High Dynamic Third-Order Cross-Correlator for measuring >10^{13}:1 laser contrast

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In the last decade, the development of lasers has allowed to reach peak power of several Petawatt (10^{15} W) [1]. With such peak powers, it has become crucial to know the temporal structure of the laser pulse, especially in the field of light-matter interactions at extreme intensities. We will present the performances of a high dynamic (>13 orders of magnitude) third-order cross-correlator. We believe that this new cross-correlator is suitable for measuring the contrast of current high peak power laser systems but also for future coherent sources based on Optical Parametric Amplification (OPA) which opens the way to even higher pulse contrast [2].

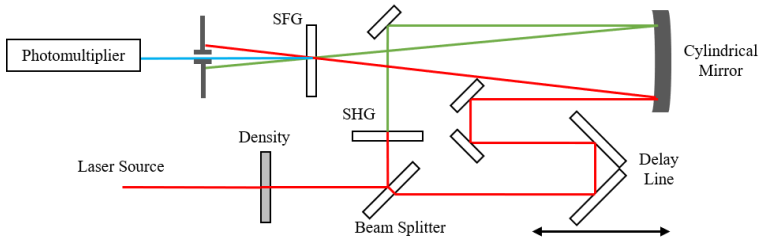

Figure 1. Layout of the high dynamic third-order cross-correlator

Our cross-correlator is based on a temporal scan between a reference beam from a Second Harmonic Generation (SHG) and the fundamental input beam (see Figure 1). Both are used to have a non-collinear focusing geometry to increase the signal-to-noise ratio of the Sum Frequency Generation (SFG) beam. The latter is further filtered out using a slit and detected by a photomultiplier sensitive to 266 nm light. This new cross-correlator has been carefully designed to be free of replicas over a scanning range of 3.2 ns.

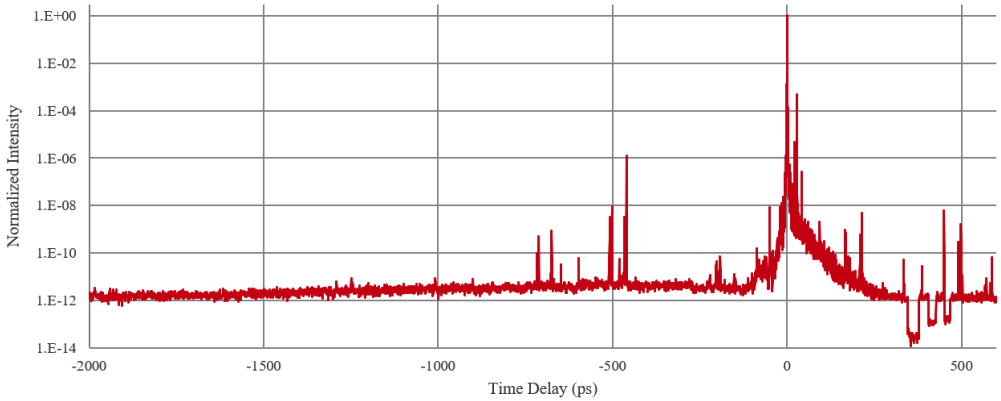

Figure 2. Typical contrast measurement with our high dynamic third-order cross-correlator

A measurement performed on a Ti:Sa CPA system with a pulse contrast of >10^{11} is presented in Figure 2 along with the dynamic of our cross-correlator (>10^{13}). Current development is being focused on increasing the dynamic range and reducing the parasitic optical noise in our cross-correlator.

1. U. Schramm et al., "First results with the novel petawatt laser acceleration facility in Dresden," *Journal of Physics: Conf. Series*, **874** (2017) 012028, doi:10.1088/1742-6596/874/1/012028.
2. A. Kessel et al., "Broadband Picosecond-Pumped OPCPA Delivering 5 TW, Sub-7 fs Pulses with Excellent Temporal Contrast," in *2017 European Conference on Lasers and Electro-Optics and European Quantum Electronics Conference*, (Optical Society of America, 2017), paper CG_P_5, ISBN: 978-1-5090-6736-7