

An RF Wien Filter for Direct EDM Measurement at COSY

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RF technique for Electric Dipole Moment (EDM) measurement:

- Integrate an RF Wien Filter which allows to manipulate the spin without affecting the momentum, because the Lorentz force is 0
- Since spins are precessing in the horizontal plane, WF has to be operated at spin frequency (or harmonics)

(see Talks by J. Pretz, M. Rosenthal, E. Stephenson, N. Hempelmann and E. Valetov)



Technical Requirements

- Field quotient
 - deuterons:

$$E_x = -c \cdot \beta \cdot \mu_0 \cdot H_y$$
$$Z_q = \frac{-E_x}{H_y} = c \cdot \beta \cdot \mu_0 \approx 173 \ \Omega$$

- Orthogonality
- Homogeneity
- Frequency

harmonic k-4 -3 -2 -1 0 +1 +2 3121.6 2371.4 **1621.2 871.0 120.8 629.4 1379.6**

Novel Waveguide-based RF Wien filter





Concept

 $\mathbf{\Psi}^{))}$ $\mathbf{\Psi}$

Wave mismatch method

- TEM supporting structure
 - Parallel-plates waveguide





Concept

 $\mathbf{Y}^{(0)}$ \mathbf{Y}

Wave mismatch method

- Induce wave mismatch with a resistor
 - Second wave propagation via reflections





Concept

Wave mismatch method

- Waves interfere
 - Quotient between E and H fields can be controlled
 - Wien filter condition can be fulfilled

E H S











Structure (cont.)







Driving circuit





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Waveguide RF Wien Filter: Fields













Beam Setup for Homogeneity Calculations





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Modeling Mechanical Tolerances



variable	distribution
x_1	$G\left(808.8,0.1\right)\mathrm{mm}$
x_2	$G\left(808.8,0.1 ight)\mathrm{mm}$
x_3	$G\left(182,0.1\right)\mathrm{mm}$
x_4	$G\left(182,0.1 ight)\mathrm{mm}$
x_5	$G\left(0,1 ight)$ mrad
x_6	$G\left(0,1 ight)$ mrad
x_7	$G\left(0,1 ight)$ mrad
x_8	$G\left(0,1 ight)$ mrad
x_9	$G\left(0,1 ight)$ mrad
x_{10}	$G\left(0,1 ight)$ mrad



















Performance Analysis under Uncertainty













- A concept for high precision RF Wien has been developed and a prototype is now under assembly
- The system is expected to maintain high level of field homogeneity considering mechanical tolerances and misalignment
- The driving circuit is also under construction by Barthel-HF Technik GmbH
- The RF Wien filter is expected to be installed in April in COSY/Jülich for first direct EDM measurements at 871 kHz.



Thank you for your attention

Questions?

