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Photoinjector RF Cavity Design for High Power CW FEL

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The project is under way to develop a key enabling technology for high-power CW FEL: an RF photoinjector capable of producing continuous average current greater than 100 mA. The specific aim is a 700 MHz pi-mode, normal-conducting RF photoinjector, 3 nC of bunch charge, 100 mA of current (at 33.3-MHz bunch repetition rate) and emittance less than 10 mm-mrad. This level of performance will enable robust 100-kW-class FEL operation with electron beam energy <100 MeV, thereby reducing the size and cost of the FEL. This design is scalable to the MW power level by increasing the electron bunch repetition rate from 33.3 MHz to a higher value. The major challenges are emittance control and high heat flux within the CW 700-MHz RF cavities. Results of RF cavity design and cooling schemes are presented, including both high-velocity water and liquid-nitrogen cooling options.

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