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A compact linear accelerator coaxially integrated with a high-power microwave source

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Particle accelerators have long been instrumental in advancing scientific research, medical treatments, and industrial processes. However, traditional radio-frequency accelerators are encumbered by their size, expense, and reliance on external microwave sources.

In this paper, we propose a novel linear accelerator concept that integrates a high-power microwave source directly into the accelerator, which eliminates the need for external microwave drivers, resulting in a more compact, cost-effective, and simplified system.

We designed an X-band backward wave oscillator driven by a hollow continuous electron beam of 50 keV, the high-power microwave generated from which is then input to a centrally positioned X-band standing-wave acceleration structure via a radial coupler. The witness beam, traversing the acceleration structure, can be accelerated from 50 keV to higher than 4 MeV through 10 acceleration cells.

This scheme serves as a fundamental exploration of the possibilities of integrated accelerator designs, paving the way for further innovations in the field of more efficient, scalable and versatile accelerator systems.

Footnotes

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