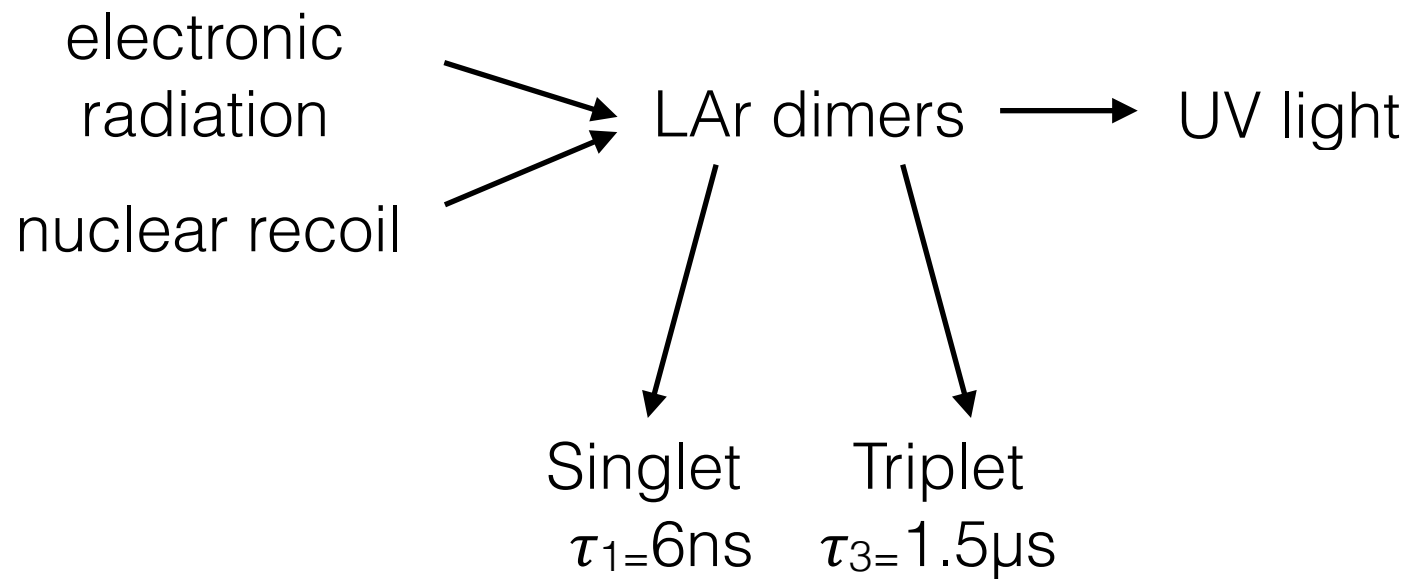
Status of the DEAP experiment

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Lake Louise Winter Institute, 19 February 2014

