

***“We’re going DEAPer underground!”***

- Jamiroquai

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DMUK Meeting  
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# DEAP-3600

Built ~6800 feet (2.07km) underground in SNOLAB

UK groups: RHUL, RAL, Sussex

Readout: 255 PMTs

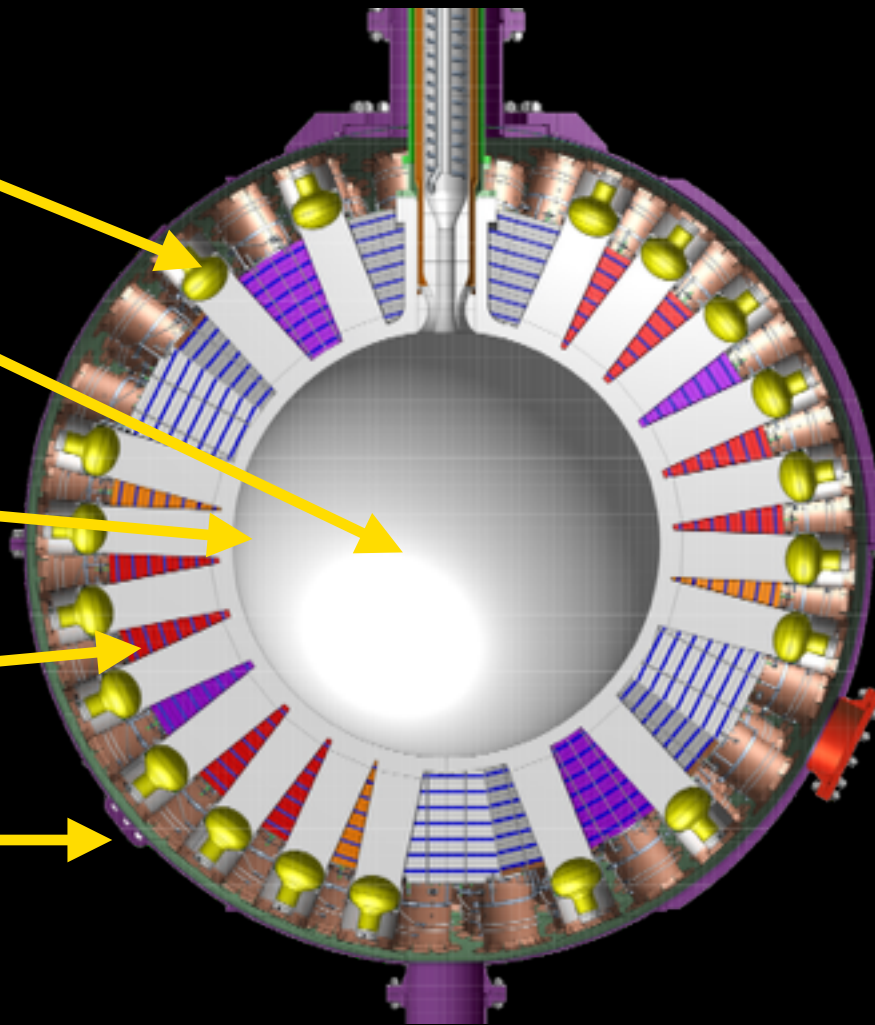
3600 kg of Liquid Ar  
in Acrylic Vessel

Wavelength  
Shifter Layer

Filler Blocks

Steel Shell

Water Tank  
around detector,  
8m diameter



Builds on  
experience:

