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Employing double-achromat bunch compressors for plasma-wakefield accelerator experiments

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Plasma-wakefield acceleration is a promising technique for future accelerators in that it can deliver significantly higher (factor of ~100-1000) accelerating fields compared to conventional RF accelerators, and also be used to generate beams of ultralow (⊠0.1 mm mrad) normalized emittance. However, many challenges remain to be overcome, one of which is the hose instability, where a witness bunch (in the case of external injection) or part of the driver bunch is offset transversely from the propagation axis. This can lead to severe beam degradation and –loss, particularly for tightly focused beams of low emittance. In the past few years, much progress has been made to understand the mechanisms of this instability and to mitigate its effects, but the most obvious way to circumvent the whole ordeal is to remove the offsets altogether. We have studied the use of double-achromat bunch compressors, within the setting of the MAX IV linear accelerator, to remove transverse offsets stemming from leaking higher-order dispersion and coherent synchrotron radiation, for the specific use in plasma-wakefield acceleration.

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