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## Estimation of Magnet Alignment Accuracy for SPring-8 Upgrade using Resonance-Frequency Tracked Vibrating Wire

SPring-8 major upgrade, SPring-8-II, is being designed. The new storage ring requires alignment errors of 25 micro-meters (one standard deviation) or less for multi-pole magnets on a straight line between adjacent two bending magnets. Using a test bench consisted of five multi-pole magnets with typical field gradients, we have demonstrated an alignment of these magnets by introducing a vibrating wire method (VWM) without conventional fiducialization. A systematic error due to a wire sag and kink was dominant in static errors during the alignment procedure. Maximum displacement from the theoretical catenary curve along longitudinal axis was 10 micro-meters for a 3.6 m-long wire with 0.24 mm of sag. The other static errors, for example, a deviation of vibration amplitude, a systematic error caused by background field gradients due to remanent fields, etc., were negligibly small compared with the above displacement. In addition, a long-term drift of the magnetic center caused by a temperature rise of water-cooling magnet and a deformation of the girder was observed. In order to track the drift, we developed a resonance-frequency tracked vibrating wire for a sustainable measurement. Actual accuracy of our alignment procedure including these dynamic errors will be described in this paper.

### Summary

**Author:** Dr FUKAMI, Kenji (JASRI/RIKEN)

**Co-authors:** Dr ZHANG, Chao (JASRI); Dr KIMURA, Hiroaki (JASRI/RIKEN); Mr KIUCHI, Jun (SPring-8 Service Co., Ltd.); Mr AZUMI, Noriyoshi (JASRI/RIKEN); Dr MATSUI, Sakuo (RIKEN); Dr WATANABE, Takahiro (JASRI/RIKEN); Mr KAI, Tomoya (SPring-8 Service Co., Ltd.)

**Presenter:** Dr FUKAMI, Kenji (JASRI/RIKEN)