ALIGNMENT SCHEME OF SEXTUPOLE AND MOVER IN THE PRE-ALIGNMENT MP MODULES OF HEPS

L. Wu†, C. H. Li, Z.H.Wang, S.Lu, L.Dong, S.Yang
IHEP, Beijing, China wulei@ihep.ac.cn

Abstract

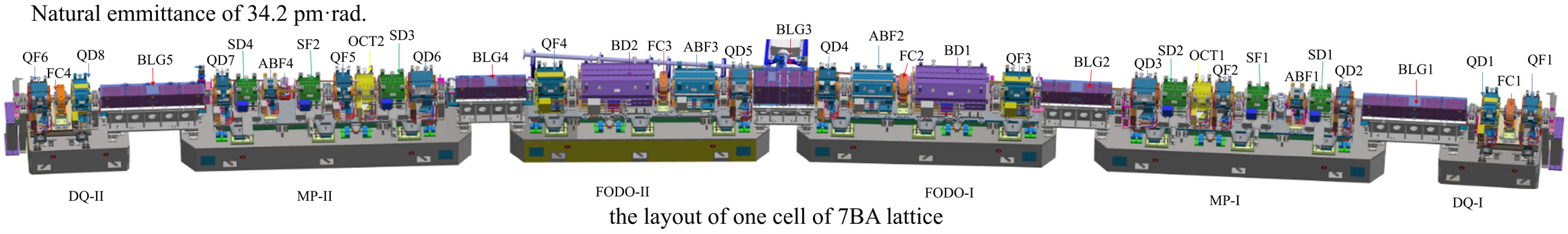
A set of alignment adjustment mechanism is present between each multipole magnet and the girder to fine-tune the magnet's six degrees of freedom position in HEPS st orage ring. All sextupoles are installed on Movers that can be remotely adjusted both transversely and vertically. Due to the Mover's inability to adjust angular orientation, the pre-alignment of the sextupole is different from other multipole magnets in HEPS. This paper introduces the alignment requirements of sextupole and Mover, error an alysis and control measures, as well as the alignment process.

◆**HEPS storage ring:** 48 7BA cells (24 super-periods)

Circumference 1360.4 m

3 types of modules： 2 DQ ; 2 MP ; 2 FODO

Natural emmittance of 34.2 pm·rad.



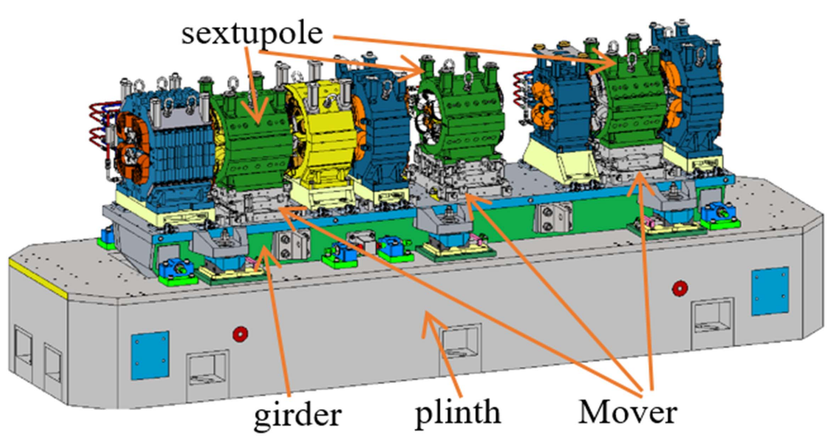
the layout of one cell of 7BA lattice

SEXTUPOLE AND MOVER ALIGNMENT

◆ **Aligment tolerance requirements：**

Parameters	Accuracy
Transversal and Vertical Position Deviation	≤0.03mm
Longitudinal Position Deviation	≤0.1mm
Rotation Deviation Around x/y/z Axes	≤0.1mrad

