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Acceleration of stable, low-divergence proton beams from novel liquid sheet targets

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Despite the huge potential of laser-driven proton acceleration to provide compact sources of MeV proton beams suitable for a variety of applications, several factors hamper their wider adoption including: the challenges associated with operating these accelerators at high-repetition rate; low shot-to-shot stability; and large beam divergence which leads to rapidly decreasing proton flux with distance from the source. Recent experiments at the GEMINI TA2 laser facility (200 mJ, 10 TW, 5 Hz) have demonstrated the acceleration of high-stability, low-divergence proton beams with high-flux and MeV energies using a sub- micron thickness water-sheet target developed at SLAC National Accelerator Laboratory. Here, we will report on the experimental results and supporting PIC simulations which highlight the important role of the water vapour on collimation of the proton beam. The measured proton beams are already suitable for applications requiring high proton flux and the platform can be easily extended to kHz repetition rates extending the utility of the source to a wide range of applications in radiobiology, materials science and fundamental physics.

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