

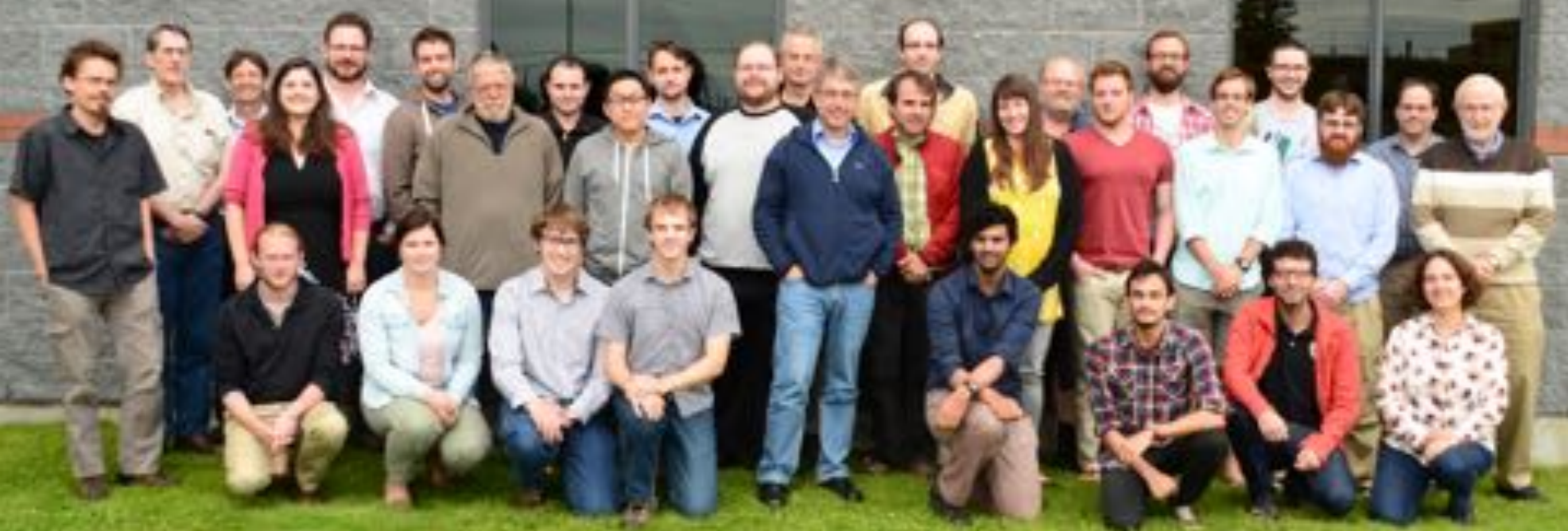


# Construction of the DEAP-3600 Dark Matter detector and first commissioning results.

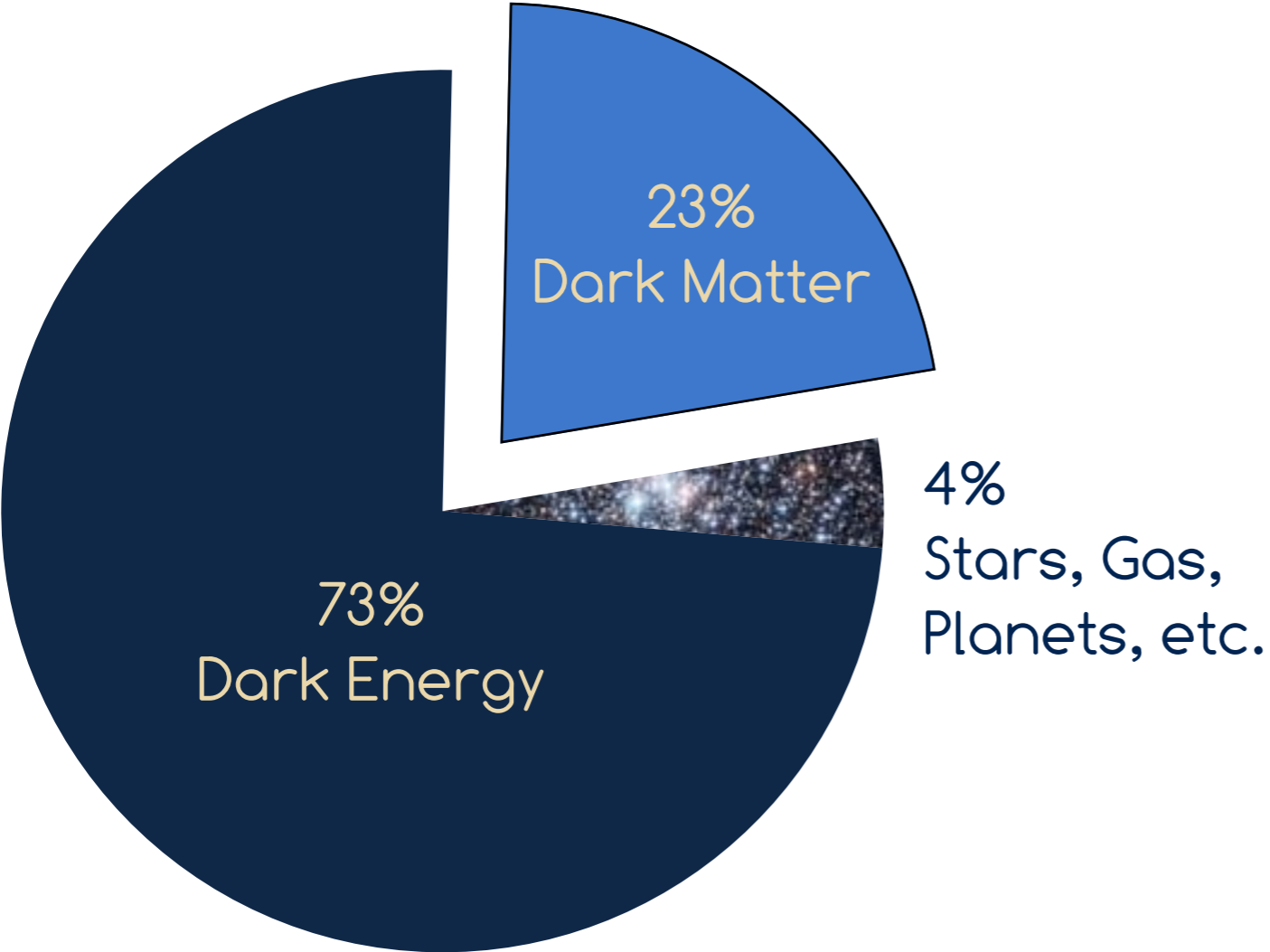
Tina Pollmann

for the DEAP collaboration

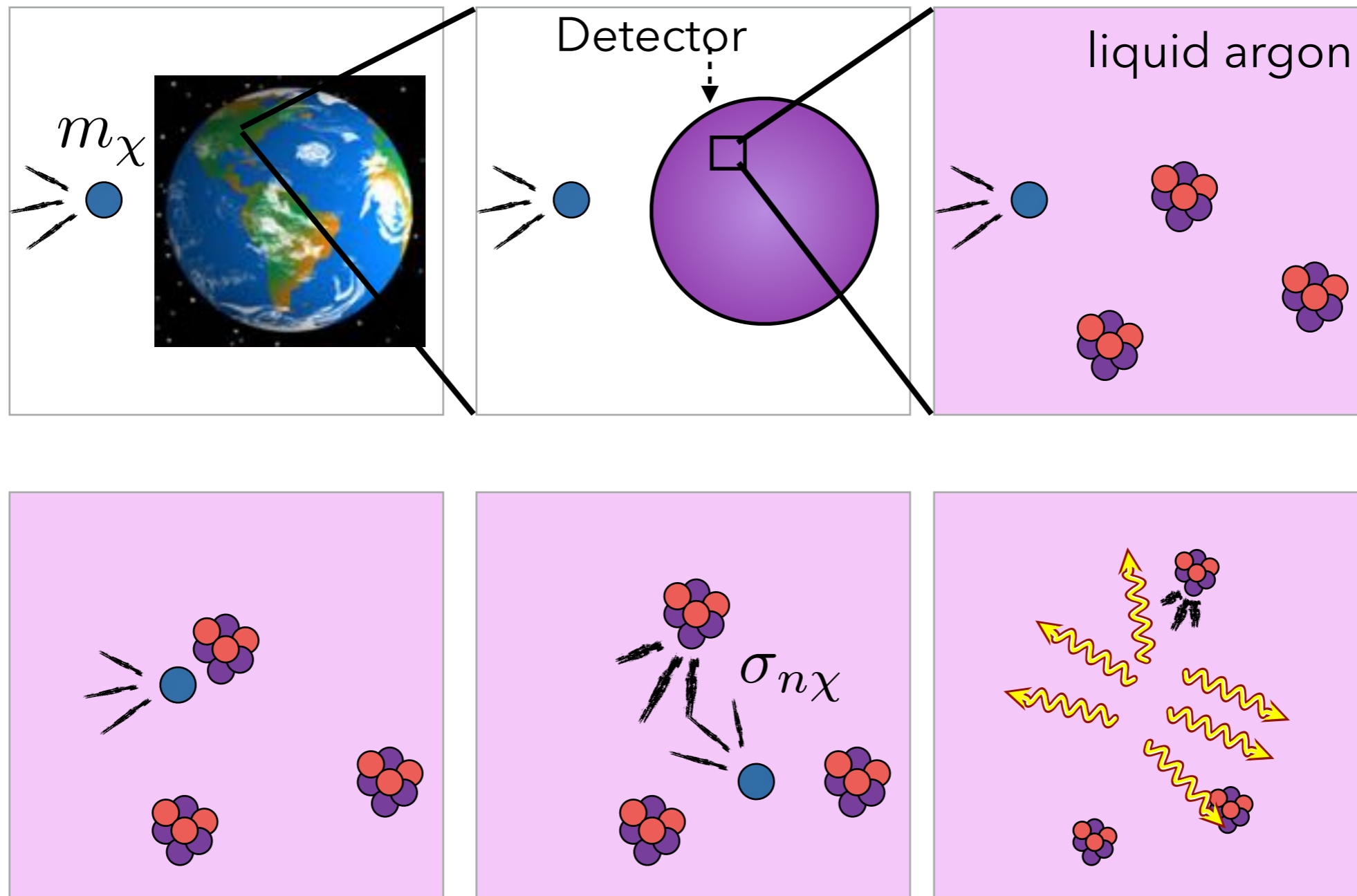
WIN2015, Heidelberg, June 10 2015



The standard model of astronomy puts the composition of the universe at 23% Dark Matter.

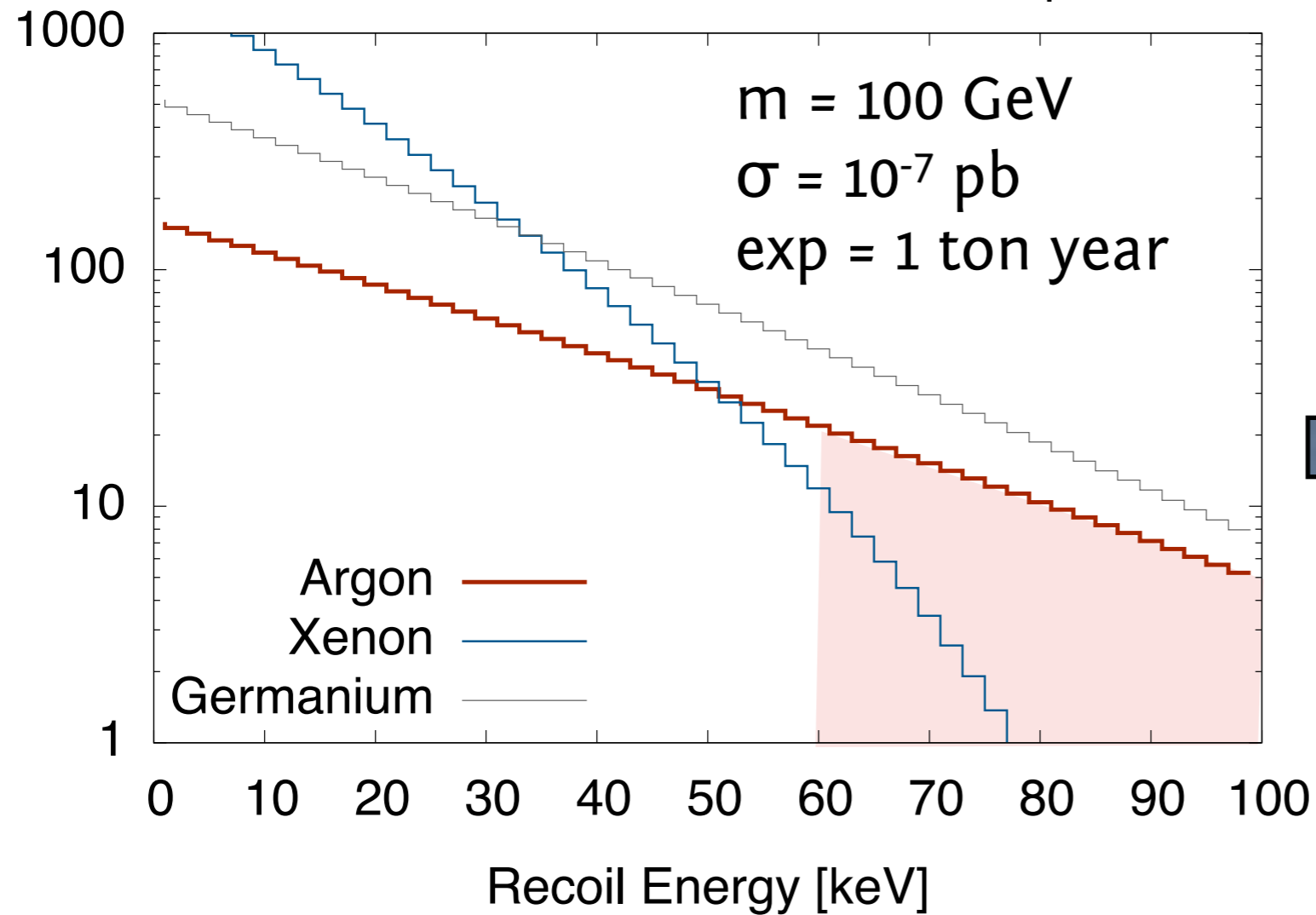


DEAP is a **direct detection** experiment, looking for scintillation light produced when an argon nucleus recoils after scattering on a Dark Matter particle.



# The challenges of **direct detection**: low energy, small signal rate

Differential dark matter recoil spectrum.



