

Enabling technologies for measurements of short-lived particle dipole moments

δ = electric dipole moment (EDM)
sensitive to new physics

$$\delta = d \frac{q\hbar}{2m} \frac{S}{\hbar}$$

$$\mu = g \frac{q\hbar}{2m} \frac{S}{\hbar}$$



μ = magnetic dipole moment (MDM)
QCD studies, baryon substructure, SM test

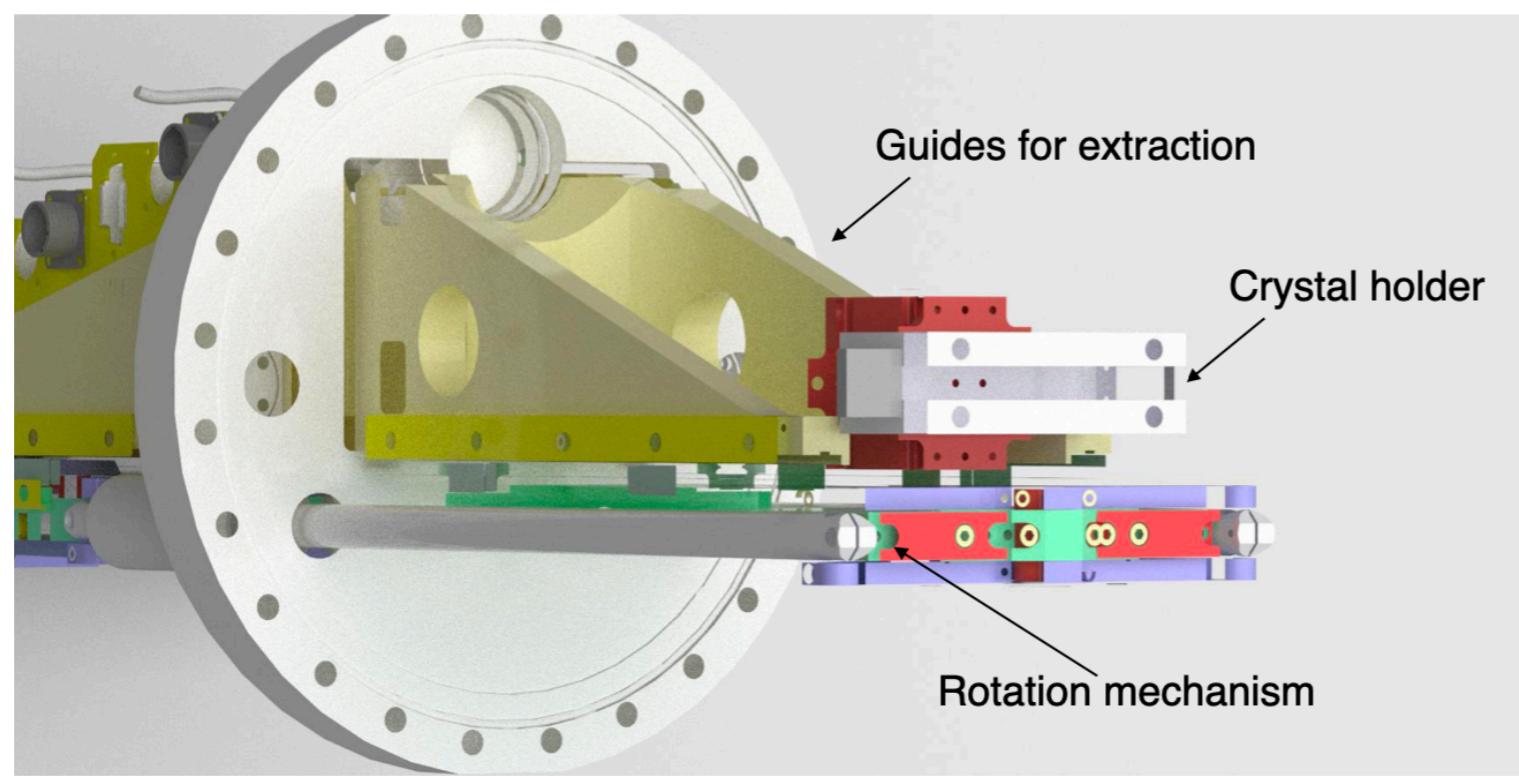
F. J. Botella et al., Eur.Phys.J.C 77, 181 (2017)

