Introduction and goals of the workshop

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European Research Council
Established by the European Commission

SELDOM webpage
@SeldomTeam

Outline

- Introduction
- Goals of the workshop
- Practical information

Electromagnetic dipole moments

Electromagnetic dipole moments are static properties of particles, never measured for short-lived **charm**, **beauty** baryons, and **τ** lepton

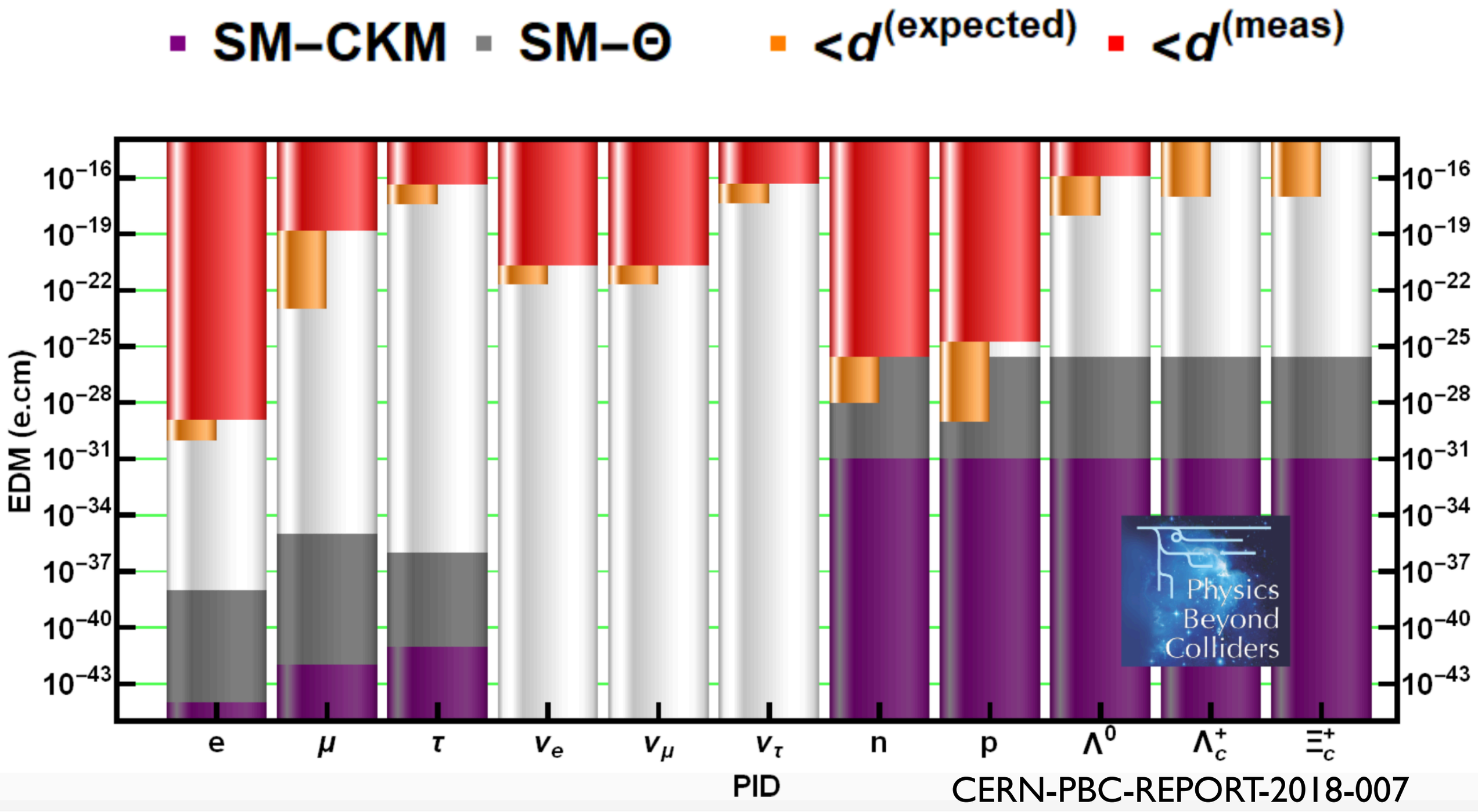
δ= electric dipole moment (EDM) $\qquad \boldsymbol{\delta} = d\mu_N \dfrac{\mathbf{S}}{2}$

