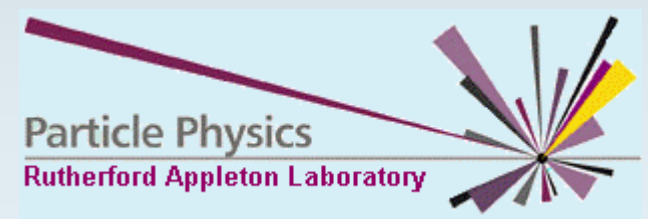


CRYOGENIC NEUTRON EDM EXPERIMENT

STATUS AND PROSPECTIVE DEVELOPMENT

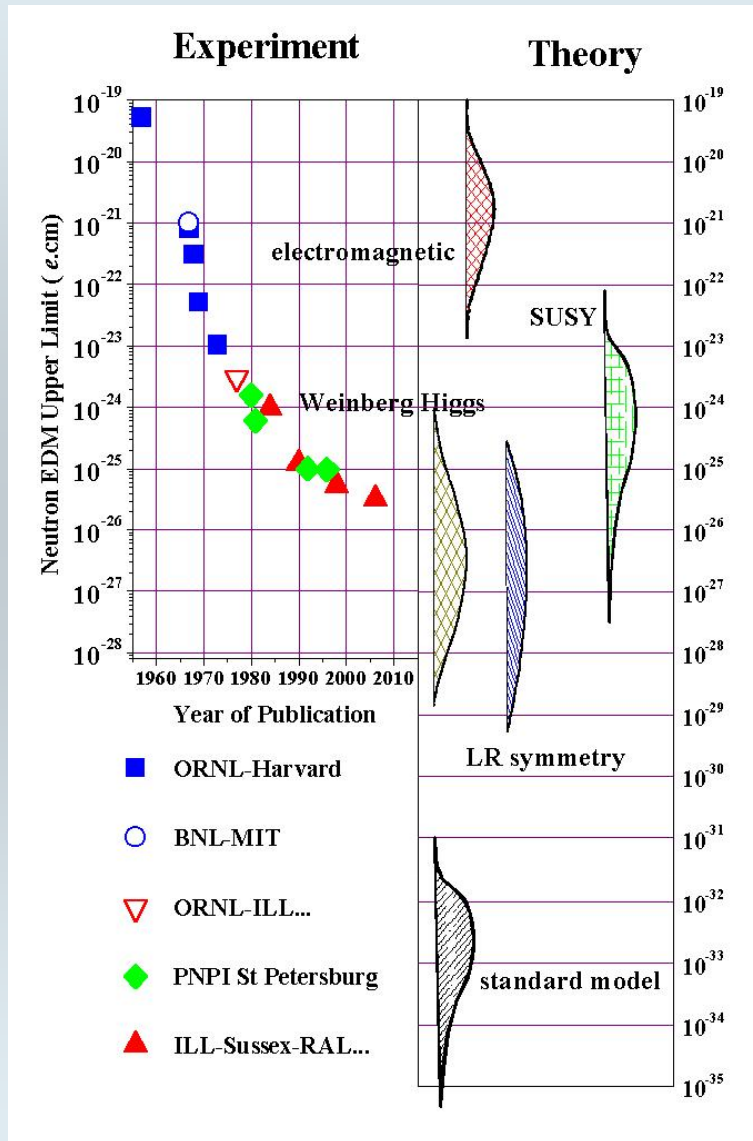
UltraCold & Cold Neutrons. Physics & Sources'
Saint-Petersburg, Russia 2009



CRYOEDM COLLABORATION



Why ?



- “..the validity of the parity assumption must rest on experimental evidence..”

J.M.Smith, E.M.Purcell, N.F.Ramsey,
Phys. Rev. 108, 120, (1957)

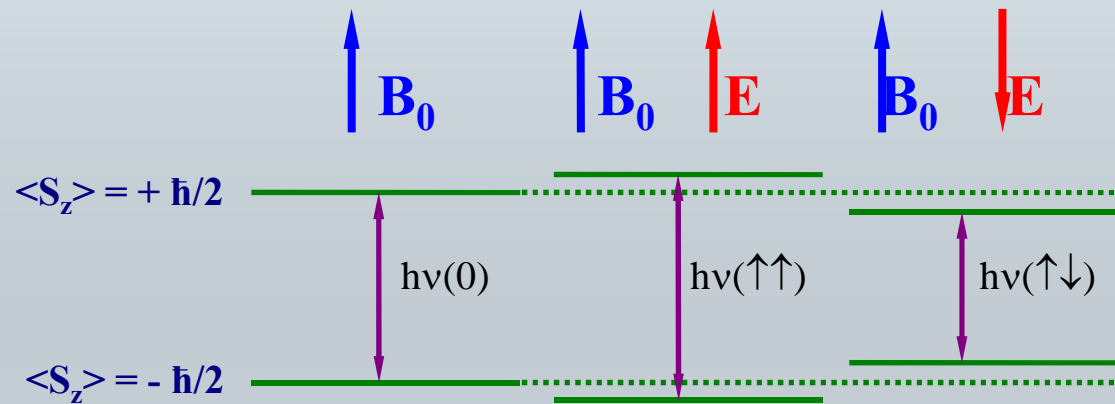
- CP violation is observed in K and B meson systems.

