Contribution ID: **154** Contribution code: **WEP086** Type: **Poster Presentation**

The Pulsed Ion Reflex Klystron: A New Accelerator for High Efficiency Voltage Conversion

Wednesday 13 August 2025 16:00 (2 hours)

Beam Alpha developed a kilowatt-scale fusion microreactor that directly converts nuclear energy to electrical energy without intermediate heat steps. This device has an output of 1.6 million volts DC. A converter is needed to transform this potential energy into useful electrical power. To achieve this the “Pulsed Ion Reflex Klystron” has been developed. The PIRK aims to achieve high conversion efficiencies by directing negatively charged ions through a re-entrant resonant cavity hundreds of times to gradually transfer energy from the moving particles to said cavity. Ions will be released into a 6-meter linear accelerator with roughly 1000 precisely spaced electrodes forming a quasi-parabolic potential. This potential is symmetric about the midpoint of the tube causing ions to oscillate with a frequency of approximately 1 MHz independent of energy. Perturbations to this parabolic potential are designed to provide radial electrostatic beam focusing. An algorithm is devised to produce optimal voltage curves to maximize both longitudinal bunching and radial confinement, and these curves are examined against practically realizable potentials. Energy is coupled out of the resonant cavity using a loop antenna connected to a silicon carbide rectifying diode. This converts the RF in the cavity to a 400V intermediate DC bus that can easily be inverted to wall power.

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Yes

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

Yes

Footnotes

Funding Agency

I have read and accept the Privacy Policy Statement

Yes

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Session Classification: WEP: Wednesday Poster Session

Track Classification: MC7 –Accelerator Technology and Sustainability