- EDM searches are sensitive to **new physics**. Violation of P, T and CP via CPT theorem

μ= magnetic dipole moment (MDM) $\qquad \boldsymbol{\mu} = g\mu_N \dfrac{\mathbf{S}}{2}$

- MDM provide stringent test of the Standard Model for leptons and **QCD models** for baryons

Status of EDM measurements



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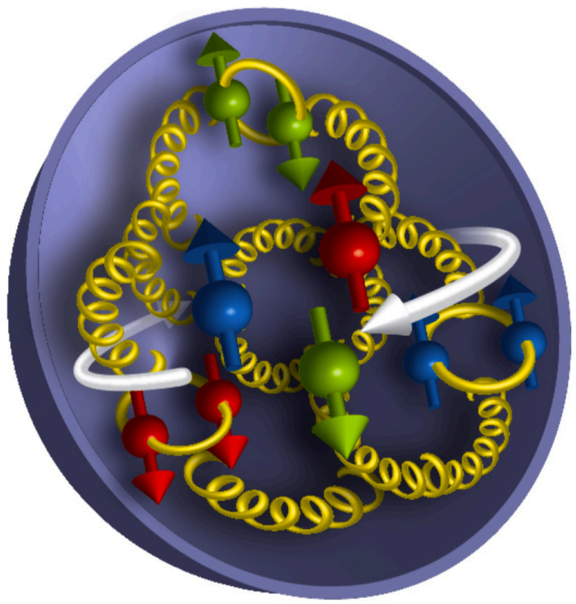
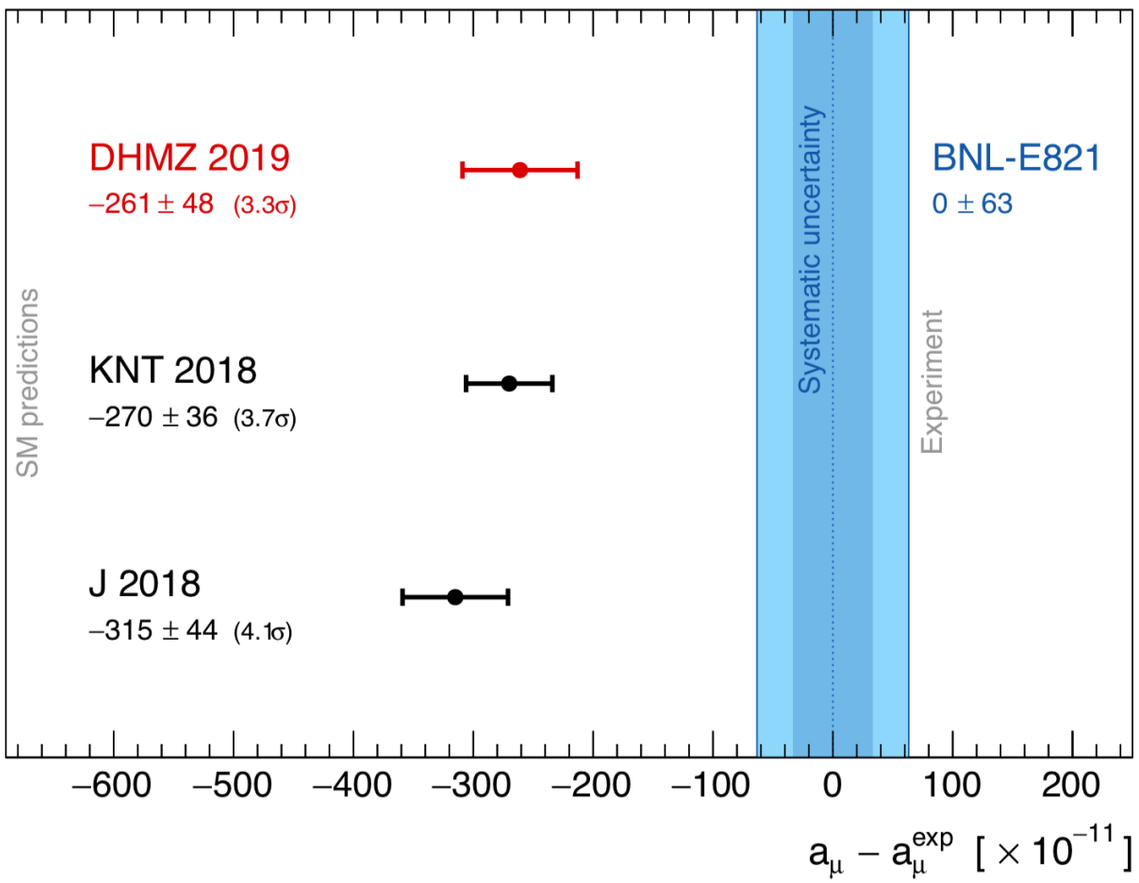
MDM physics motivations

