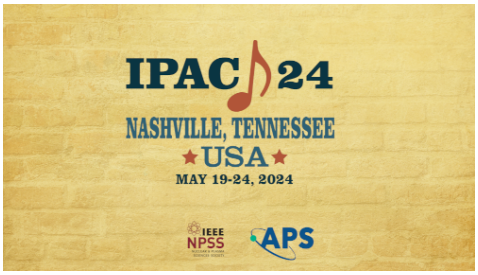

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Staging of high-efficiency and high-quality laser-plasma accelerators for collider applications

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The viability of next generation, compact, TeV-class electron-positron colliders based on staging of independently-powered plasma-based accelerators relies on the possibility of accelerating high-charge bunches to high energy with high efficiency and high accelerating gradient, while maintaining a small energy spread and emittance. Achieving a small energy spread with high-efficiency requires employing witness bunches with optimally tailored current profiles (optimal beamloading). Such profiles are analytically known in the case of plasma-wakefield accelerators operating in the blowout regime, while in the case of laser-plasma accelerators (LPAs) can only by computed numerically, and their determination requires, among other things, taking into account the laser driver evolution. A small bunch energy spread is a necessary condition to enable staging and minimize emittance degradation from chromaticity when bunches are transported from one plasma accelerator stage to the following one. In this contribution we will discuss examples of LPA stages operating in different regimes, namely a self-guided stage in the nonlinear regime and a quasi-linear stage in a hollow plasma channel, providing high-gradient, high-efficiency, and quality-preserving acceleration of bunches for collider applications. We will present, for each example, the current profile distribution for optimal beamloading, and we will analyze bunch emittance degradation when staging of such LPAs is considered.

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