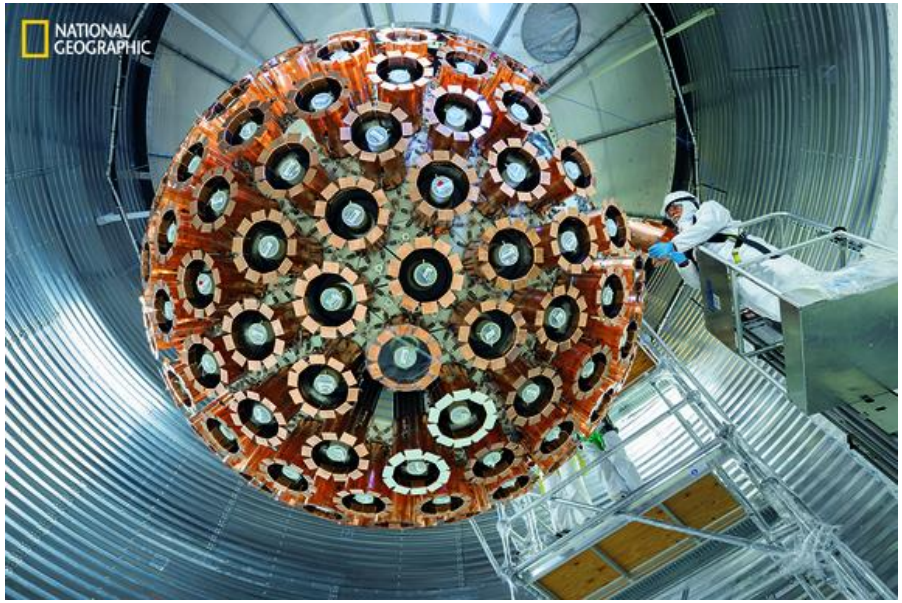
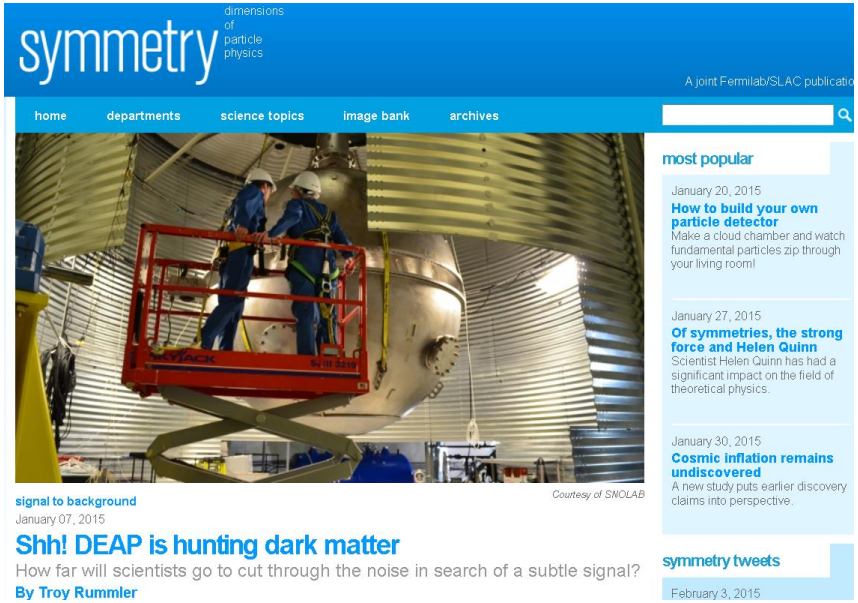
News from DEAP-3600





