

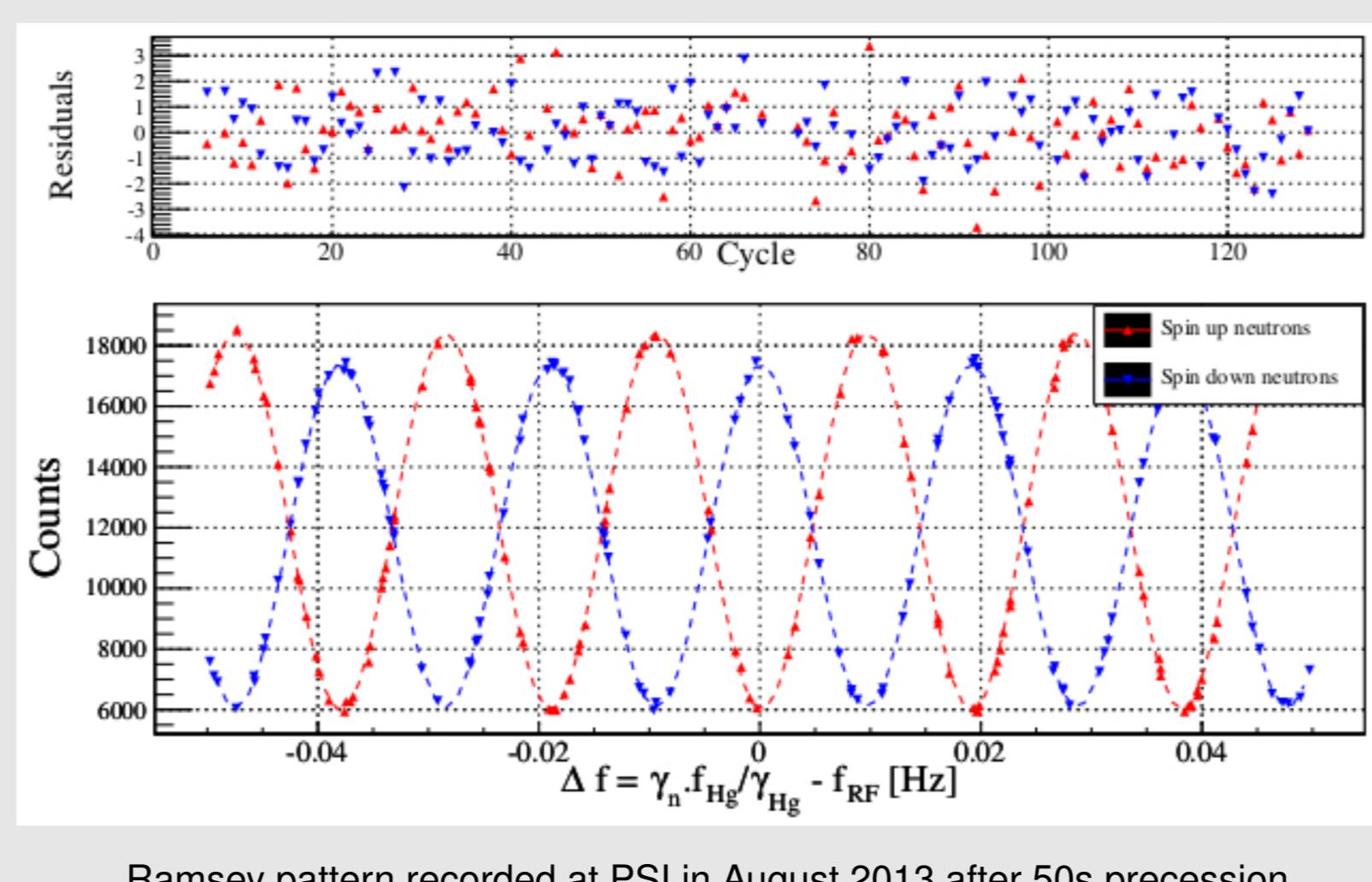
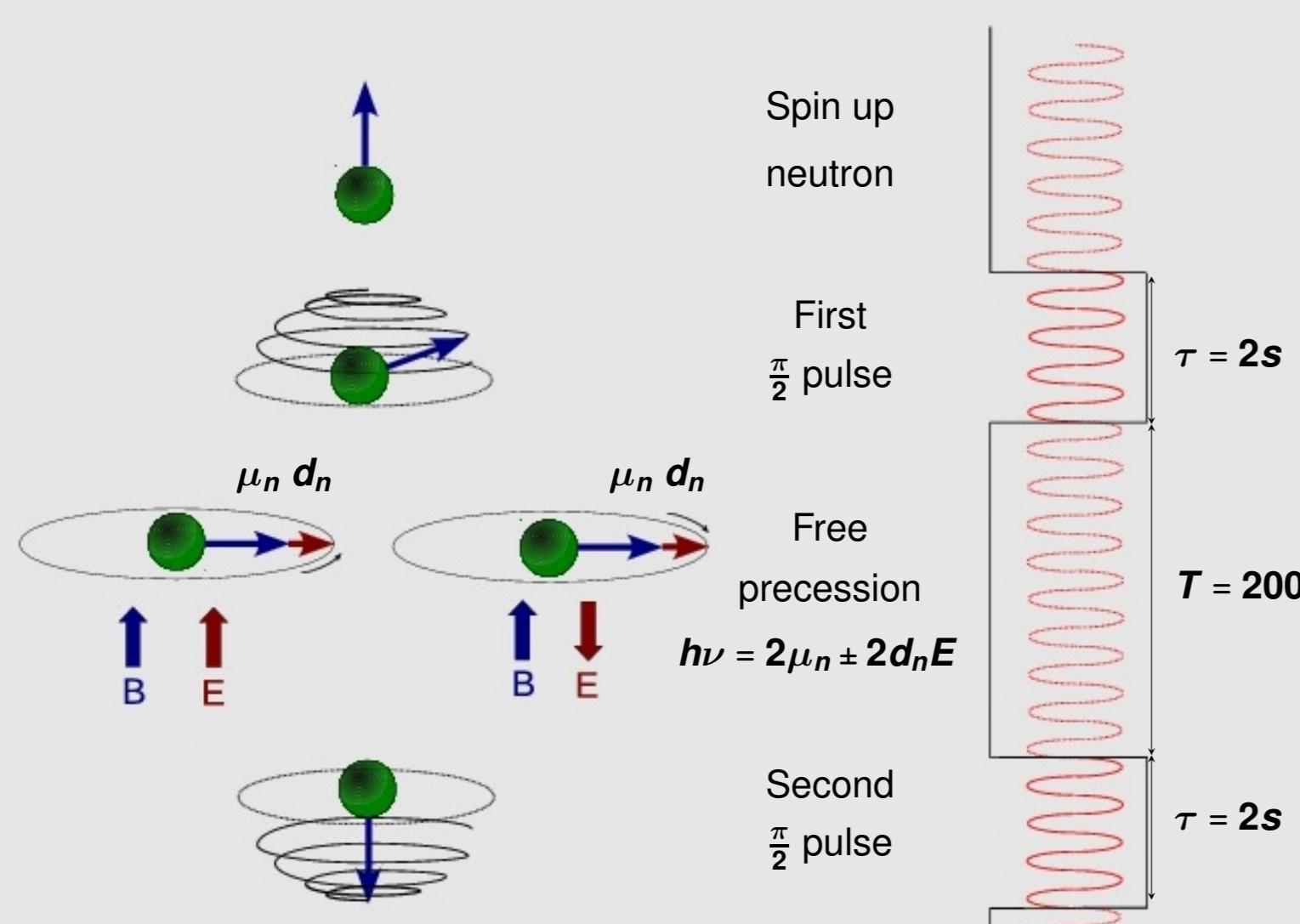
