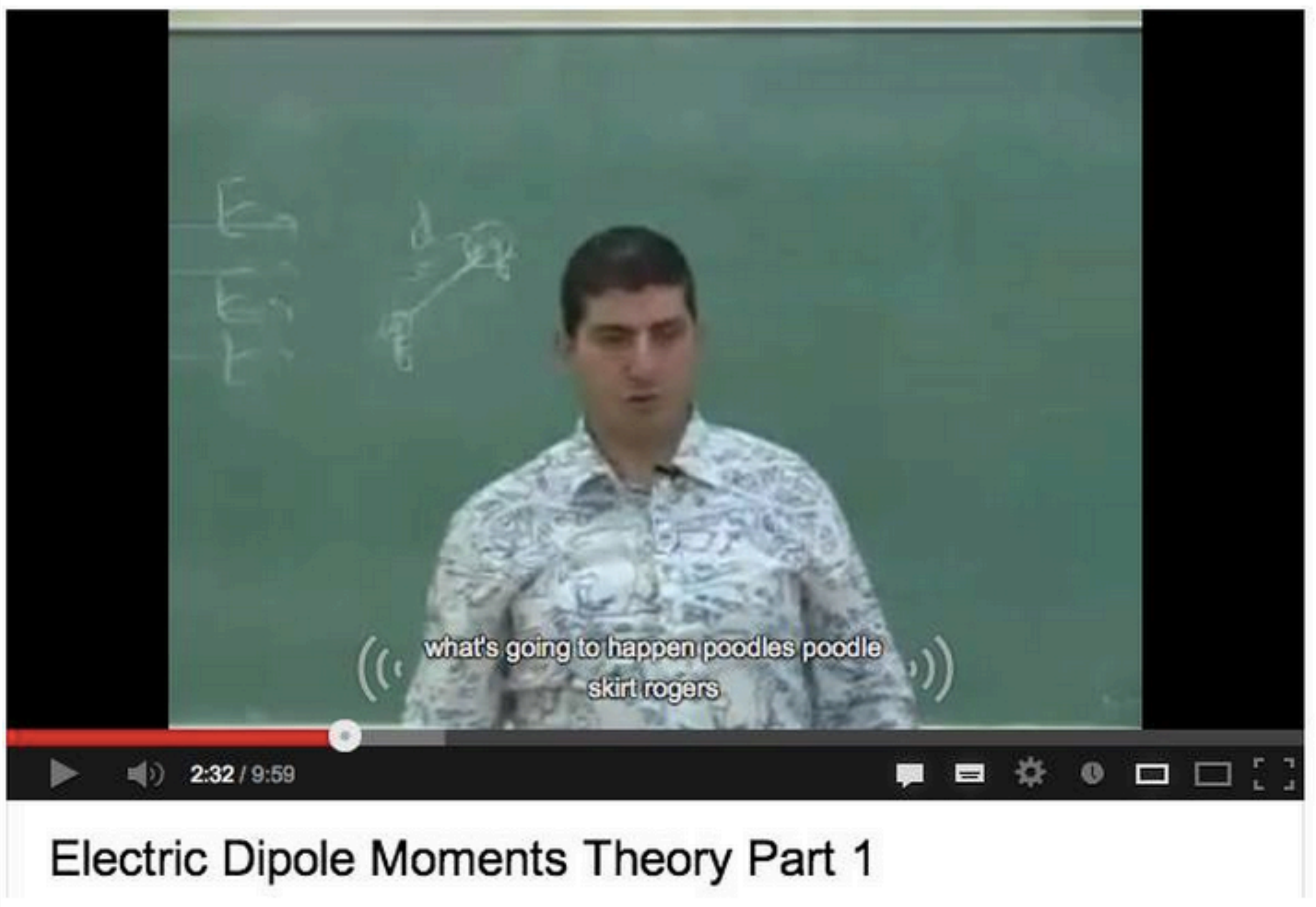
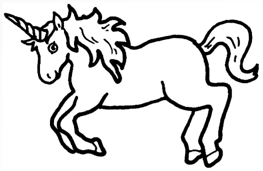
PAUL SCHERRER INSTITUT PSI NIKHEF

Search for the Electric Dipole Moment

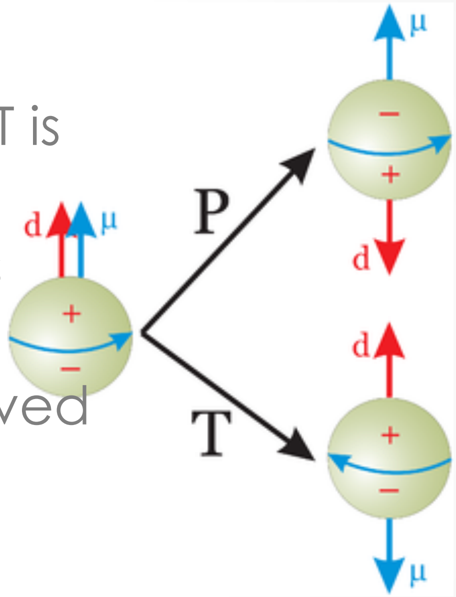
nEDM- Whats that?