- Test of the Standard Model with leptons, *i.e.* muon g-2
- Measurement of MDM of particles and antiparticles for **test of CPT symmetry**

- For baryons provide experimental anchor points for testing low-energy QCD models, related to **non-perturbative QCD** dynamics
- Test of **baryon substructure**



Muon g-2 and CPT tests



- Muon g-2: precision SM test. Accuracy of measurements matched by accuracy of calculations

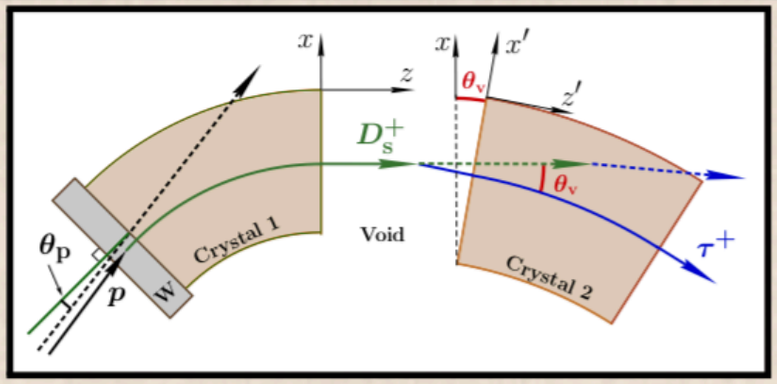
Particle	(g+-g−)/g
electron	$(-0.5\pm2.1)\cdot 10^{-12}$
muon	$(-1.1\pm1.2)\cdot 10^{-9}$
proton	$(0.3\pm0.8)\cdot 10^{-6}$

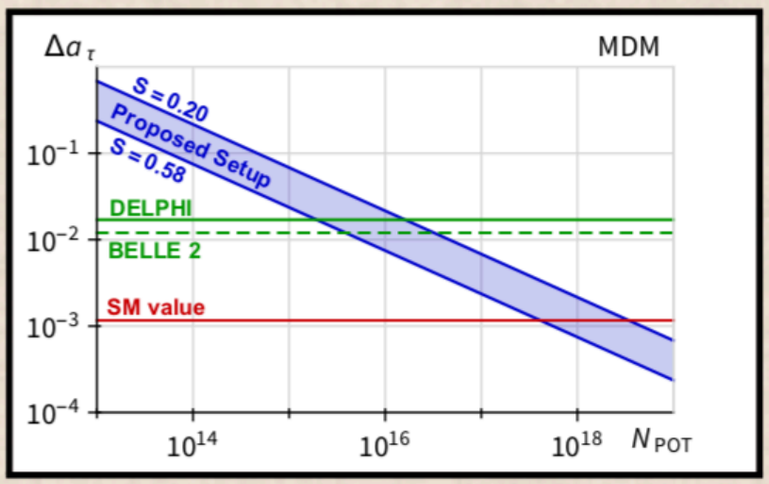
- Significant CPT tests performed in few particle systems