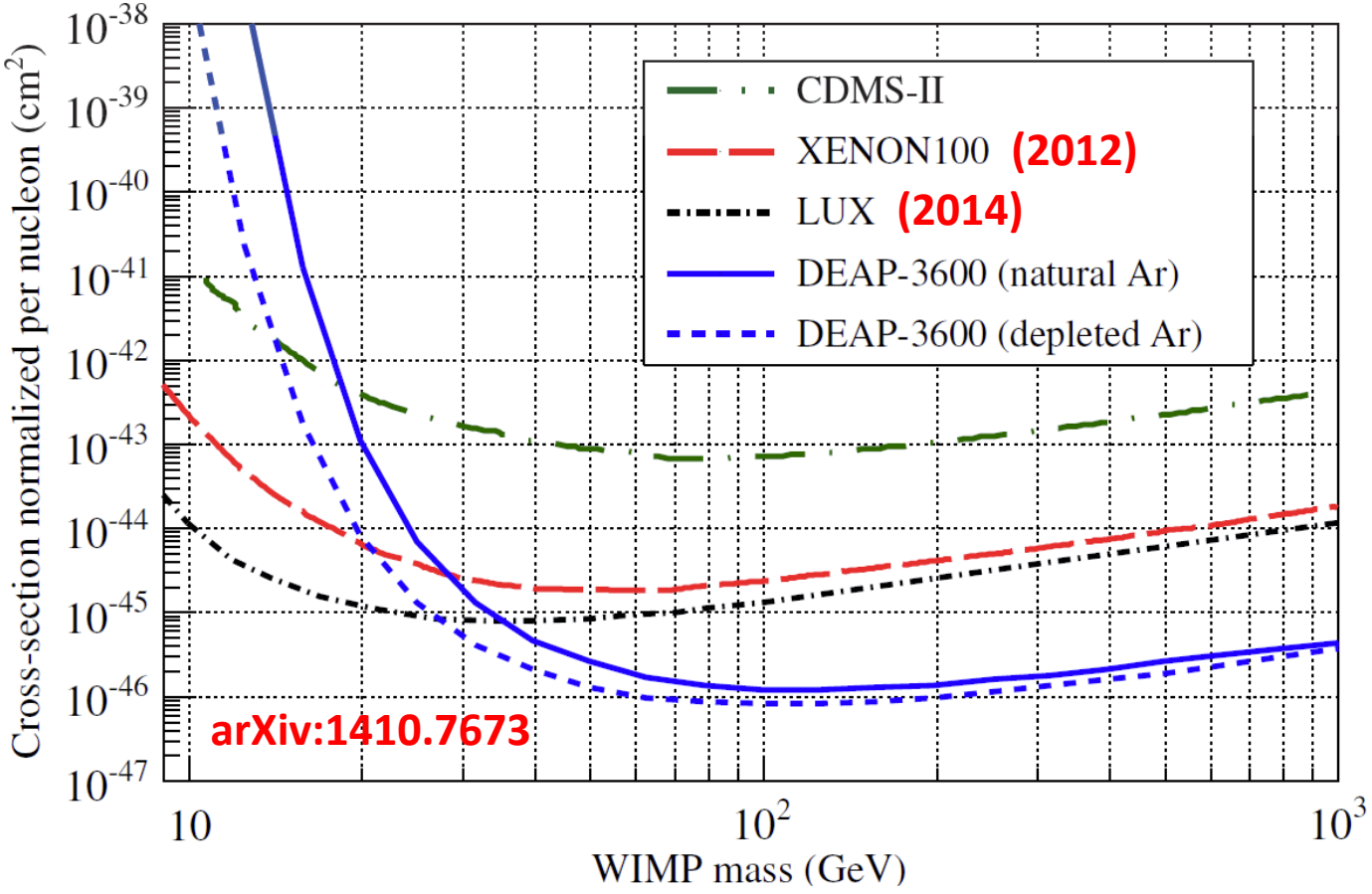
James Bueno, University of Alberta
on behalf of the DEAP collaboration

UNIVERSITY OF ALBERTA

11 February 2015

Dark-matter **E**xperiment using **A**rgon **P**ulse Shape Discrimination

- Searching for spin-independent scattering of WIMPs from a liquid argon target.
- Located 2 km below ground at SNOLAB, Ontario.