- CP violation outside of SM is needed to explain observed particle-antiparticle asymmetry in the Universe

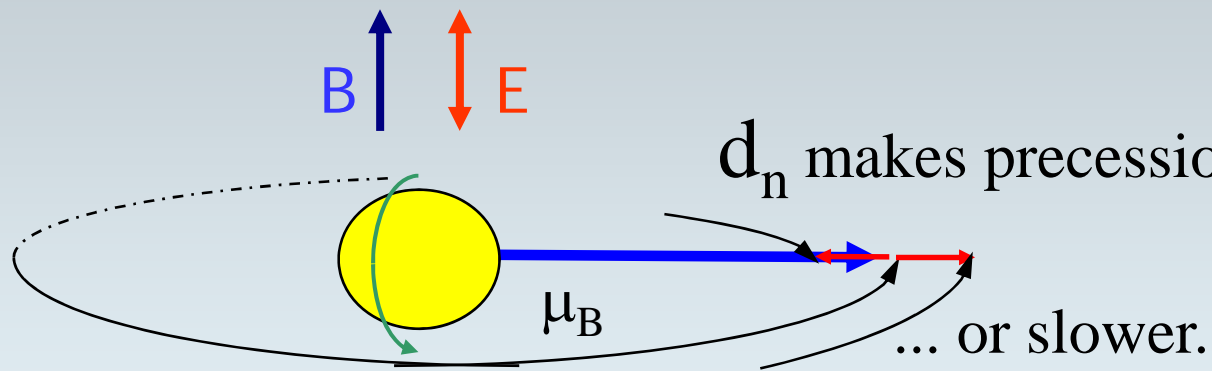
$$d_n < 2.9 \cdot 10^{-26} \text{ e} \cdot \text{cm}$$

Method

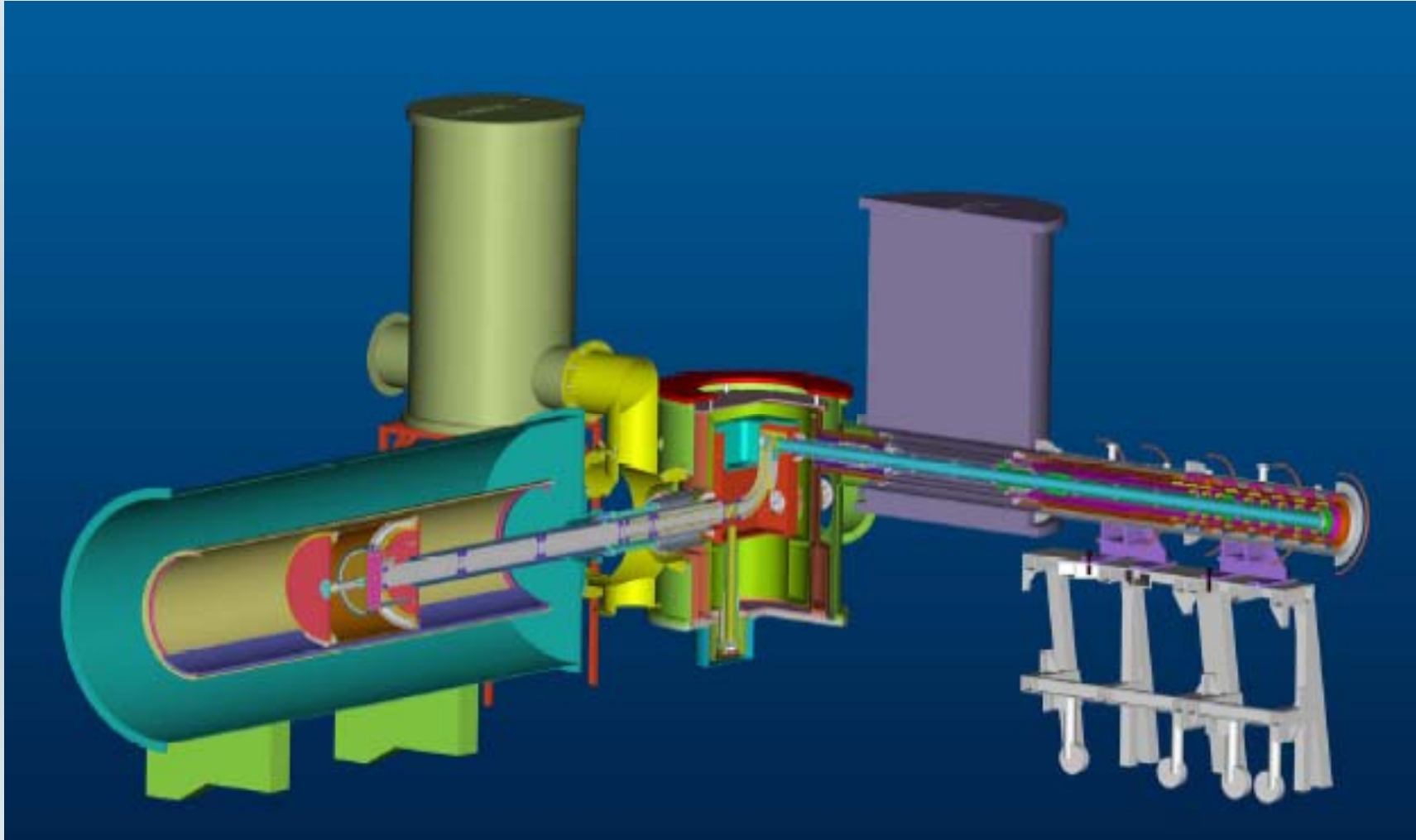
Measure Larmor spin precession freq in parallel & antiparallel \mathbf{B} and \mathbf{E} fields:



