Contribution ID: **372** Contribution code: **TUPB053** Type: **Poster Presentation**

Design of 200 mA superconducting linear electron accelerator

Tuesday 27 August 2024 16:00 (2 hours)

Electron accelerators utilized for radiation processing demand high beam currents and power outputs to maximize processing rate. Compared to conventional room-temperature accelerators, superconducting linear accelerators offer the capability to accelerate high-intensity continuous-wave (CW) electron beams. Therefore, the Design of a compact, 200mA, 2-5MeV CW superconducting linear accelerator holds promising potential for broad industrial applications. The Institute of Modern Physics (IMP) has recently completed operational testing on a conduction-cooled 5-cell-βopt=0.82 Nb3Sn superconducting cavity, thereby demonstrating the technical feasibility of miniaturizing superconducting accelerators. However, beam losses within the superconducting cavity, caused by factors such as mismatch between the inlet beam velocity and the cavity's optimal beta value, are impermissible. This paper addresses these challenges by methodically optimizing the beam line, ensuring 100% transmission within the superconducting cavity while maintaining compactness. The detailed beam dynamic design and the multi-particle simulation results were presented in this paper.

Footnotes

Funding Agency

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Session Classification: Tuesday Poster Session

Track Classification: MC2: Electron Accelerators and Applications: MC2.2 Electron linac projects