E. Bagli et al., Eur.Phys.J.C 77, 828 (2017)

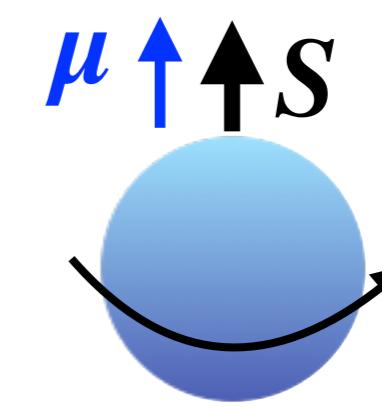
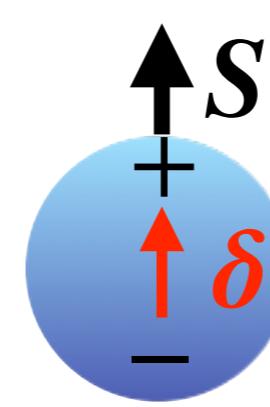
A.S. Fomin et al., JHEP 1708, 120 (2017)

A.S. Fomin et al., Eur. Phys. J. C 80, 358 (2020)

Proposed experiment at LHC to measure **charm baryons** dipole moments

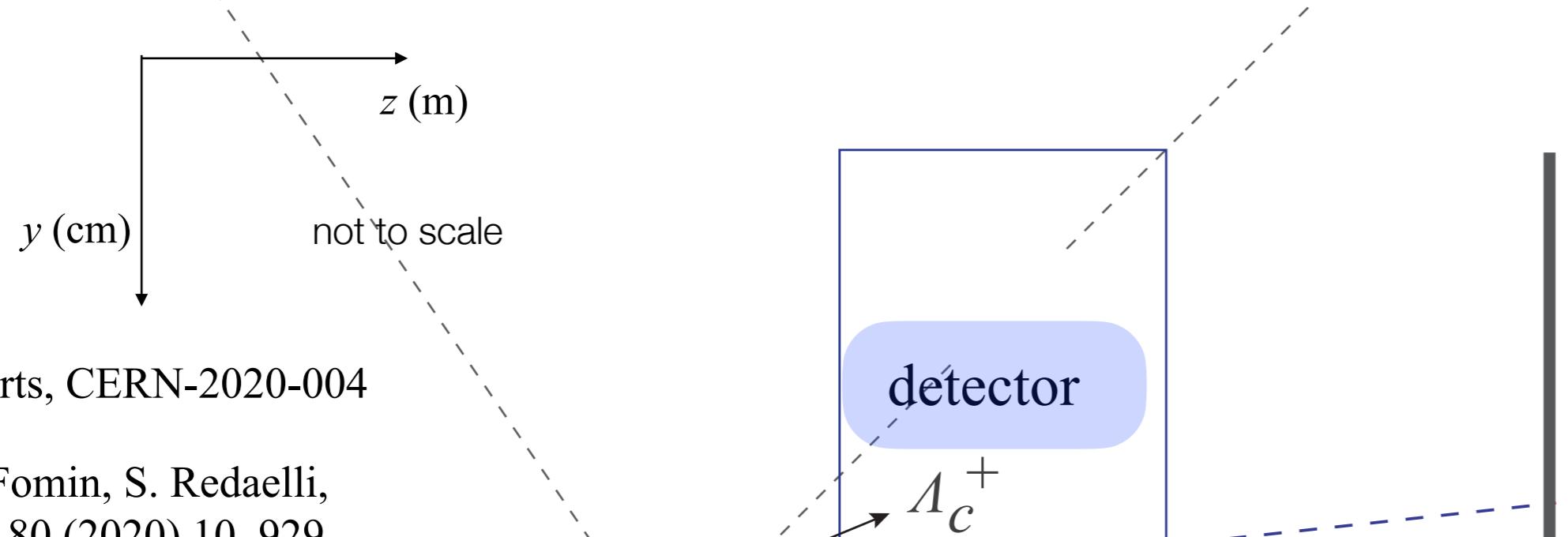
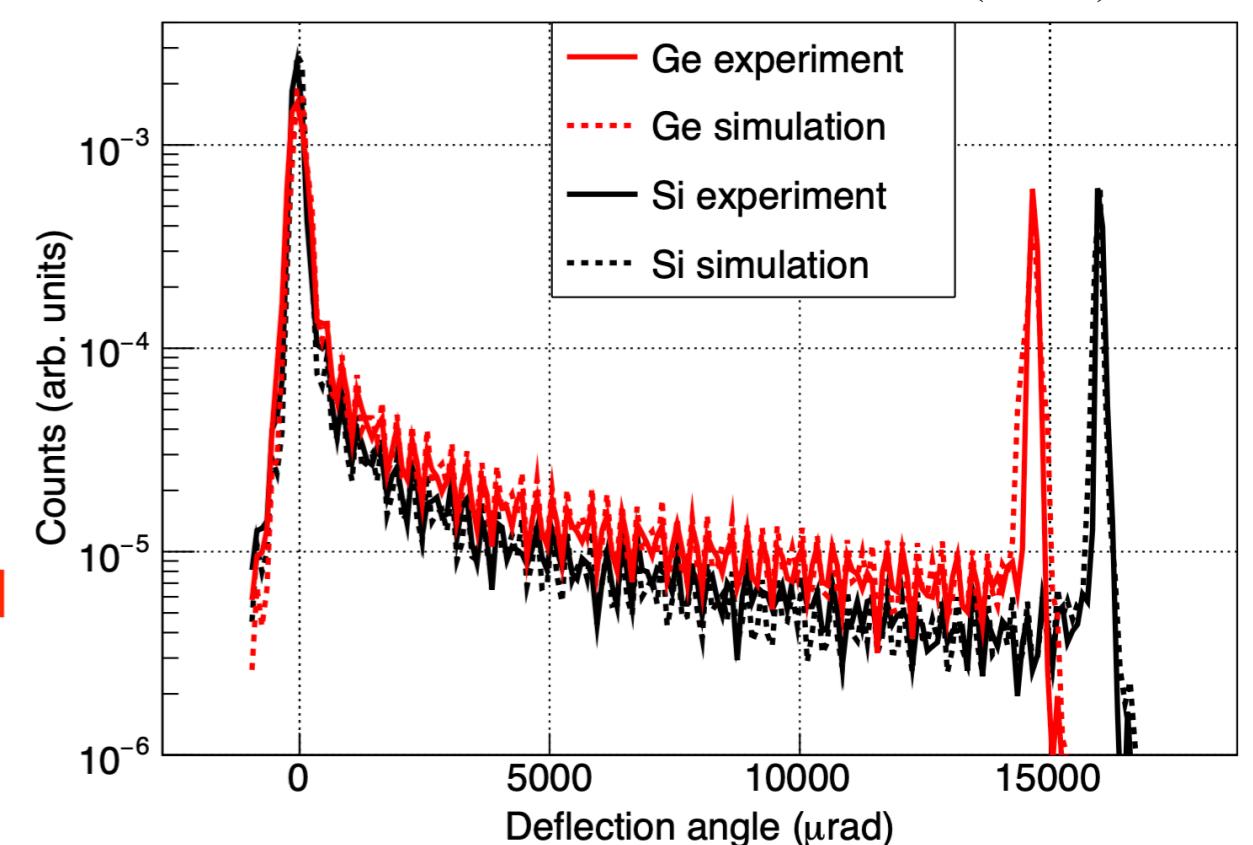