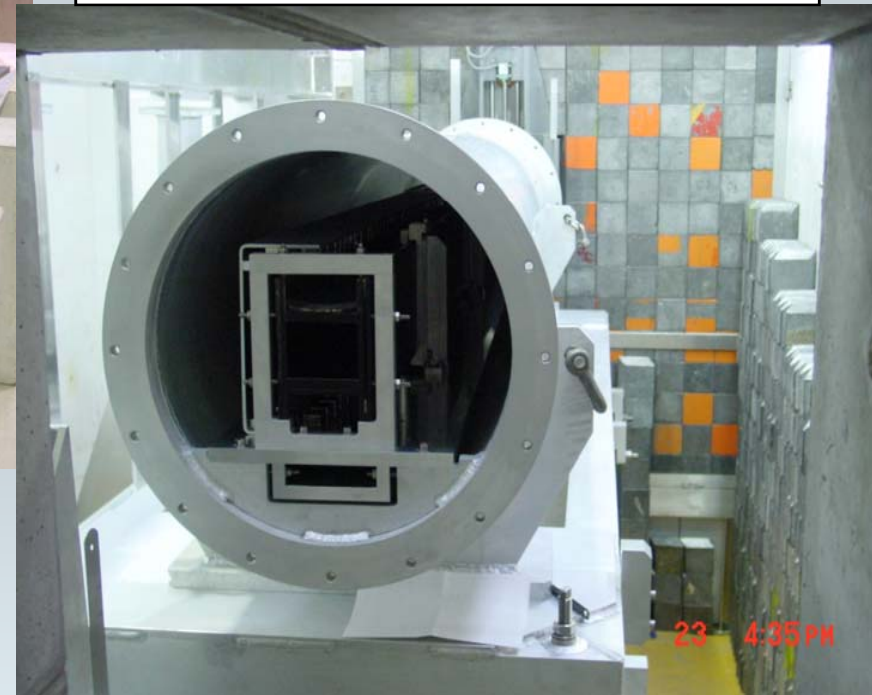
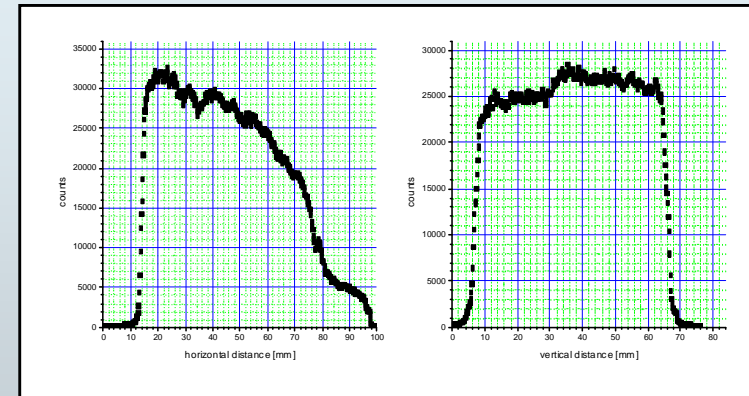
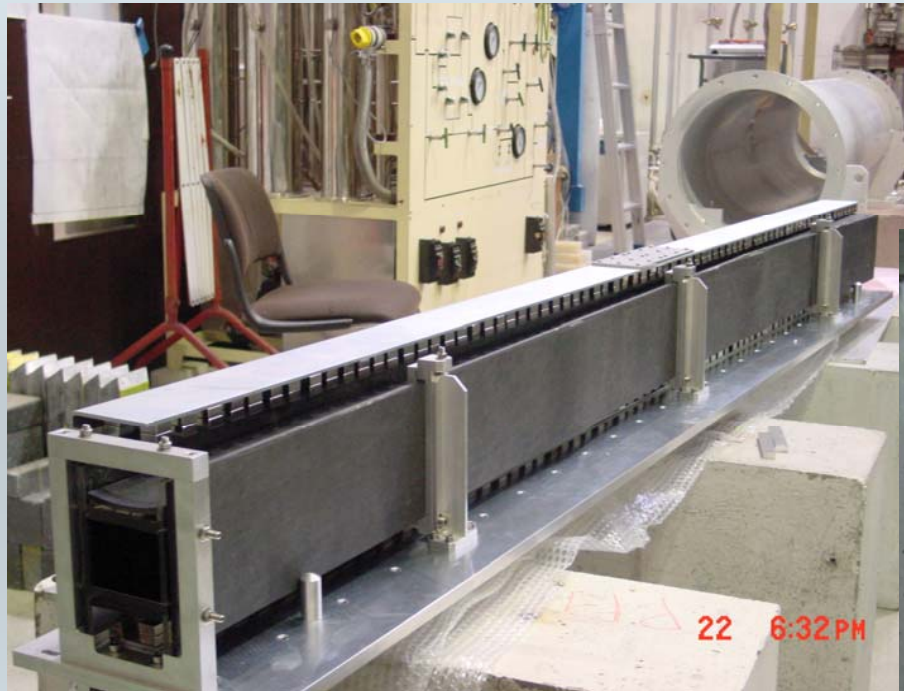
$$\nu(\uparrow\uparrow) - \nu(\uparrow\downarrow) = -4 \frac{\mathbf{E} \cdot \mathbf{d}}{h}$$



