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Synchronizing the timing of the electron and Hadron storage rings in the Electron-Ion Collider

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The Electron-Ion Collider has an electron storage ring (ESR) and a hadron storage ring (HSR) with beams traveling in opposite directions that collide initially at one but eventually at two interaction points. Our desired machine configurations require a wide range of energies for both rings: 5 to 18 GeV in the ESR, and 41 to 275 GeV/u in the HSR. The range of velocities in the HSR requires that we have a radial position in the arcs which depends on energy for energies from 100 to 275 GeV/u, and that we use a separate arc for a 41 GeV/u beam. We describe the requirements placed on our design to ensure synchronization for all these energies. When there are two detectors, the large beam-beam forces will not support having bunches colliding at both detectors simultaneously, so the design must ensure that bunches collide at only one IP. We describe the constraints this places upon our machine design and the bunch patterns that we use. We discuss the impacts on the timing of orbit manipulations that we expect to make in the ESR: the superbends that increase the radiation at 5 GeV and orbit shifts to adjust damping partition numbers.

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Footnotes

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