Goniometer for crystal positioning in primary vacuum
20 μ rad, 20 μ m precision



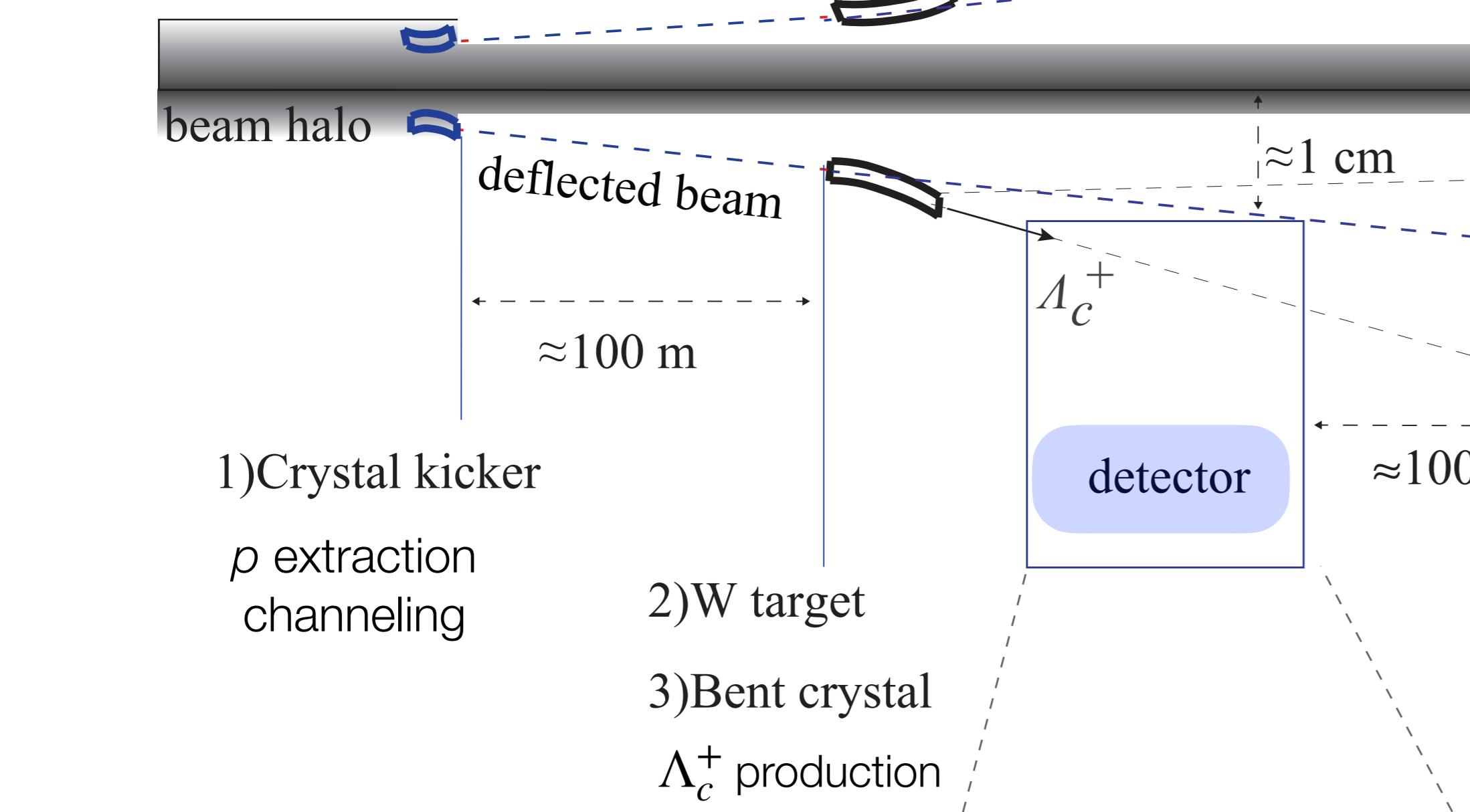
SELDOM

S. Aiola et al., PRD 103, 072003 (2021)