nEDM and the Strong CP Problem

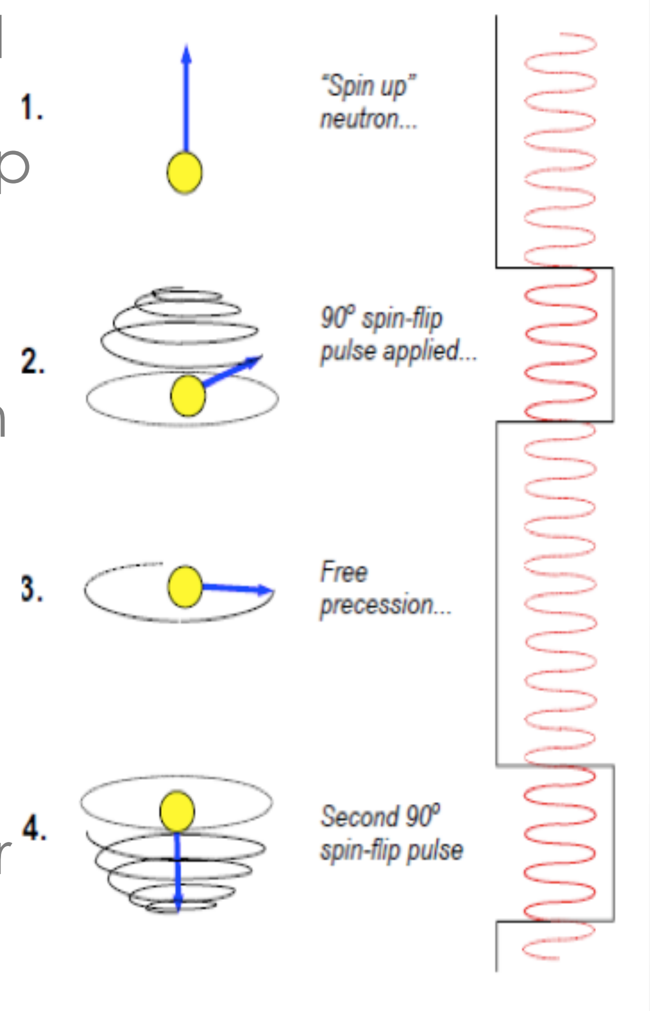


- An Electric Dipole Moment (EDM) violates PT symmetry (T changes magnetic moment, P changes electric dipole moment). Since CPT is conserved, CP must be violated as well.
- Since the neutron is composed of quarks it is sensitive to CP violation in QCD.
- There is no reason why CP should be conserved in QCD, when it is violated in Electroweak theory.
- The upper limit on the neutron EDM introduces a fine tuning in the Standard Model of an order of 10^{10} known as the Strong CP problem.
- This fine tuning problem can be solved by physics beyond the Standard Model (such as SuperSymmetry).