Liquid argon scintillation

+	−
Easily purified	Intrinsic β radiation (^{39}Ar, 1 Bq / kg)
Liquid at 87 K	Needs cooling mechanism
Scintillation light not re-absorbed	UV scintillation needs wavelength shift
High light yield	
Pulse shape different for electronic and nuclear recoils	

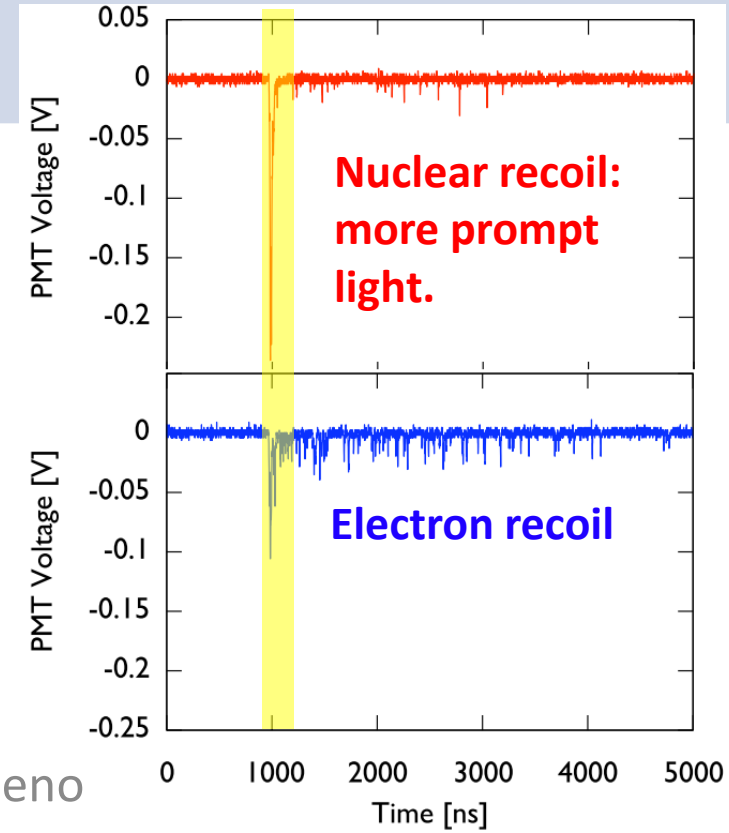