Liquid Argon as a Scintillator to search for Dark Matter

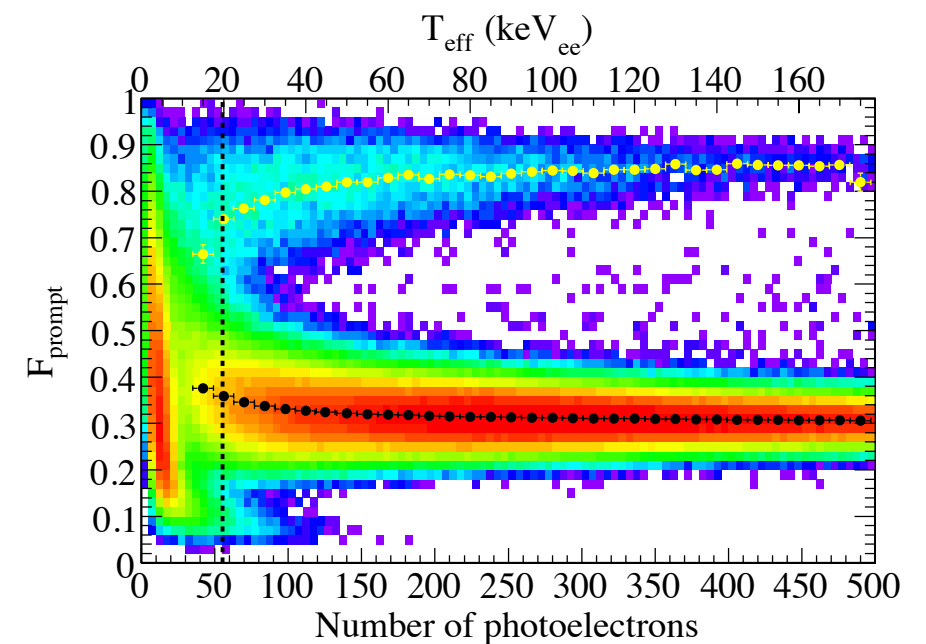


$$\frac{\text{Singlets}}{\text{Triplets}} = 3$$

$$\frac{\text{Singlets}}{\text{Triplets}} = 0.3$$

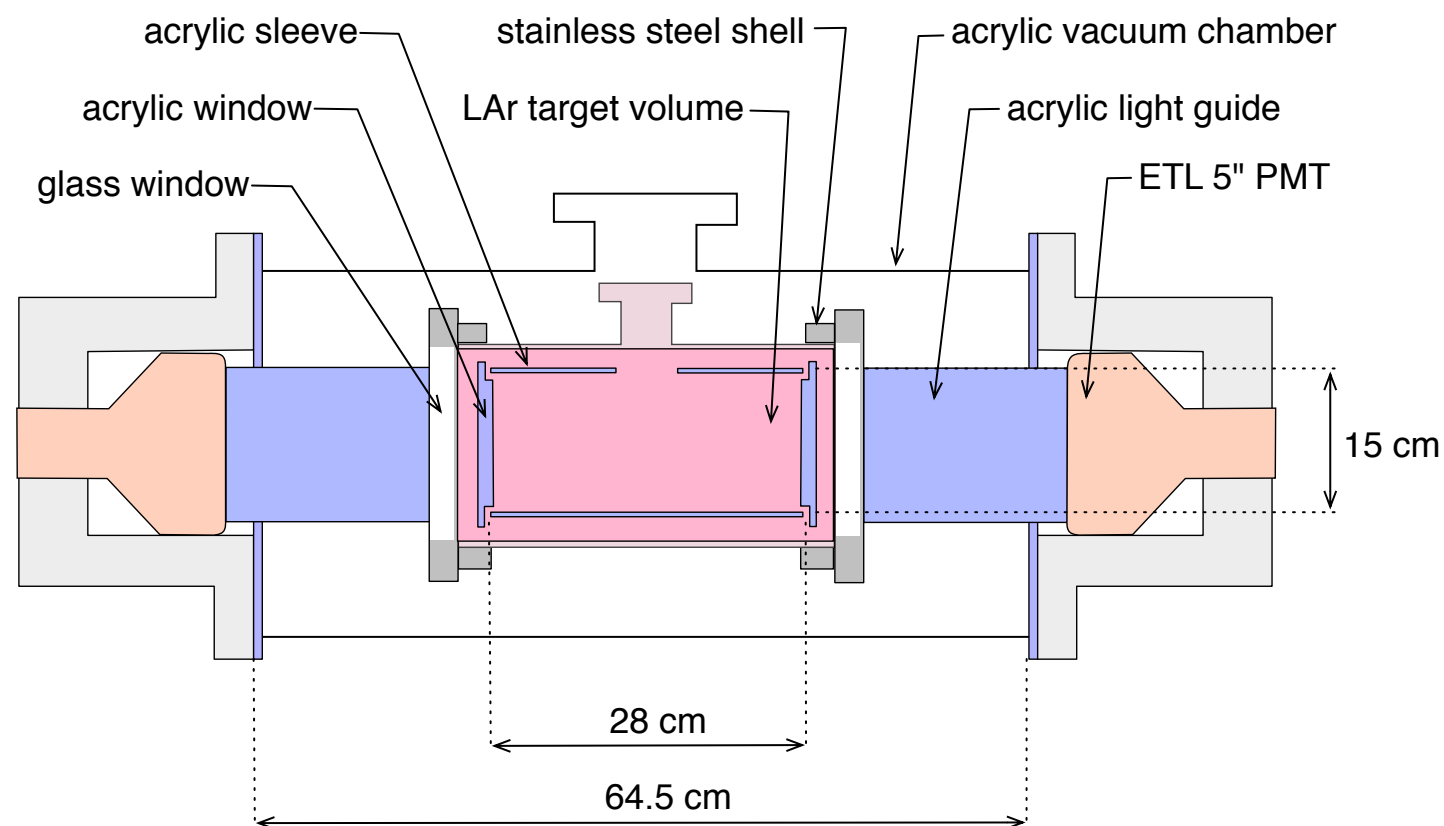
- Liquid Argon Scintillation allows for good Pulse Shape Discrimination (PSD)