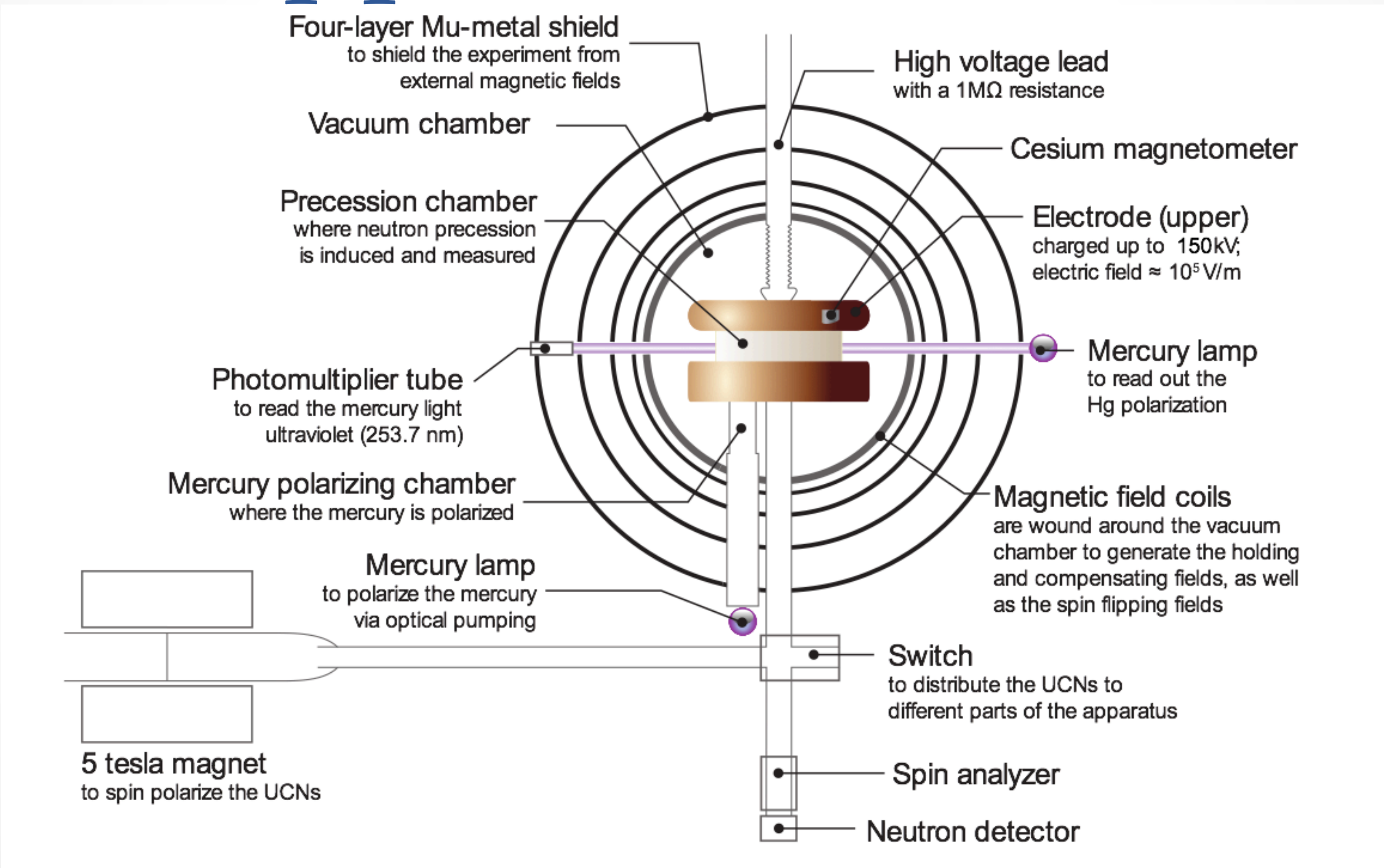


Separated Oscillatory Field Method

- Invented by Ramsey in 1949
- One main constant magnetic field
- Two rotating and coherent magnetic field separated by a gap where only constant field works
- Incoming neutron has spin aligned to constant field.
- First oscillating field rotates the spin by 90 degrees
- In the gap, neutron will precess along direction of constant field
- Second oscillating field rotates it another 90 degrees, so maximum phase change
- Only occurs when neutron's Lamor frequency matches the oscillation frequency of the magnets



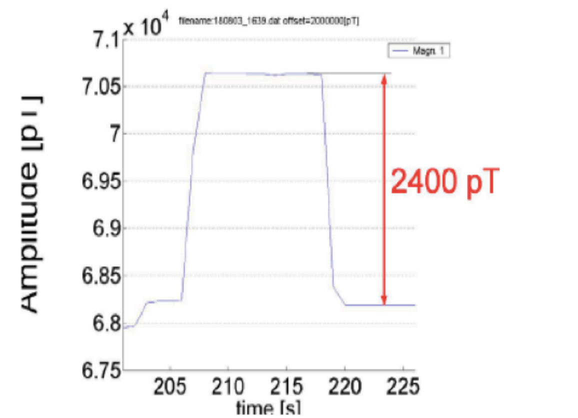
RAL/Sussex/ILL apparatus at PSI



Active Shielding

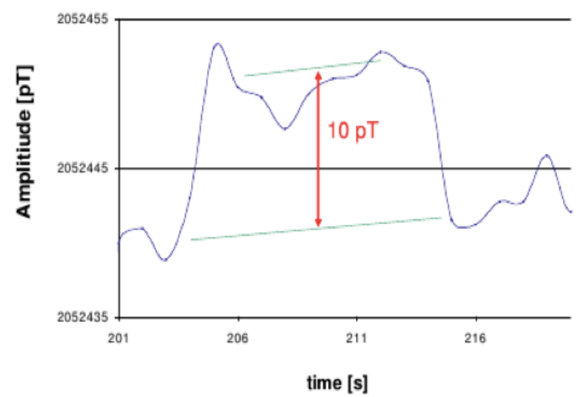
- 4 layers of passive shielding
- 8 coils for active stabilisation

stabil. off



- combination of Cs-magnetometer-array and 3He-magnetometers is capable of tracing magnetic field variations of $\partial B \approx 2$ fT

stabil. on



nEDM- Collaboration

- Collaboration consists of approx. 30 scientists from 14 institutes, 10% PhD students.
- 7 collaborations (200 physicists) in nEDM field exist worldwide.

Averaged yearly expenses:

- PhD+postdoc salaries (non-PSI): 180 kCHF/yr
- operations 36 kCHF/yr
- travel 10kCHF/yr
- apparatus 6kCHF/yr

Future Plans

- Experiment is designed to be as cost effective as possible. Phases I and II completed, phase III comprises of three physics result-based scenarios.
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Completed phases

- Phase I: upper limit $d_n < 10^{-25} e$ cm [6 days running time]
- Phase II: upper limit of $d_n < 10^{-27} e$ cm [600 days]

Scenarios for phase III

- Non-zero nEDM signals are observed: running in different configuration to limit systematics to $10^{-27} e$ cm
- No non-zero nEDM signals observed, design parameters too conservative: keep running until sensitivity is reached [approx 2 years more]
- No non-zero nEDM signals observed, design parameters too optimistic: build new UCN source [approx. 1MCHF]

Fin.