

On the development of a novel waveguide RF Wien filter for Electric Dipole Measurements at COSY/Jülich

Jamal Slim for the JEDI Collaboration

Acknowledgement: A. Nass, F. Rathmann and H. Soltner

DPG Tagung, Münster, 2017







Proof of principle experiment using COSY ("Precursor experiment")

- In magnetic machine, particle spins (deuterons, protons) precess about stable spin axis ('direction of magnetic fields in dipole magnets).
- Use RF device operating on some harmonic of the spin-precession frequency:
 - Phase lock between spin precession and device RF.
 - Allows one to accumulate EDM effect as function of time in cycle (1000 s).

Goal of proof-of-principle experiment:

Show that storage ring (COSY) can be used for a first direct EDM measurement.

(See Talks by Martin Gaisser and Fabian Müller).





RF Wien filter

Cooler Synchrotron COSY

Ideal starting point to investigate EDM measurements in storage rings



The RF Wien filter causes a spin phase advance via the magnetic moment without distortion of the beam closed orbit that introduces a vertical polarization component via the electric dipole moment in the other field elements of a storage ring.











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

Waveguide RF Wien filter





V)))

Waveguide RF Wien filter



NIMA 828 (2016) 116-124

\/)))





Waveguide RF Wien filter











Driving circuit











Driving circuit

Variable resistor







V)))))

Water cooled fixed 50 Ω resistor





Field calculations







V))))))

Lorentz Force





Homogeneity







Modeling of mechanical tolerances

variable	distribution
x_1	$G\left(808.8,0.1\right)\mathrm{mm}$
x_2	$G\left(808.8,0.1\right)\mathrm{mm}$
x_3	$G\left(182,0.1 ight)\mathrm{mm}$
x_4	$G\left(182,0.1\right)\mathrm{mm}$
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



NIMA (accepted) doi: 10.1016/j.nima.2017.03.040, arXiv:1612.09235





Probabilistic performance

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







 $\mathbf{V}^{())))))))}$ \mathbf{V}

Sobol indicies



NIMA (accepted) doi: 10.1016/j.nima.2017.03.040, arXiv:1612.09235



Summary

 $\mathbf{Y}^{(1)}$

The waveguide RF Wien filter has been designed for best possible electromagnetic performance under mechanical uncertainty

Timetable

- Finished:
 - Fabrication and circuit realization
 - Mechanical precision measurements
- In progress:
 - Control system
 - Electrical tests and measurements
- Installment
 - April 2017
- Commissioning June/ September and December 2017
- First EDM measurements
 - 2018





Thank you for your attention

slim@ihf.rwth-aachen.de



