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Design of Pelletron accelerator using novel accelerating tube without gap insulators

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A novel modular electrostatic accelerating tube, *free from gap insulators, is designed that addresses the limitations of traditional metal-insulator bonded accelerating tubes**, which are costly and prone to damage from high-voltage discharges and beam impacts. This design uses ultra-high vacuum (UHV) as the insulator, with electrodes placed in series under vacuum. High voltage is coupled longitudinally to the first cylindrical electrode via a ceramic-bonded stainless steel flange, with homogeneous electric field flatness of 0.001. Electrostatic analysis using COMSOL Multiphysics and TRAVEL code confirms the field homogeneity and smooth beam acceleration, respectively. Designed for 75 kV operation, extendable to q×100keV energy gains, it leverages vacuum-compatible resistors for inter-electrode HV coupling. Field flatness is extendable to few meters of length and thus enabling megavolts. Beam optics and electrical specifications for Pelletron accelerators using these tubes supports practical feasibility. The grounded cylindrical structure ensures safety and offers an economical, scalable design for small low-energy implanters, Pelletron accelerators, and mass spectrometers.

Footnotes

*R. Hellborg, Electrostatic Accelerators (Springer, 2005)**S. Kumar and A. Mandal, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 814, 73 (2016).

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