

PROGRESS TOWARDS THE FIRST MEASUREMENT OF THE DEUTERON ELECTRIC DIPOLE MOMENT AT COSY

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MATTER-ANTIMATTER ASYMMETRY



$$\frac{n_b - n_{\bar{b}}}{\gamma} = (6.14 \pm 0.25) \cdot 10^{-10} \quad (WMAP \ 2003)$$



A. Sakharov (1967) for baryogenesis:





ELECTRIC DIPOLE MOMENT





 $H = +\vec{d} \cdot \vec{E} - \vec{\mu} \cdot \vec{B}$

 $H = -\vec{d}\cdot\vec{E} - \vec{\mu}\cdot\vec{B}$

EDM is a probe for CP violation beyond the SM



Towards the first deuteron EDM measurements at COSY

Vera Shmakova





<u>At storage rings:</u> vertical \boldsymbol{B} field, radial \boldsymbol{E} field

MDM causes fast spin precession in horizontal plane

EDM causes slow spin rotation out of horizontal plane, up and down





EDM AT COSY

COSY (Jülich, Germany)

- magnetic storage ring
- polarized protons and deuterons up to 3 GeV/c







Starting point for direct deuteron EDM measurement



Vera Shmakova

EFFECT ON PRECESSION AXIS



EDM absence case

EDM effect



 $y \uparrow y' \parallel \vec{c}$

z (beam)

Magnetic misalignment effect





MEASURING METHOD





RF Wien filter

Heberling, Hölscher and J. Slim

- Lorentz force $\vec{F}_L = q(\vec{E} + \vec{v} \times \vec{B}) = 0$ $\vec{B} = (0, B_y, 0)$ and $\vec{E} = (E_x, 0, 0)$





POLARIZATION BUILD-UP

- Wien filter operated with B filed normal to the ring plane
- $\alpha(t) = \arctan(\frac{P_y}{P_{xz}})$
- Observed initial slopes of polarization buildup variated of Wien filter and solenoid rotations
- Observed slopes correspond to the EDM of $d \sim 10^{-17} e \cdot cm$



Forschungszentrum

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FIRST RESULTS



Orientation of precession axis at location of RF Wien filter determined from the minimum of the surface

Spin tracking calculations are going to provide the orientation of spin precession axis without EDM









- EDM measurements are needed for understanding the source of CP violation
- First measurement of deuteron EDM is performed at COSY
- Experiment performed is a proof of principal of EDM measurement at storage rings







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THANK YOU!