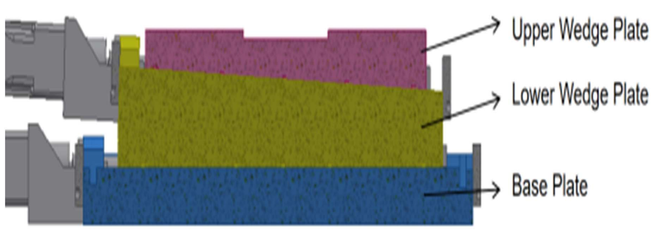
◆ **Sextupole and Mover in MP module:**

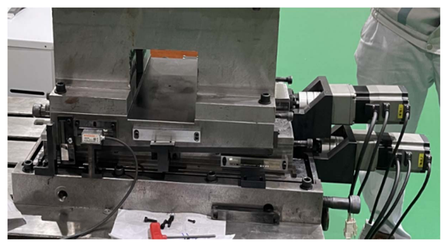


Sextupole and Mover alignment process :

- Confirm that the Mover is in the mid-position of the motion range.
- Adjust the lower axis of the Mover during a large range, measure its parallelism with the magnet's X-axis, and adjust the horizontal adjustment mechanism of the Mover to achieve the predetermined accuracy.
- Locking the Mover (torque of 100N·m), reconfirm the parallelism of motion axis.
- Manually adjust the horizontal position of the sextupole and lock it (torque of 80N·m), measure the vertical deviation of sextupole, and determine the thickness of shims.
- Use a tool to lift the magnet, insert shims, lock the magnet, check for deviations.
- Repeat the previous step until the vertical deviation of the magnet relative to the predetermined value is ≤10μm, and the horizontal position deviation is ≤ 20μm.
- Manually fine-tune the horizontal position of the Mover, and lock the Mover when the horizontal position deviation of the magnet is ≤ 10μm.
- Adjust the lower axis of the mover with a large motion range to reconfirm its parallelism with the sextupole' X-aixs meets the requirements.
- Adjust the vertcial position of Mover to ensure that the deviations in all directions of sextupole are ≤ 10μm, completing the alignment of the sextupole.

◆ **Mover:** Beam Based Alignment； X(transverse)&Y(vetical) adjustment





◆**Key point:**

- ensure meets the tolerence at the initial position Δx/ Δy/ Δz： 30μm →No dynamic error is generated
  θx/ θy/ θz： 0.1mrad →Generate dynamic errors
- maintain the tolerance during the movement

◆**Adjustment deviation** ≤0.015mm； **Variation during locking** ≤ 0.01mm.

◆**Error analysis and control measures**

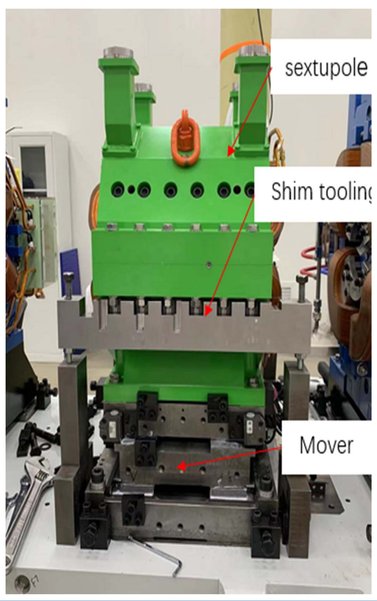
- θx： Error Δz (vertical motion)
  →Flatness of the girder surface & leveling of the girder.
- θy： Error Δz (transverse motion)→Adjusted by manual mechanism of mover .
- θz: Error Δy (transverse motion), error Δx (vertical motion)
  → Flatness of the girder surface& leveling of the girder& Parallelism of the mover motion axis relative to the base.

◆**Alignment scheme：**

- between mover and girder: no shim →machining precision of mover and girder
- between mover and sextupole： shim

√ Only shim sextupole, vertical errors compensated by mover motion to reduce the number of shimming iterations.

√ Relax the horizontal adjustment precision of sextupole and fine-tune the mover.



CONCLUSION

Due to being installed on a remote BBA Mover, the sextupole in the HEPS storage ring has a different alignment scheme in the pre-alignment unit compared to other s torage ring magnets. Through analysis and testing, an alignment scheme for the sextupole and Mover has been identified, balancing alignment adjustment precision and alignment efficiency.