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Beam-based alignment at the Cooler Synchrotron (COSY)

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The Jülich Electric Dipole moment Investigations (JEDI) collaboration is performing a measurement of the electric dipole moment (EDM) of charged hadrons in storage rings. To perform this measurement with a high precision, it requires a small systematic error. A large contribution to the systematic error is due to unknown magnetic fields, which are picked up when one is off of the optimal orbit. This effect can be reduced by controlling the orbit to a high precision to a small orbit root mean square (RMS) an thus preventing the pickup of these unknown magnetic fields.

In order to achieve a good orbit RMS in an accelerator, one needs to know the size of the offsets between the beam position monitors (BPMs) and the quadrupoles. These offsets can be determined with the use of the beam-based alignment method, which finds the magnetic center of a quadrupole with respect to the electric center of a BPM. When the offsets between the BPMs and quadrupoles are then known, one can re-calibrate the BPMs to have the zero orbit going through the magnetic centers of the quadrupoles. Thus, one prevents picking up extra magnetic fields, by going through the quadrupoles at a known, central, position instead of being at an off-center position.

The working principle of this method will be explained and the results of the beam-based alignment measurement done at the Cooler Synchrotron (COSY) will be shown.

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