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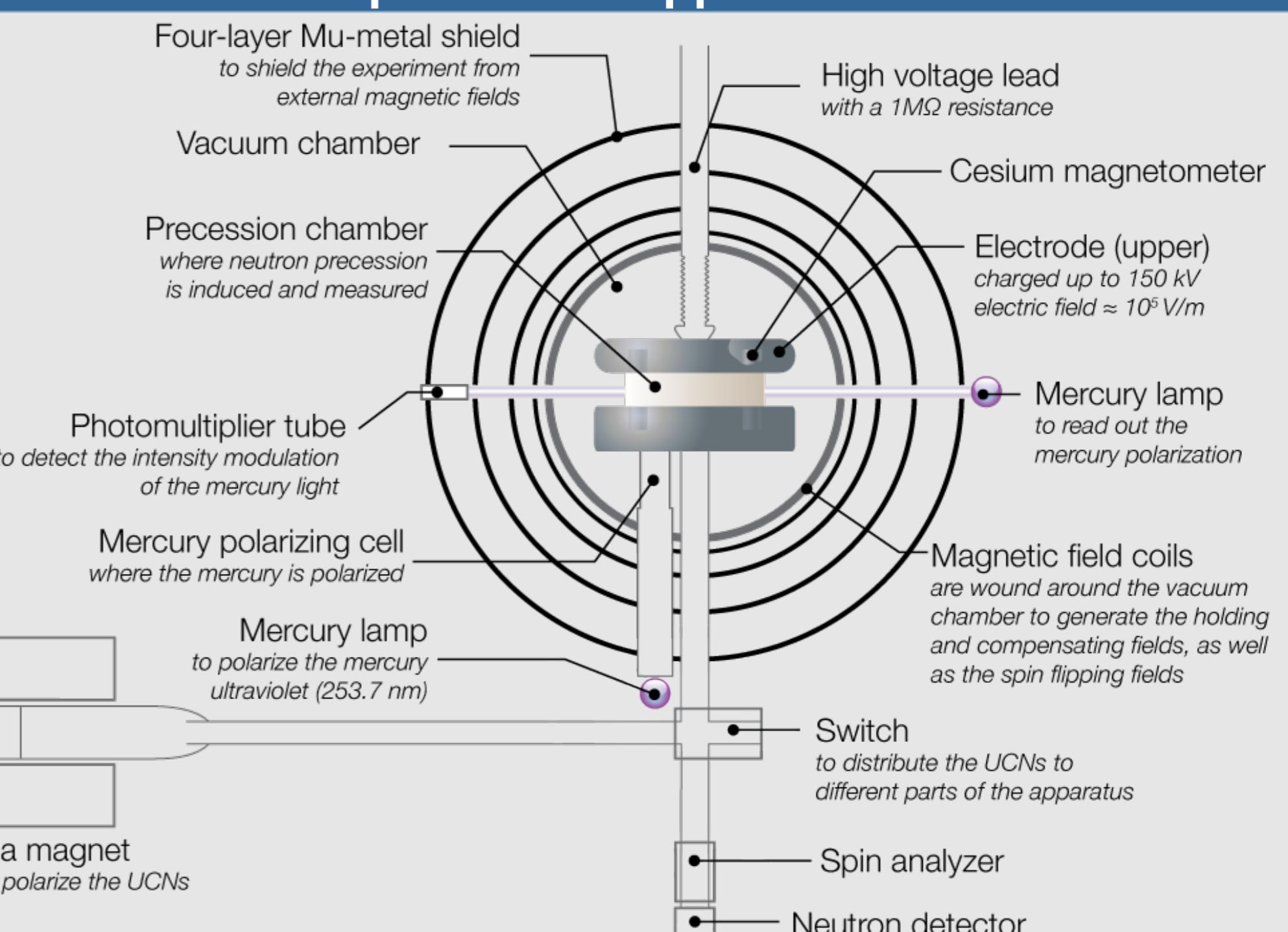
The neutron Electric Dipole Moment experiment at PSI

