Effect of plasma-wave topology on enabling high precision HEP using a plasma-based collider

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In this work we for the first time unravel the constraints on the topology of a plasma-wave underlying the acceleration stages of the plasma-based accelerator [1] for enabling high-precision exploration of high- energy physics within and beyond the Standard model at the interaction point of a future plasma-based collider [2][3]. Using analytical theory and 3D PIC simulations we present a significant variation of the electromagnetic fields of a plasma wave depending upon its geometry in comparison to the well- established models presently used in plasma collider designs [2][3]. We show that the plasma wave geometry affects the ability of a linear collider design [4] to address the symmetry violations that are maximally violated in the Standard Model, at the collider interaction point. We show using a 3D PIC simulation based scaling law that the parameters of the plasma wave geometry play a critical role in enabling high-precision HEP, vital for availing beams that would allow such precision at the interaction point of a future plasma collider

References

[1] W. Lu, et. al., A nonlinear theory for multidimensional relativistic plasma wave wakefields, Physics of Plasmas 13, 056709 (2006); doi: 10.1063/1.2203364
[2] A. Seryi, M. Hogan, S. Pei, T. Raubenheimer, P. Tenenbaum, T. Katsouleas, C.K. Huang, C. Joshi, W. B. Mori, P. Muggli, A concept of plasma wakefield acceleration linear collider (PWFA-LC), WE6PFP081, Proceedings of PAC09, Vancouver, BC, Canada
[3] E. Adli, et. al., A Beam Driven Plasma-Wakefield Linear Collider: From Higgs Factory to Multi- TeV, SLAC-PUB-15426, arXiv:1308.1145
[4] The International Linear Collider Technical Design Report, Volume 2: Physics ILC-REPORT-2013-040, arXiv:1306.6352