Excited dimers

Electron or nuclear recoil

Singlet state, τ = 6 ns

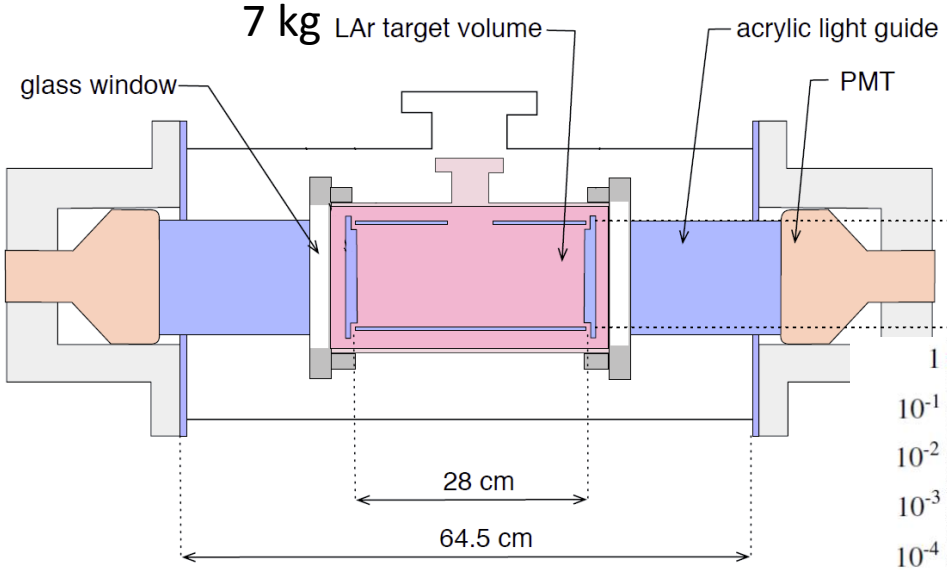
&

Triplet state, τ = 1.5 μs

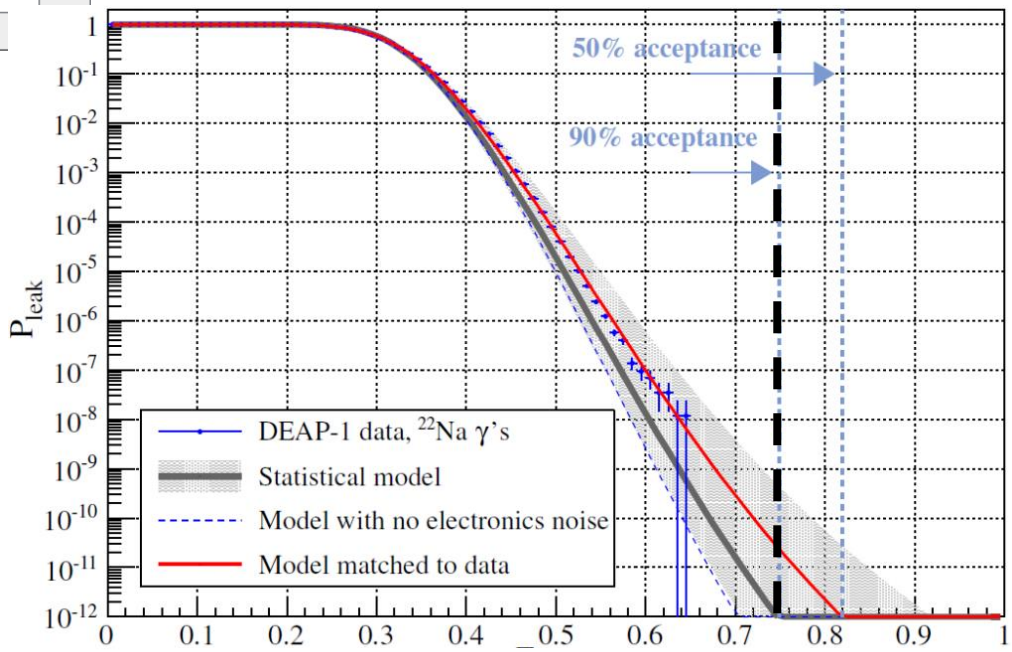


DEAP-1

- Proof of principle experiment, included demonstration of pulse shape discrimination between β/γ and nuclear recoils.



