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LLRF and Beam Dynamics estimates for a strawman EIC design with operational implications including Crab Cavity systems JOHN FOX, Stanford Univ, THEMIS MASTORIDIS, California Polytechnic University, ROBERT RIMMER, Jefferson Lab — The proposed US Electron-Ion collider will be very challenging in areas of LLRF, RF and beam longitudinal dynamics. Because of the dissimilarity of the electron and ion rings, the RF transients created by the clearing gaps in the current distributions will be very different in the two rings. These transients shift the synchronous phase of the beams as a function of RF bucket position, can impact the luminosity through shifts in longitudinal position of the IP, will require management of the required RF power, and will affect the performance of the RF and LLRF control loops. A machine design that uses superconducting crab cavities will also have sensitivity to gap transient and synchronous phase variations along the filled buckets in a turn with variations in crab cavity voltage seen by each bunch. This makes the problem of managing the effects of the gap transients crucial to the operation of the EIC. This talk presents methods to study the dynamics of the RF and LLRF systems for a strawman EIC machine design example. Methods are shown to estimate the RF gap transients as well as possible remedies to match the gap transients in the two dissimilar EIC rings. This work estimates the RF power required, gap transients and longitudinal coupled-bunch instabilities due to the baseline cavity fundamental impedance. The talk motivates the importance of tools and methods to estimate these effects as part of the early design phase of the Electron-Ion collider projects.

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