$$F_{\text{prompt}} = \frac{\text{Prompt Light}}{\text{Total Light}}$$

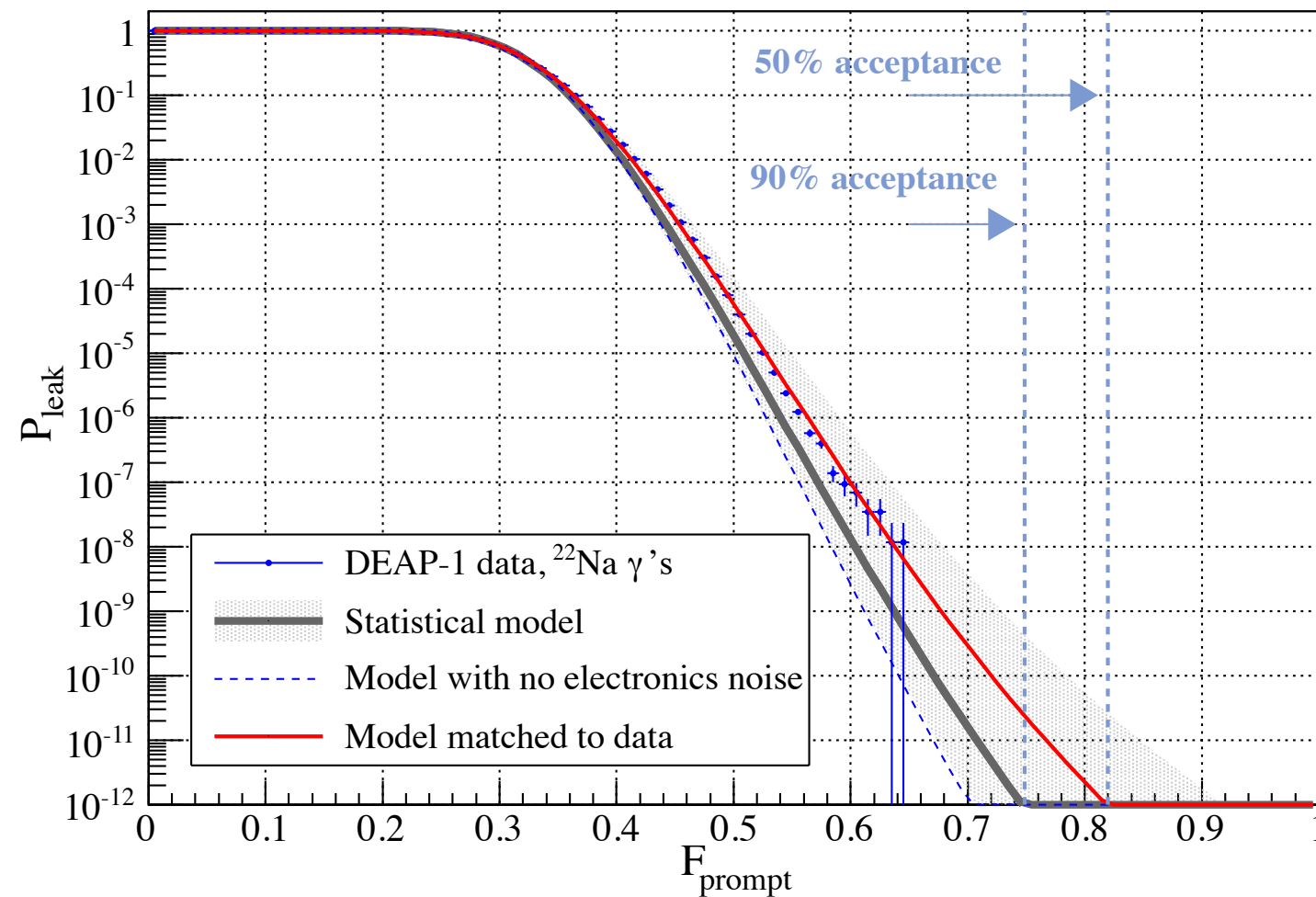


The DEAP-I prototype

- ▶ Acrylic cylinder with 7Kg of LAr, coated with TPB as wavelength shifter, and connected to 2 PMTs via acrylic light guides.
- ▶ Placed at SNOLAB, Ontario. Took data between 2009 and 2012



