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Detuning and strength optimization of an 1.3 GHz 7-cell SRF cavity for high current application

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To meet the growing demand for higher average power in Free Electron Laser (FEL), Energy Recovery Linac (ERL) technology, supported by superconducting radio frequency (SRF) cavities, offers significant performance and efficiency advantages. Shanghai Synchrotron Radiation Facility (SSRF) has initiated a project focused on the design of a 1 GeV ERL with an average beam current of 10 mA. This study presents the design and performance evaluation of an 1.3 GHz 7-cell main accelerating cavity, which is a core part of the system. Based on the completed RF design and optimization, structural analysis was carried out to assess the cavity' s mechanical strength, helium pressure sensitivity, Lorentz force detuning, and modal behavior. As part of the mechanical design, simulation-based parameter sweeps were conducted on the stiffening ring radius to optimize its design, aiming to enhance the cavity's mechanical performance and frequency variation stability. These comprehensive optimizations enhance the overall capabilities of the cavity.

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Footnotes

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