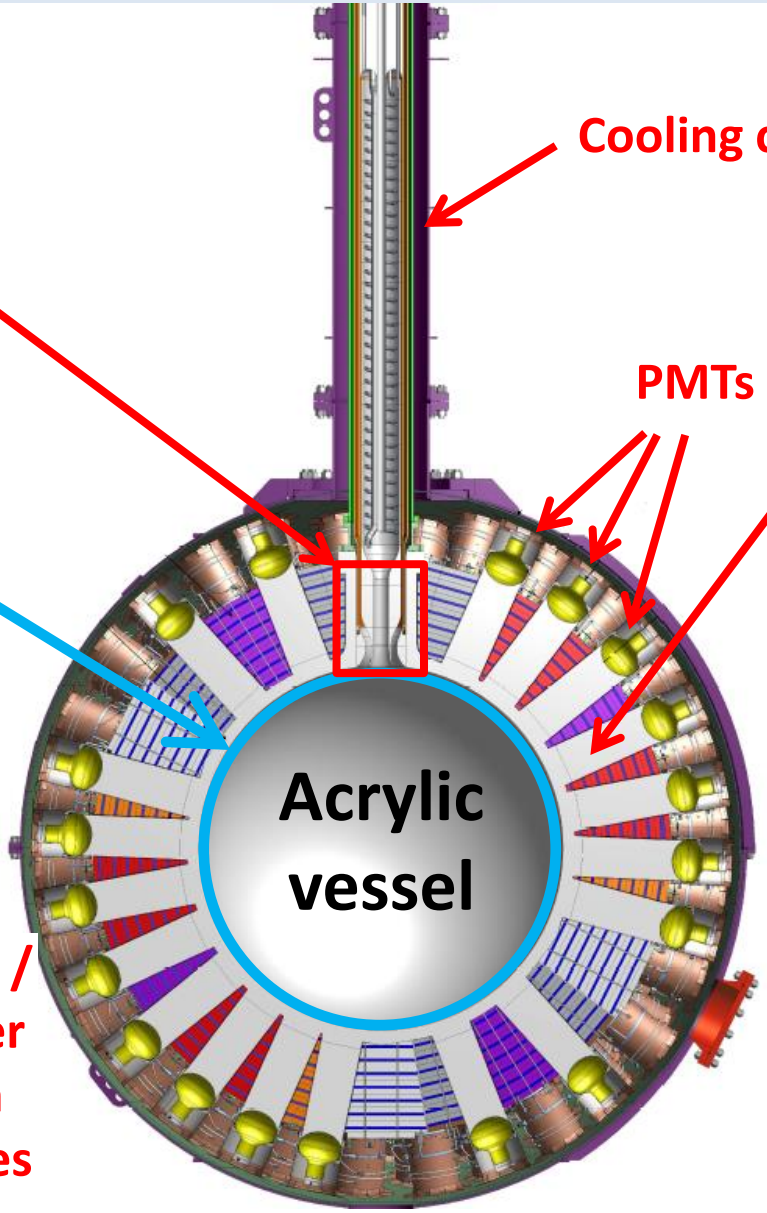
90% nuclear recoil acceptance



F_{prompt} = prompt light / total light

- Demonstrated pulse shape discrimination down to $< 2.8 \times 10^{-8}$ (90% CL) for nuclear recoil acceptance of 90%.
- Expect misidentification factor of 10^{-10} for DEAP-3600.

The DEAP-3600 detector

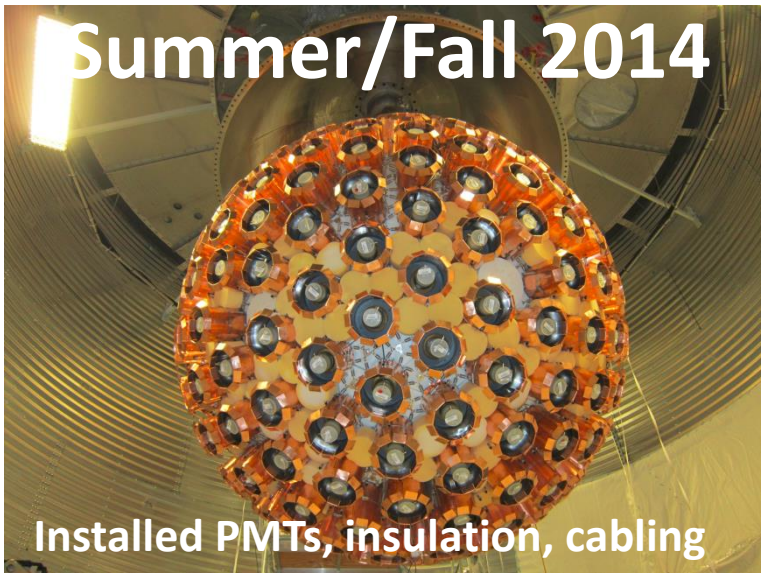


- 3600 kg liquid argon in acrylic vessel of diameter 1.7 m.
  - 1000 kg in fiducial.
- Wavelength shifter tetraphenyl butadiene (TPB) coating on acrylic vessel.
- Single phase operation with 255 PMTs (Hamamatsu R5912).
- Enclosed in active veto water shield tank.

Expected backgrounds in 3 years

Background	In WIMP energy region	After fiducial cut and PSD	Mitigated by
Neutrons	30	< 0.2	SNOLAB, acrylic light guides, water tank
Surface α's	150	< 0.2	Material selection, re-surfacing (later slide)
^{39}Ar β's	1.6 x 10^9	< 0.2	Pulse shape discrimination