## DEAP-3600

- 1000 kg fiducial mass target volume

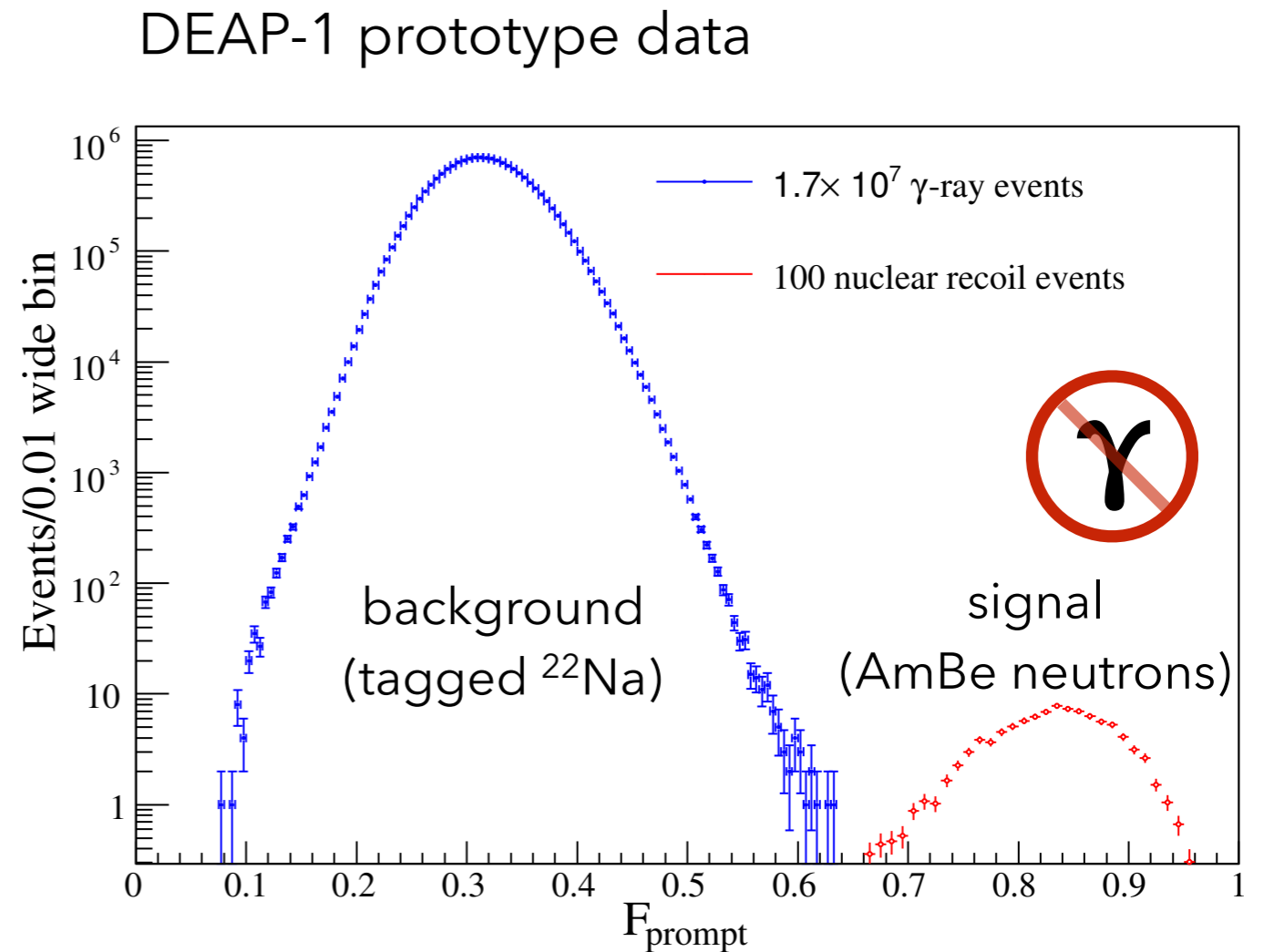
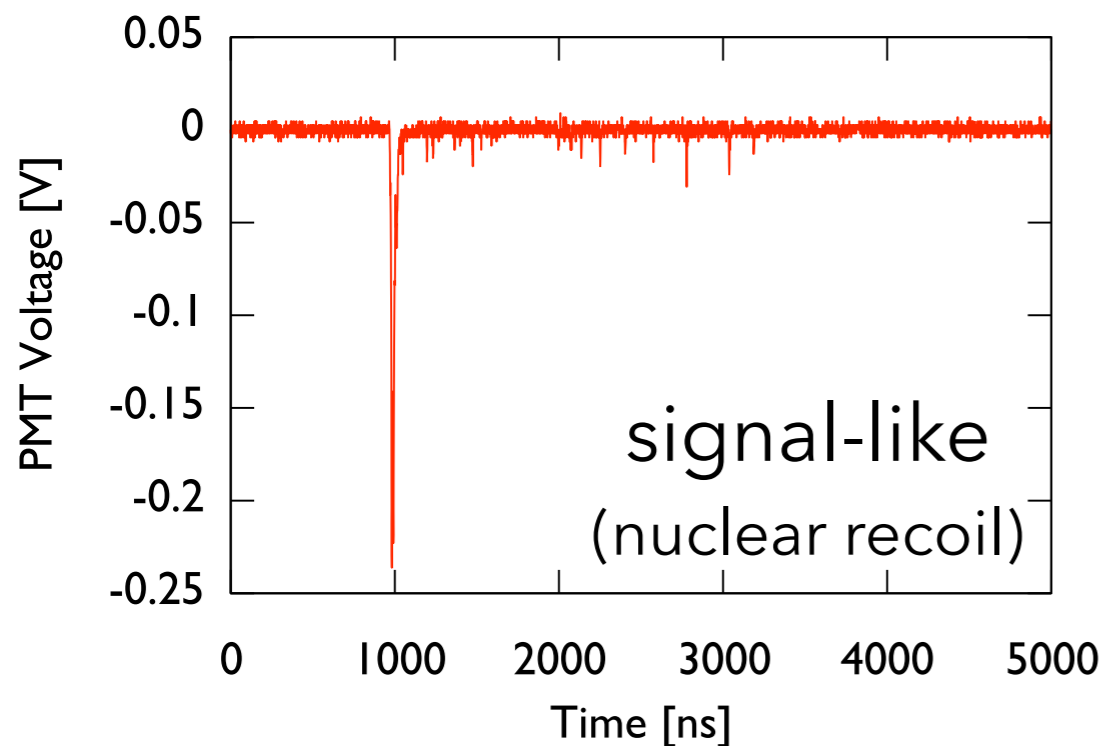
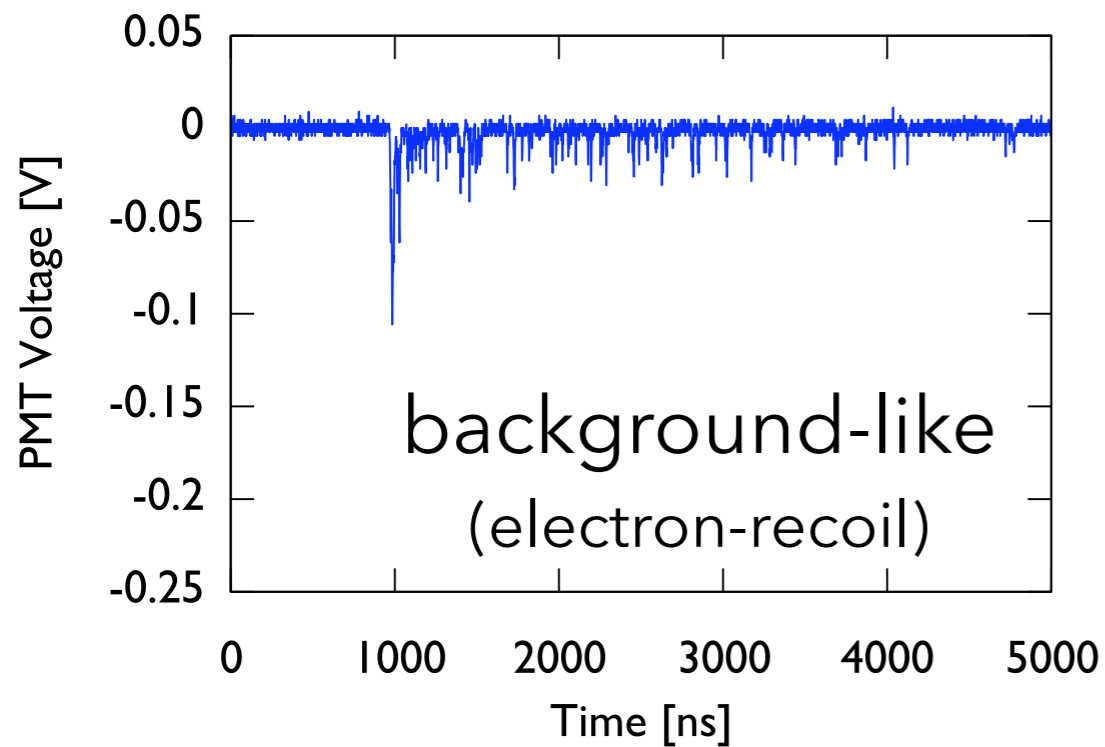
- 8 PE/keV lightyield



- $< 0.2$  background events/year



The argon scintillation pulseshape differs by exciting particle type, allowing PSD against electron-recoil events projected to reach  $10^{-10}$  at 60 keVr, 8PE/keV.



Exploiting the singlet (6 ns) and triplet (1.5  $\mu\text{s}$ ) lifetime difference.

DEAP-3600



SNO+



**SNO+ LAB**

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

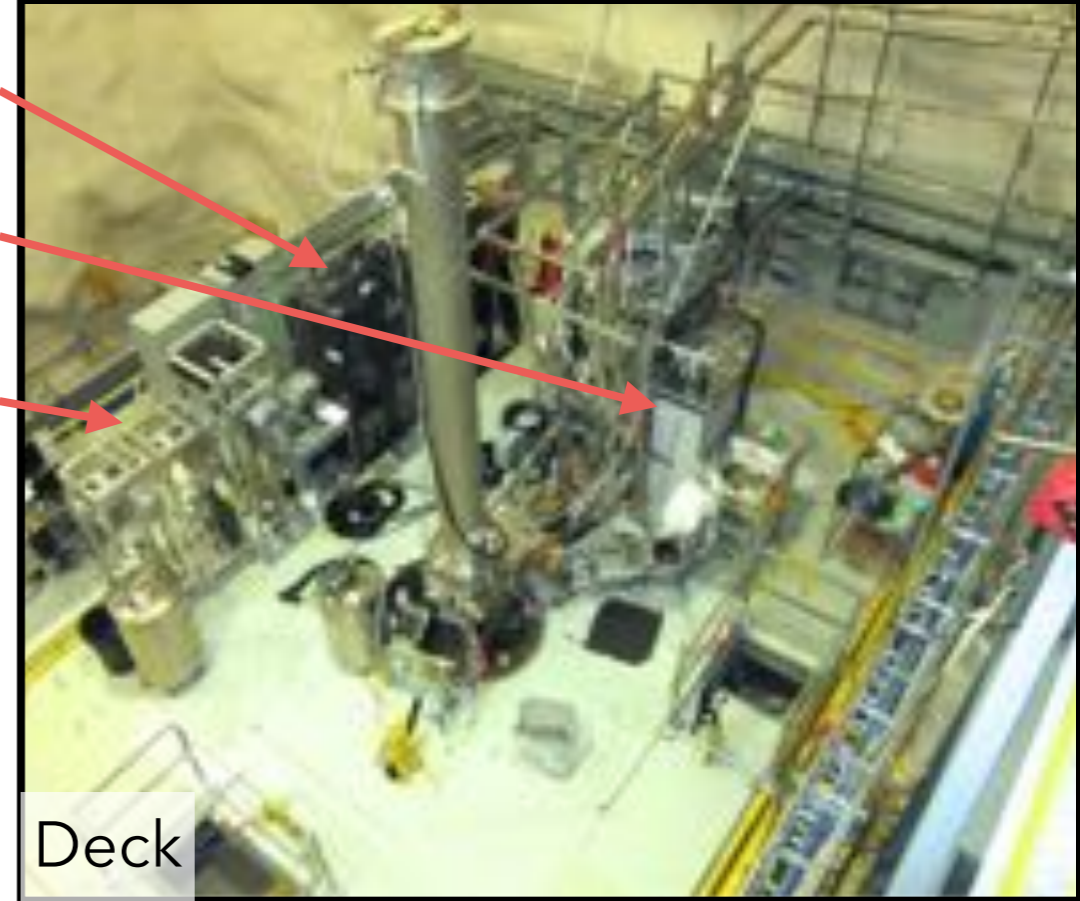
2 km (6800 ft) deep. 0.27  $\mu/m^2/day$ .