*Argon:*  
MicroCLEAN,  
DEAP-1

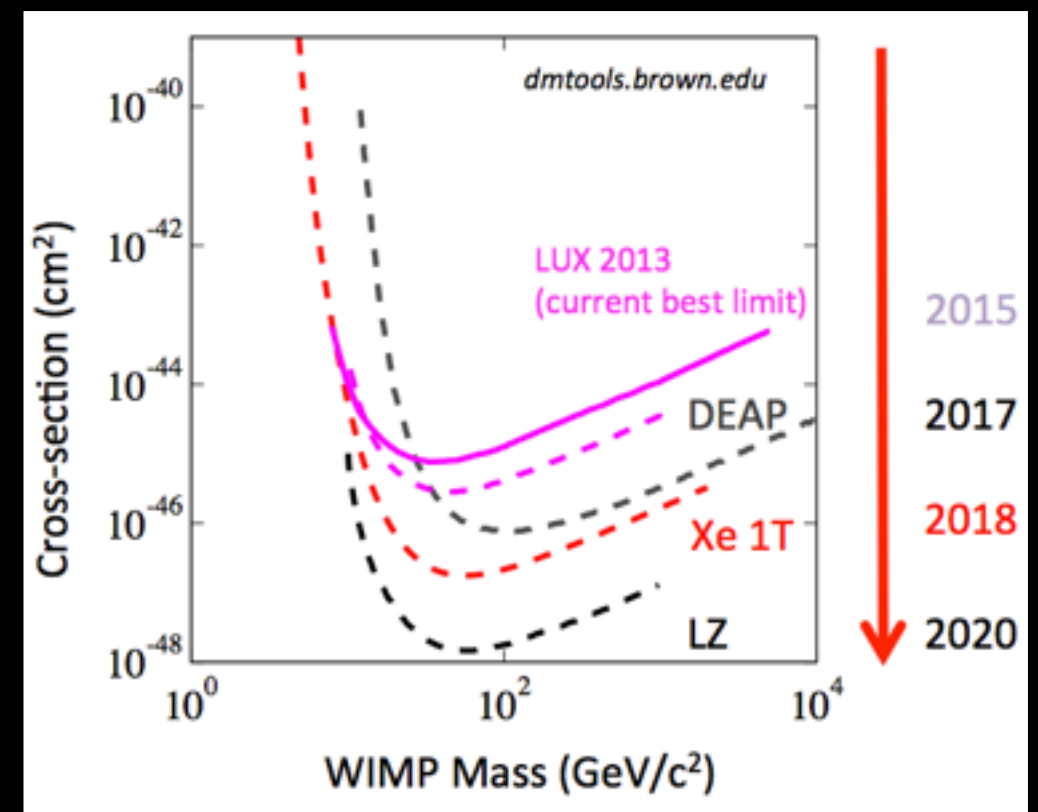
*Geometry:*  
MiniBooNE and  
SNO

Clean PID from  
scintillator timing  
profile

# DEAPly Sensitive

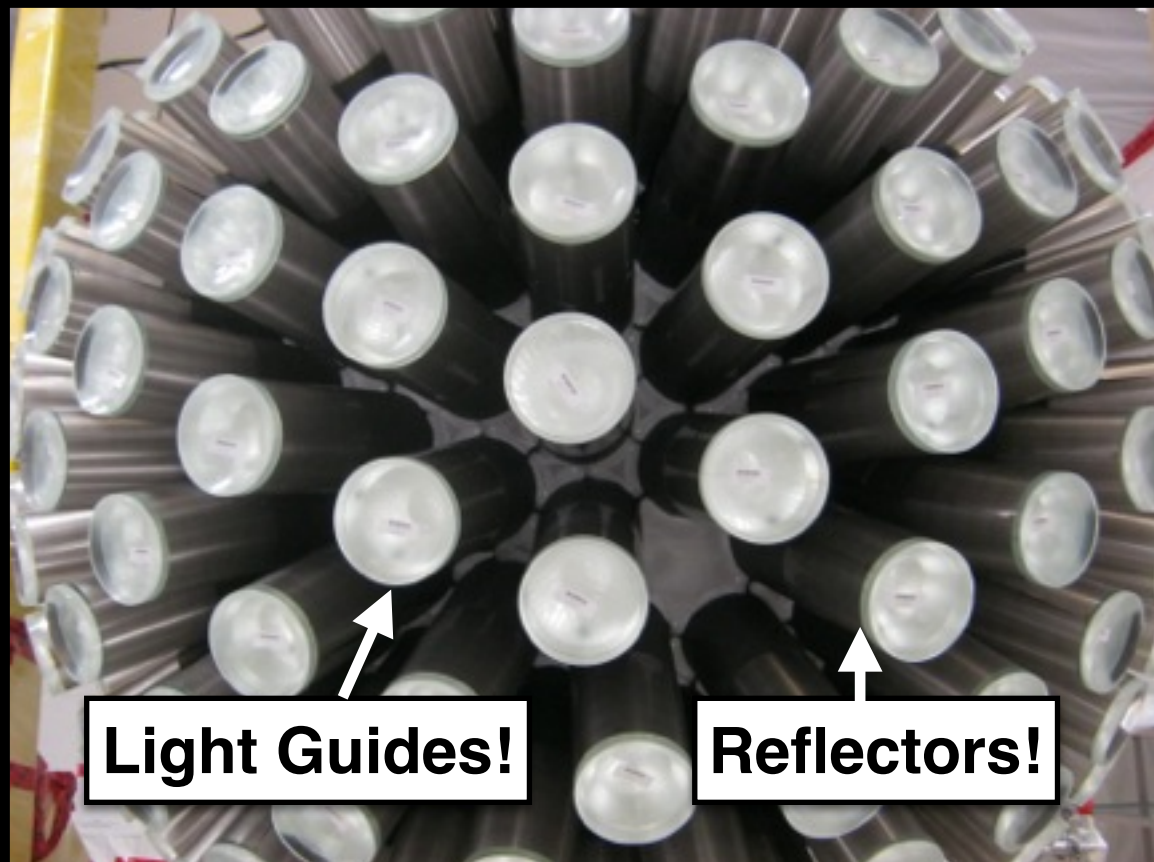
- Large fiducial mass of target - 1000kg
- Energy threshold - 60 keVr over 3 yr run for 1000kg
- Main background reduction possible using fiducial radius cut
- Discriminate recoil types with different lifetimes
  - WIMP + Neutron Events (7ns)
  - Electronic recoils (1.5 $\mu$ s)

Background (in fiducial volume)	DEAP-3600 Goal
Radon in Ar	<1.4 nBq/kg
Surface $\alpha$ 's	<100 $\mu$ Bq/m
Neutrons (all sources)	<2 pBq/kg
Ar39	<2 pBq/kg
<b>Total (3 year, 1000kg)</b>	<b>&lt;0.6 events</b>

