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Thermal Performance of a 50 kW Minichannel Beam Dump at FRIB

Wednesday 13 August 2025 16:00 (2 hours)

The Facility for Rare Isotope Beams (FRIB) produces high-intensity, high-purity rare isotope beams through interactions between a primary beam and a graphite production target, currently operating at approximately 20 kW of primary beam power. To absorb unreacted primary beams downstream of the production target, an intermediate beam dump, called the minichannel beam dump (MCBD), was developed and implemented. The MCBD features a static structure tilted at 6°, which reduces the surface power density by a factor of 10. It is fabricated as a bimetallic assembly with a high-thermal-conductivity copper alloy absorber and aluminum alloy cooling channels (2 mm wide × 7 mm high) to mitigate oxidation and enhance heat removal. The system's thermal performance was experimentally validated using a 17 keV electron beam, with measured surface temperatures agreeing with CFD simulations within 10%, confirming its reliability for higher-power operation. The current system is thermally limited by the temperatures at the absorber and wing surfaces. To enable operation at 50 kW, geometric optimization was performed by adjusting the surface angle across the entire structure to more effectively distribute heat on the copper absorber and reduce the thermal load on the aluminum wings. This work presents both thermal validation and simulation results demonstrating enhanced cooling performance with the optimized MCBD design for 50 kW beam operations at FRIB.

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Yes

Would you like to submit this poster in student poster session on Sunday (August 10th)

No

Footnotes

Funding Agency

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Yes

Author: SONG, Jeongseog (Facility for Rare Isotope Beams)

Co-authors: Mr BULTMAN, Nathan (Facility for Rare Isotope Beams); Mr REAUME, Marc (Facility for Rare Isotope Beams); QUISPE-ABAD, Raul (Facility for Rare Isotope Beams); PATIL, Mohit (Facility for Rare Isotope Beams); LEE, Geunhyeong (Facility for Rare Isotope Beams); MILLER, Samuel (Facility for Rare Isotope Beams); KANEMURA, Takuji (Facility for Rare Isotope Beams); WEI, Jie (Facility for Rare Isotope Beams)

Presenter: SONG, Jeongseog (Facility for Rare Isotope Beams)

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