**DEAP  
3600**

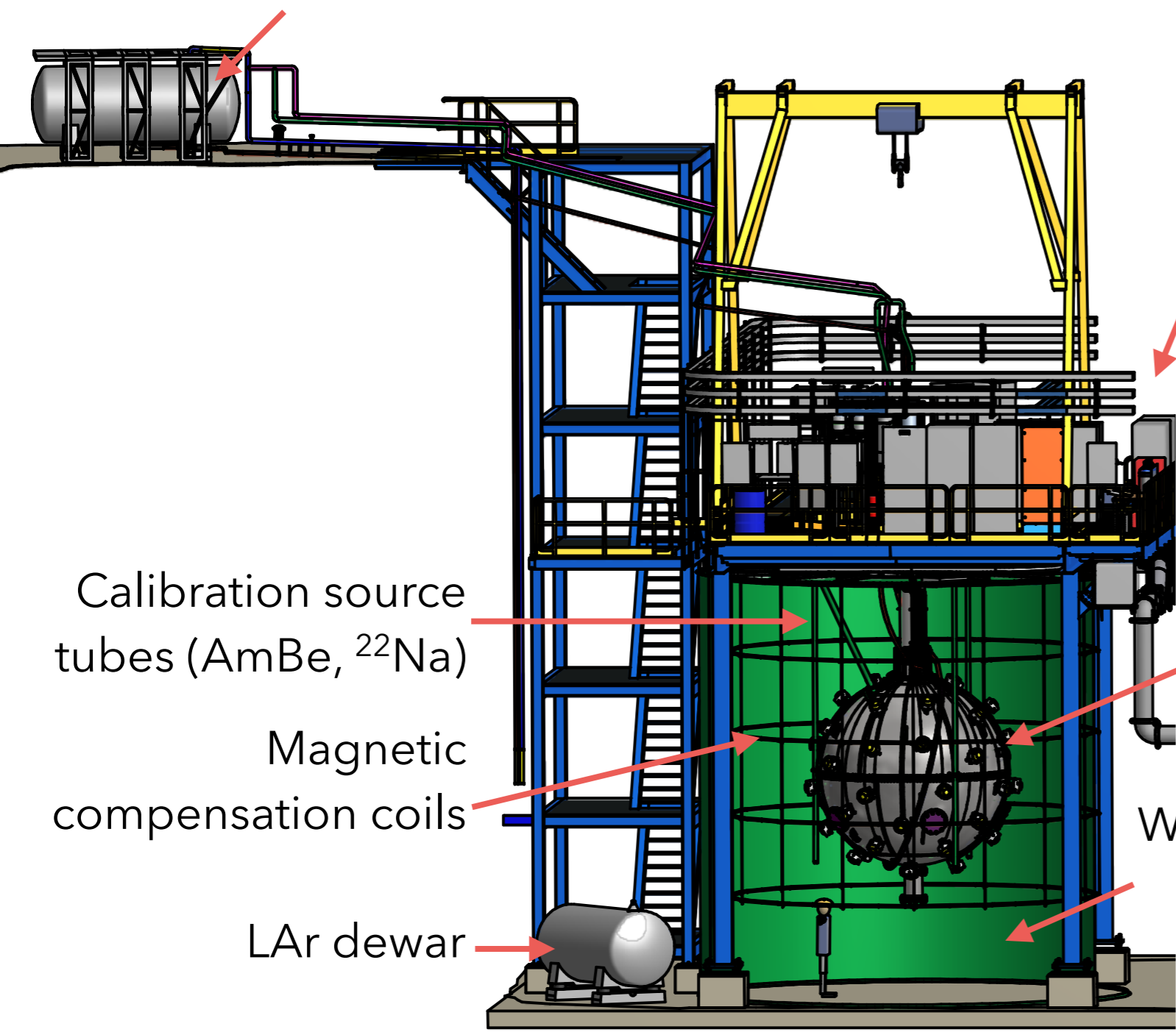


LN<sub>2</sub> cryocooler

DAQ racks  
Process systems  
Calibration source deployment system



Deck



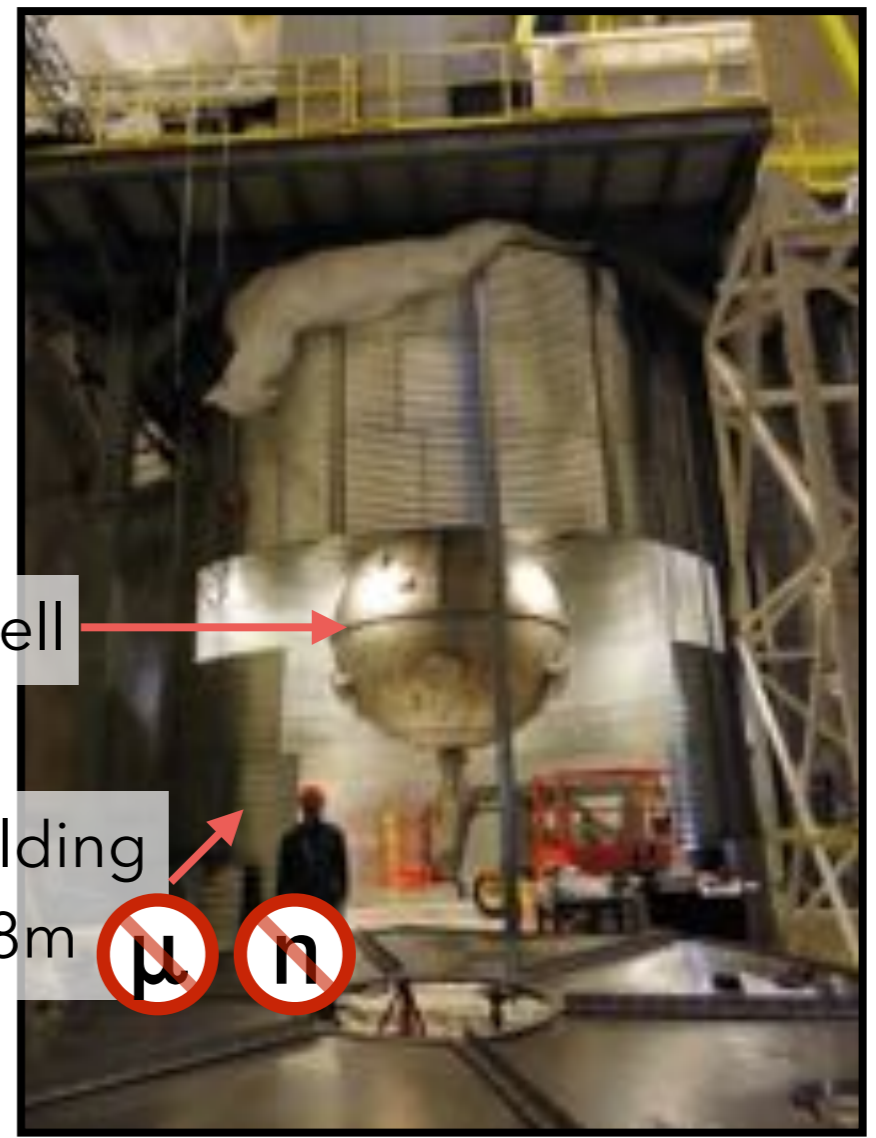
Calibration source tubes (AmBe, <sup>22</sup>Na)

Magnetic compensation coils

LAr dewar

Steel shell

Water shielding tank. Ø 8m



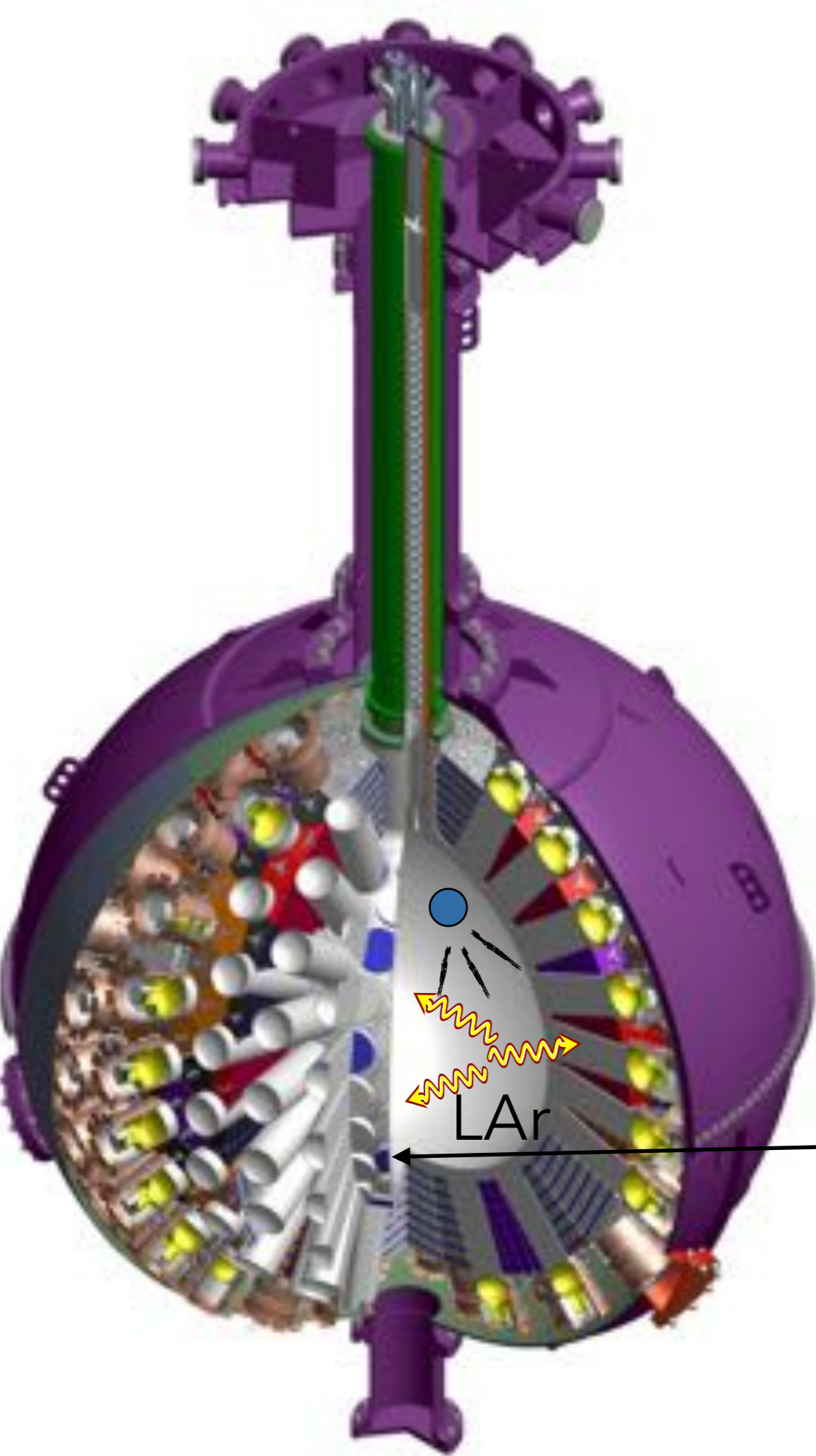


# The DEAP-3600 detector.

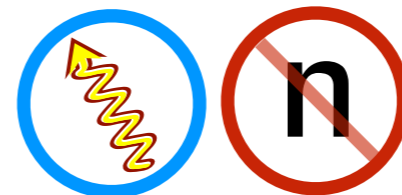


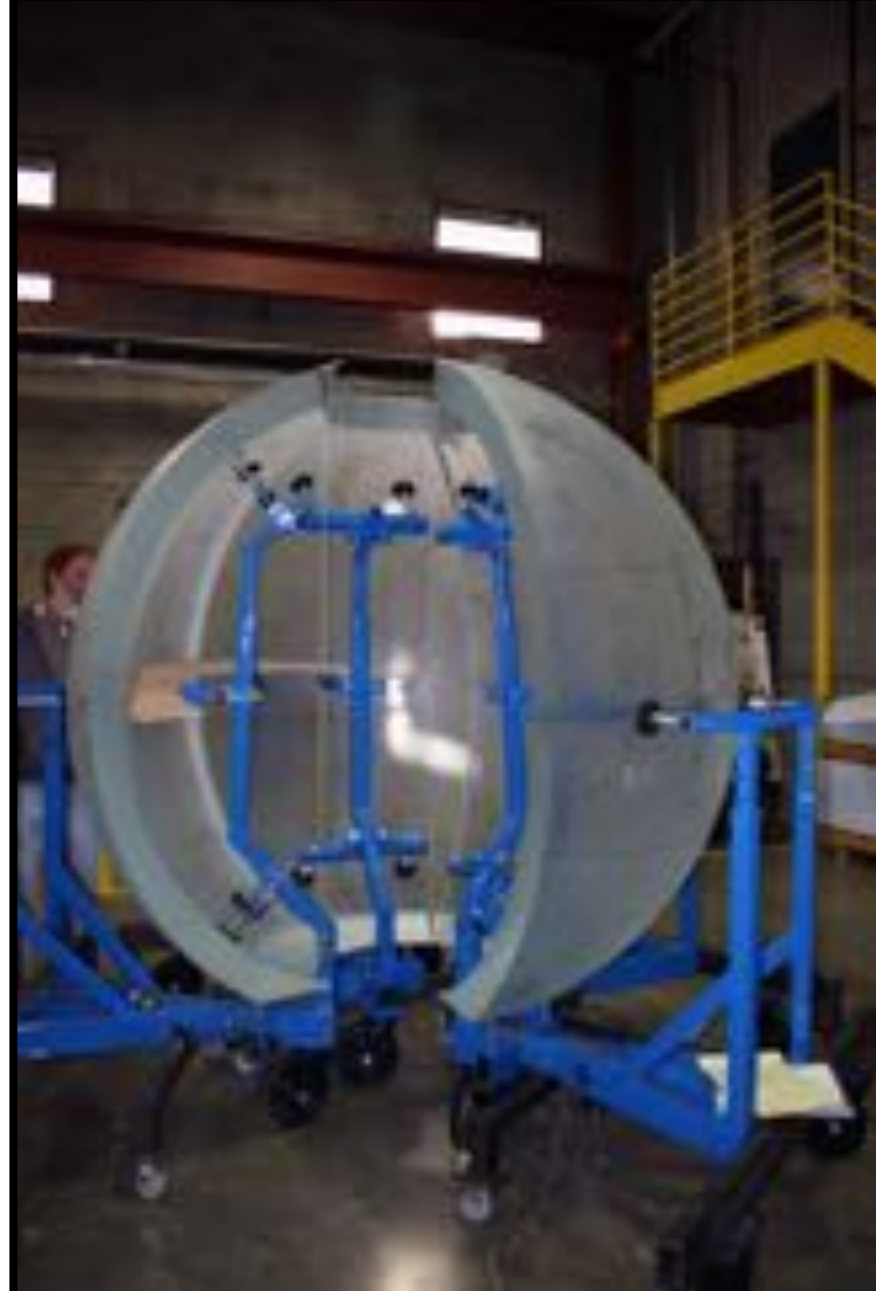
Liquid Argon (84 K,  $-188^{\circ}\text{C}$ )  
single-phase  
3.6 tonnes (total)  
1 tonne (fiducial)

# The DEAP-3600 detector.

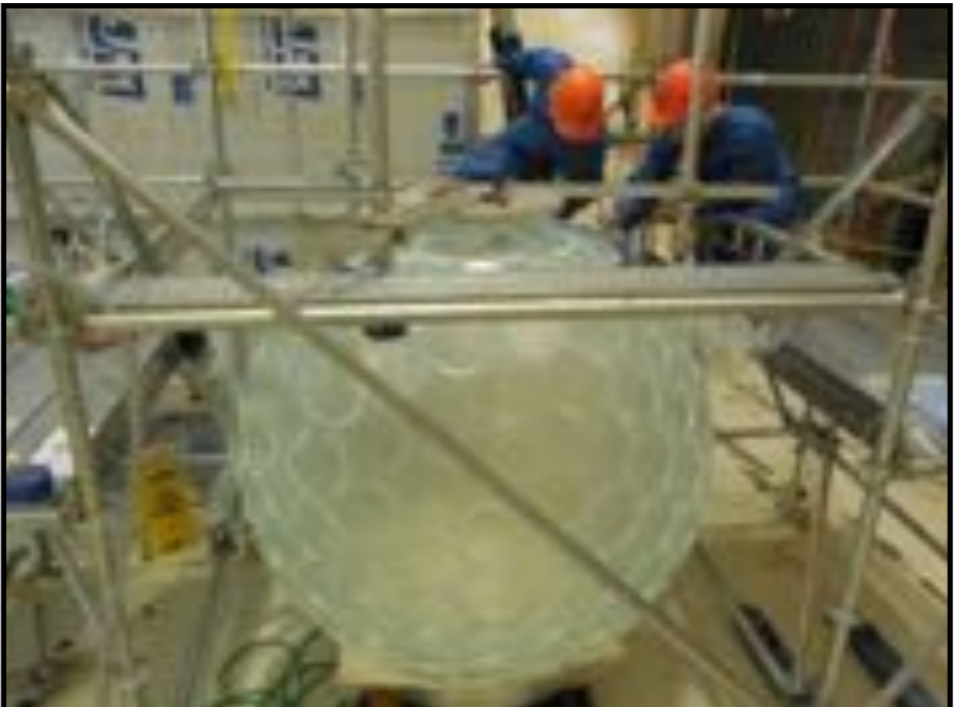


Acrylic vessel.