Measurement technique: Ramsey's method of separated oscillating fields

- Polarized ultracold neutrons confined in a storage volume.
- Difference of UCNs Larmor frequency in a magnetic field with parallel and anti-parallel electric field.



Experimental apparatus



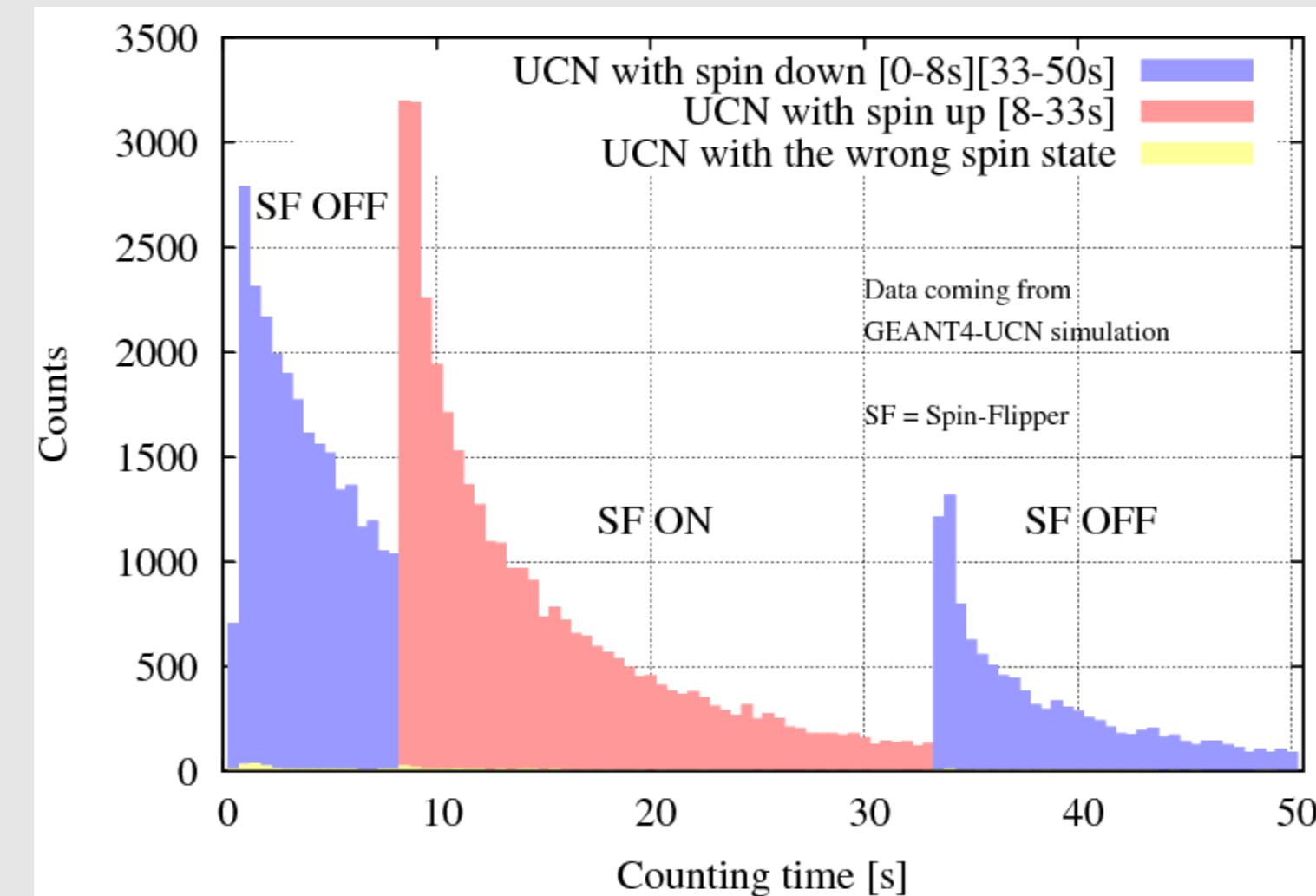
Experimental keys

- $d_n = \frac{h(\nu_{\uparrow\uparrow} - \nu_{\downarrow\downarrow}) - 2\mu_n(B_{\uparrow\uparrow} - B_{\downarrow\downarrow})}{2(E_{\uparrow\uparrow} + E_{\downarrow\downarrow})}$
- Magnetic field monitoring using Hg co-magnetometer and external Cs magnetometers.
- Statistical precision $\sigma_{d_n} = \frac{h}{2\alpha TE\sqrt{N}}$
- N : UCN count, E : electric field, T : free precession time, α : visibility of the Ramsey central fringe.
- Better precision $\Rightarrow \alpha, N, T, E$ increase.
- With UCN detection system: possibility to improve α and N .

