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Laser-seeded modulation instability within LHC proton beams CARL SIEMON, VLADIMIR KHUDIK, GENNADY SHVETS, University of Texas at Austin — A new method for seeding the modulation instability (MI) within an SPS-LHC proton beam using a laser pulse is presented. Using simulations, we show that a laser pulse placed ahead of a proton beam excites axially symmetric self-modulation modes within the proton beam and leads to peak accelerating fields that are comparable to previously proposed seeding methods. We then demonstrate that a plasma density ramp placed in the early stages of the laser-seeded MI leads to stabilization and sustained accelerating electric fields (of order several hundred MeV/m) over long propagation distances (_ 100 - 1000 meters). To directly compare the efficiencies of the laser and other seeding methods, simulation results for two scenarios are discussed: a) a laser is placed in the "center" of an infinitely long proton beam; b) the same proton beam is cut at the center (no laser pulse). Analytics are presented that determine the behavior of the strongly coupled, long beam regime for each of these cases.

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