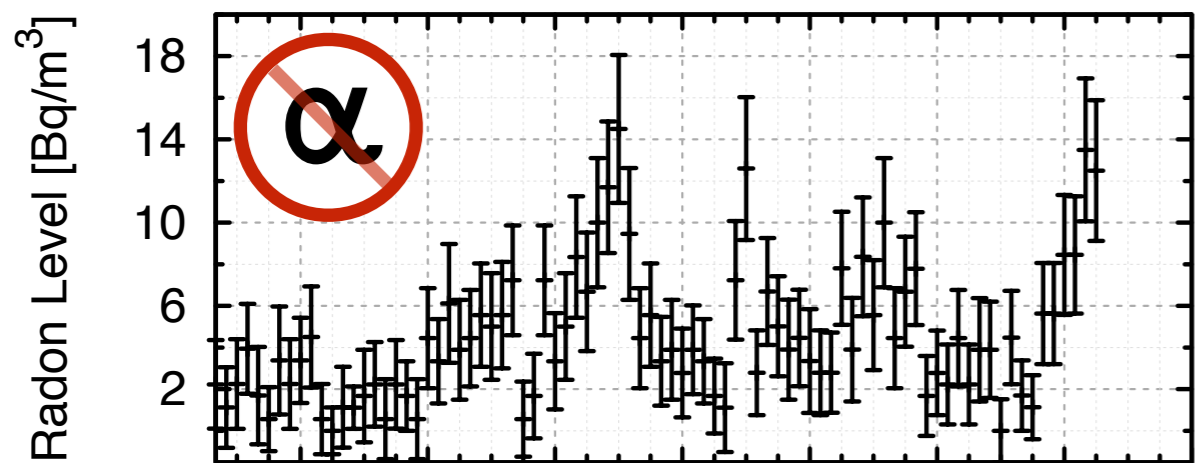
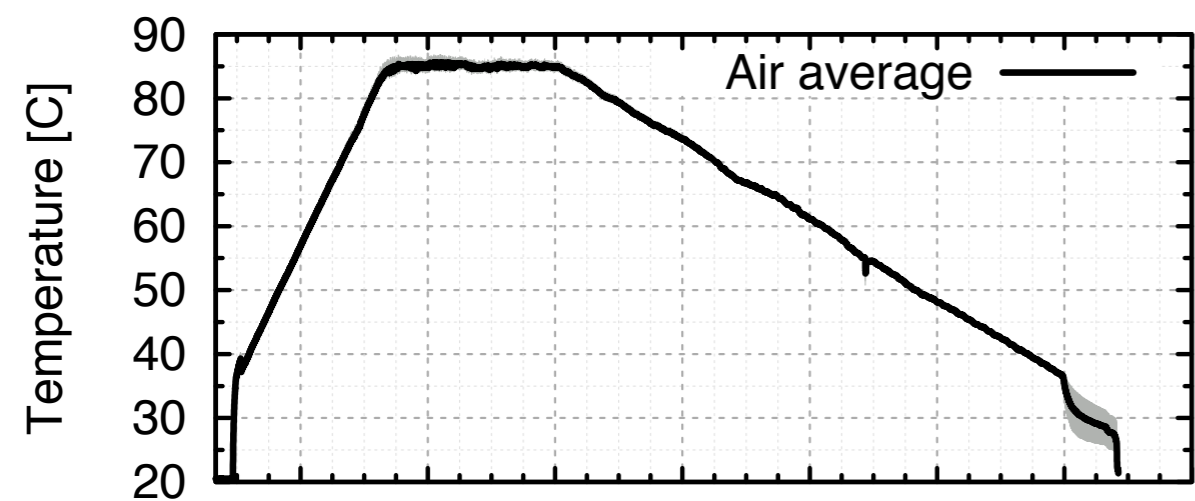




$<10^{-19}$  g/g  $^{210}\text{Pb}$ ,  $\sim$  ppt U and Th



AV from clean acrylic,  
assembled underground.



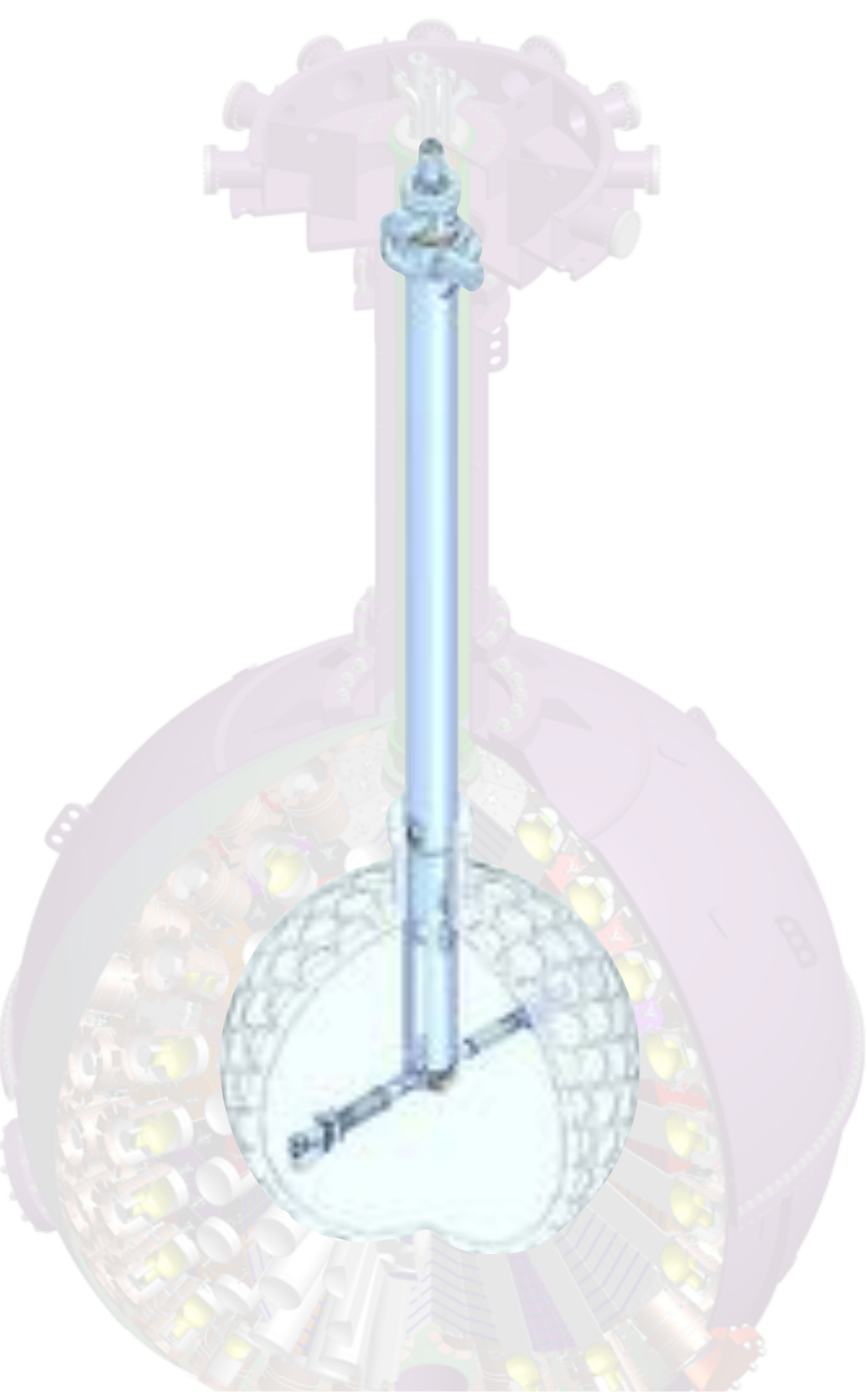
02/01 02/02 02/03 02/04 02/05 02/06 02/07 02/08  
Date (2013, month/day)



AV annealed at ~85 C, 5 times.



Radon monitored and controlled.

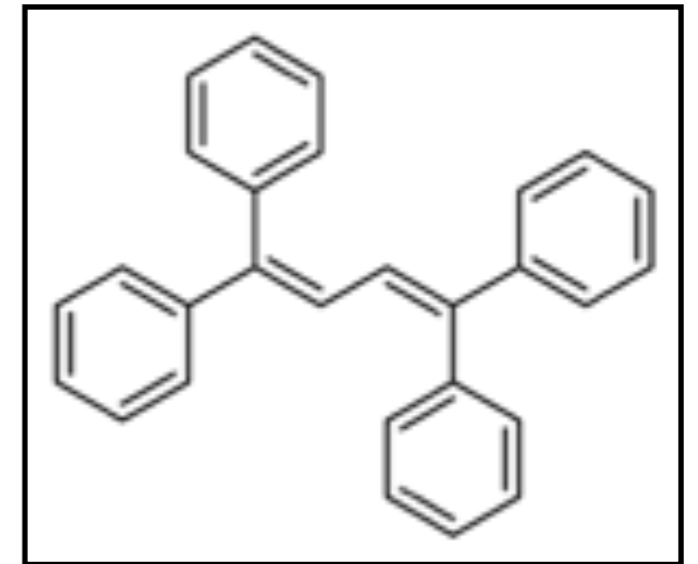
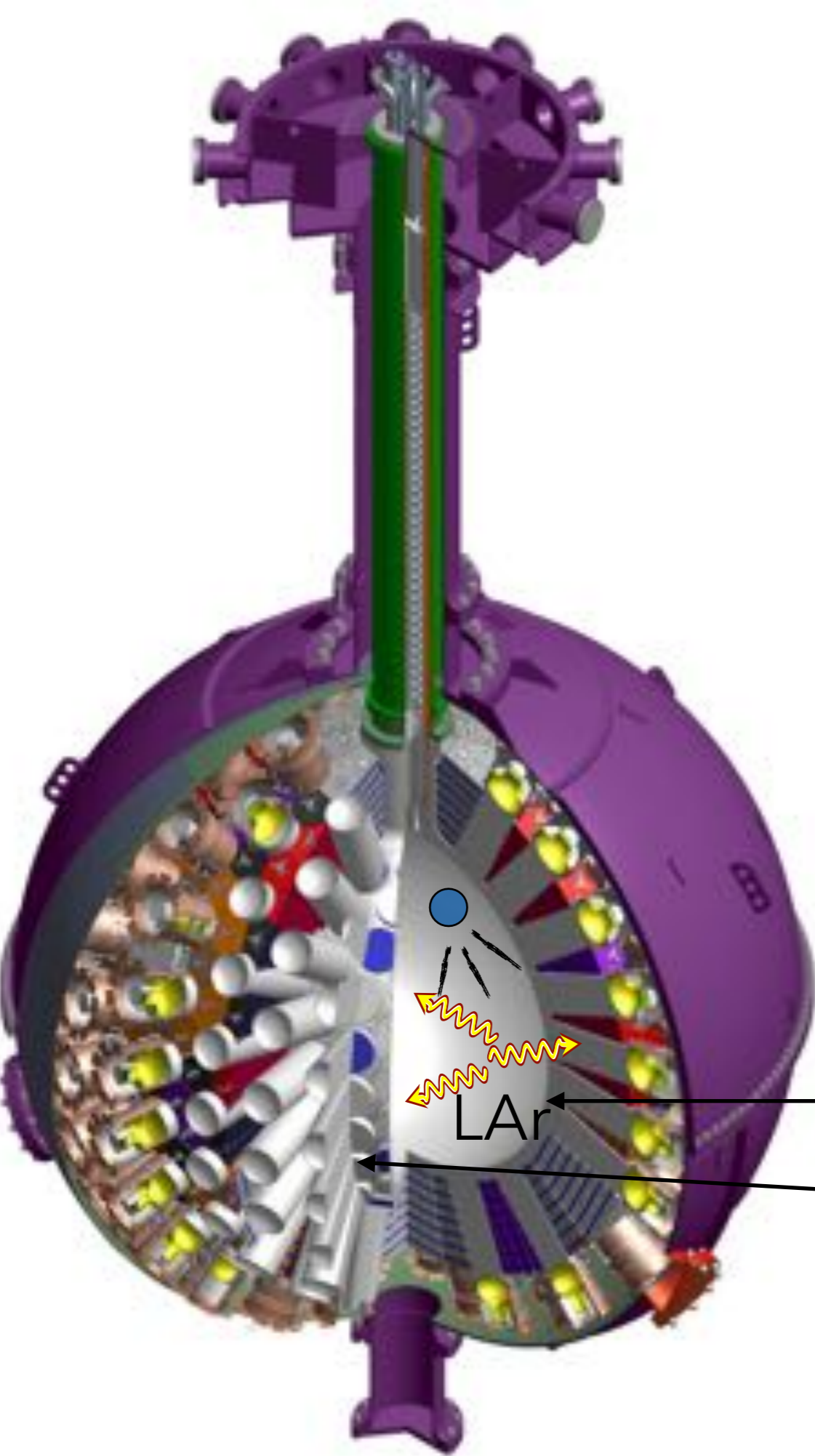


Once AV is radon-tight,  
residual deposits are removed.



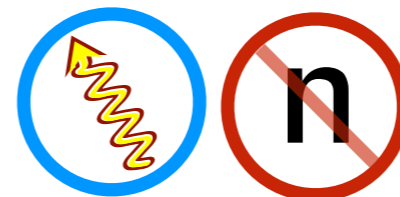
Resurfacer takes fraction of a mm off the AV's inside.

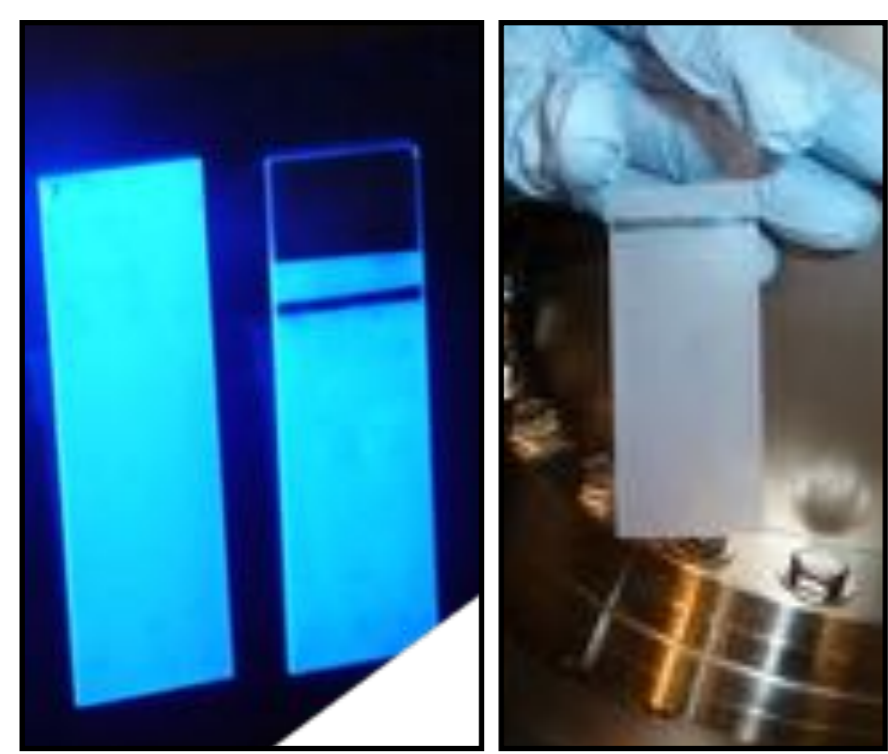
# The DEAP-3600 detector.



