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High Repetition Rate Laser Wakefield Acceleration

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Today, many LWFA experiments rely on targets, which operate with short bursts of gas to reduce gas load within the vacuum system to a minimum. However, even in burst mode it requires considerable time to reduce the pressure in the vacuum system to a level low enough for the next laser shot, which is one of the most limiting factors in electron repetition rate. Here, we show a design, which is implemented at the LUX beamline for plasma-driven undulator radiation. It allows for continuous flow operation of a capillary-type target. The system enables electron repetition rates, which are only limited by the repetition rate of the driver laser. Continuous flow operation minimizes pressure fluctuations inside the target and eliminates timing jitter issues between laser pulse and target gas bursts. Our concept features a differential pumping setup, specially designed for laser applications, and allows for direct online pressure measurement at the target inlets, which yields absolutely calibrated values.

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