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New capabilities of the iP2 beamline for laser-solid interaction studies at the BELLA PW facility

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The newly commissioned short focal length, high intensity beamline, named iP2, at the BELLA Center enables frontier experiments in high energy density science. This 1 Hz system provides a focused beam profile of <3 micron in FWHM, resulting in an on-target peak intensity greater than $5e21$ W/cm², and a pointing fluctuation on the order of 1 micron. A temporal contrast ratio of $<1e-14$ on the nanosecond timescale is expected with the addition of an on-demand double plasma mirror setup in the near future. This beamline is well suited for studies requiring ultra-high intensity and substantial control over the temporal contrast, such as investigation of novel regimes of advanced ion acceleration and their applications. The recent results from iP2 commissioning experiments will be presented as well as the outlook for in vivo radiobiological studies at ultra-high dose rates. In preparation for an experimental campaign to investigate the magnetic vortex acceleration regime, a series of 3D simulations using the WarpX code were performed to optimize the target design and guide the development of diagnostics. We studied the acceleration performance with different laser temporal contrast conditions at normal and oblique laser incidence angles. The simulation results will be presented along with an overview of the planned experimental setup at iP2.

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Primary authors: HAKIMI, Sahel (Lawrence Berkeley National Laboratory); Dr OBST-HUEBL, Lieselotte (Lawrence Berkeley National Laboratory); Dr NAKAMURA, Kei (Lawrence Berkeley National Laboratory); HUEBL, Axel (Lawrence Berkeley National Laboratory); BULANOV, Stepan (Lawrence Berkeley National Laboratory); JEWELL, Anya (Lawrence Berkeley National Laboratory); DE CHANT, Jared (Michigan State University); Dr SNIJDERS, Antoine (Lawrence Berkeley National Laboratory); TOTH, Csaba (Lawrence Berkeley National Laboratory); GON-SALVES, Anthony (Lawrence Berkeley National Laboratory); SCHROEDER, Carl (Lawrence Berkeley National Laboratory); VAN TILBORG, Jeroen (Lawrence Berkeley National Laboratory); VAY, Jean-Luc (Lawrence Berkeley National Laboratory); Dr ESAREY, Eric (Lawrence Berkeley National Laboratory); GEDDES, Cameron (Lawrence Berkeley National Laboratory)

Presenter: HAKIMI, Sahel (Lawrence Berkeley National Laboratory)

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