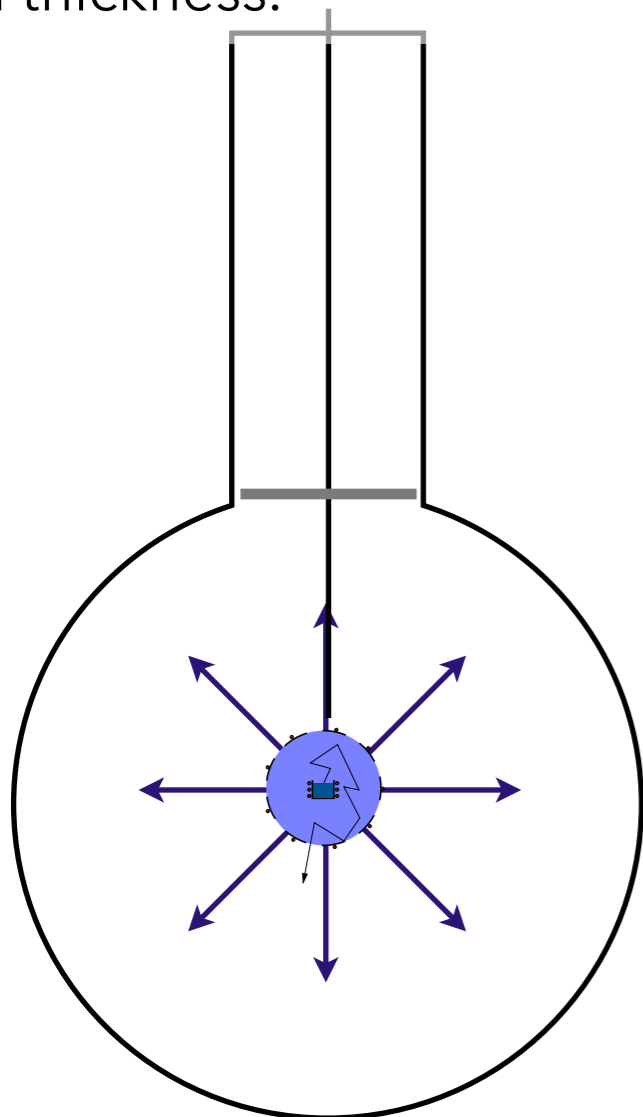
TPB wavelength shifter. 

Acrylic vessel.





TPB under UV and visible light.  
~ $\mu\text{m}$  thickness.



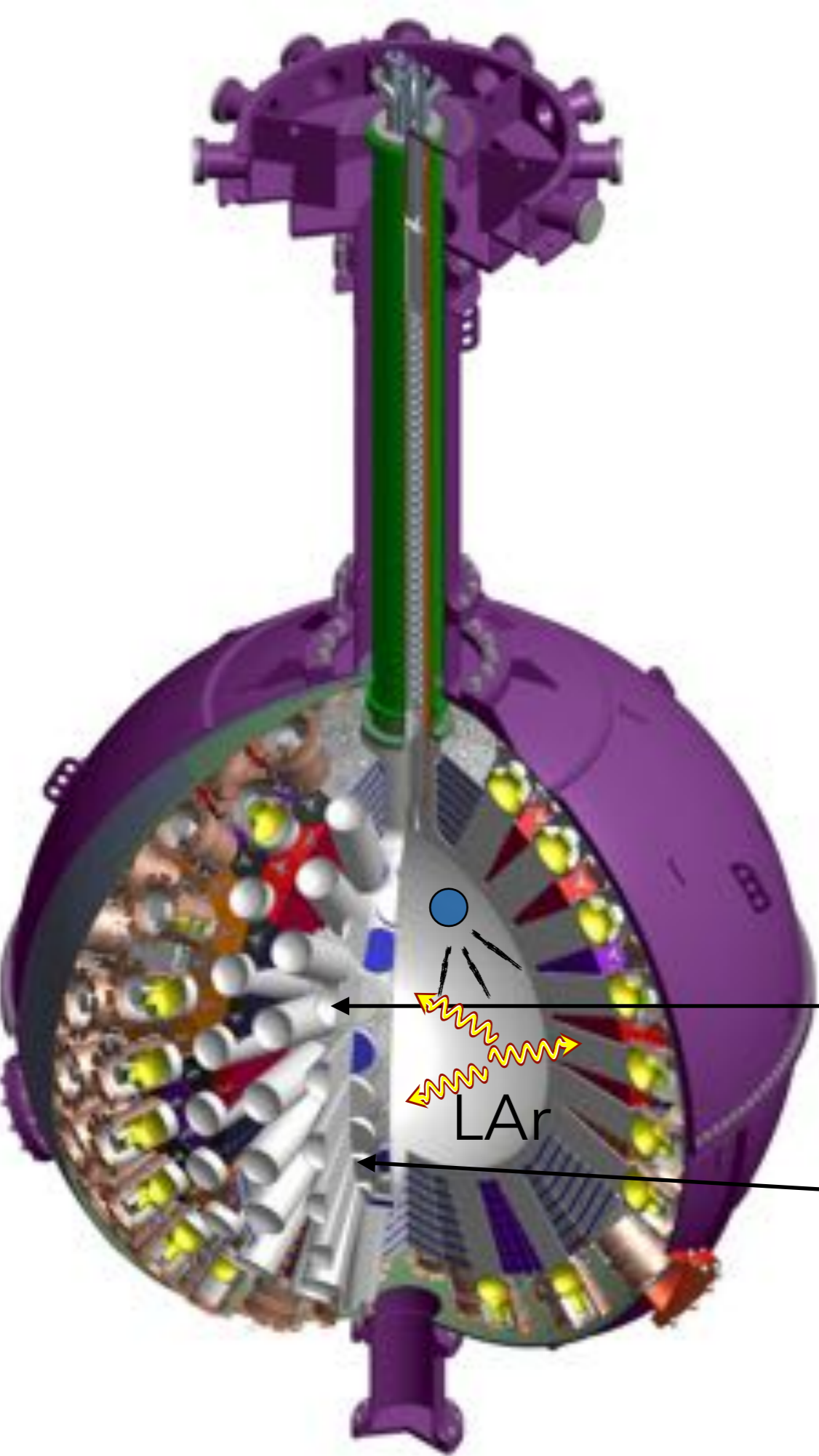
$4\pi$  thermal evaporation source.



TPB deposition system being installed.



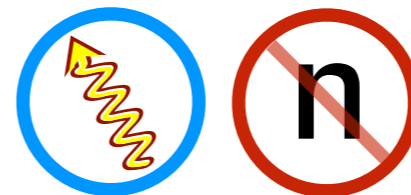
# The DEAP-3600 detector.



Light guide. 

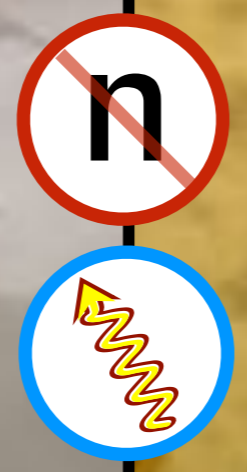
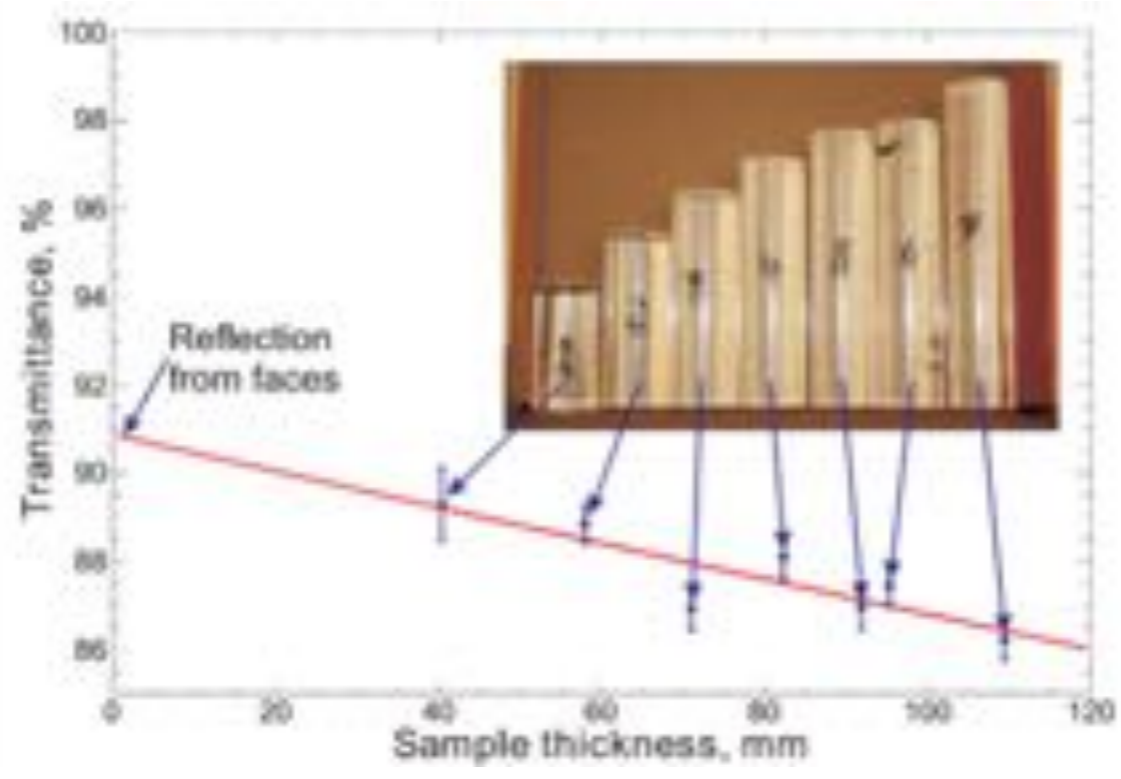
LAr

Acrylic vessel.





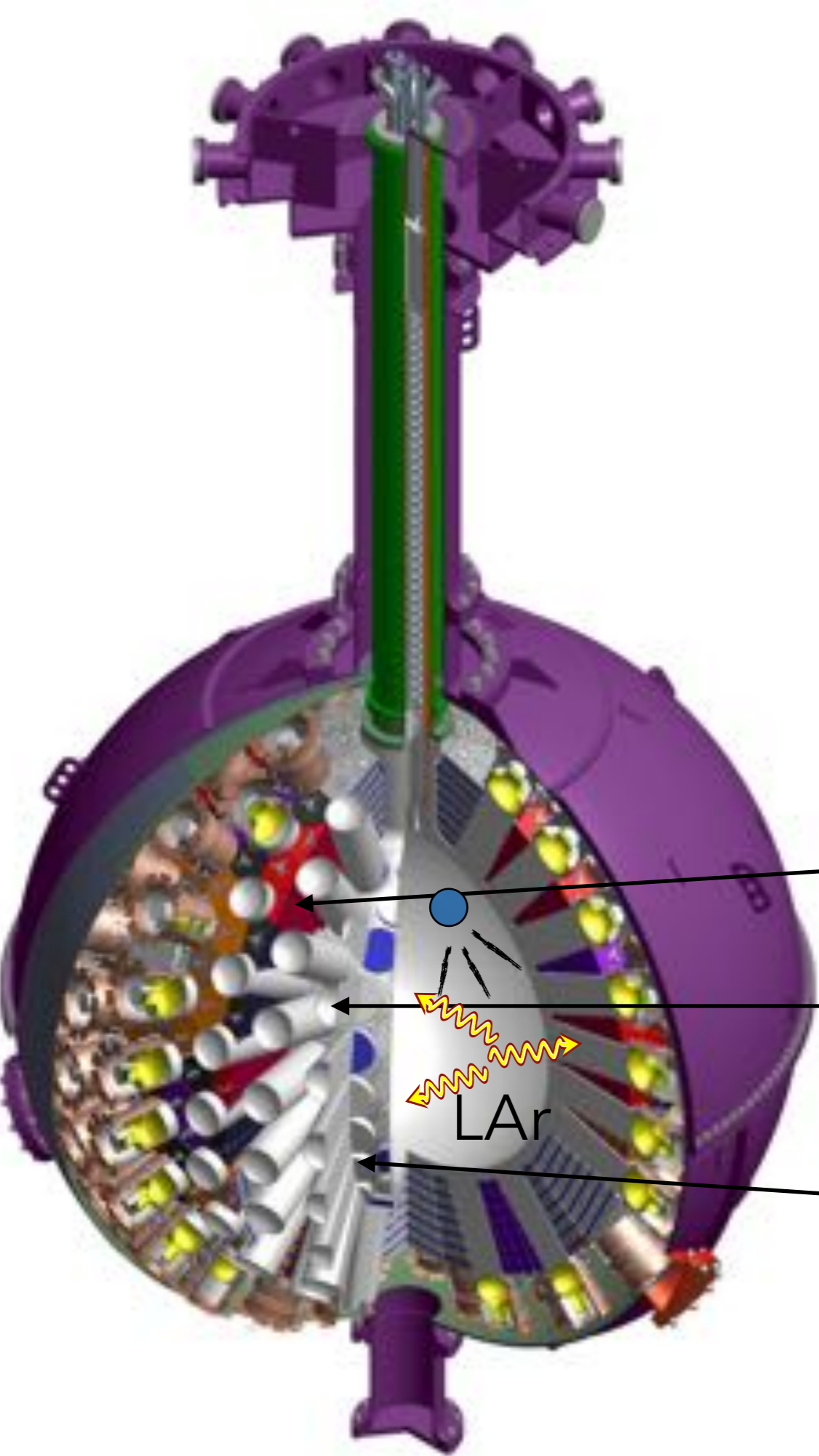
LG acrylic with best transparency, bonded meticulously.



Specular and white reflector covers all surfaces.



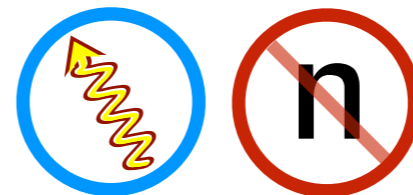
# The DEAP-3600 detector.

