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GeV Electrons due to a Transition from Laser Wakefield Acceleration to Plasma Wakefield Acceleration M.Z. MO, Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Canada, P.-E. MASSON-LABORDE, CEA DAM DIF, A. ALI, Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Canada, S. FOURMAUX, P. LASSONDE, J.-C. KIEFFER, INRS-EMT, Université du Québec, Varennes, Canada, W. ROZMUS, Theoretical Physics Institute, University of Alberta, Edmonton, Canada, D. TEYCHENNÉ, CEA, DAM, DIF, R. FEDOSEJEVS, Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Canada — The Laser Wakefield Acceleration (LWFA) experiments performed with the 200 TW laser system located at the Canadian Advanced Laser Light Source facility at INRS, Varennes (Québec) observed at relatively high plasma densities (1x10^{19}cm^{-3}) electron bunches of GeV energy gain, more than double of the predicted energy using Lu's scaling law. This energy boost phenomena can be attributed to a transition from LWFA regime to a plasma wakefield acceleration (PWFA) regime. In the first stage, the acceleration mechanism is dominated by the bubble created by the laser in the regime of LWFA, leading to an injection of a large number of electrons. After propagation beyond the depletion length, where the laser pulse is depleted and it can no longer sustain the bubble anymore, the dense bunch of high energy electrons propagating inside the bubble will drive its own wakefield in the PWFA regime that can trap and accelerate a secondary population of electrons up to the GeV level. 3D particle-in-cell simulations support this analysis, and confirm the scenario.

Paul-Edouard Masson-Laborde
CEA, DAM, DIF

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