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Bubble-beam accelerators: breaking the paradigm

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Most particle accelerators utilize beams with a charge density concentrated in the center of the bunch in real 3-dimensional space and the 6-dimensional phase space. In this work, by enhancing the space-charge forces in the photo-cathode injector of the Compact Linear Electron Accelerator for Research (CLEAR) at CERN, we produce electron bunches with a “bubble-like” shape, with a charge density mostly concentrated on the outside shell. We demonstrate that the dynamics of such beams can be tailored to achieve stable uniformity in the coordinate and momentum transverse planes simultaneously. This would allow reaching a uniform dose distribution without a severe loss of particles which is of the great interest in the irradiation community. Additionally, we investigate the potential benefits of bubble-beams across several accelerator pillars: for driving light sources, for advanced acceleration technologies, and for particle colliders.

Footnotes

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Europe

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