Guided re-acceleration of high-energy protons by helical coil targets

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Proton accelerators are in significant demand due to their widespread societal applications, for instance clinical cancer therapy, as the protons target deep-seated tumours with negligible damage to the surrounding healthy tissues. High capital and operational costs associated with conventional accelerators make proton therapy less accessible, which triggered the interest in the search for affordable alternatives. In this context, proton acceleration employing high-power lasers has recently emerged as a promising alternative to conventional techniques. In addition to the compactness and cost-effectiveness, the laser-driven sources deliver high doses in an extremely short burst, offering a unique perspective for radiobiological studies. The key challenge, however, is to overcome the broad energy spread and large divergence of the laser-driven proton beams. Herein, we present recent results on controlling these shortcomings by employing helical coil targets and potential solutions which enable the operation of these targets at a high repetition rate.