

nEDM - SF

- Current neutron Electric Dipole Moment experiments all use a similar approach:
 - Stored ultracold neutrons (UCNs) in room temperature apparatus, measure NMR frequency shift when applying a large electric field
 - Best limit (1.8×10^{-26} ecm) is from PSI based experiment with UK developed single chamber apparatus and Hg co-magnetometer system
 - Double chamber measurements (PSI-n2EDM, ILL, LANL, TRIUMF) expected to reach 10^{-27} ecm sensitivity in the next few years, likely the limit of this approach
- Cryogenic experiment in superfluid (SF) helium can potentially reach 10^{-28} ecm
 - Due to higher neutron densities achievable with in-situ UCN production, higher electric field, long UCN storage time, superconducting magnetic shielding...
 - New collaboration between USA and Europe is being explored to bring a cryogenic nEDM experiment to the European Spallation Source (ESS), expected to be the world's most powerful neutron source

Project inputs to drafting days (to be provided in ≤ 5 slides)

Where information is not available, please note this

For all projects :

Key physics deliverables (name up to 5). Be quantitative where relevant/possible.

Key deliverable: ***nEDM measurement with 10^{-28} ecm sensitivity***. Derived deliverables: *Test of BSM theories, CP violation measurements*

Please quote the datasets and running/exposure time required for the numbers above.

The data sets required for a 10^{-28} ecm nEDM sensitivity is ultracold neutron precession frequency data in conjunction with magnetometry data in a controlled magnetic and electric field. The running time will be 4 years after commissioning

Environmental cost of construction (in units of tonnes of CO2 equivalent) INFORMATION NOT AVAILABLE

Environmental cost of operation per year (in units of tonnes of CO2 equivalent)

Estimate of financial costs (provide separate numbers for R+D phase, construction phase and operations phase)

Does your project plan dedicated submission(s) for the ESPPU (if so, give details).

Yes, there will be a submission to the ESPPU update by the EDM community for the March 2025 deadline. This reflects a European-level effort for building up EDM experimental systems (and theory).

Non-Collider Projects inputs:

- Comparison of physics goals with the current state of the art in the area.
 - *Current state of the art (room temperature, dual chamber UCN) aims to reach 10^{-27} ecm in the next few years.*
 - *New strategy required to go beyond this. Cryogenic experiment using superfluid He allows a pathway to greater sensitivity*
- List the project's main advantages compared to competitor projects.
 - *Higher UCN densities from efficient superthermal production, produce UCN directly in measurement cell to avoid transport losses*
 - *Higher E field (linear gain in sensitivity) possible as LHe has high dielectric strength*
 - *Novel spin-dressing measurement method with ^3He comagnetometer*
- Preferred location for the project
 - *European Spallation Source (ESS), Lund - Sweden*
- Project timeline (if possible provide separate by the R&D, construction and exploitation periods)
 - *R&D 2025-2030, construction in 2030s*
- Main risks/obstacles for realisation of physics goals (e.g. development of new technologies, construction of a new facility)
 - *beamline/space allocation at ESS*
- Anticipated area(s) of UK involvement
 - *Cryogenics, high voltage, magnetic environment and sensors, design and engineering*
- Total number of FTE /year required for construction/operation. What is the expected UK FTE?
 - *Not able to estimate yet*