CryoEDM apparatus

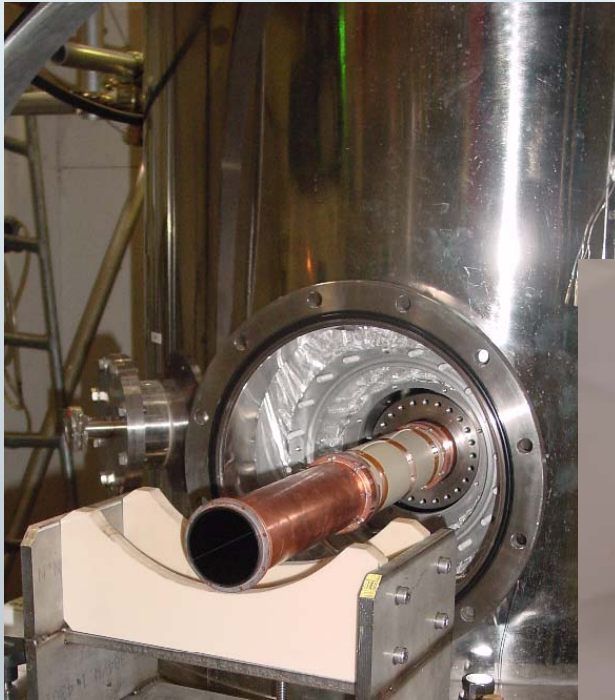


Polarizer

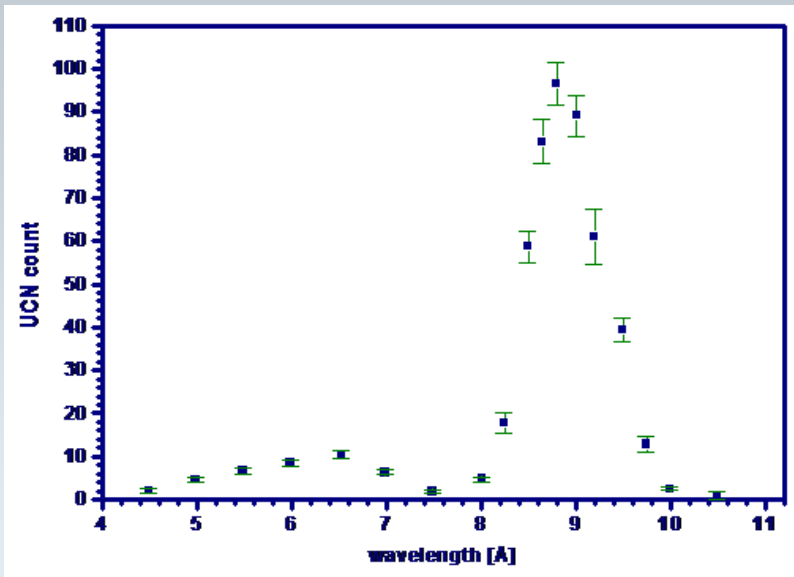
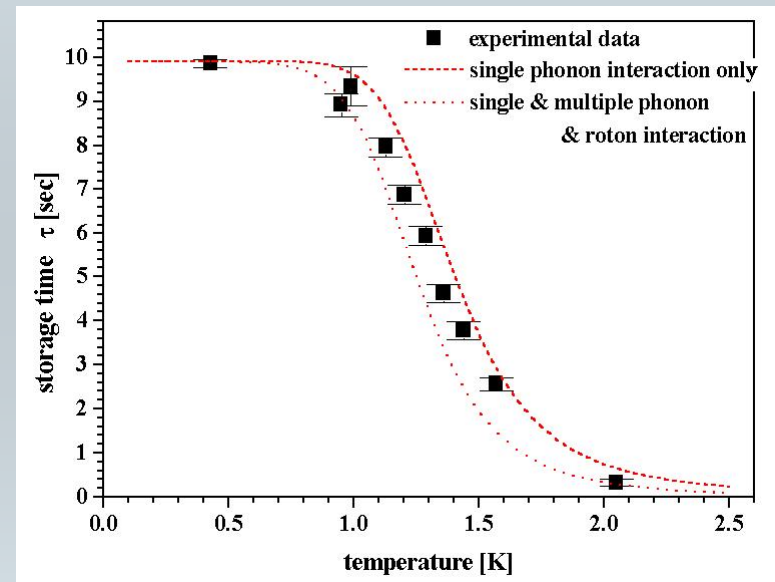


Polarisation $93\% \pm 2\%$
Flux $8.9 \text{ \AA} : \Phi \approx 3.2 \times 10^7 \text{ n s}^{-1} \text{ cm}^{-2} \text{ \AA}^{-1}$
Beam divergence 22.8 mrad

