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# The BELLA PW iP2&2BL Upgrades – Radiation and Laser Safety considerations and implementations for safe and efficient user experiments

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After a decade-long successful operations [1] and producing new results in the field of Laser Plasma Acceleration (LPA) research [2-4] by the Berkeley Lab Laser Accelerator (BELLA), the PW laser system's recent upgrades were completed in 2022. The first is the "Second Beamline" (PW-2BL), where the fully amplified, stretched pulses are split before compression, enabling two independently adjustable laser pulses to interact with a variety of target arrangements in one target chamber with up to ~40 J total energy. The new BELLA PW 2BL provides the opportunity to conduct the next generation of LPA experiments, such as staging, laser-driven waveguides for increased electron energy, and positron acceleration. The other upgrade is labeled as "Interaction Point #2" (PW-iP2) [5], in which the already compressed PW laser pulses of the original beamline are transported (via a 1:1 reflective telescope using two long focal length OAPs) to a new target chamber allowing a short focal length (0.5 m) arrangement resulting in a small focal spot in the order of ~ 3 um and high laser intensity of >5×10^21 W/cm^2.
An overview of the special considerations, planning and implementation processes related to radiation shielding, laser and radiation interlock systems required for the safe and efficient operation of the new BELLA PW beamlines and conduction of the planned experiments will be presented. Specific topics include: analysis of hazards, development of appropriate hazard mitigation strategies, design details of new shielding components, radiation field monitoring, and interlocked radiation detector and laser beam shutter systems, conditions for high power operations – all matched to the expected particle beam parameters in new experiments.
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[1] K. Nakamura et al., IEEE J. QE 53, 1200121 (2017).
[2] W.P. Leemans et al., Phys. Rev. Letters 113, 245002 (2014).
[3] A.J. Gonsalves et al., Phys. Rev. Letters 122, 84801 (2019).
[4] S. Steinke et al., PRAB 23, 021302 (2020).
[5] S. Hakimi et al., Phys. Plasmas 29, 083102 (2022).

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**Primary authors:** TOTH, Csaba (Lawrence Berkeley National Laboratory); Dr GONSALVES, Anthony (Lawrence Berkeley National Laboratory); Dr NAKAMURA, Kei (Lawrence Berkeley National Lab); Dr OBST-HUEBL, Lieselotte (Lawrence Berkeley National Lab); TURNER, Marlene (LBNL); PICKSLEY, Alexander (LBNL); HAKIMI, Sahel (Lawrence Berkeley National Laboratory); STACKHOUSE, Joshua (UC Berkeley); HARVEY, Zachary (Lawrence Berkeley National Laboratory); TONCHEVA, Greta (Lawrence Berkeley National Laboratory); Dr TILBORG, Jeroen

van (Lawrence Berkeley National Laboratory); Dr SCHROEDER, Carl (Lawrence Berkeley National Laboratory); Dr GEDDES, Cameron (Lawrence Berkeley National Laboratory); Dr ESAREY, Eric (Lawrence Berkeley National Laboratory)

**Presenter:** TOTH, Csaba (Lawrence Berkeley National Laboratory)

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