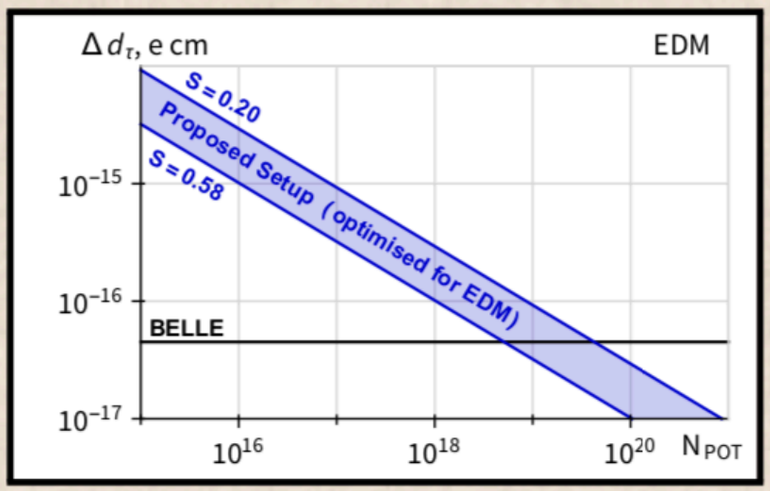
Tau g-2 and EDM

From A. Lusiani talk at European Strategy Update, Granada - May19

Fomin, Korchin, Stocchi, Barsuk, Robbe 2018



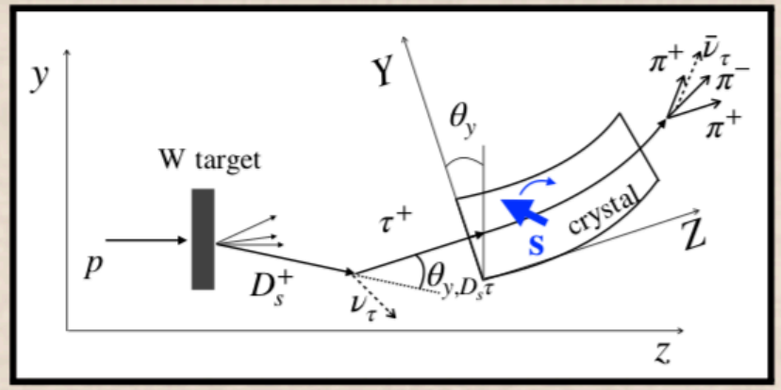


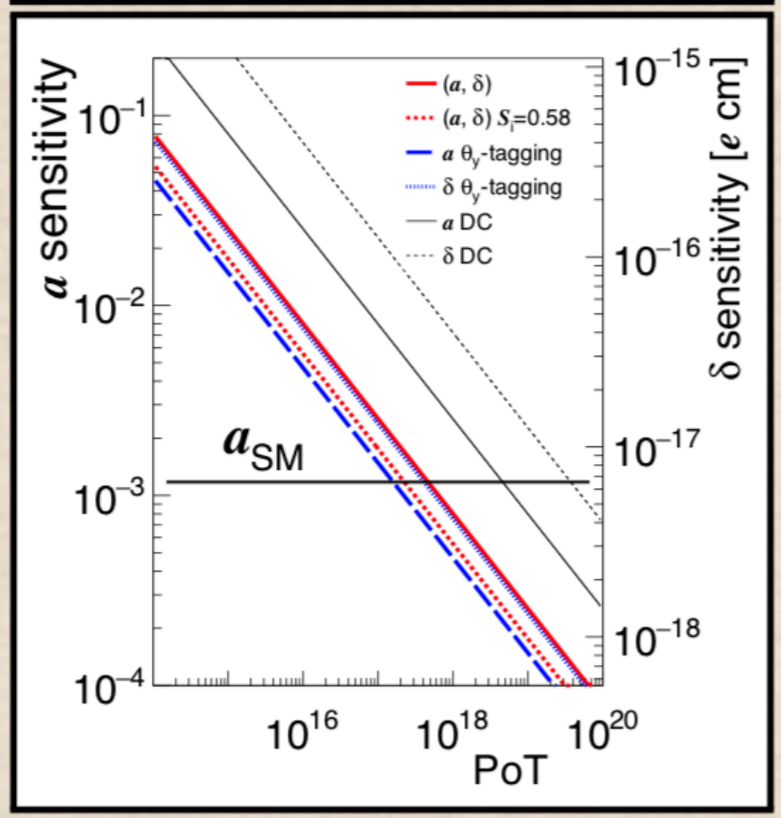


BelleII prospects on tau $g-2$ and EDM

- Chen, Wu 2018, simulation of just statistical errors
