Observation of Beam Orbit Fluctuation with Forced-Vibrating Magnets and Vacuum Chambers

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Abstract

Fluctuations of the beam orbit have been observed quantitatively when the quadrupole magnets and vacuum chambers are vibrated by external force. The vibration frequency spectra, amplitudes, and phases of each component are measured individually at the same time. The calculated spectra of closed orbit distortions, which were reconstructed from vibration spectra of each component with involving eddy currents in the vacuum chamber, were well agreed quantitatively with those of observed orbit fluctuation. At the frequencies of 1 to 100 Hz, contribution of the vacuum chamber vibration to the beam fluctuation was found to be greater than those of quadrupole magnet vibration at SPring-8. Vertical beam position stabilization at frequencies from 10 to 50 Hz was dramatically improved by reducing vacuum chamber vibration with minimizing the flow rate of its cooling water. These results show that reducing vibration of vacuum chambers, as well as quadrupole magnets, is essential for the stabilization of beam position, or improving effective transverse emittance. It will give us a new guideline of component design for future accelerators.

Keywords: beam stabilization, vibration, beam position, emittance, vacuum chamber

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