Contribution ID: **90** Type: **Poster**

A Study of Beam Alignment Based on Coupling Modes in Third Harmonic Superconducting Cavities at FLASH

An electron beam excites higher order modes (HOMs) when passing through an accelerating cavity. These HOMs may adversely affect the beam quality and in the worst case result in a beam-break-up instability. It is therefore important to ensure these HOMs are well-suppressed and their effect on the beam is minimized by aligning the beam to the electrical axis of the cavity. Compared to the TESLA 1.3 GHz cavities, HOMs generated in third harmonic cavities are significantly larger, therefore their impact on the beam need to be carefully minimized. Moreover, modes which have strong couplings to the beam propagate through the whole cryo-module containing four third harmonic cavities. Results are presented on the first analysis of beam alignment by minimizing the power of the strong coupling modes in the third harmonic cavity module at FLASH. A single electron bunch per RF pulse is used.

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