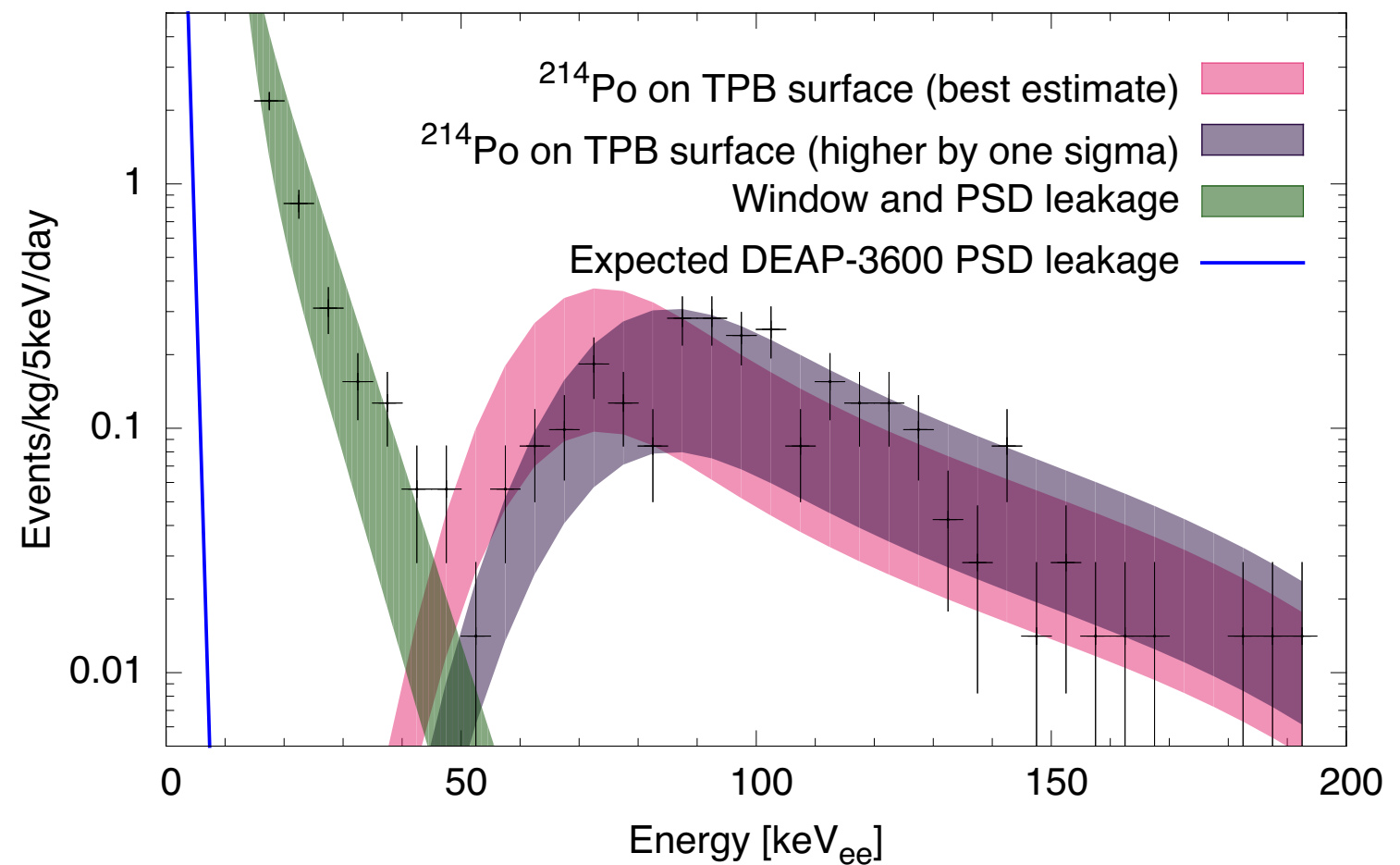
PSD discrimination measured with DEAP-I



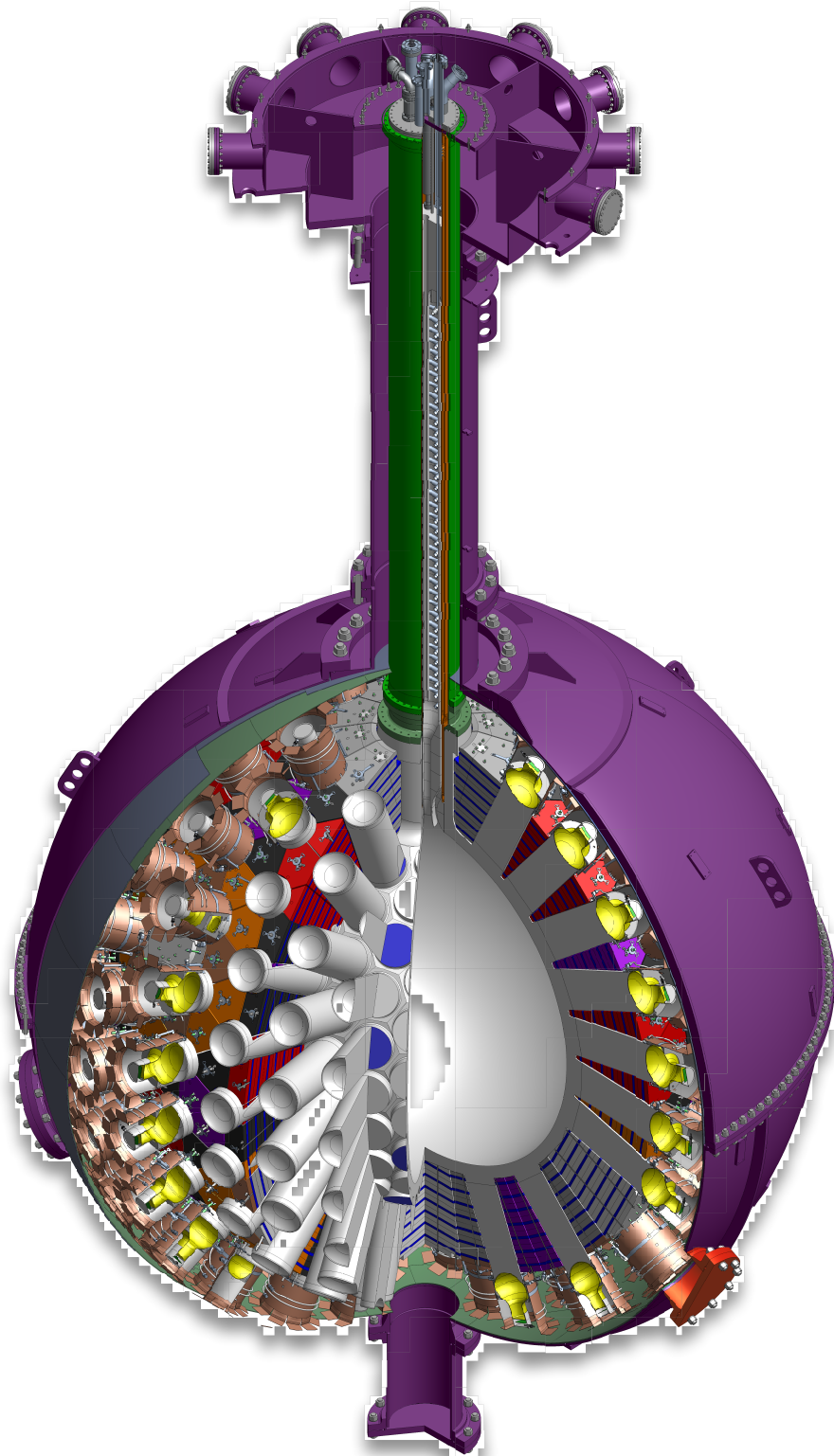
- ▶ Tagged ^{22}Na γ source.
- ▶ In the 120-240 peV WIMP window PSD discrimination has been proved up to 2.8×10^{-8} events.
- ▶ An analytical model projects a discrimination power of 10^{-10} at 60 keV_r for DEAP-3600

Low energy backgrounds measured in DEAP-I

- ▶ <40 keV_{ee} PSD leakage and events from windows
- ▶ >40 keV_{ee} Alpha events
 - ▶ Alphas from decays in regions of the detector semi obscured to the PMTs.
 - ▶ Surface alphas from Rn daughters on the acrylic and TPB.



