Contribution ID: **462** Contribution code: **TUP010** Type: **Poster Presentation**

A Self-Consistent Simulation Study of Halo Formation in the PIP-II Linac Driven by Nonlinear Space Charge and RF Field Effects

Tuesday 12 August 2025 16:00 (2 hours)

We present a study of halo formation mechanisms in the high-power PIP-II SRF linac, combining analytical modeling with self-consistent 3D Particle-In-Cell (PIC) simulations. Focusing on the low-energy front-end and transitions between SRF cavity families, we use PIC simulations with realistic 3D field maps to analyze the evolution of the beam distribution. Our results demonstrate that nonlinear space-charge forces, particularly in the presence of initial beam mismatch and non-axisymmetric RF field components, are the dominant drivers of halo development. We show that the halo structure predicted by our simulations deviates significantly from the predictions of simplified particle-core models. Our analytical work, supported by the simulations, identifies the complex resonant interactions responsible for transporting particles to large amplitudes, which are not captured by standard treatments. These findings are crucial for accurately defining the machine aperture and informing the beam loss budget for the machine protection system and devising techniques to avoid beam loss during commissioning and operation.

Please consider my poster for contributed oral presentation

Yes

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

No

Footnotes

Funding Agency

Fermi Forward Discovery Group

I have read and accept the Privacy Policy Statement

Yes

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Session Classification: TUP: Tuesday Poster Session

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