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Developing a reliable test bed for laser plasma accelerator driven compact light sources

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The Hundred Terawatt Undulator (HTU) beamline at the BELLA Center is being used as a test bed for the development of compact laser plasma accelerator (LPA)-driven light sources, with a particular focus on developing a reliable LPA-driven FEL. While LPA technology is well established, hurdles remain to make it usable for practical light source applications. Stability and reliability are primary concerns. The laser plasma interaction that results in the trapping and accelerating of electrons involves various nonlinear physical processes making it sensitive to subtle variations. Furthermore, there is a basic requirement that the transverse jitter of an electron beam in an undulator should be a small fraction of its transverse beam size for an efficient FEL. This requirement imposes an onerous condition on the transverse stability of the high power lasers used to generate the electron beams.

I will discuss recent efforts undertaken at the BELLA Center to address some of these challenges. In particular, I will focus on recent results that demonstrated substantial improvement in the transverse stability of LPA generated electron beams as well as ongoing efforts to make stability improvements to our laser system that will improve shot-to-shot variation in e-beam charge. Progress on LPA-driven FEL lasing using the 4m VISA undulator will be also be presented.

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