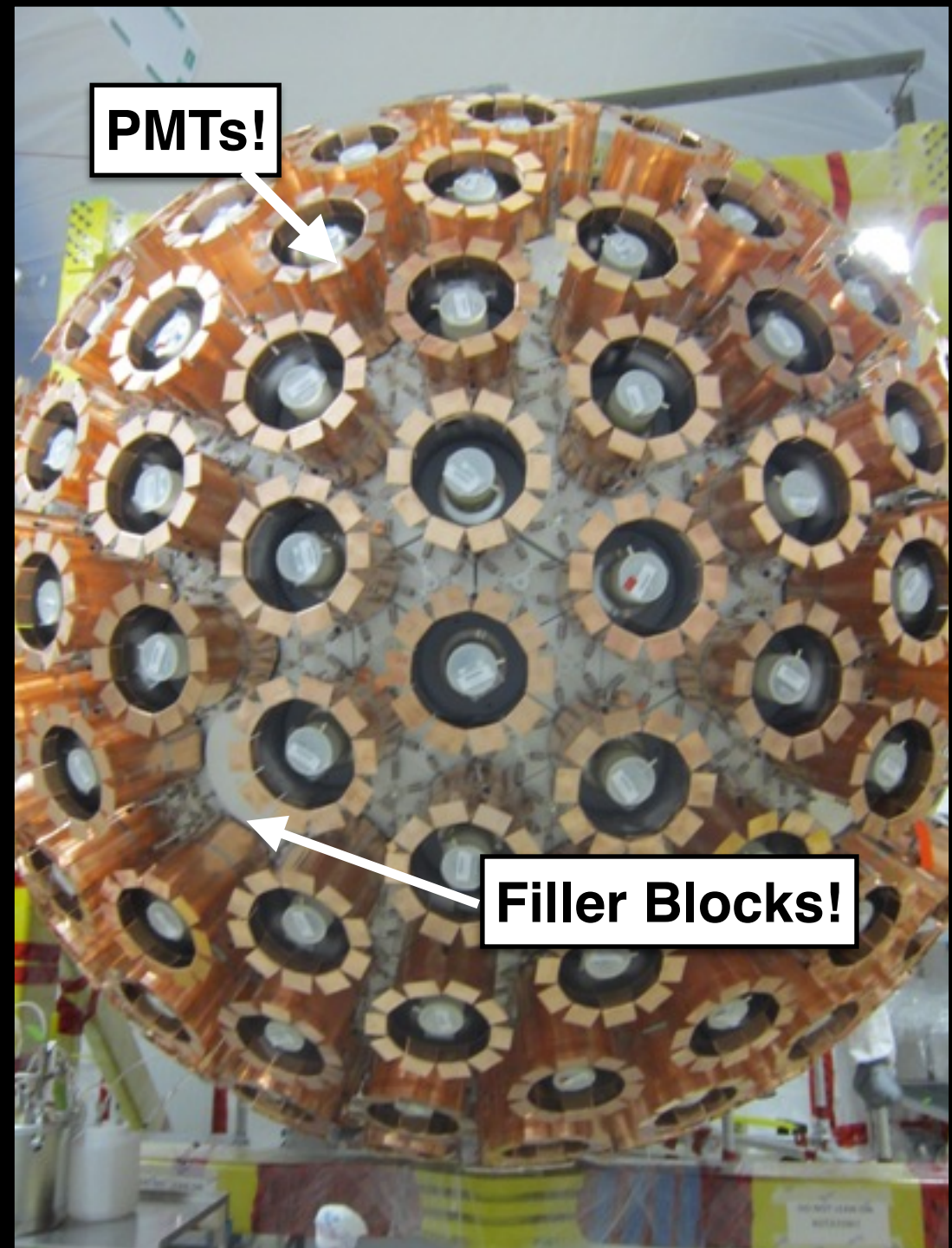




# We've been busy!



- Acrylic vessel light sealed
- Reflective surface installed on acrylic light guides
- Polyethylene+polystyrene filler blocks installed
- PMTs installed





# Current work - still busy!



- Resurfacer assembly
- Control operation testing
- Removal of radon from inner layer of acrylic
- Ready acrylic for TPB deposition ( $\lambda$  shifter)



- Outer vessel pressure testing
- Lots of winching up and down!
- Ensuring vacuum for other tests on cooling + process systems

# Reconstruction

- We already have a position + energy fitter
  - Generates simulation of PMT response using lookup tables
  - Lookup tables are made using monte carlo simulations
    - Likelihood compares measured charge vs predicted charge for each PMT, given position vertex hypothesis

- Timing reconstruction added as simple likelihood addition:

$$\mathcal{L} = \mathcal{L}_{x,E} \mathcal{L}_t$$
$$\mathcal{L}_{nll} = -\log(\mathcal{L})$$