Design of the U Simultaneous Spin Analyzer (USSA)

Present spin analysis: sequential UCN detection

- UCN spin components analyzed one after the other.
- Storage of one spin component above the analyzer.
- UCN losses: N ↓.
- Depolarizations on analyzing foil: α ↓.
- Statistical precision decrease.
- Solution: use a Simultaneous Spin Analyzer.

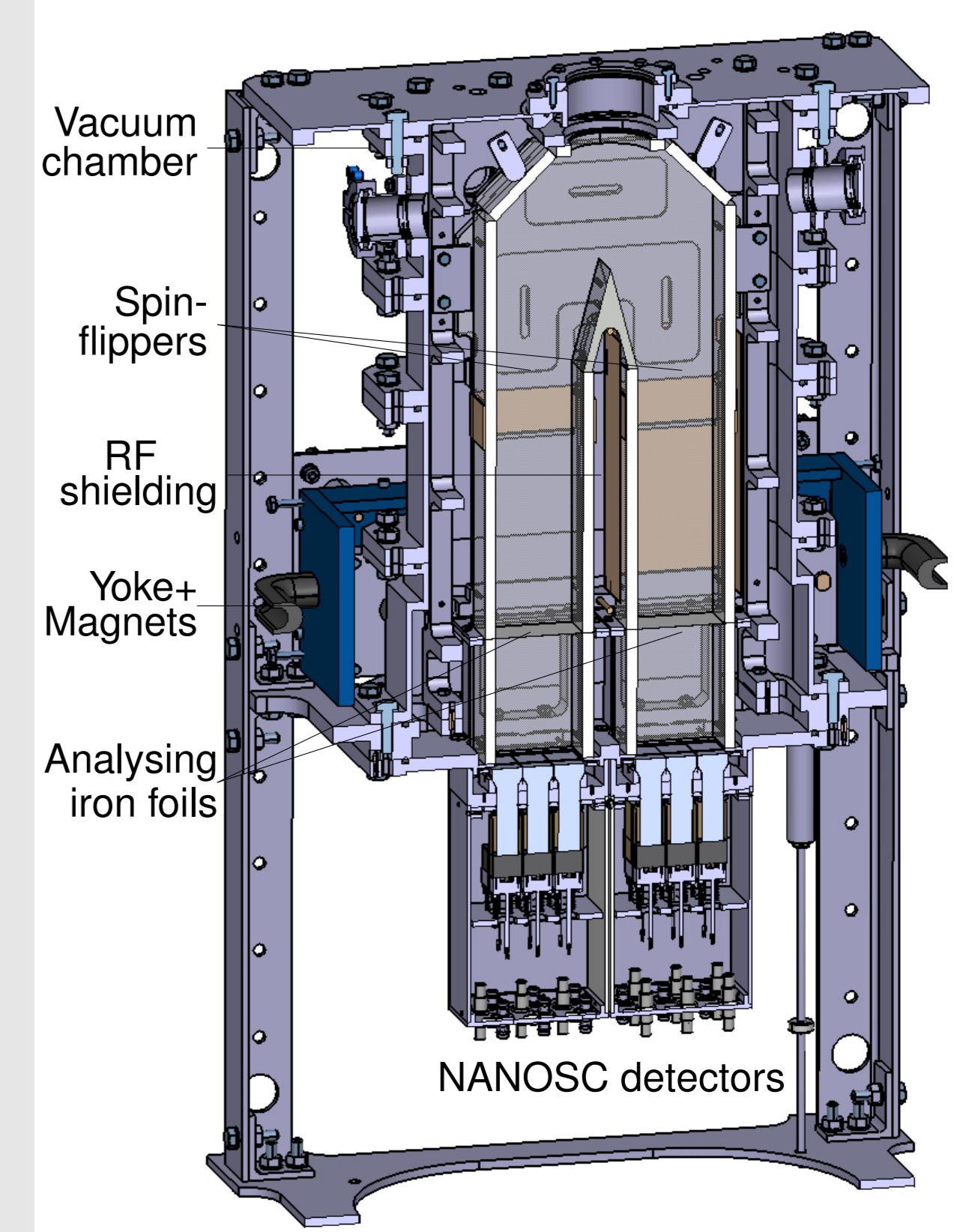
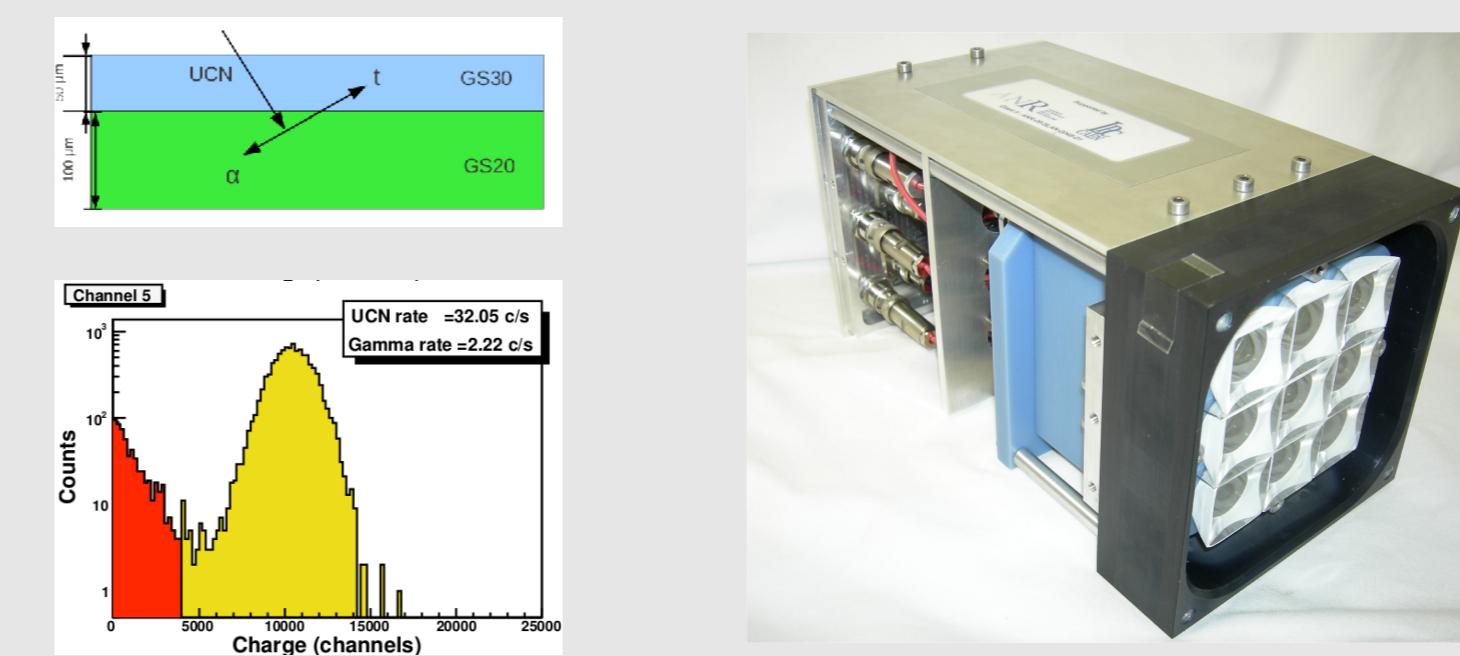


Final design of the USSA

- RF shielding to avoid cross-talk between arms.
- Walls: float NiMo coated glass.
 - $V_F = 210$ neV.
 - Low roughness (~ 10 nm).