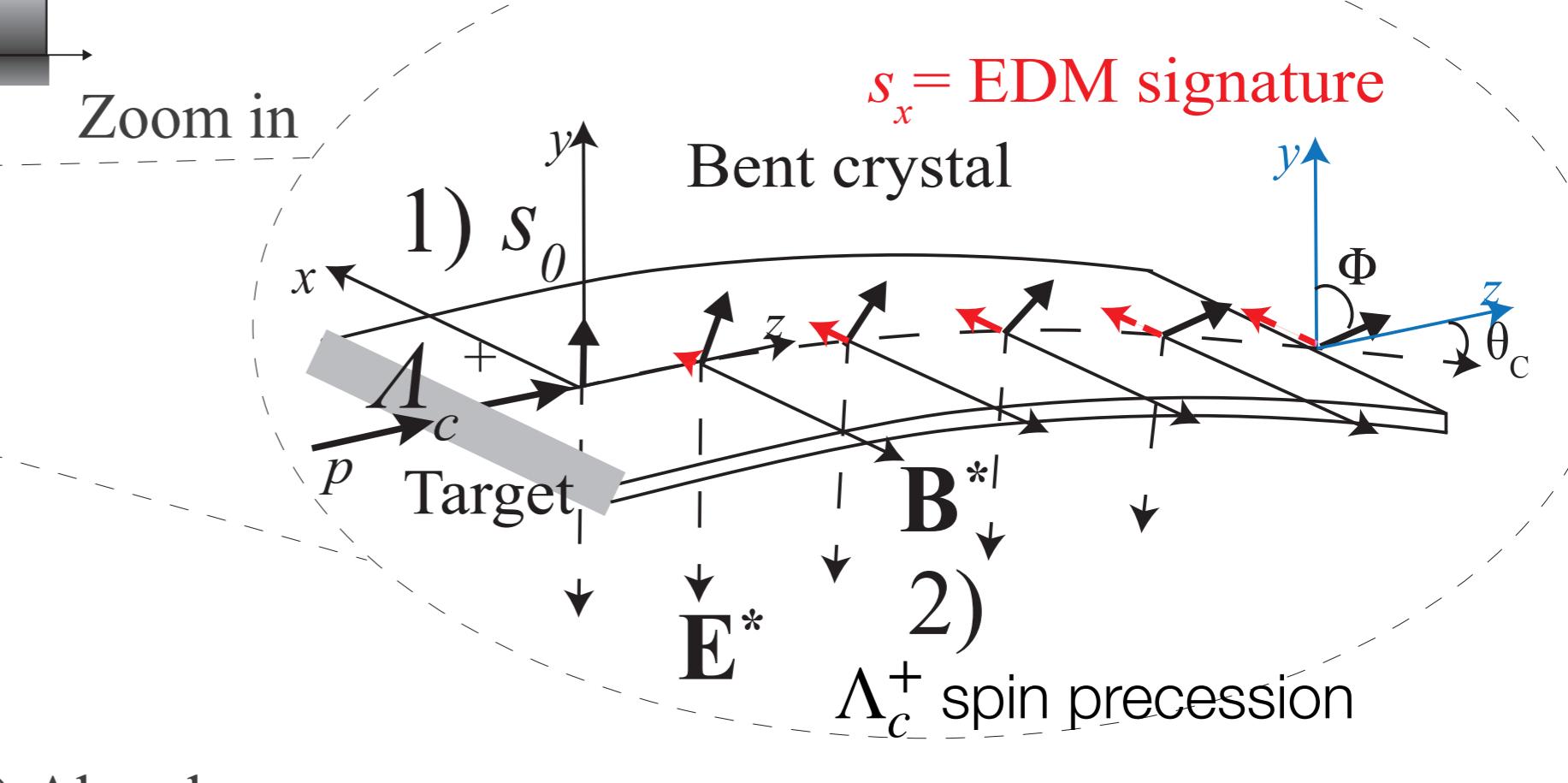


CERN Yellow reports, CERN-2020-004

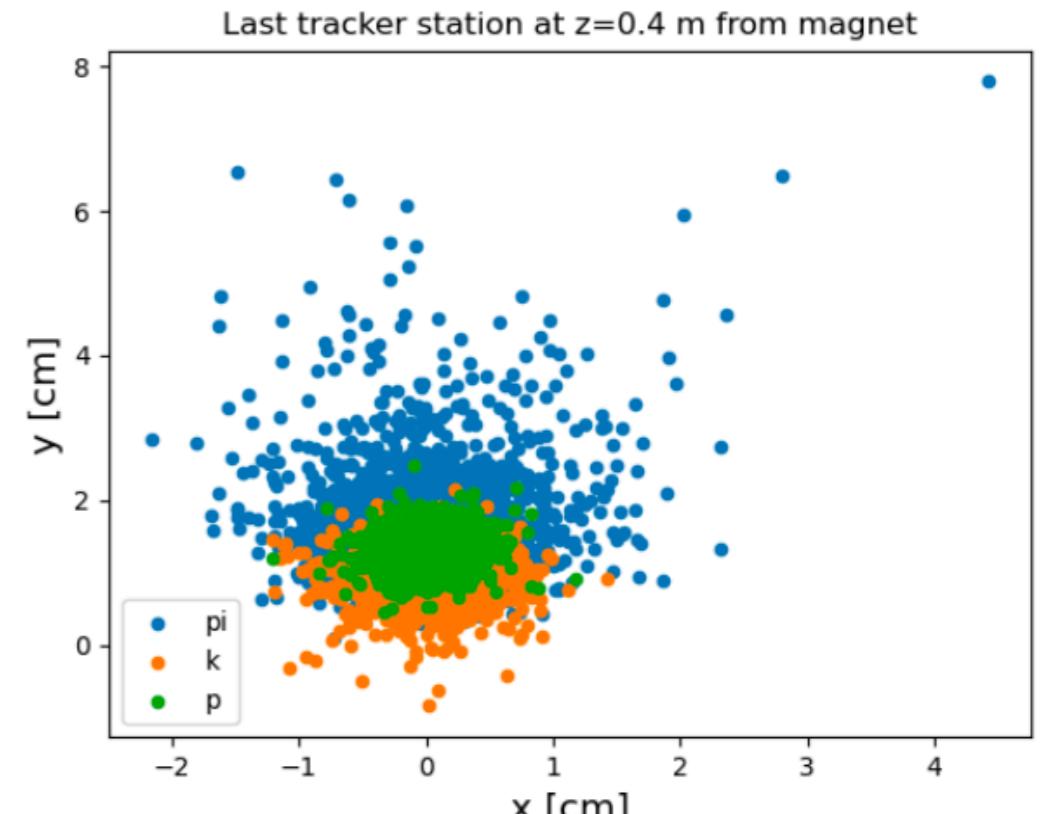
D. Mirarchi, A. S. Fomin, S. Redaelli, W. Scandale, EPJC 80 (2020) 10, 929



