**Definitions (spin %)**

- Electric dipole moment (EDM): \( \delta = d \mu \frac{\vec{p}}{2} \)
- Magnetic dipole moment (MDM): \( \mu = g \mu_B \frac{\vec{p}}{2} \)

with

- \( \mu_B \): particle magneton
- \( d, g \): adimensional factors
- \( \vec{\beta} \): spin polarization vector

**Physics motivation**

- EDM:
  - of an elementary particle violates T and P
  - symmetries \( \rightarrow \) CP violation via CPT theorem, new CPV source for baryogenesis
  - flavour-diagonal source of CPV \( \rightarrow \) new physics \textit{beyond the Standard Model}

- MDM:
  - probes baryon substructure
  - particle and antiparticle MDM \( \rightarrow \) CPT test

**Experimental method**

**Spin precession in bent crystals**

- Large electric field between crystal planes, effective B = 500 T [3, 4]

The decay angular distribution is sensitive to the polarization [5, 6]:

- Spin precession angle sensitive to MDM:
  \( \Phi \approx \frac{g - 2}{2} \theta_C \)
- X component of the spin vector after the precession sensitive to EDM:
  \( s_x \approx s_0 \frac{d}{g - 2} (\cos \Phi - 1) \)

**Setup**

- Goniometer for target+cryystal designed: accuracy on position \( \approx 20 \mu \text{m}, \) rotation angle \( \approx 20 \mu \text{rad} \)

**Sensitivity**

Expected yields with IR3 test, 7 TeV proton beam, proton flux \( 10^6 \text{ p/s}, \) baryons production spectrum from PYTHIA after channeling through 7 cm length, 7 mrad bent Ge crystal:

- \( \epsilon(1000) \) of \( D^+ \rightarrow K^+ \pi^+ \pi^- \) events recordable in 2 days of data-taking

- \( \epsilon(1000) \) of \( A_2^+ \rightarrow pK^+ \pi^- \) (\( E_2^+ \rightarrow pK^+ \pi^- \)) events recordable in less than 2 months of data-taking

10^7 p/s possible with improved extraction technique

**LHC status**

- Full simulation with DD4HEP (detector geometry) + GEANT4 to optimize the setup

**LHC machine studies ongoing:**

- Performed LHC machine layout simulation [7]
- Successful layout test done at SPS. Test in LHC (IR3) possibly during Run3 or Run4
- Channeling of 6.5 TeV at LHC already demonstrated [8]

Decays considered:

- \( D^+, \ D^+_s, \ A_2^+ \) decaying to three charged hadrons
- Charm hadron decays separable exploiting invariant mass resolution, need \( \sigma_{m} < 50 \text{ MeV} \), possible optimizing tracking station length D

**References**