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Matching and guiding of an laser plasma accelerated electron beam in a undulator with FODO lattice

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Compact free electron laser (FEL) technology enabled by plasma-based accelerators is rapidly maturing with several milestone demonstrations in the last 2-3 years. Still, critical work is needed to bridge the gap from proof of concept experiments to reliable operation of plasma-based FELs. At the BELLA Center, we have a laser plasma accelerator (LPA) beamline equipped with an electron beam transport section that culminates in a 4m long, strong focusing undulator. This undulator system with 16 embedded FODO cells, represents a comparable proxy to many undulator systems used at XFEL beamlines. Notably, the presence of distributed focusing imposes tight requirements on both transverse matching and alignment of the beam through the undulator in order to enable FEL lasing. Recent efforts have demonstrated quasi matched propagation of the LPA beam in the undulator. Additionally, through control of the launch trajectory into the undulator coherent enhancement of the undulator radiation can be triggered, a strong indication of FEL gain. Recent results and future plans are discussed.

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