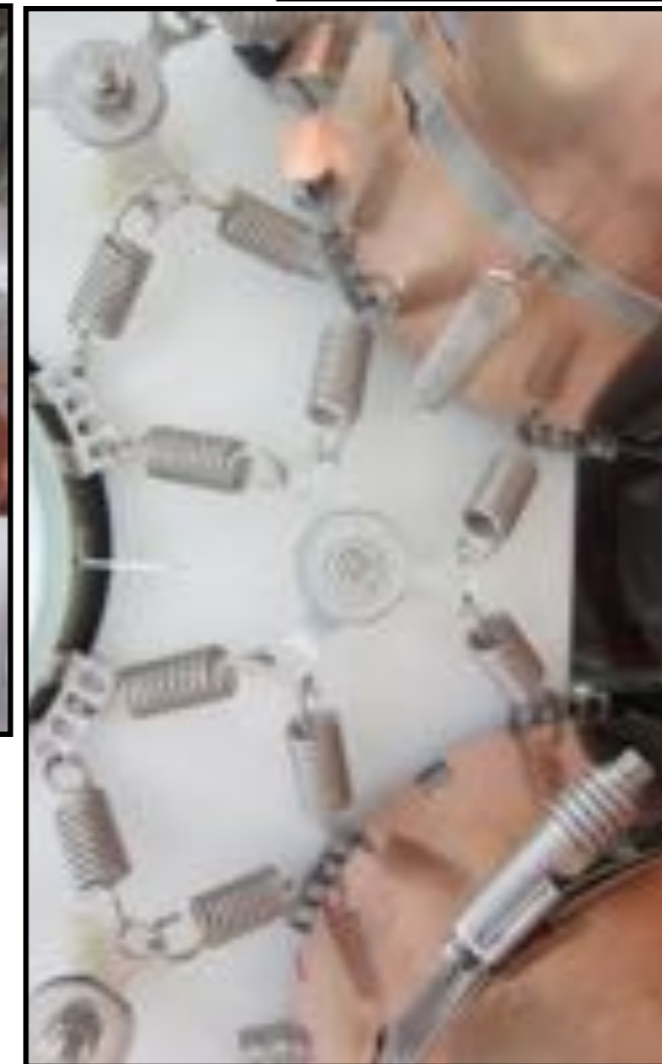
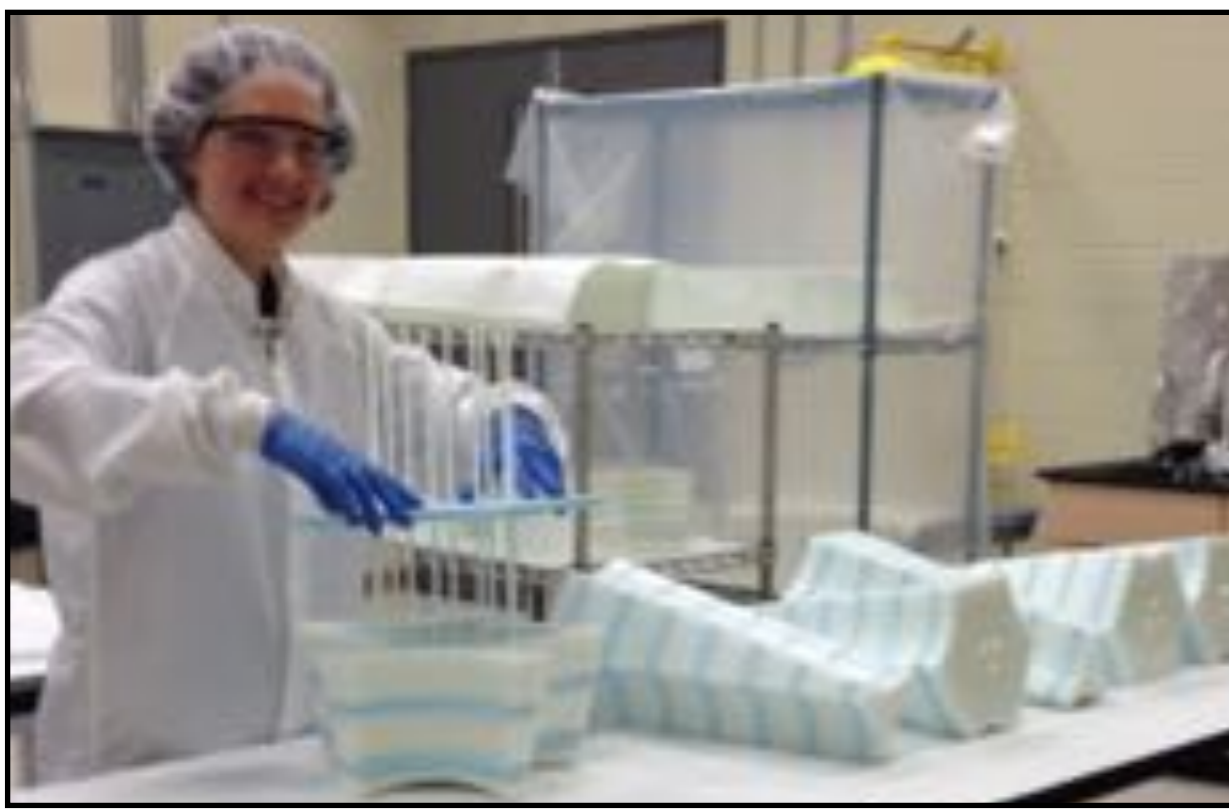


Filler block. 

Light guide. 

Acrylic vessel.





Filler-blocks for extra neutron and heat shielding.



# The DEAP-3600 detector.

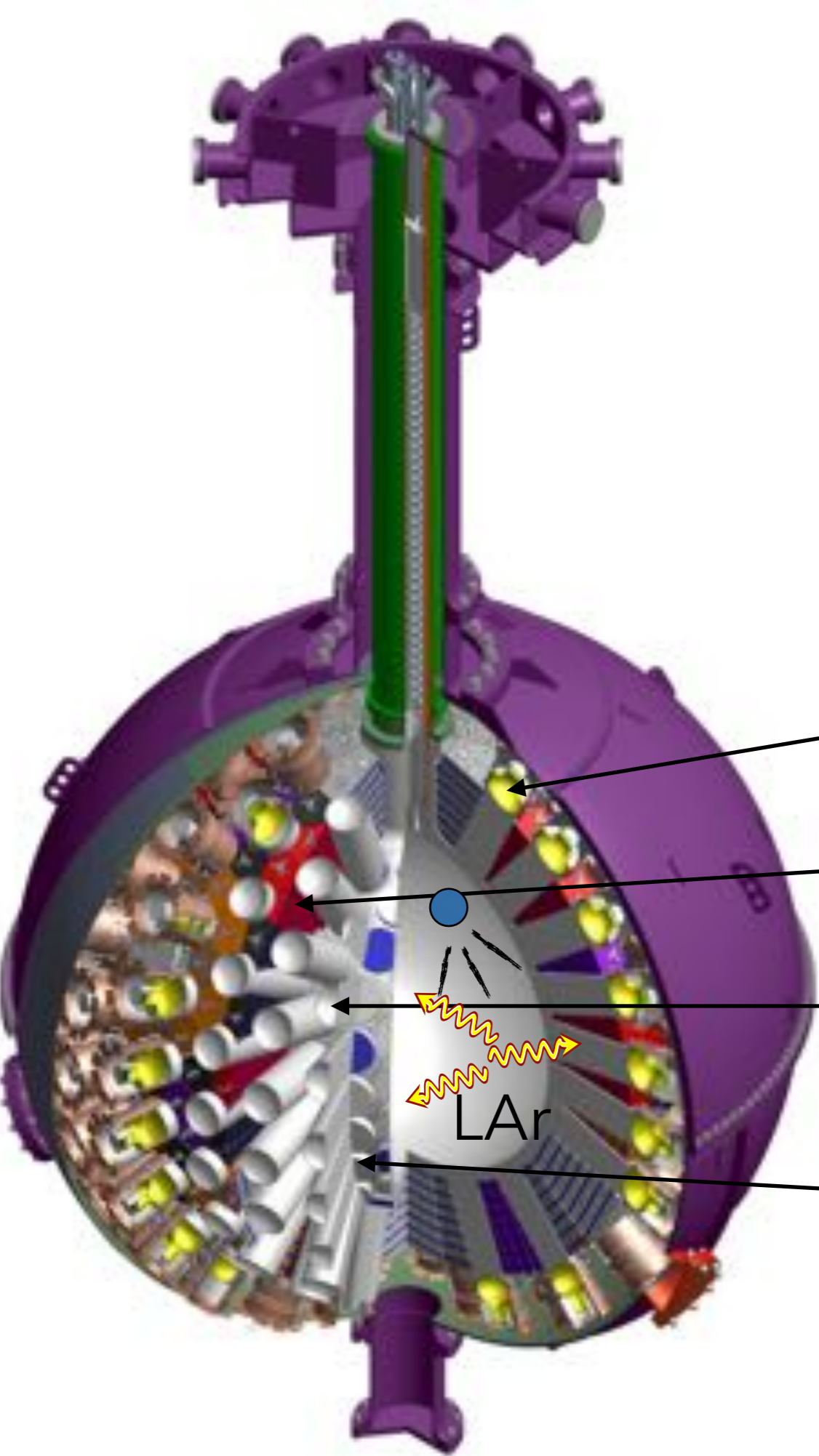
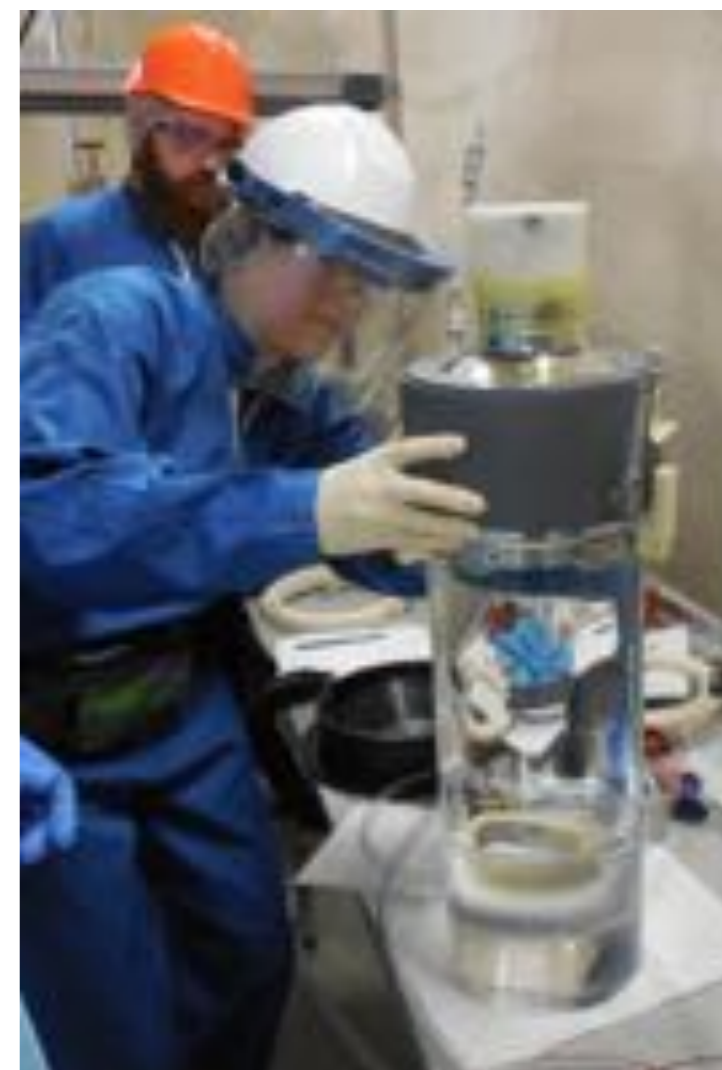
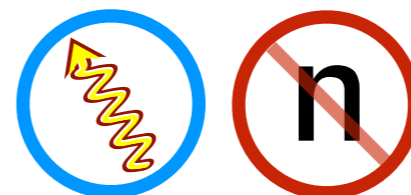


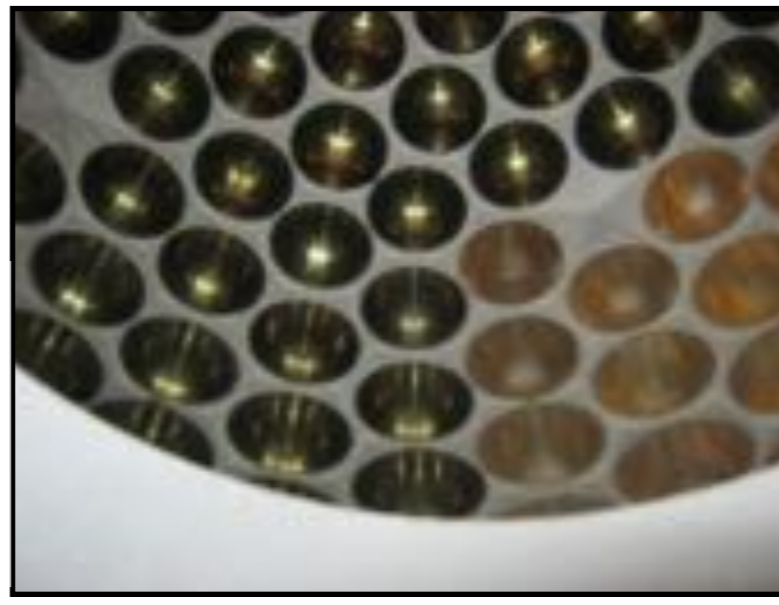
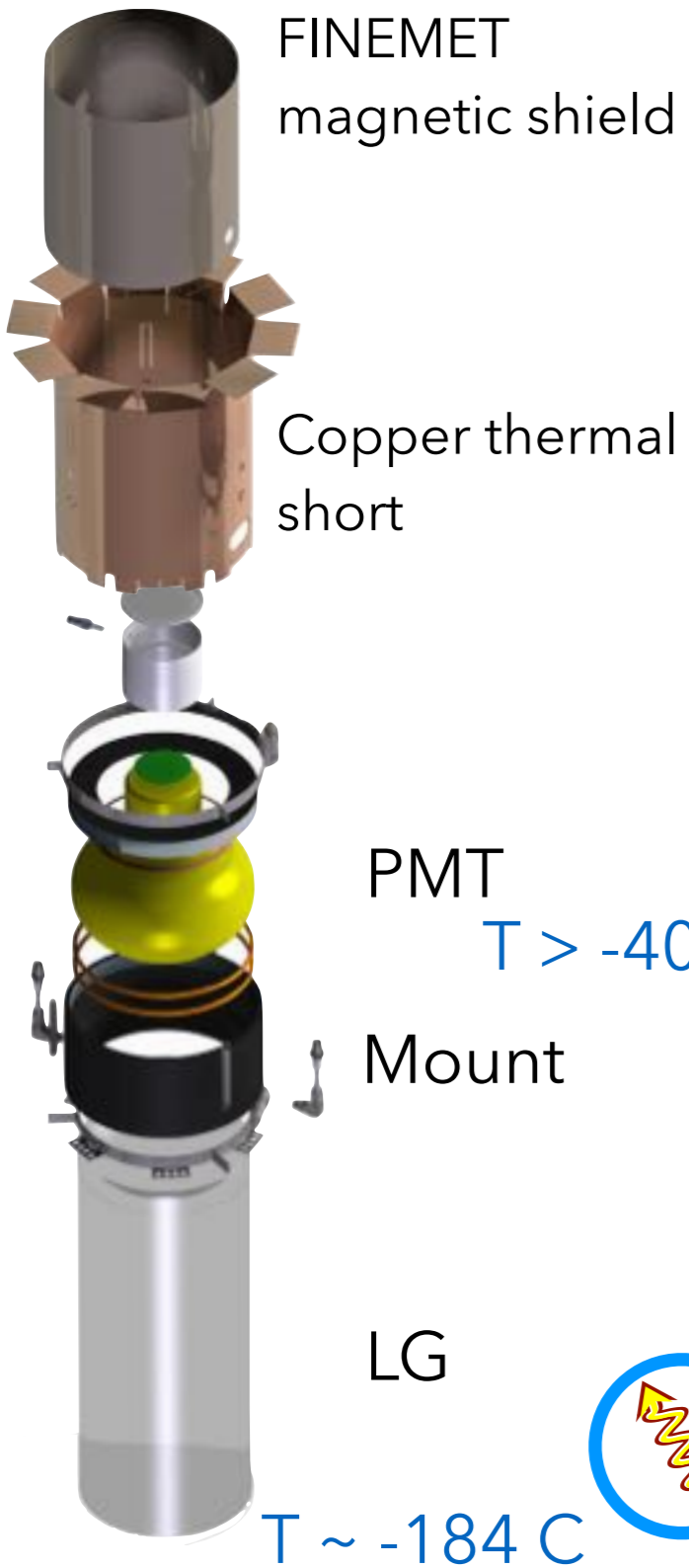
Photo multiplier.