Construction and installation at SNOLAB

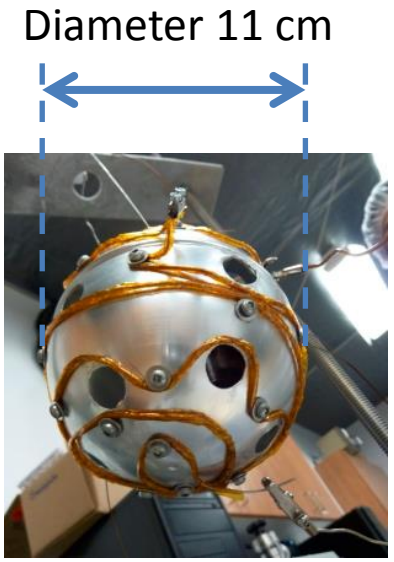


Recent activity

Resurfacing the acrylic vessel

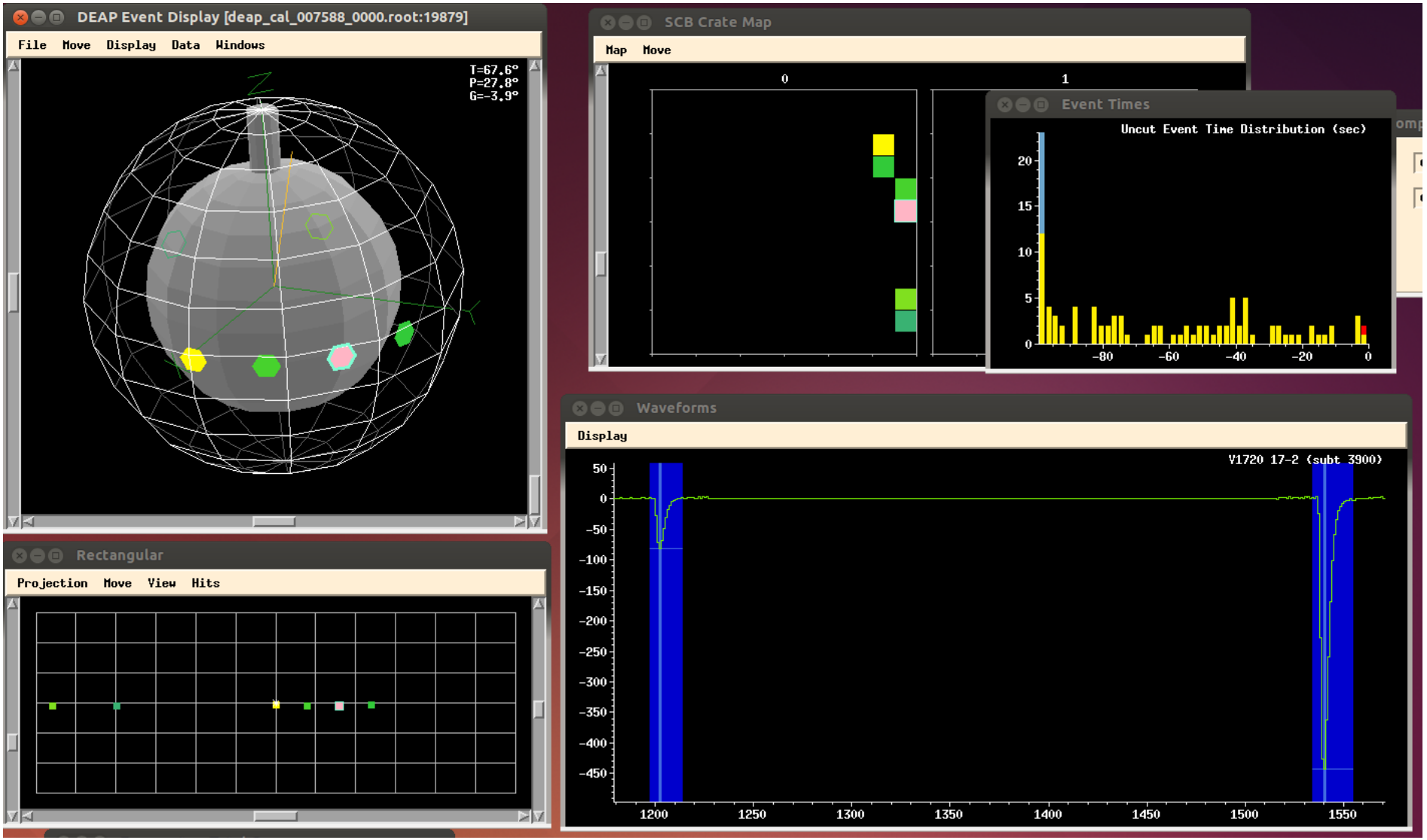
- Used custom built "re-surfacer" to sand off 1 mm of acrylic, removing implanted Rn daughters.
- Operated September 2014 to November 2014.