The DEAP-3600 detector

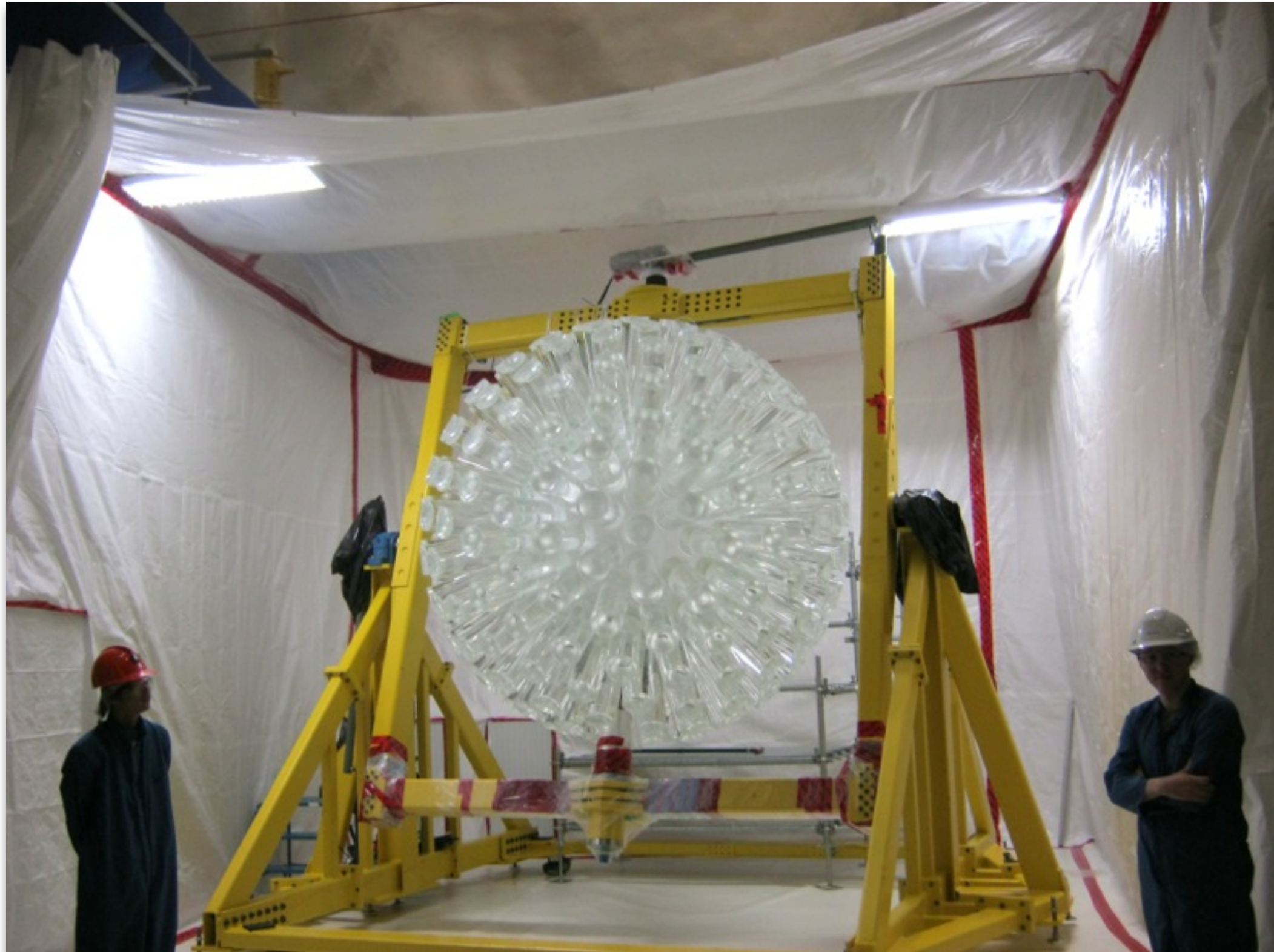


- ▶ Single phase scintillator detector.
- ▶ 85 cm radius acrylic vessel
- ▶ 3600 kg of LAr, 1 T of fiducial volume.
- ▶ 255 8-inches Hamamatsu R5912 HQE PMTs through 50cm long acrylic light guides. 75% coverage.
- ▶ 8m diameter water shielding tank.
- ▶ Currently under final assembly at SNOLAB, Ontario.