Filler block. ~~n~~

Light guide. ~~n~~

Acrylic vessel.

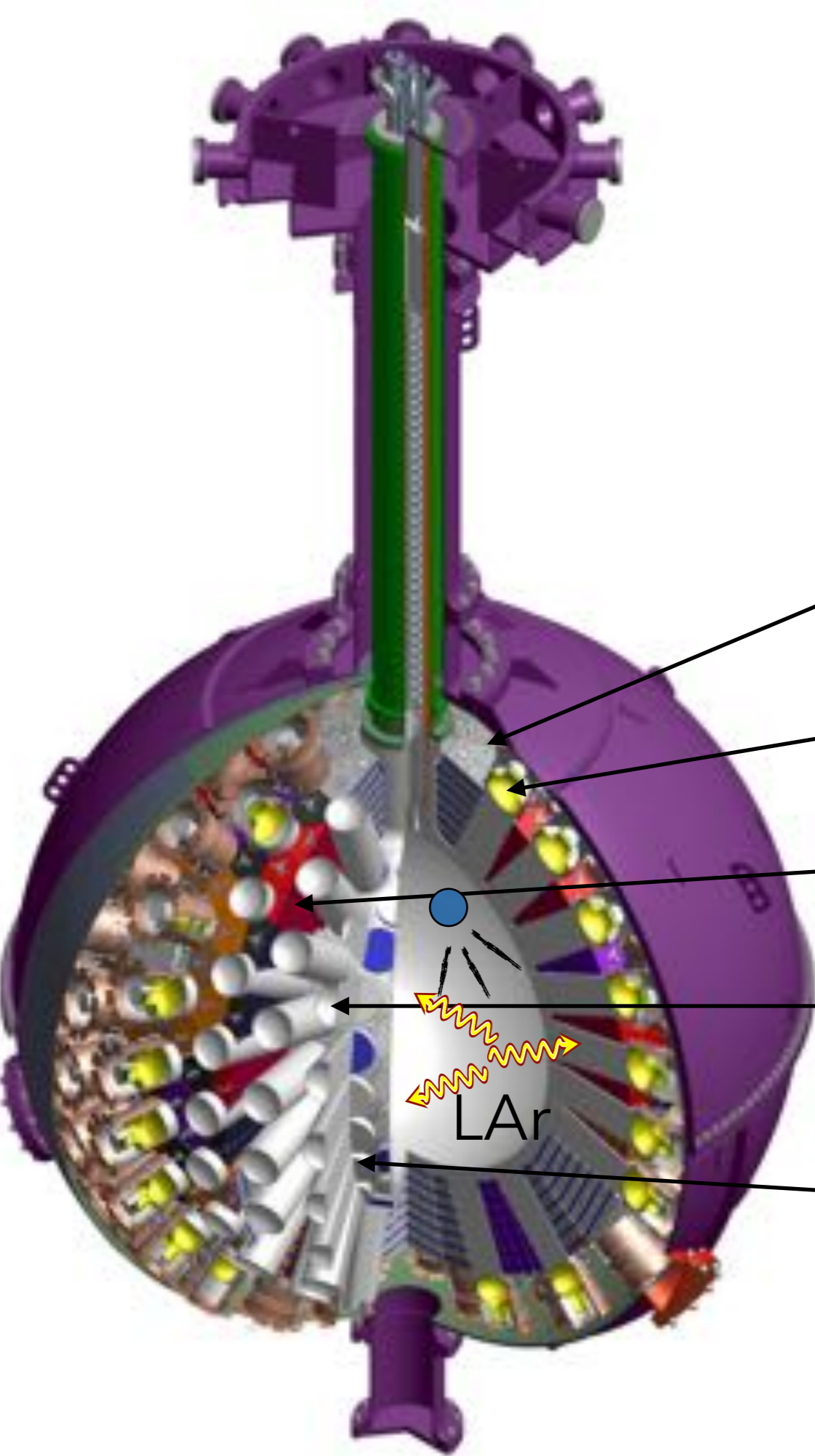




255 Hamamatsu 5912  
PMTs, oil coupled to LG  
faces. 71% coverage.



# The DEAP-3600 detector.



Cables, insulation.

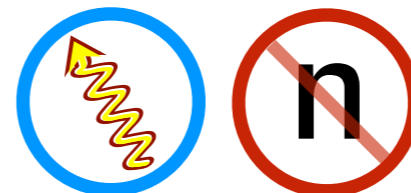
Photo multiplier.

Filler block. 

Light guide. 

LAr

Acrylic vessel.

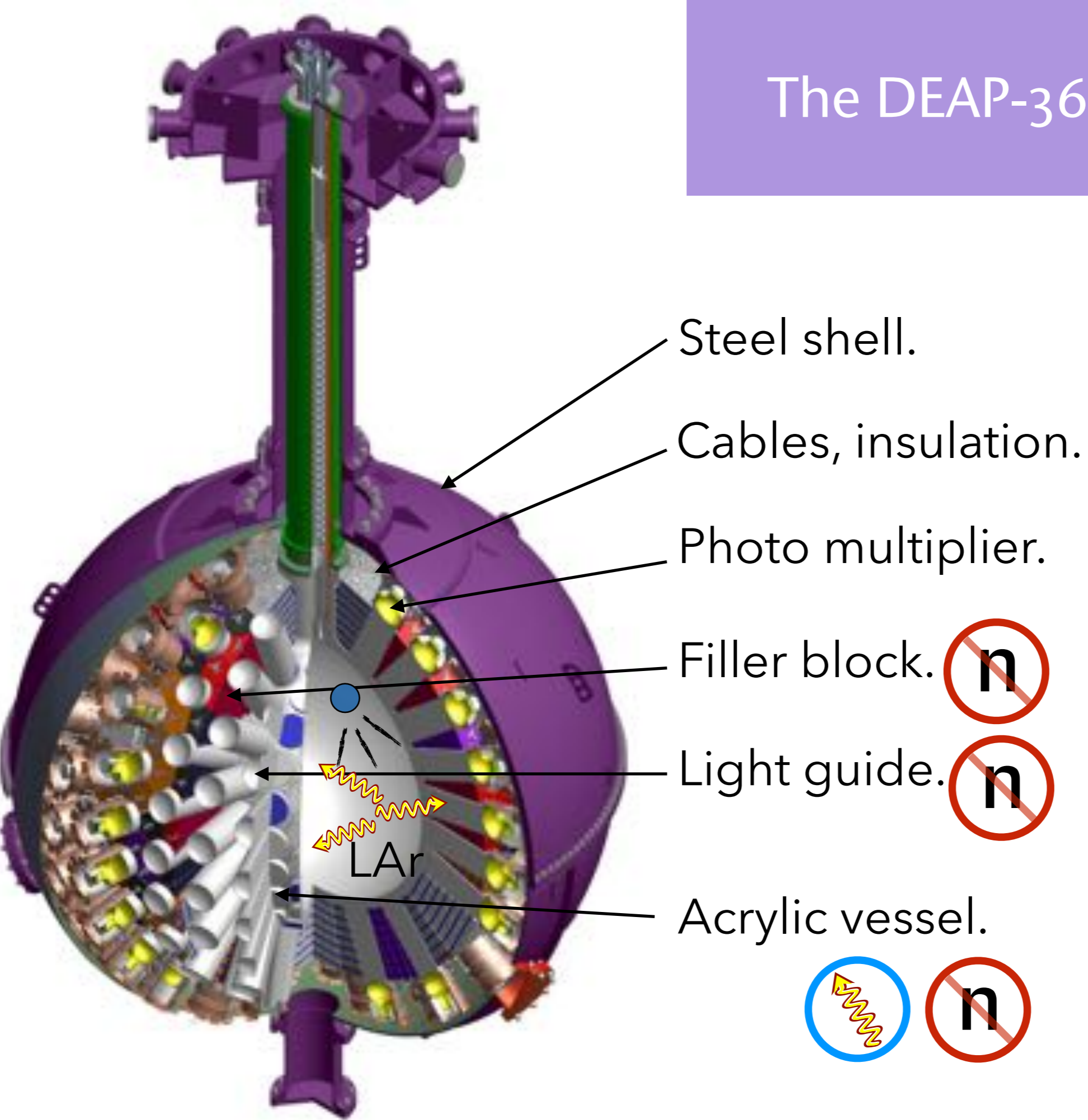


CAEN V1720  
250MHz,  
V140 digitizers





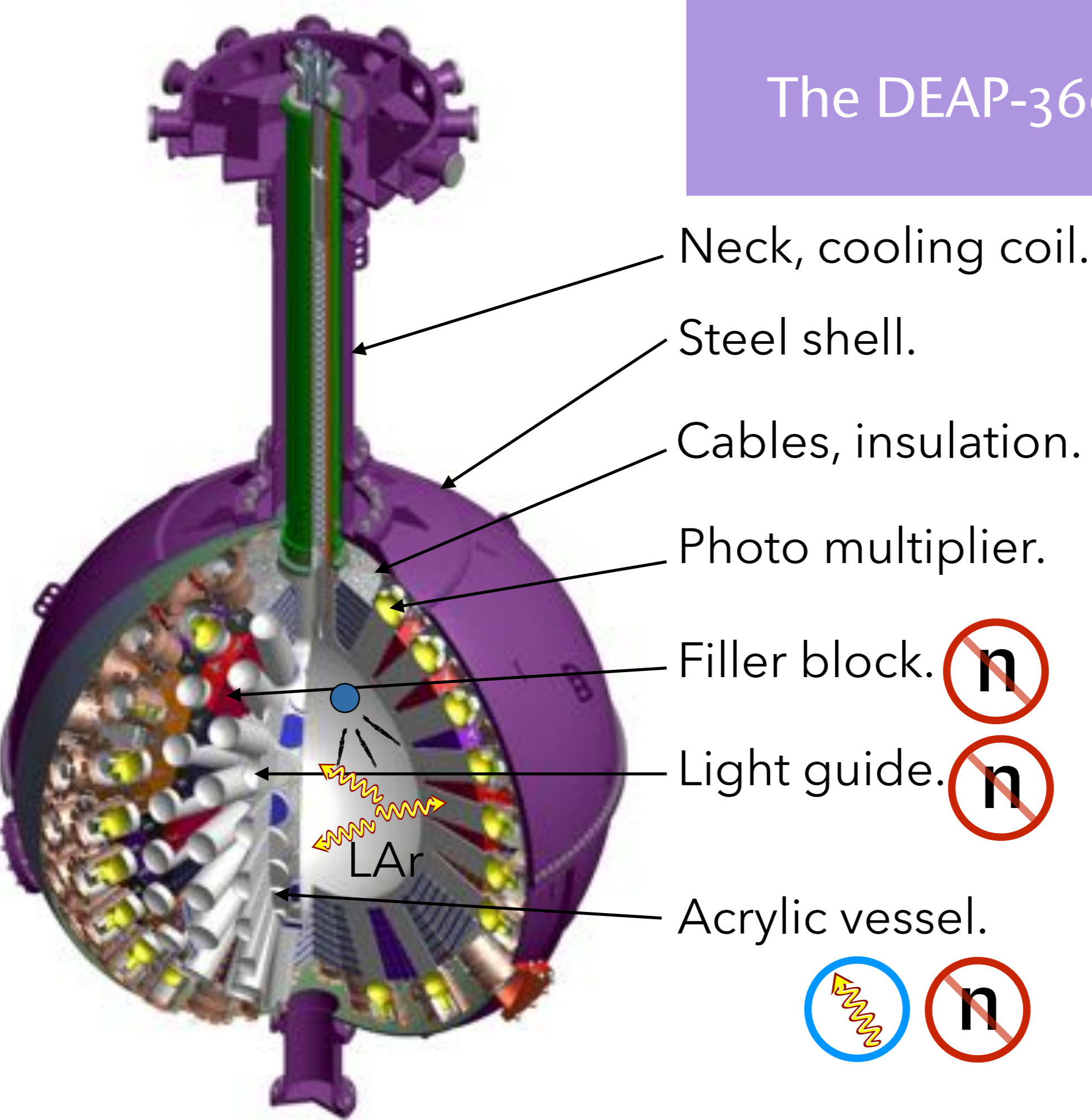
# The DEAP-3600 detector.



Veto PMTs detect Cherenkov light from muons passing through the water tank.