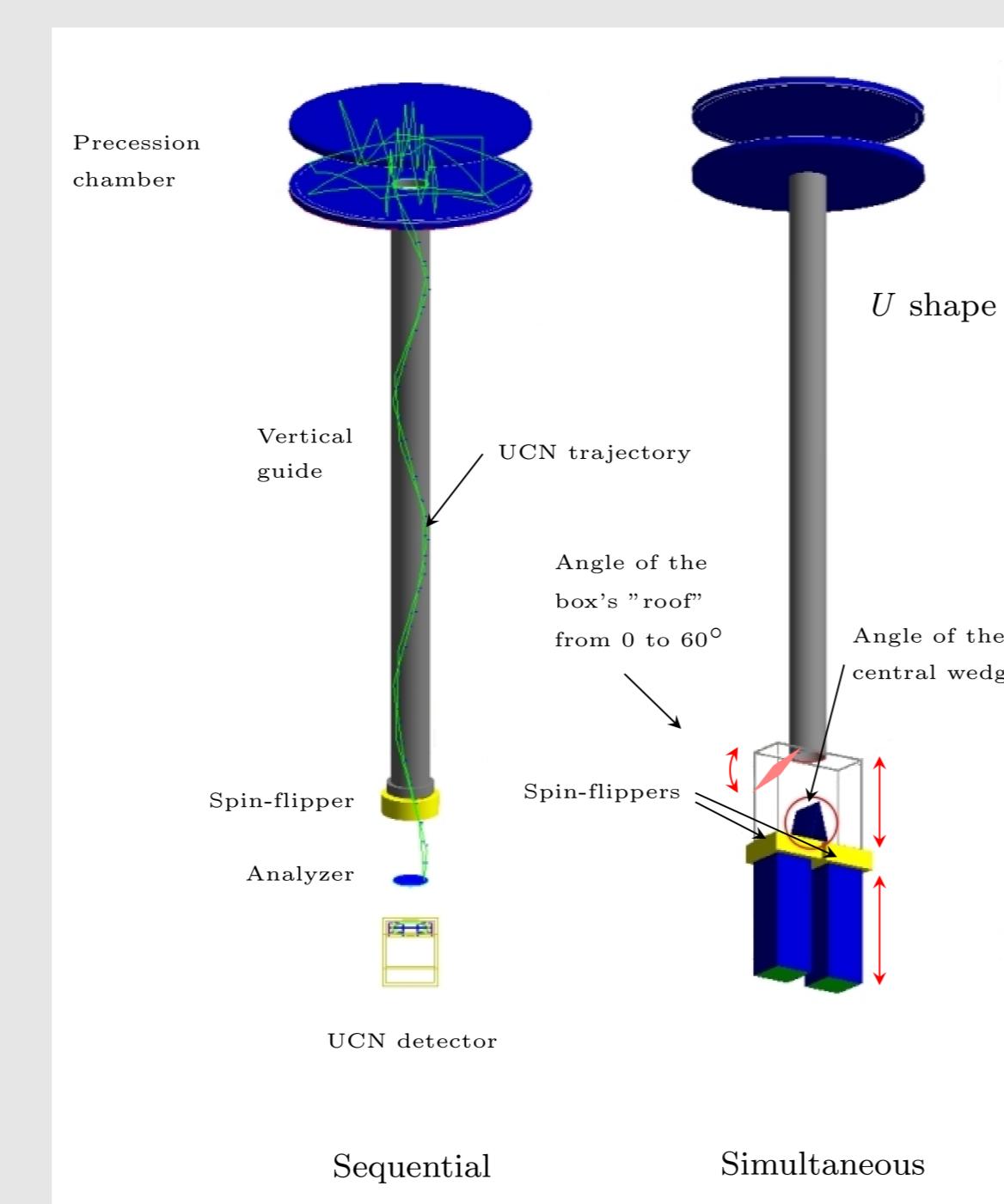
NANOSC detector

- Segmented detector for high UCN flux.