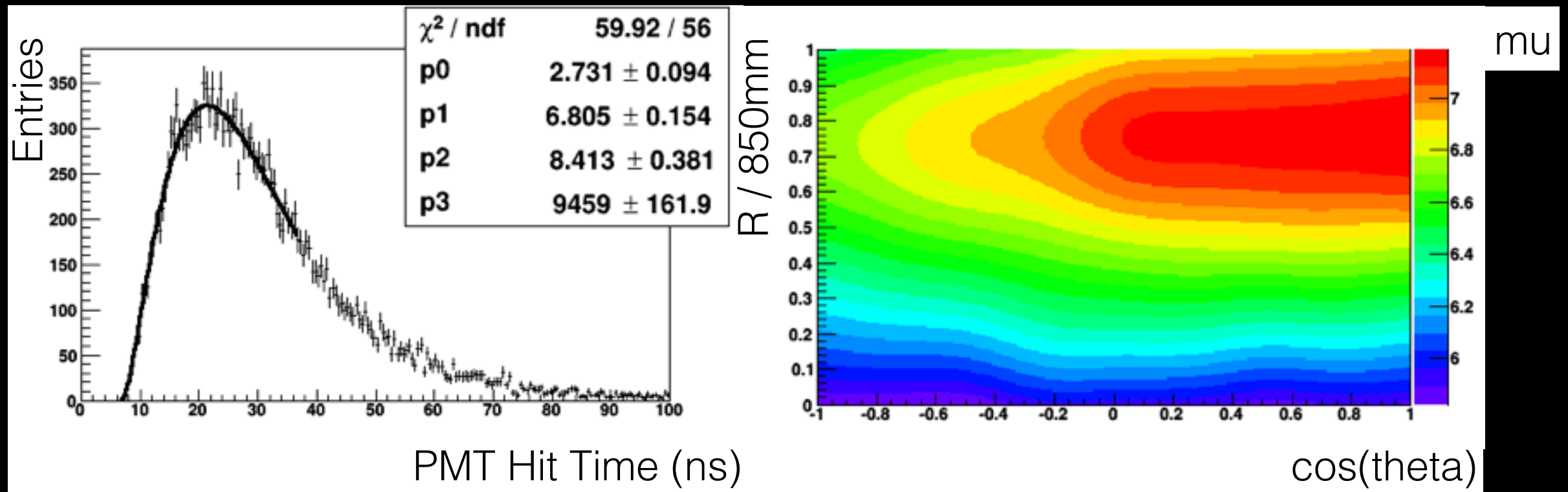
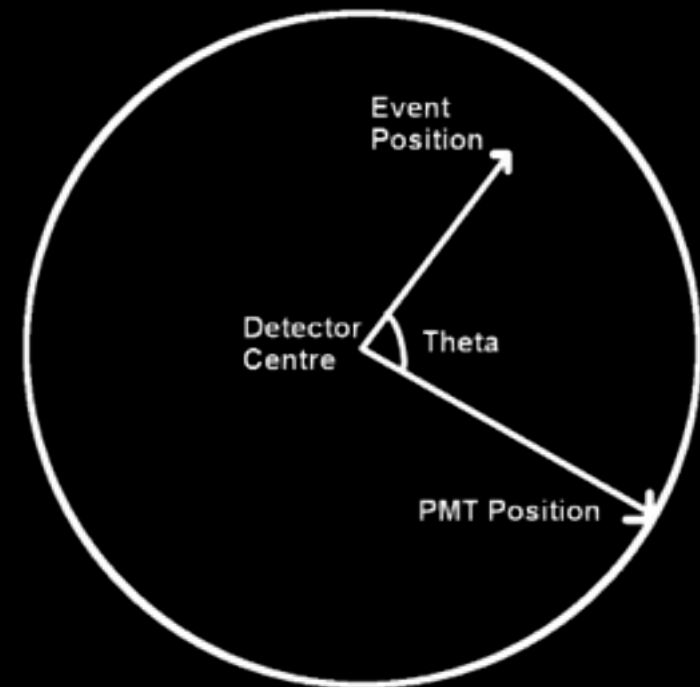
- More information for fitter -> better fit -> better reconstruction
- Better position reconstruction -> bigger fiducial volume
- Starting position: simulate 80 positions -> increasing radius
- 50000 Ar40 events at each position
- Generate lookup tables to inform Shellfit's simulation

# Timing Information

- Fit PMT hit time distribution with gamma distribution:

$$f(x) = \frac{\left(\frac{x-\mu}{\beta}\right)^{\gamma-1} \exp\left(-\frac{x-\mu}{\beta}\right)}{\beta \Gamma(\gamma)}$$

- Plot 3 parameters  $\gamma, \beta, \mu$  vs angle and event radius



## **Team SNOLAB**

**Next few weeks:  
DEAP3600 resurfacer run, tests**

**After:**

**Calibration + commissioning starts  
Ar fill planned for September  
Physics data-taking early 2015**

## **Me at RHUL**

**Next few weeks:  
Improve MC + implement timing  
response maps in likelihood in the  
reconstruction algorithm  
Measure change in position  
reconstruction resolution**



**(That's me, at SNOLAB!)**

**Thanks for listening!**

**Questions?**