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Strong Hadron Cooling for the Electron Ion Collider

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The anticipated peak and average luminosity of $L = 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ of the Electron Ion Collider can be achieved with strong cooling of the hadron beam, as the emittance of the very bright beams is subject to rapid growth due to Intrabeam Scattering. The techniques which are envisioned to be applied and to stabilize the beam emittance range from bunched beam stochastic cooling, bunched beam electron cooling to coherent electron cooling which is the extension of stochastic cooling to much larger bandwidth. There are also alternatives such as frequent replacement of the hadron beams enabled by an on-energy hadron injector which provide the required luminosity without strong hadron cooling. The techniques are described and discussed and the achievable peak and average luminosity for the full range of center of mass energies is discussed.

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