LHCb- and dedicated-detector solutions are under consideration



Hit distribution for $\Lambda_c^+ \rightarrow pK^-\pi^+$
Area \approx few cm 2 , rate \approx 100 MHz/cm 2



Dedicated detector layout at the LHC insertion region 3 (IR3)

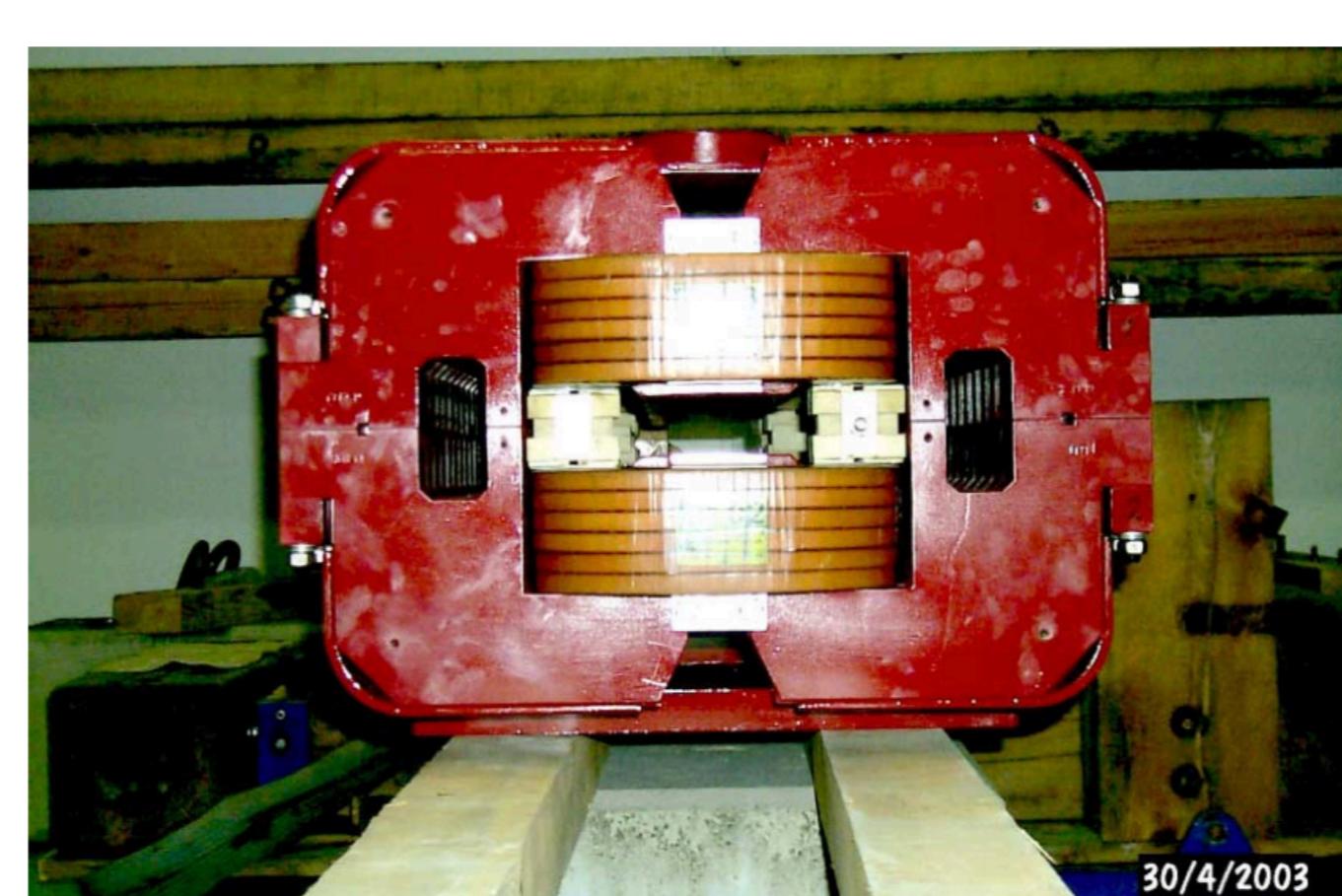
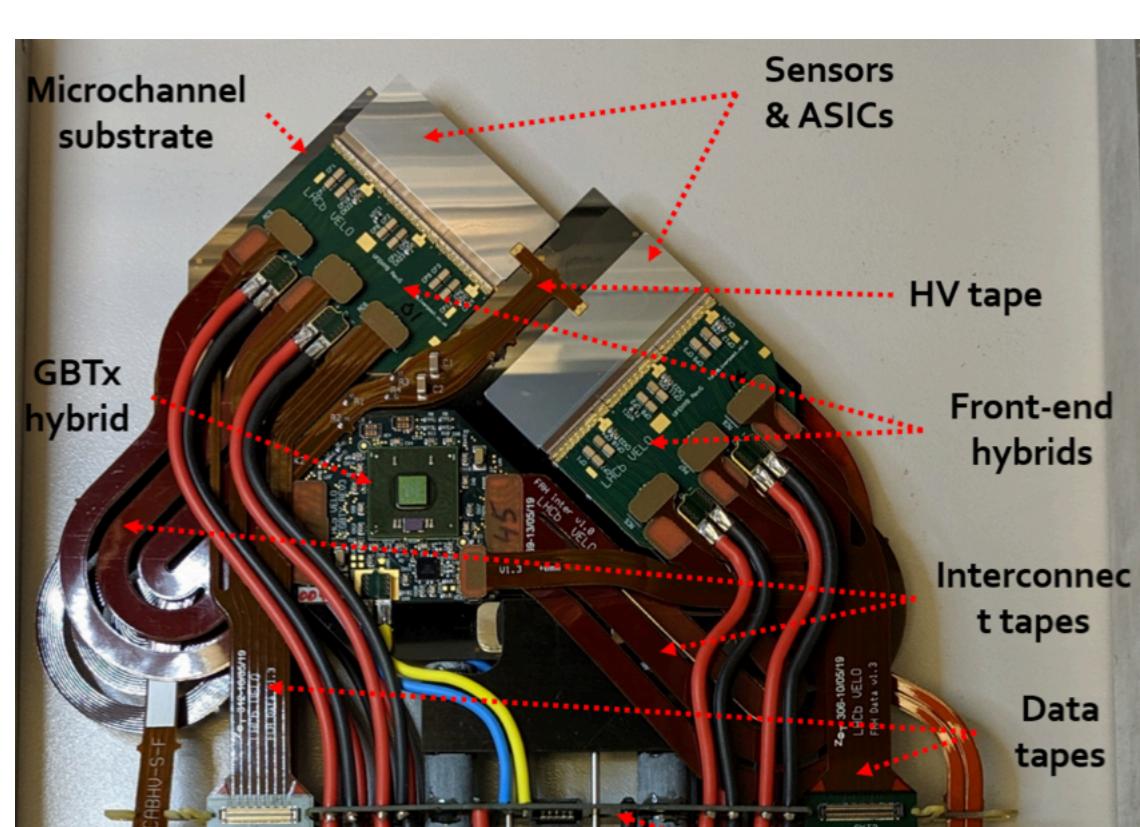
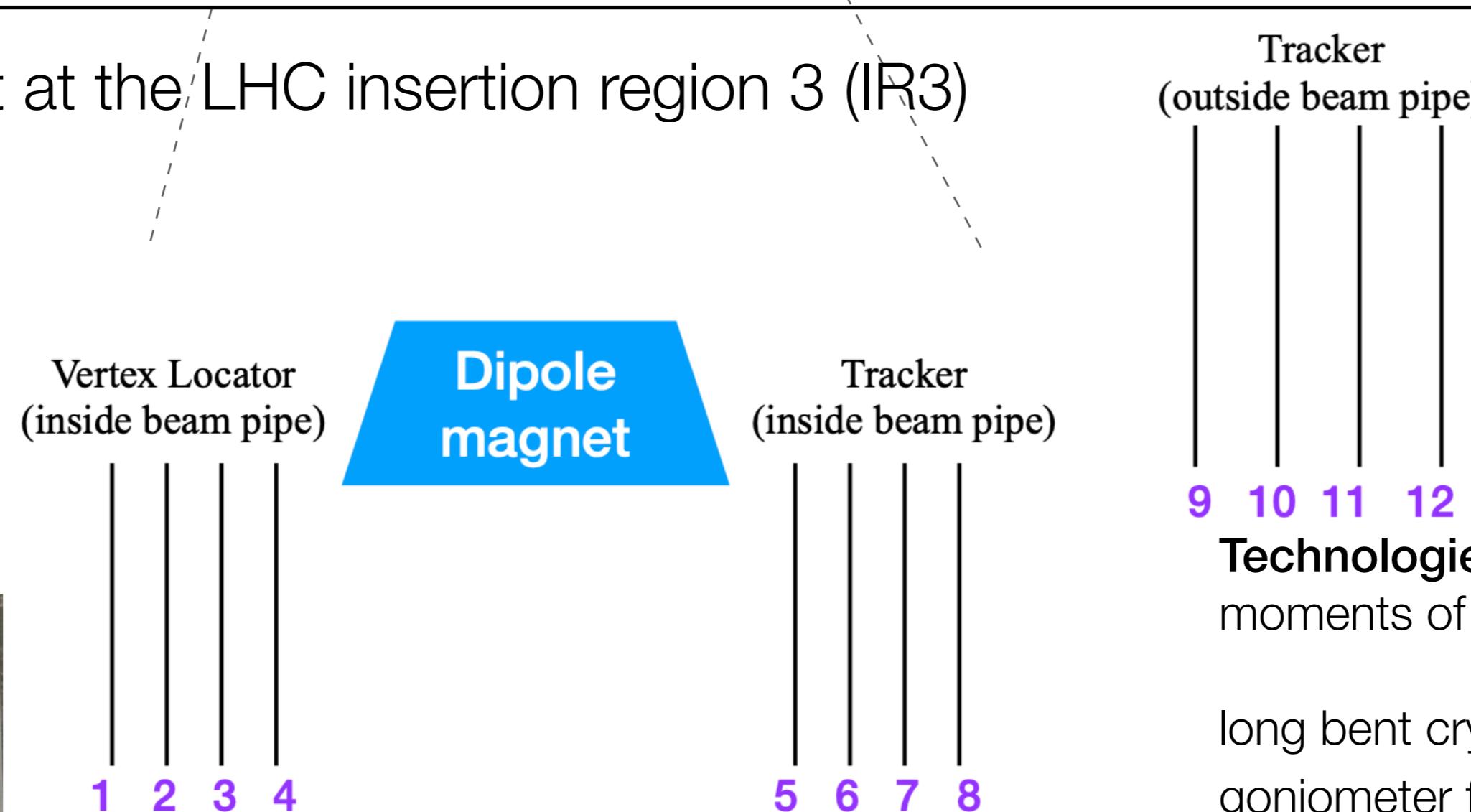
VeloPix modules in Roman Pots

for Vertex and Tracker stations

1 cm from the beam

55x55 μ m 2 pixel,
pixel hit rate 600 MHz/cm 2 ,

12 μ m hit resolution



LHC orbit correction dipole
MCBW (1.7 m, 1.1 T) is
considered for the spectrometer
(Credits: Pascal Hermes, CERN)

Technologies enabling the first measurement of dipole moments of charm baryons

long bent crystals (Ge, Si) ✓

goniometer for precision positioning of the crystals ✓

VeloPix modules ✓

Dipole magnet MCBW ✓

Challenges: machine operations, detector integration in vacuum

Proof-of-principle test at LHC IR3 under discussion (aim at first data in LHC Run3)

test machine and operational aspects

measure channeling efficiency at TeV energies

study detector performance and background levels