- $\Delta|d_\tau^{\mathbf{NP}}| = 2.04 \cdot 10^{-19}$ e cm, $\Delta|a_\tau^{\mathbf{NP}}| = 1.75 \cdot 10^{-5}$
  (beware: here one actually measures NP pointlike contributions)

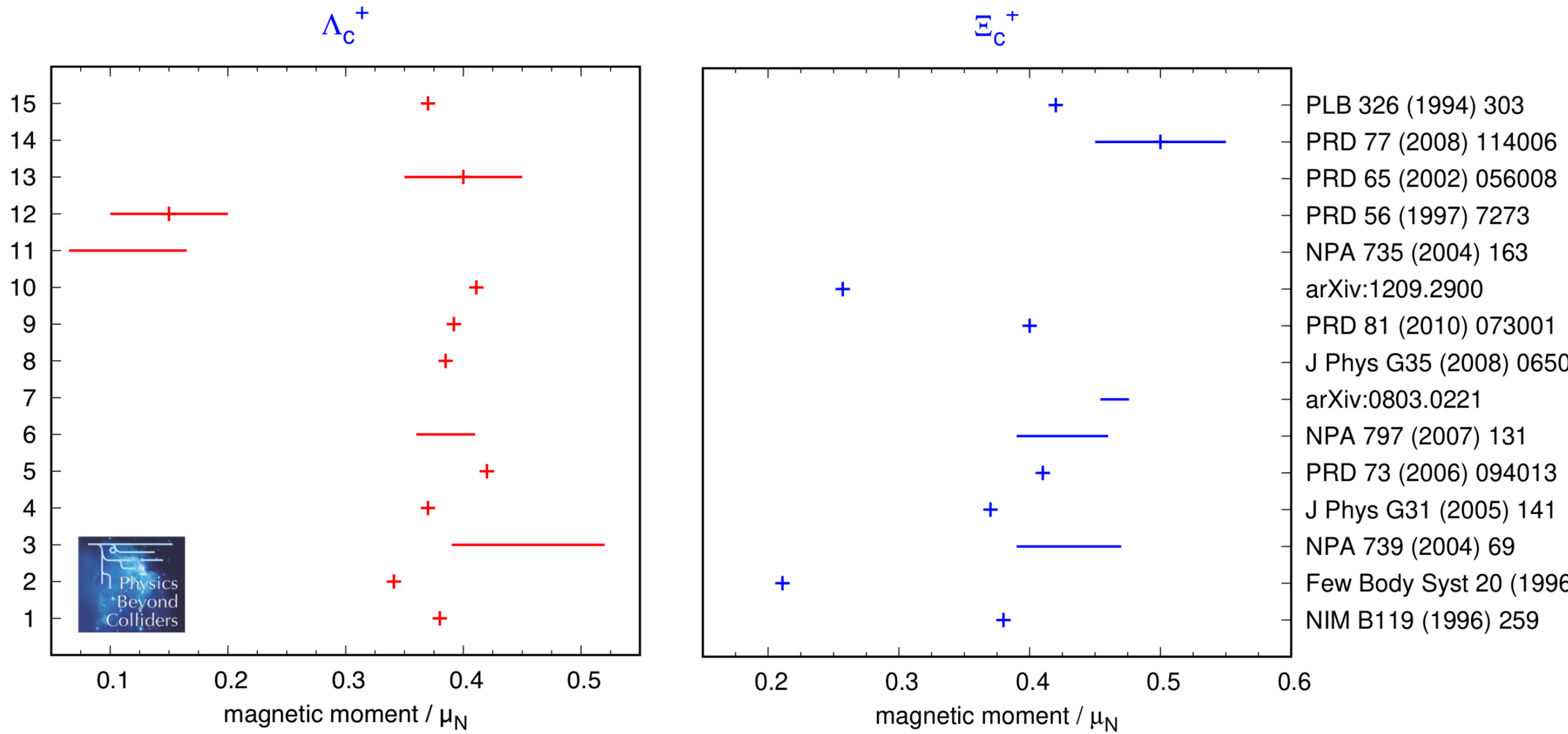
Fu, Giorgi, Henry, Marangotto, Martínez Vidal, Merli, Neri, Ruiz Vidal 2019