UCN Source



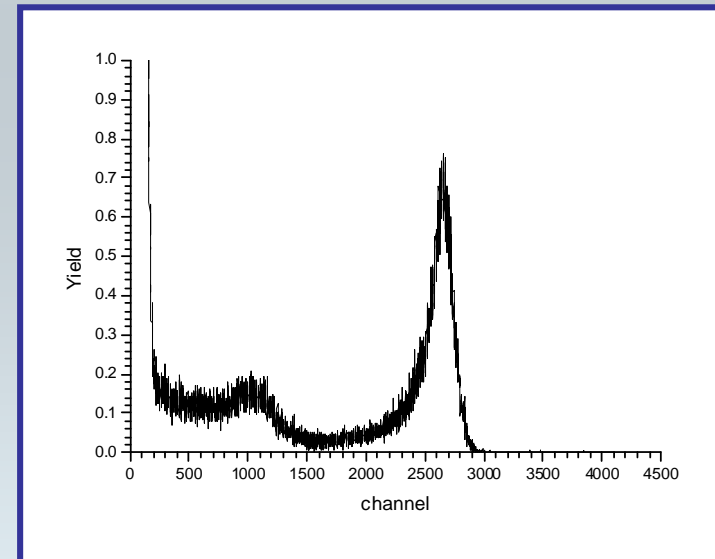
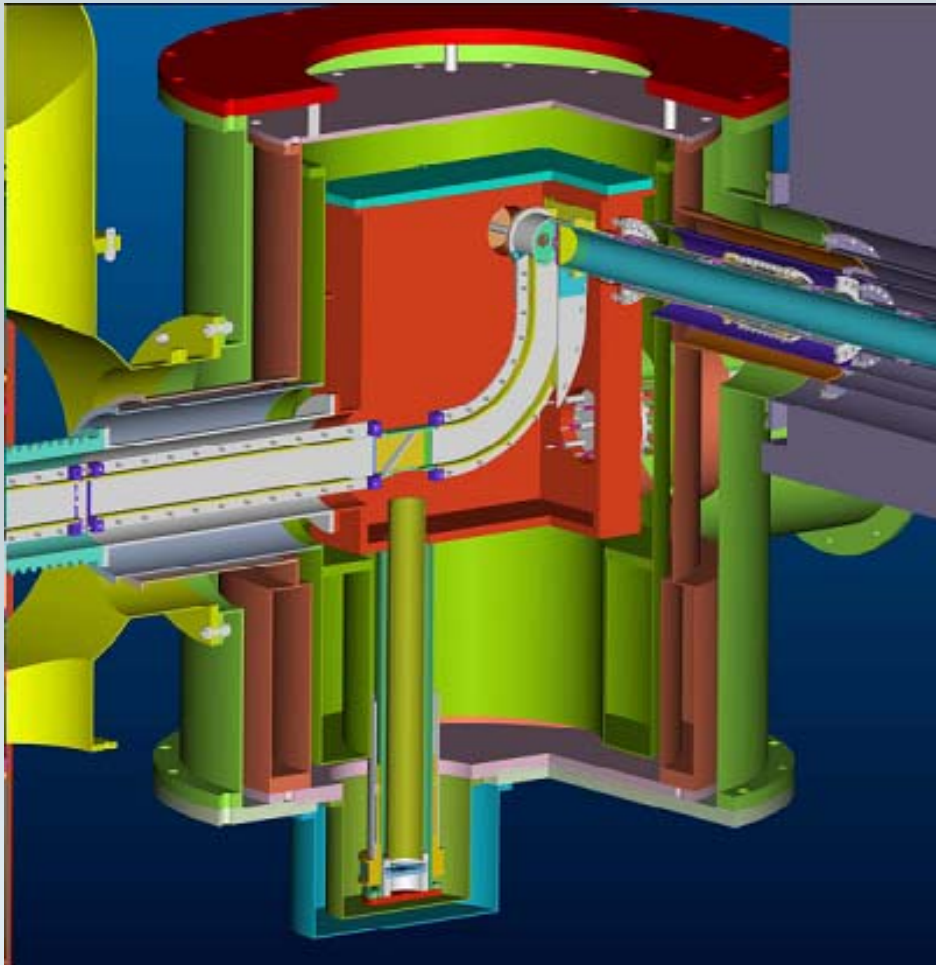
Highly polished copper,
beryllium coated, length ~3 m,
Ø 68 mm, volume ~ 10 litres



