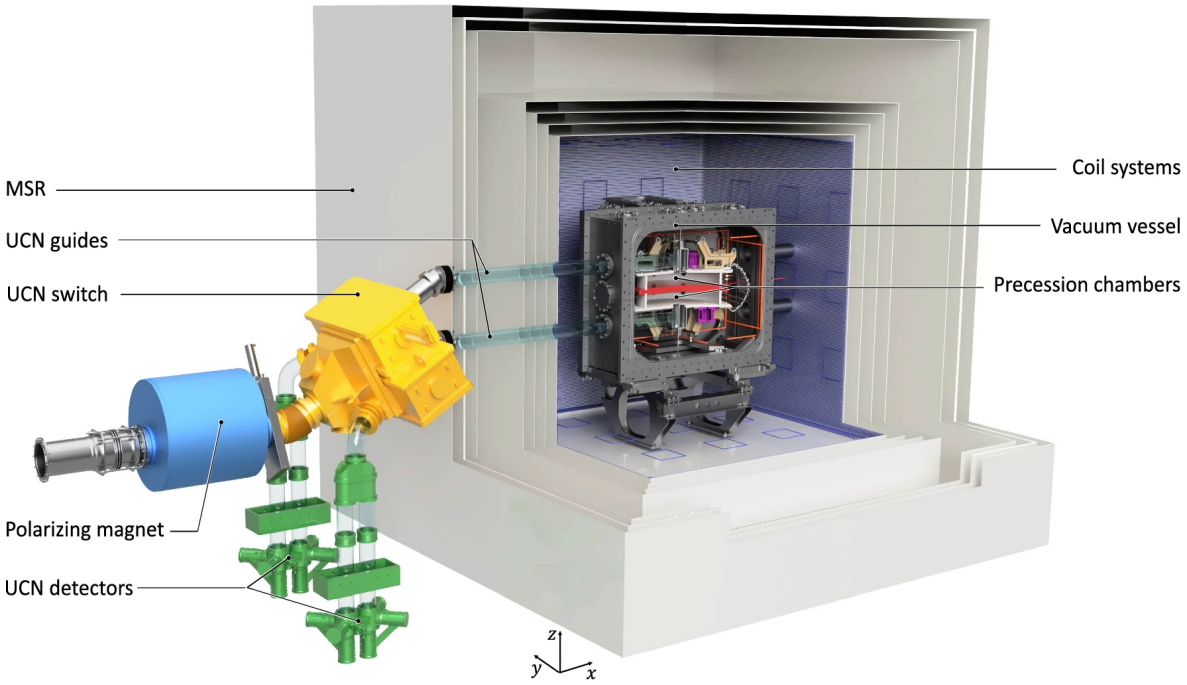
The n2EDM Experiment at the Paul Scherrer Institute (PSI)

Solange Emmenegger, Institute for Particle Physics and Astrophysics, ETH Zürich
on behalf of the nEDM collaboration at PSI

In order to allow for an excess of matter over antimatter as observed in our universe the CP symmetry needs to be violated. Electric dipole moments of elementary particles such as neutrons would violate CP. In 2020 our collaboration published the current world's best upper limit on the nEDM:

$$|d_n| \leq 1.8 \times 10^{-26} e\,\mathrm{cm}.$$

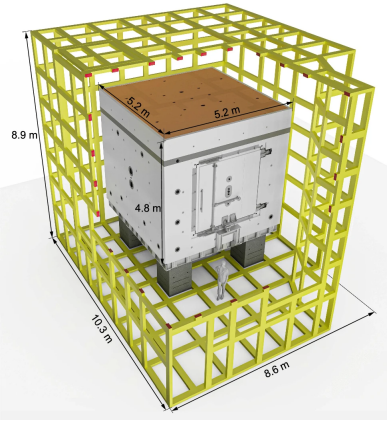
With the follow-up experiment n2EDM, we seek to improve the sensitivity by another order of magnitude. Key to achieve this goal is magnetic field control and quality.



Magnetic Shielding

In n2EDM the background magnetic field is first attenuated with the help of an active magnetic shield consisting of eight orthogonal coils (yellow structure below). This provides a low field environment for the innermost part of the apparatus which is additionally protected by a passive magnetic shield consisting of 6 layers of mu-metal with quasi-static shielding factor of 100'000.

Overview



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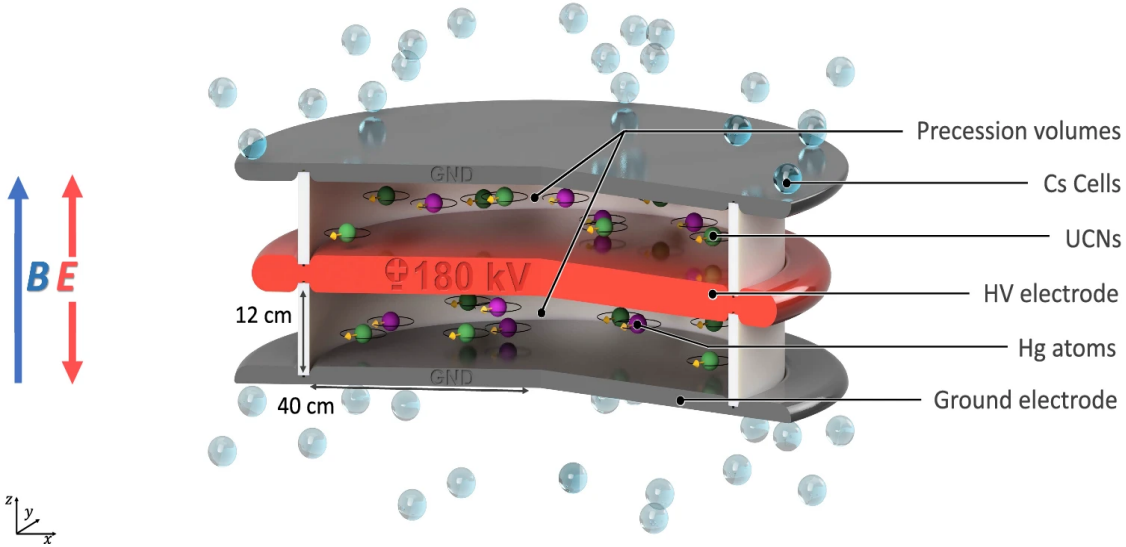
Double Precession Chamber

The n2EDM experiment features a double precession chamber where both electric field states can be measured at the same time. The neutrons share the precession cell with the Hg-comagnetometer which is used to compensate for field changes. Additionally 114 Cs magnetometers mounted on the ground plates monitor the magnetic field gradients to improve the field quality.



Experimental Method

To extract the nEDM value the precession frequency of stored ultra-cold neutrons in a magnetic and electric field is once measured in parallel and antiparallel states. The difference between the two frequencies, which are measured with Ramsey's method of separated oscillatory fields is directly proportional to an nEDM. The statistical sensitivity under ideal conditions is then

$$\sigma\left(d_n\right) = \frac{\hbar}{2\alpha E T \sqrt{N_0}}$$