MDM of heavy baryons

Provide experimental anchor points for heavy baryon MDM model predictions. Trigger further theory activity



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Goals of the workshop

Study EMD/MDM at LHC(b)

- Discuss the proposals for directly probing MDM/EDM of unstable particles at LHC(b)
  - **charm** (**beauty**) baryons: fixed-target production and spin precession in bent crystals with LHCb
  - **strange** baryons: *pp* production and spin precession in LHCb dipole magnet
  - **tau** lepton: dedicated experiment with bent crystals. Possible preparatory studies in LHCb

Pospelov's comments on charm MDM/EDM

- In light hadrons, most of the MDM is generated by light "valence" quarks, and it scales as $(eQ_q/m_{\text{const quark}})$ where $m_{\text{const quark}}$ is the mass of the constituent light quarks (i.e. mass of a light quark "dressed" by QCD to be ~ 300 MeV).
- Therefore, to start seeing MDM of charm, one needs to measure to accuracy better than $m_{\text{const quark}}/m_{\text{charm}}$.
- Acceptable result: 10% measurement of the MDM

  Desirable result: few% measurement of the MDM.
- Achieving a result better than $(10^{-17} - 10^{-18})$ e cm would be a milestone showing that charmed EDM can probe beyond the weak scale.
- *Truly interesting* [for me] benchmark would start from *just above* the indirect limits, at 10^{-20} e cm benchmark.

European Strategy for Particle Physics 2020

- The proposals have been mentioned and endorsed in the Physics Briefing Book. See http://cds.cern.ch/record/2691414

The physics reach of the LHC complex can greatly be extended at a very limited cost with the addition of an ambitious and long term **LHC-FT research program**. The efforts of the existing LHC experiments to implement such a programme, including specific R&D actions on the collider, **deserve support**……

In addition, **double crystal LHC-FT experiments** give access to studies beyond QCD, such as **MDM and EDM** of heavy baryons.