$$R = (0.91 \pm 0.13) \text{ cm}^{-3}\text{sec}^{-1}$$

Detectors

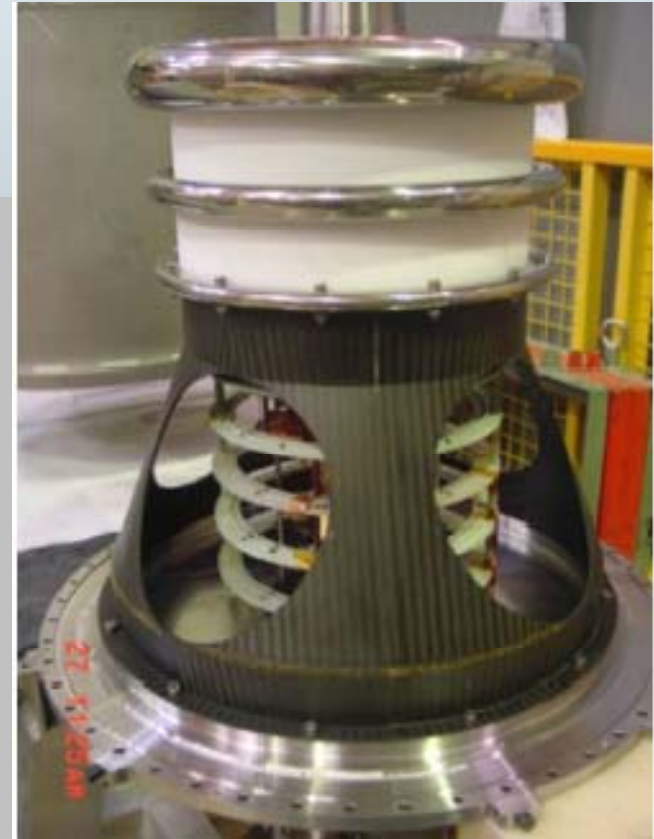
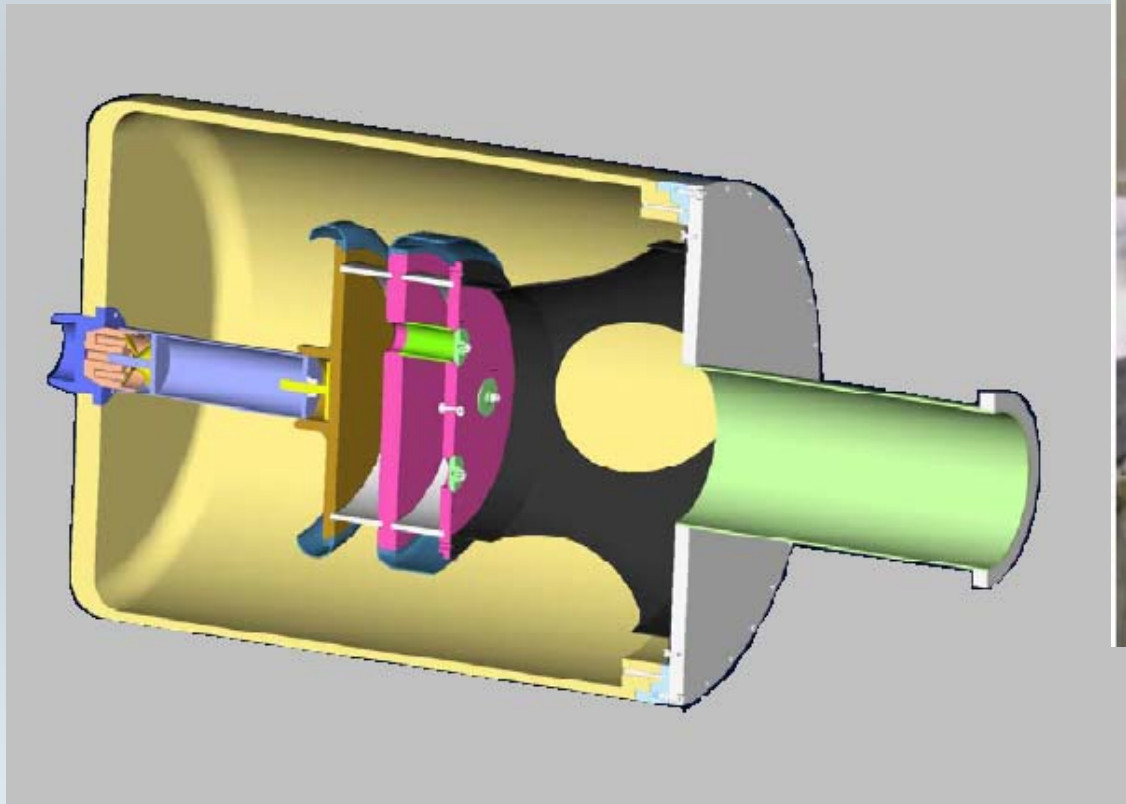
ORTEC detector, working area - 300 mm²
Converter – Li⁶