Preparing for TPB layer



- Preparing to evaporate ~1 µm thick layer of TPB onto the acrylic vessel.
- Deposition method already tested in a 20 inch vessel.

Recent data


DEAP Event Display [deap_cal_007588_0000.root:19879]
File Move Display Data Windows
T=67.6°
P=27.8°
G=-3.9°
SCB Crate Map
Map Move
0
1
Event Times
Uncut Event Time Distribution (sec)
20
15
10
5
0
-80
-60
-40
-20
0
Rectangular
Projection Move View Hits
Waveforms
Display
V1720 17-2 (subt 3900)
50
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
1200
1250
1300
1350
1400
1450
1500
1550

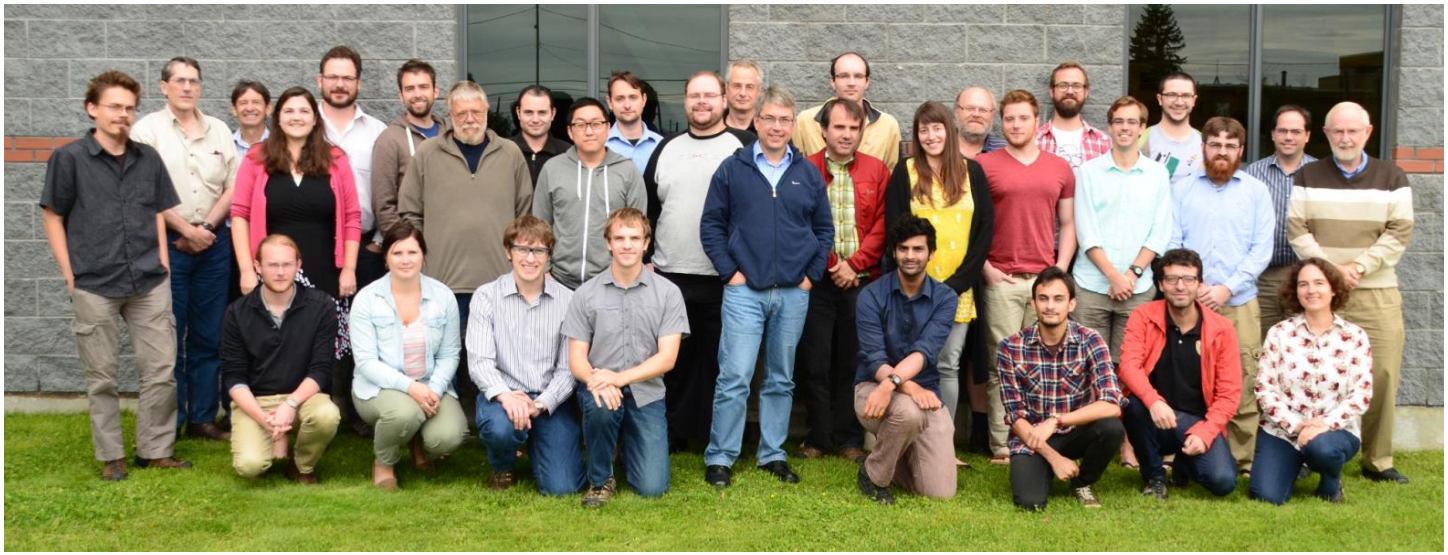
Summary

- DEAP-3600 aims for world leading WIMP-nucleon cross-section sensitivity of 10^{-46} cm^2 using 3600 kg of liquid argon.

- In 3 years of running, expect < 0.6 background events in the WIMP region of interest.

- Detector construction almost complete.
  - We are running and configuring the DAQ / PMTs.
  - Calibration data already being acquired.
  - Going cold in Spring/Summer 2015.

The DEAP collaboration



~60 collaborators in Canada and the UK

UNIVERSITY OF ALBERTA

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Particle Physics Rutherford Appleton Laboratory

Science & Technology Facilities Council

SNOLAB MINING FOR KNOWLEDGE CREUSER POUR TROUVER... L'EXCELLENCE

University of Sussex

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UNAM