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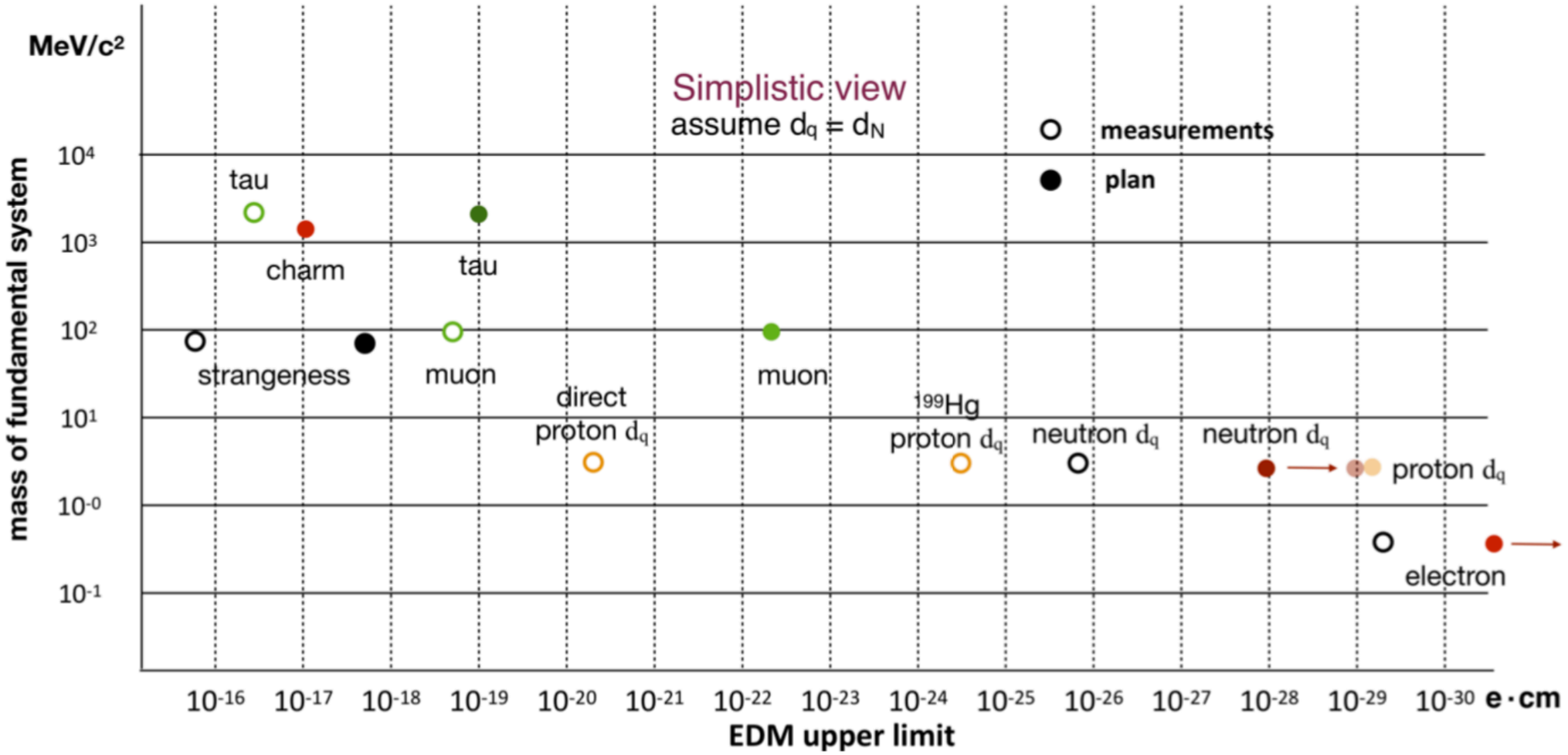

Main topics of discussion

- **Physics** program
- **Channeling** and spin precession in bent crystals
- **Spin** precession in LHCb magnet
- **Machine** layout
- **Experimental** techniques
- **R&D** in progress

Work in collaboration

- Crucial to **join** effort and expertises of different communities to transform the proposal into an **experiment**:
  - theorist
  - experimentalist
  - bent crystals
  - machine
  - engineering

Contributions to the project

- Setup a collaborative **framework**
- **Critical items** for the experiment and crucial contributions
- Identify areas of **interest** and expertise
- **Responsibilities**
- **Timeline**

Let’s start the meeting and fruitful discussions!

Practical information

- Register at the workshop and wear the badge
- Wi-FI: eduroam
- Lunches and coffee breaks are provided
- Visit of Ca’ Granda at 18:00
- Welcome cocktail this evening at 19:00 (Loggiato)
- Scientific secretariat: Noemi De Lorenzo