- Key physics deliverables (name up to 5). Be quantitative where relevant/possible.
  - The first direct search for the proton EDM. Phase I limit of < 1E-29 e.cm, improving on current (indirect only) limit of ~ 1E-25 e.cm by at least 1E4. The SM prediction is 1E-31 e.cm. The phase II limit targets the SM prediction.
  - Phase I limit on QCD-theta, strong CP problem and CP-violation on strong sector of < 1E-13, improving on current limit of ~ 1E-10 by at least 1E3.
  - Phase I limit on the deuteron EDM of 1E-26 e.cm.
  - Sensitive probe for axionic dark matter for axions with frequencies (1 mHz → 1 MHz), and masses (1E-7 eV → 1E−22 eV).
  - Sensitivity to range on BSM models predicting large EDMs (e.g. SUSY, 2HDM, extra dimensions) in mass range 1 GeV → 1PeV.

- Please quote the datasets and running/exposure time required for the numbers above.
  - Five running years total.
  - Year 1:
    - Commissioning run, 10^{-27} $e{\cdot}$cm, first publication.
    - Shutdown improvements: 10^{-28} $e{\cdot}$cm reached within one week of statistics in new configuration.
  - Years 2 - 5:
    - Four physics run years to reach 10^{-29} $e{\cdot}$cm.
    - Signal accumulation rate at 1E−29 e · cm is 10−9 rad/s for 1E8 s = 1158 days.

- Environmental cost of construction (in units of tonnes of CO2 equivalent)

  Assuming operational cost per year (below) for five years construction: ~ 35 kt CO2e.

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

  https://eshq.fnal.gov/wp-content/uploads/2021/05/2018-Environmental-Report.pdf
  https://gm2-docdb.fnal.gov/cgi-bin/sso/RetrieveFile?docid=1319&filename=Muon_g-2_Life_Cycle_Costs%20V2.pdf&version=5
  0.20707 kg CO2e per kWh

  Muon g-2 storage ring only: 5.8 kt of C02 equivalent per year
  Muon g-2 share of proton production: 53 kt of C02 equivalent per year

  Is it likely pEDM storage ring power will be less since there's no superconducting magnet.

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

  Muon g-2
  Accelerator much cheaper for proton EDM
  Ring will be about the same
  R&D: $5M

Construction: Muon g-2 $80M. Brendan reckons $100M for proton EDM.
Operations: $5M per year.

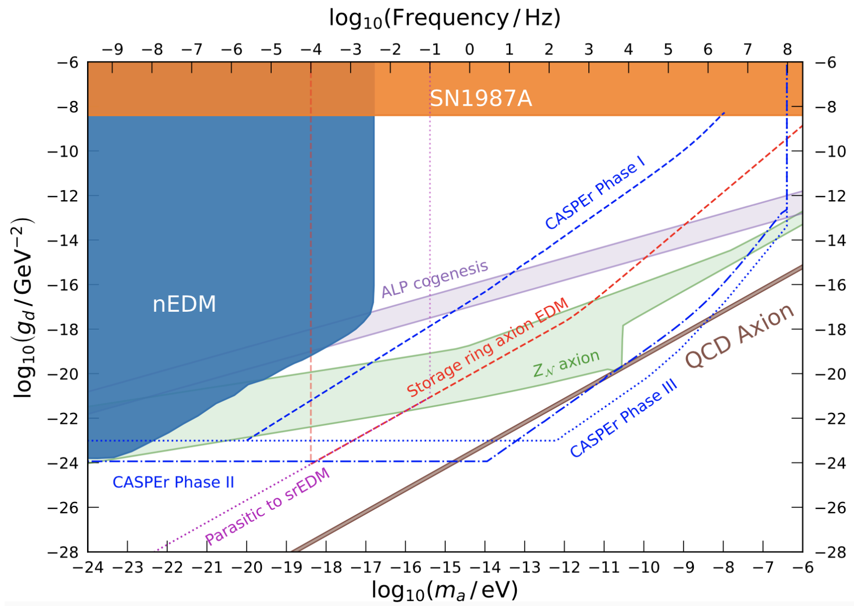
Scale for pEDM:
R&D: £5M
Construction £100M
Operations: £5M per year

- Does your project plan dedicated submission(s) for the ESPPU (if so, give details)
    - Single European document in preparation for all EDM projects:
        - "*Community input to the European Strategy on particle physics: Searches for Permanent Electric Dipole Moments*"
        - Editors: M. Athanasakis-Kaklamanakis, M. Au, R. Berger, S. Degenkolb, J. Devries, S. Hoekstra, A. Keshavarzi, D. Ries, P. Schmidt-Wellenburg, and M. Tarbutt,
        - Endorsed by the European EDM projects and collaborations.

- Comparison of physics goals with the current state of the art in the area.
    - No previous direct limit on proton EDM and no competitor experiment.
    - Current best limit on nucleon EDM ~ 1E-26 e.cm.

- List the project's main advantages compared to competitor projects.

    - No other EDM search has potential to get close to or reach SM prediction.
    - Compared to neutron EDM experiments:
        - At 1E-29 e.cm, pEDM will do 1E2 better than nEDM2.
        - The proton EDM could be an order of magnitude larger than the neutron, while the deuteron EDM could be three orders of magnitude larger than the neutron for the same physics reach.
        - Recent theoretical studies have additionally suggested that both the magnitude of nEDM and its sensitivity to new physics are charge-dependent, implying pEDM searches are potentially more sensitive probes than nEDM.
        - pEDM could be an order of magnitude larger.
        - dEDM could be three orders of magnitude larger.
    - No better probe of theta QCC or strong CP problem.
    - Axionic search is parasitic. Get it for free.



- New physics reach of FCC is 100 TeV, compared to 1PeV for pEDM.

- Preferred location for the project

  BNL (AGS) or CERN

- Project timeline (if possible provide separate by the R&D, construction and exploitation periods)

  Phase I Proton EDM only:
  - R&D to TDR: 2030-2035, 5 years
  - Construction: 2035-2040, 5 years
  - Operations : 2040-2045, 5 years
  - Exploitation: 2045 - 2050, 5 years

  Deuteron EDM, extra 5 years.
  Proton EDM Phase II (SM prediction), extra 5 years.

- Main risks/obstacles for realisation of physics goals (e.g. development of new technologies, construction of a new facility)
  - Location with high-intensity polarised proton source e.g. BNL.
  - OR location with high-intensity proton source converted to polarised source.
  - OR construction of new facility.

- Anticipated area(s) of UK involvement
  - Electrostatic deflectors (electrodes)
  - Polarimeters
  - Simulation
  - Analysis and physics exploitation

- Total number of FTE /year required for construction/operation. What is the expected UK

FTE?

https://programplanning.fnal.gov/wp-content/uploads/2019/02/g-2_EOP-E989_Final_v5.1003.pdf
Muon g-2: 96 FTE / year.
UK: 13 FTE / year