# The DEAP-3600 detector.

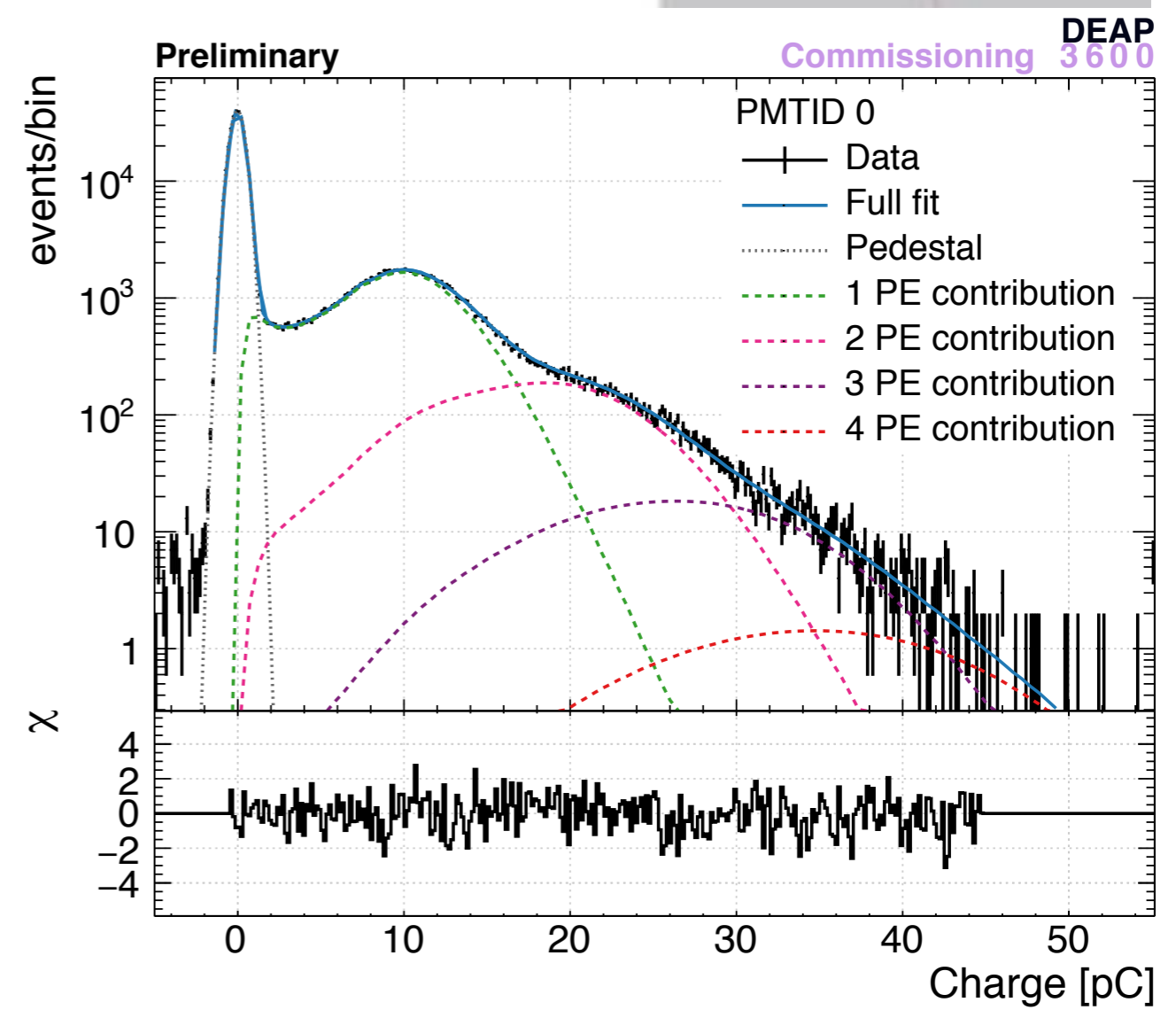
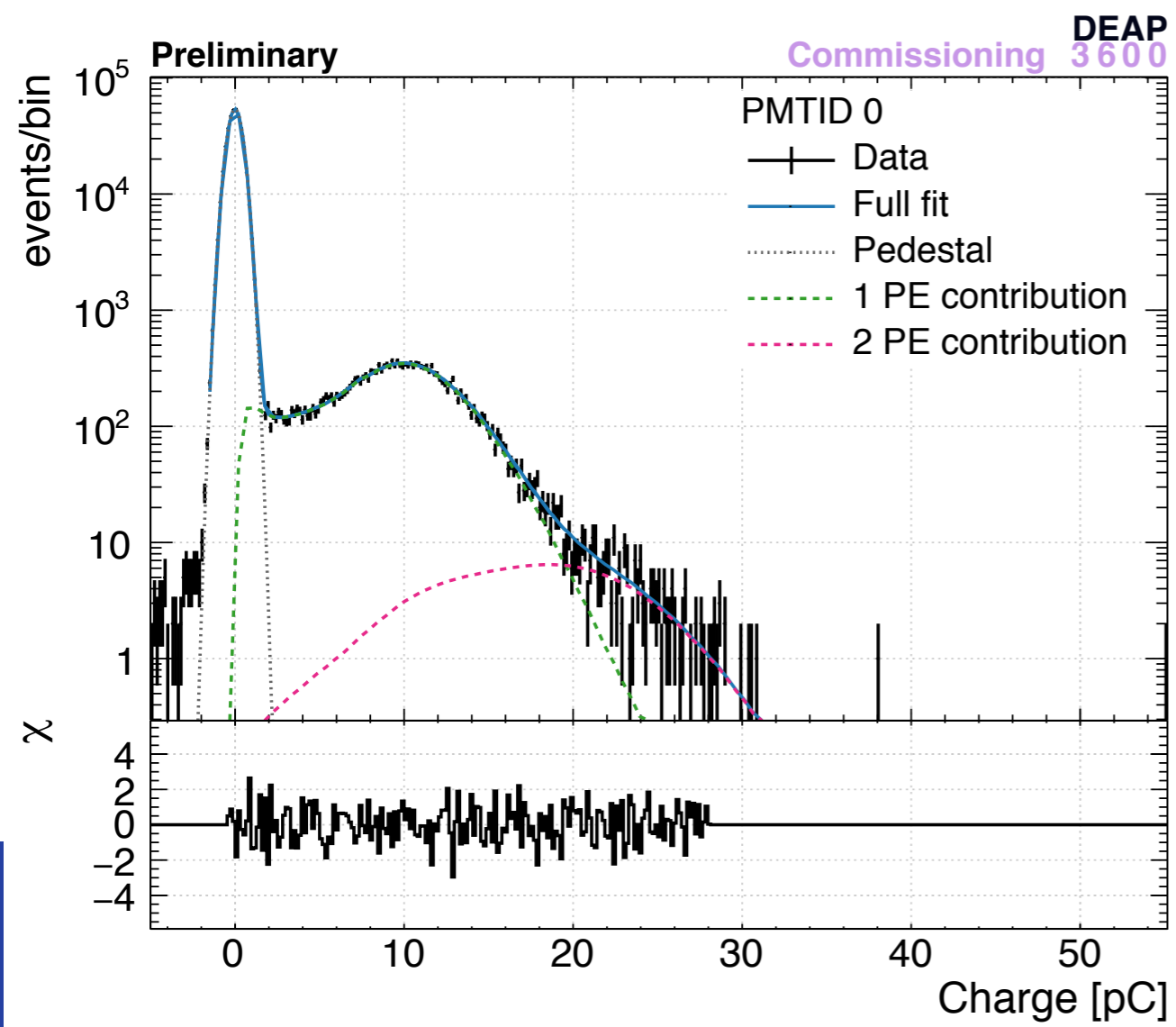
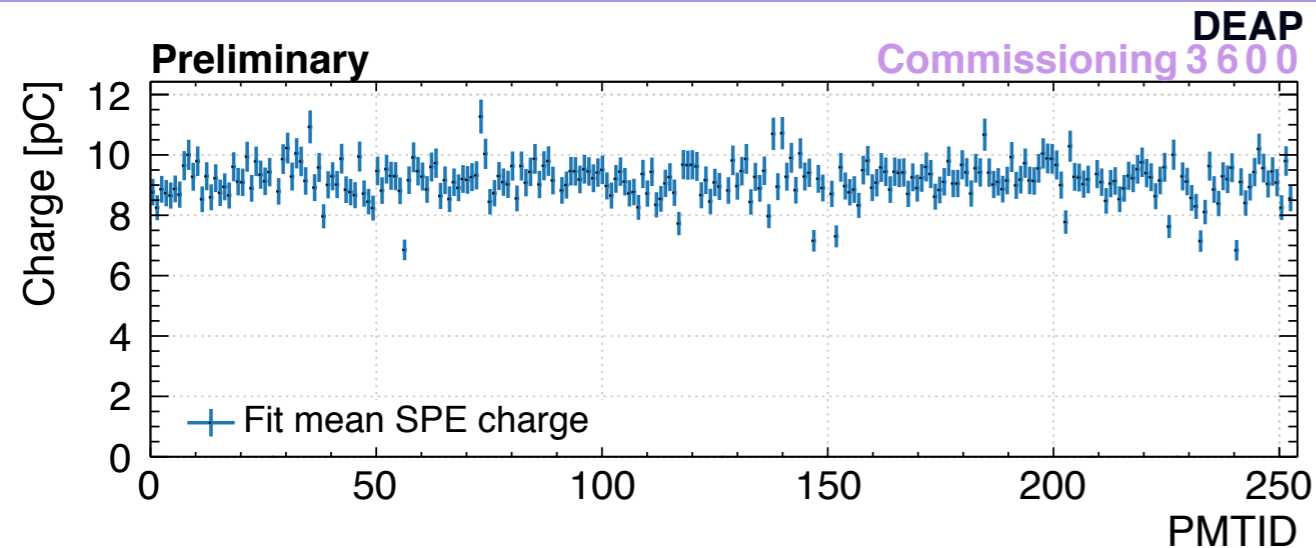


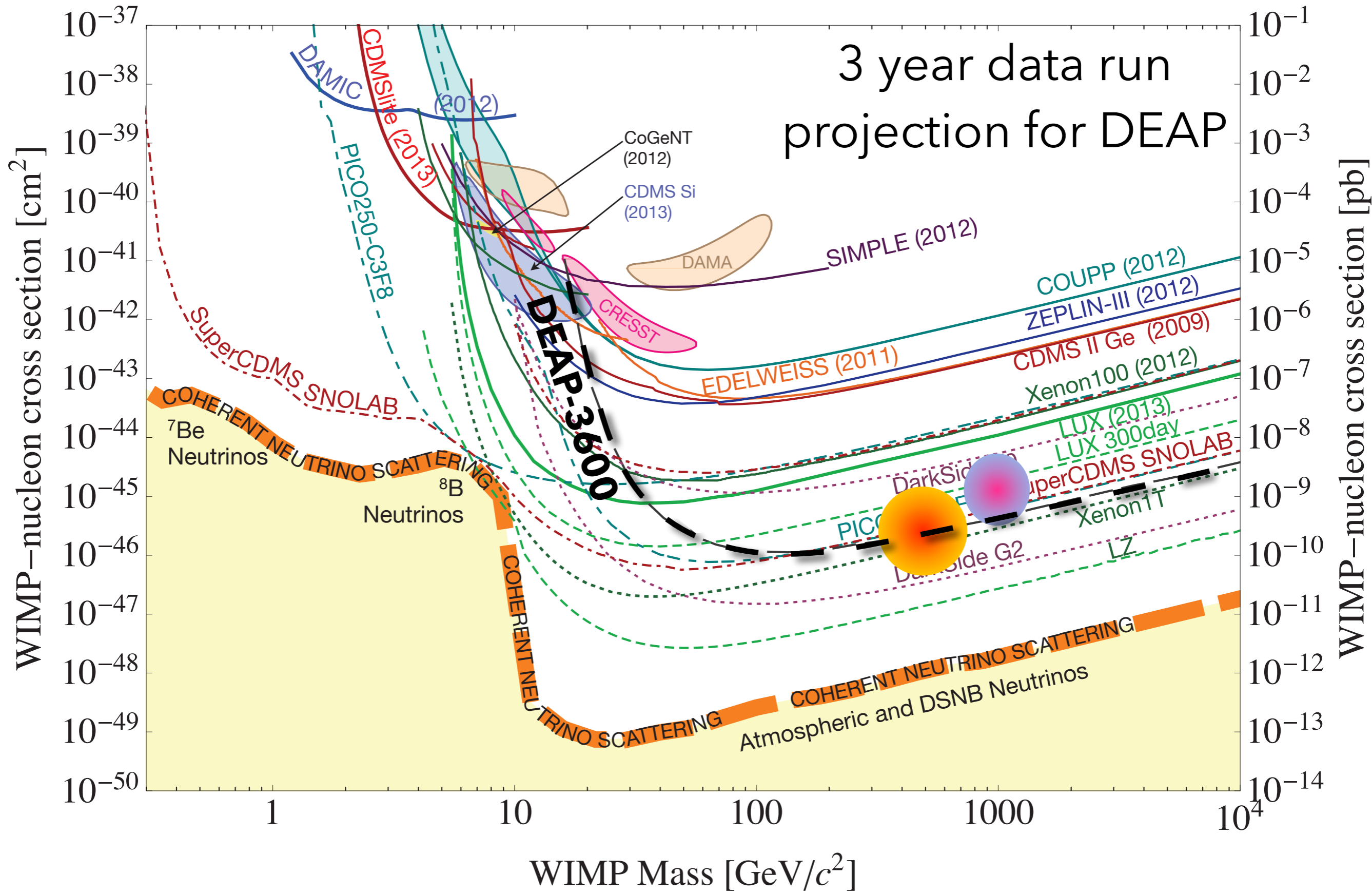


Liquid nitrogen storage, gas scrubber and cooling coil.

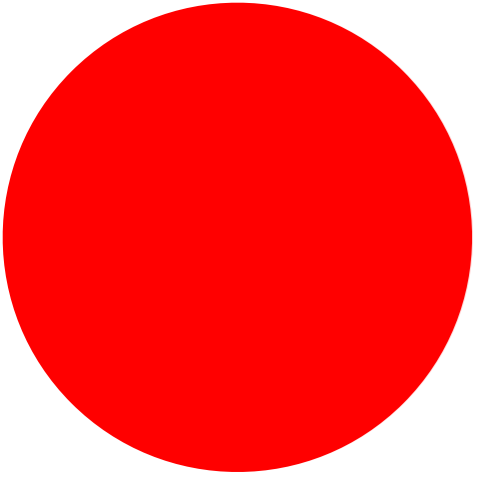


# LED light injection system used to commission PMTs and DAQ system.

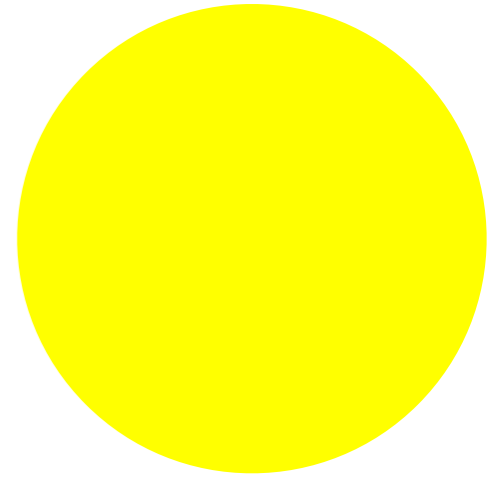








Font test Stone Sans 28 pt



Font test Avenir Next 33 pt

