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Initial design of a beamline for ultra-intense laser-matter interactions at the BELLA-i PW laser user facility

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BELLA, the Berkeley Lab laser accelerator center hosts a 1 PW Ti:sapp laser with 1 Hz repetition rate, where electron acceleration to 4.5 GeV was demonstrated recently [1]. For electron acceleration, irradiances of up to 1019 W/cm2 are desired and these are implemented with a long focal length laser beamline and beam spots of w0=52mm. Much higher irradiances of 1022 W/cm2 can be achieved when the laser beam is focus more tightly, to a spot of w0<5 mm in a shorter focal length beamline. A key requirement for many application of laser-matter interaction in this regime, such as laser-ion acceleration or the generation of relativistic surface high harmonics is the ultra-high intensity contrast of the laser pulse.
We will describe our design for a short focal lengths beamline, BELLA-i, including multiple plasma mirrors for ultra-high contrast in the laser pulse. The resulting laser pulses will enable reliable access to many exciting aspects of high energy density laboratory physics and laser-matter interactions in the relativistic regime for a community of users.

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