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Group delay dispersion measurements using the i²PIE pulse characterization technique

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Group delay dispersion (GDD) plays an important role in the creation and control of ultrashort pulses. As ultrashort pulses travel through dispersive media, the different frequency components travel at different speeds, increasing the pulse duration due to broadening of the pulse temporal profile. To create transform limited pulses (pulses that are as short as allowed by the available bandwidth), there needs to be a flat phase profile across all the frequencies that are present in the pulse. It is therefore important to be able to characterize optical materials used in nonlinear optics experiments, since these materials influence the pulse length of ultrashort pulses and the outcome of the experiments.

We demonstrate the use of the i²PIE pulse characterization technique to measure the GDD of various optical materials (e.g. quartz window, microscope slide). i²PIE is used to measure the amplitude and phase of the pulse. The GDD is found by fitting a parabola to the measured phase profile of the broadband laser pulse after passing through the sample. The GDD of the samples can be determined with a resolution of $\pm 5 \text{ fs}^2$, which is comparable with standard GDD measurements, and an order of magnitude better than GDD measurements using the MIIPS pulse characterization scheme. This highlights the versatility of the i²PIE pulse measurement protocol and its superior performance when compared to other existing pulse characterization techniques.

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Primary author: FOUCHE, Eugene (Stellenbosch University)

Co-authors: Dr BOSMAN, Gurthwin (Stellenbosch University); Prof. NEETHLING, Pieter (Stellenbosch University)

Presenter: FOUCHE, Eugene (Stellenbosch University)

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