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Precise intensity tagging for ultrashort high-power lasers

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The LUXE (Laser Und XFEL Experiment) project at DESY Hamburg aims to measure processes in the strong-field quantum electrodynamics regime with high precision by colliding electrons or a high-energy photon beam with a high-power, tightly focused laser beam at a repetition rate of 1Hz. Simulations [LUXE CDR, arXiv:2102.02032 [hep-ex]] predict that the probability of pair production responds highly non-linearly to the laser strength parameter. Consequently, small variations in the laser intensity lead to significant variations in the experimental observables. The required precision will be achieved by intensity tagging through precise measurements on the relative variation of intensity on a shot-by-shot basis, with an ultimate aim to monitor the shot-to-shot fluctuations with a precision below 1%. We present the results of a non-linear intensity tagging method, which provides a measure of the laser intensity by comparing the fundamental to a non-linear copy of the laser focal spot from a thin non-linear crystal. This method provides a reference to crosscheck the intensity fluctuations derived from independent measurements of energy, duration and fluence.

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