DEAP-3600 detector background target

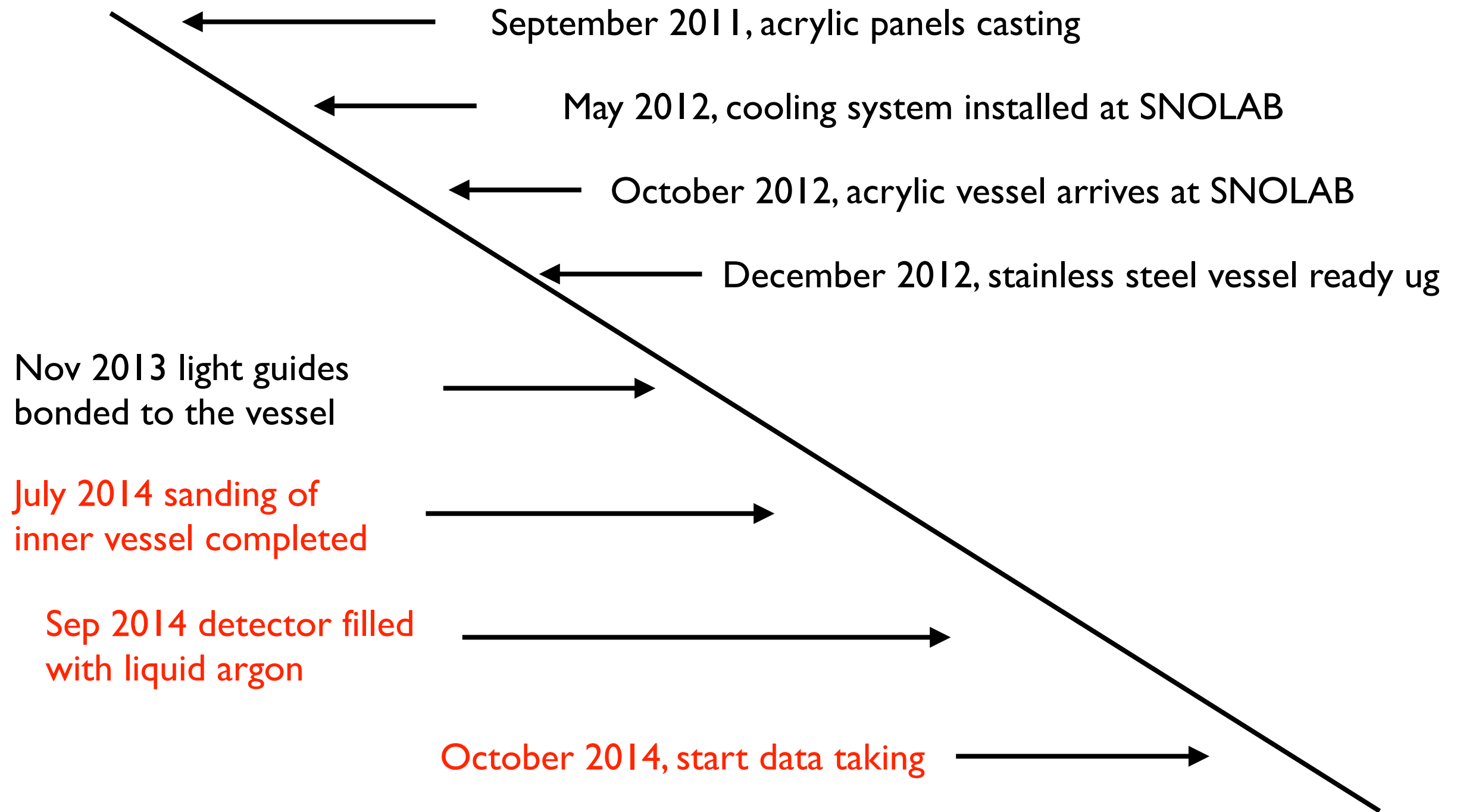
- ▶ DEAP-3600 has a background target of < 0.6 events in the WIMP region of interest for 3 years of data taking.
- ▶ This will make the detector sensitive to 10^{-46} cm² WIMP-nucleon cross section at 100 GeV.
- ▶ The acrylic for the inner vessel have been cast from MMA monomer in a clean room to keep Rn exposure to the minimum.
- ▶ An assay of 10kg of this acrylic has yield an upper limit for ²¹⁰Po content of 10^{-19} g/g, which will allow us to reach our target.
- ▶ 1mm of the inner face of the vessel will be sanded in a Rd free environment prior to filling it with Argon.

