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Development of a segmented capillary for inner plasma density control and high repetition rate plasma generation in Wakefield acceleration experiments

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Among the advanced approaches in Laser Wakefield Acceleration (LWFA), the use of tapered plasma density and extended acceleration lengths—demonstrated through gas jet experiments—has proven effective for generating high-energy beams. However, gas jet sources often fail to ensure stable beam quality and high repetition rates, limiting their applicability. Addressing these limitations within capillary sources could provide a more robust solution.

We propose a segmented capillary source to overcome the limitations of traditional designs. Modularized by function, this design achieves tapered plasma density through CFD-based structural optimization and enables high repetition-rate operation via a differential pumping module. Experimental results validate its effectiveness, highlighting its potential for advanced plasma acceleration applications.

Footnotes

Paper preparation format

Region represented

Asia

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