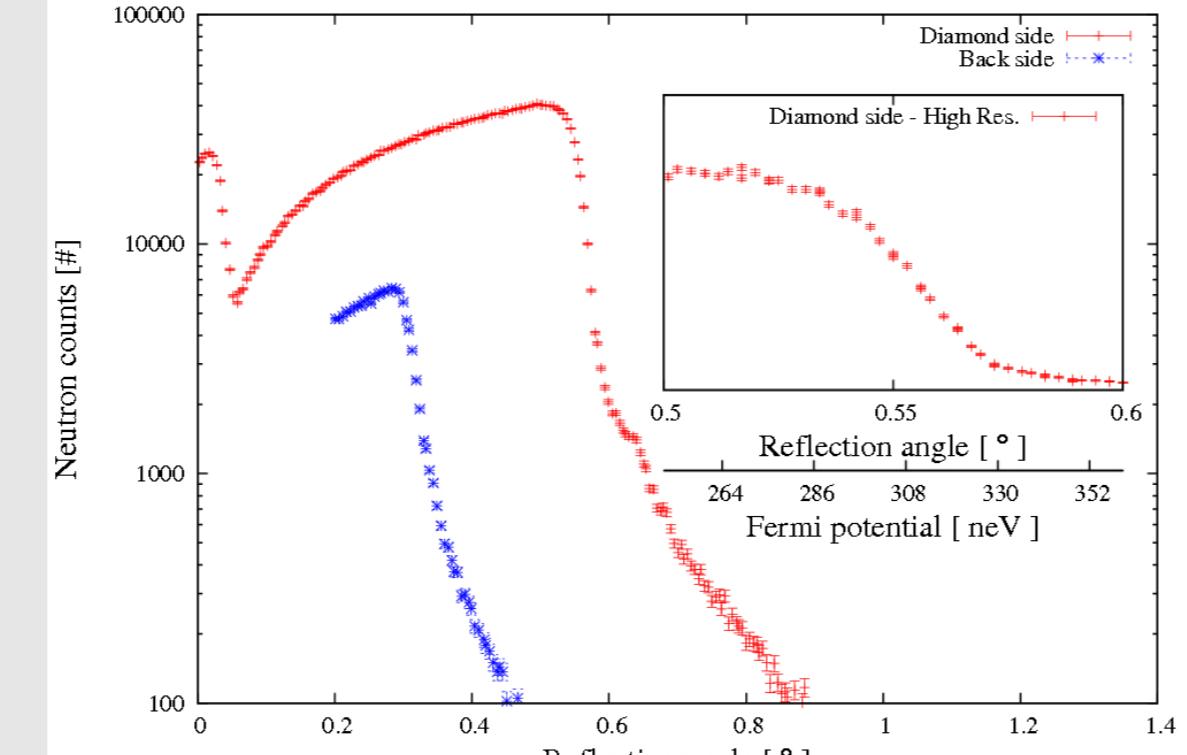
Future spin analysis: simultaneous UCN detection

- Each arm analyzing one spin state.
- Symmetric detection of each spin state.
- USSA optimization and comparison using GEANT4-UCN simulations, criteria:
- UCN extraction efficiency: ε_e
- spin asymmetry: $\mathcal{A} = \frac{N^+ - N^-}{N^+ + N^-}$



Diamond investigations to replace NiMo coating

- Goal: decrease UCN wall losses by using a higher Fermi potential V_F .
- Diamond test coating performed on quartz.
- Cold neutron reflectometry on Narziss @ PSI.
- V_F of diamond sample ~ 280 neV.
- Loss per bounce measurement required.



WEST2@PSI

- UCN energy range: 260–360 neV @foil.
- UCN transmission: **80.8(6)%**.
- Spin-flipper efficiencies:
 - $(f_A) = 97.0(12)\%$ $(f_B) = 97.1(9)\%$.
- No cross-talk: $\Delta N/N = 0.15(62)\%$.
- Analysing power: $P_{USSA} = 79.0(28)\%$.



Conclusion and perspectives

- USSA ready for the crucial test as part of the experiment.
- USSA mechanical integration and test planned before end of September.
- Ongoing Diamond coating investigations to improve UCN transmission.

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**<http://faster.in2p3.fr/>

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