DEAP-3600 today

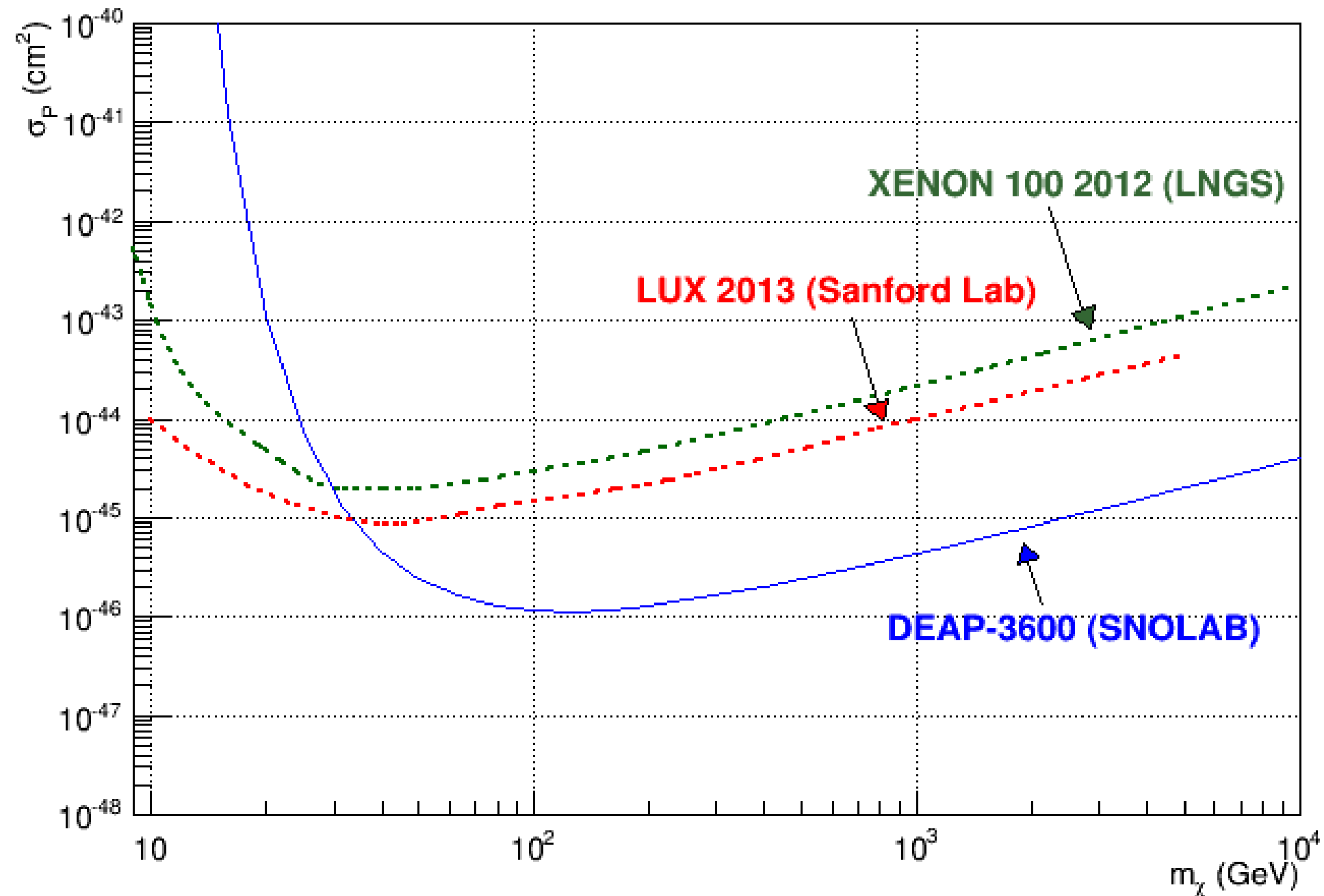


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DEAP-3600 timeline



Expected DEAP-3600 sensitivity



Summary

- ▶ DEAP-3600 is a single phase, liquid argon scintillation detector to look for dark matter.
- ▶ Extensive backgrounds and assay program, in particular ultra low background acrylic inner vessel and low radon inner detector and purification system.
- ▶ 1000 kg fiducial volume, expected <0.2 background events per year in region of interest.
- ▶ Projected spin-independent WIMP nucleon cross section of 10^{-46} cm^2 at 100 GeV.
- ▶ Assembly and filling will be completed in the next months, expected beginning of physics data taking in October 2014.