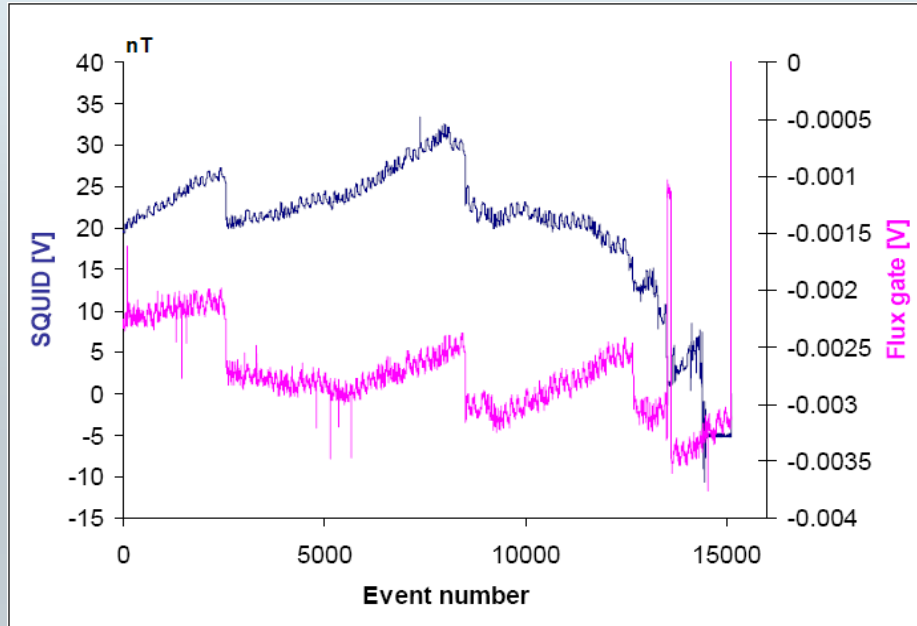
Ramsey cell

Electrodes – Ti, DLC coating

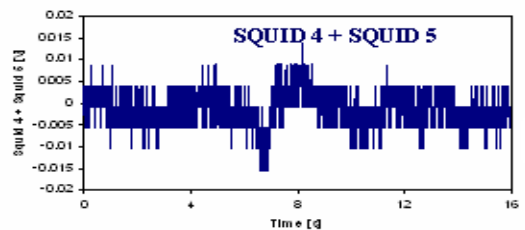
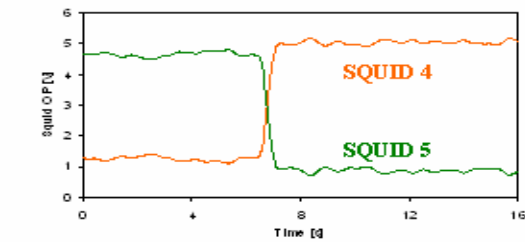
Volume of a cell – $V_{\text{cell}} \sim 3$ litres



Magnetometry

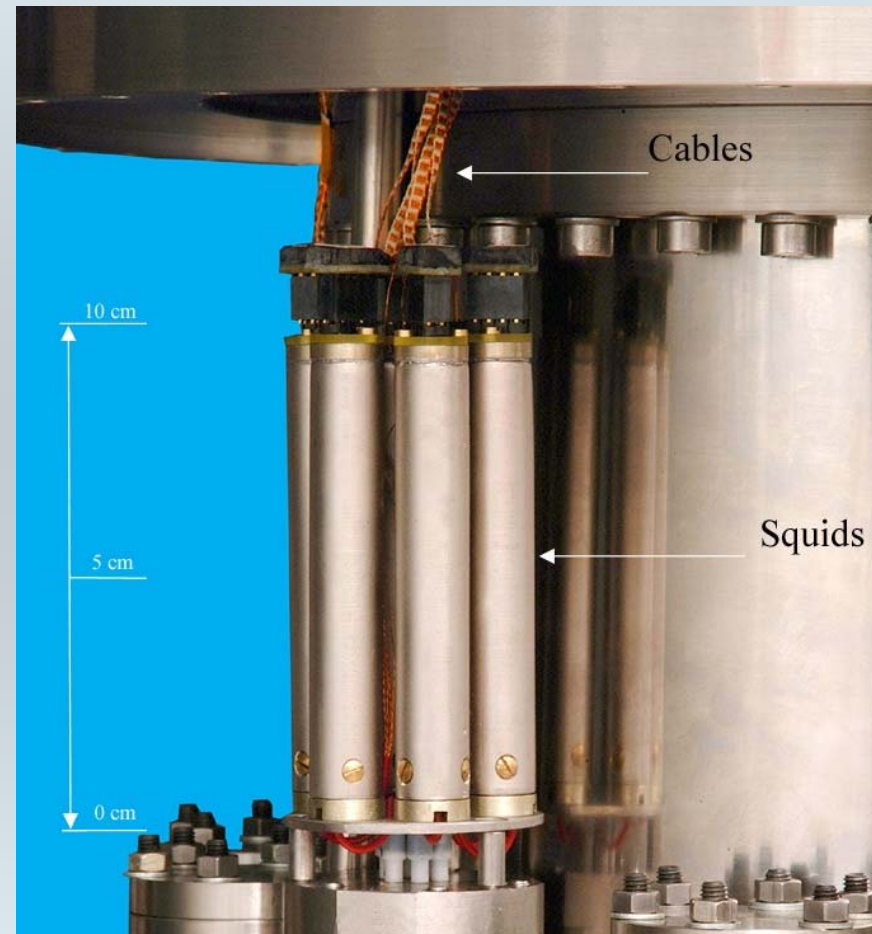


Measurements – SQUID noise limit



Resolution 0.16 pT (1.6nG) @ 1Hz

SQUID Magnetometers



Where are we?

- We have constructed CryoEDM and are in the process of commissioning the apparatus. The apparatus has been run in various configurations to characterise and optimise the functioning of the cryogenics, magnetometry and neutron related parts of the experiment. A superthermal UCN source is operational that produces UCN in numbers required for an improved EDM measurement. The cryogenic system is tested and operational and can transfer, store and detect the polarised UCN to a good efficiency after they are produced in the source.

What's next?

- Ramsey resonance measurement on the UCN
- EDM data taking.
- To measure the neutron EDM in a first step to 10^{-27} e·cm precision.
- In a later stage the experiment will move to a higher intensity 9 Å beam that will allow for a measurement of the order of 10^{-28} e·cm.