GEMINI-2D

REPORT:

CALIBRATION AND CHARACTERIZATION

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1. WAVELENGTH CALIBRATION

The GEMINI 2D Interferometer is designed to generate a pair of phase-locked replicas of the incoming light having a variable relative delay T_1. This delay is introduced by mechanically moving a birefringent crystal inside the interferometer by means of a motorized positioner.

Typically, the GEMINI 2D Interferometer is placed in the excitation path, and one measures the desired signal as a function of the position of the positioner (in mm), which is proportional to T_1. The excitation wavelength axis is then retrieved by computing a Fourier Transform (FT) of the measured signal, which is a function of mm. The result of the FT is thus a spectrum as a function of the so-called pseudo-frequencies f (in mm^{-1}). For this reason, a calibration procedure is required to retrieve the correct excitation wavelength axis (in nm) from the pseudo-frequency axis (in mm^{-1}).

NOTE: Your GEMINI 2D Interferometer has already been wavelength-calibrated.

However, if you are not satisfied with this calibration and want to perform the wavelength calibration again, the correct procedure is explained in detail in the following:

- Open the software “NIREOS Complete Example V.1.1” (that you can find in the USB stick).
- Open the “Initialize_parameters_cal.txt” file (that you can find in the same folder of the software “NIREOS Complete Example V.1.1”).

The “Initialize_parameters_cal.txt” file is a one-to-one correspondence between wavelength (in nm) and pseudo-frequencies (in mm^{-1}), that you can update either by adding new couples of values or modifying existing ones. In order to do that, you need to measure a spectrum with known narrowband spectral features (e.g. you can use a white light and an interferential filter) with the GEMINI 2D Interferometer coupled to a photodetector. You can then associate the wavelength of the known spectral features (in nm) to the correspondent pseudo-frequency read on the graph “Spectrum[mm^{-1}]” in the “NIREOS Complete Example V.1.1” and add them to the “Initialize_parameters_cal.txt” file.

2. PRECISE OPTICAL ALIGNMENT

A crucial feature of the GEMINI 2D Interferometer is that during a scan of T_1 only the horizontally (H in Figure 5) polarized replica is moved, while the absolute arrival time of the vertically (V) polarized replica is kept fixed. When the H polarized replica is anticipated in time with respect to the V polarized replica, this guarantees that, during a scan of T_1 (the coherence time), T_2 (the population) time does not vary.

Experimental Configuration

Figure 1 shows the schematic experimental configuration that allows one to measure and characterize any possible change in T_2 during a scan of T_1.
The incoming broadband light is split into two arms by means of a beam splitter (BS). In the "pump" arm, the GEMINI 2D Interferometer creates a pair of replicas with orthogonal polarizations, and a vertical (V) polarizer transmits only the V polarized replica (blue pulse in Figure 5). This replica is then recombined with the light in the "probe" arm (red pulse) by means of a second BS. The two pulses are sent to a spectrometer, that measures their spectral interference.

NOTE: Due to the finite spectral resolution of the spectrometer, spectral fringes can be well resolved by the spectrometer with values of T_2<200 fs typically.

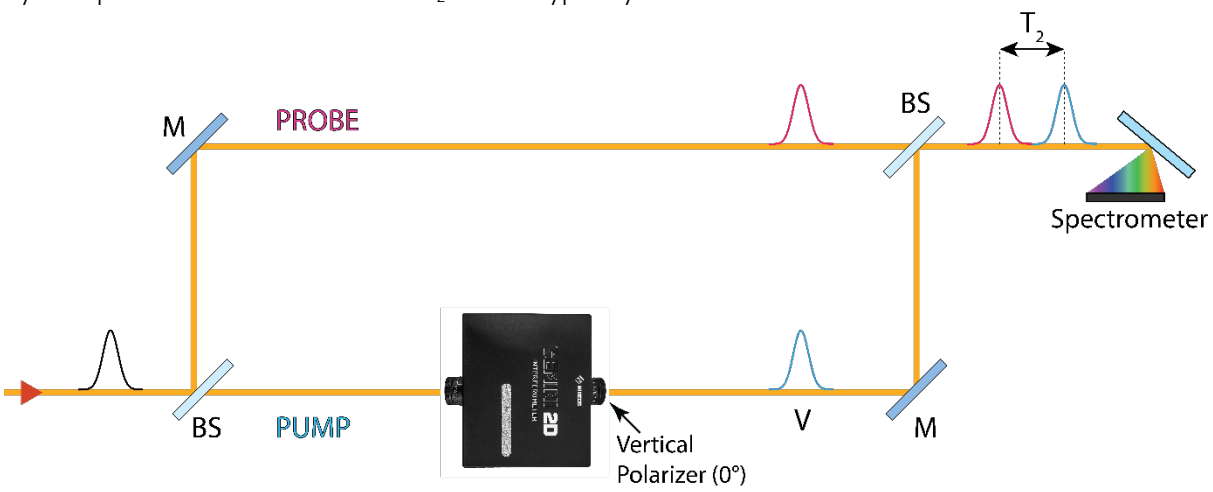

Figure 1: Experimental scheme for the characterization of the stability of T_2 during a scan of T_1.

Measurement and Characterization

In order to be sure that T_2 does not change during a scan of T_1, the procedure is to acquire many spectra of the two interfering pulses at the spectrometer for different values of T_1 (i.e. by moving the motor of the GEMINI 2D Interferometer via software). If the measured spectrum does not change (i.e. the spectral fringes do not move) during a scan of T_1, it means that the V replica in the pump arm is kept fixed and T_2 does not change.

Figure 2 reports the result of this measurement obtained with **your GEMINI 2D Interferometer**. It shows in different colours different spectra acquired at 3 different values of Motor Position. This shows that the fringes are stable during a complete scan of T_1 within approx. a half of a period. By measuring the largest deviation of the fringes between two different spectra for different T_1 values, it is possible to estimate that the change of T_2 is smaller than 3 fs during a complete scan of T_1.

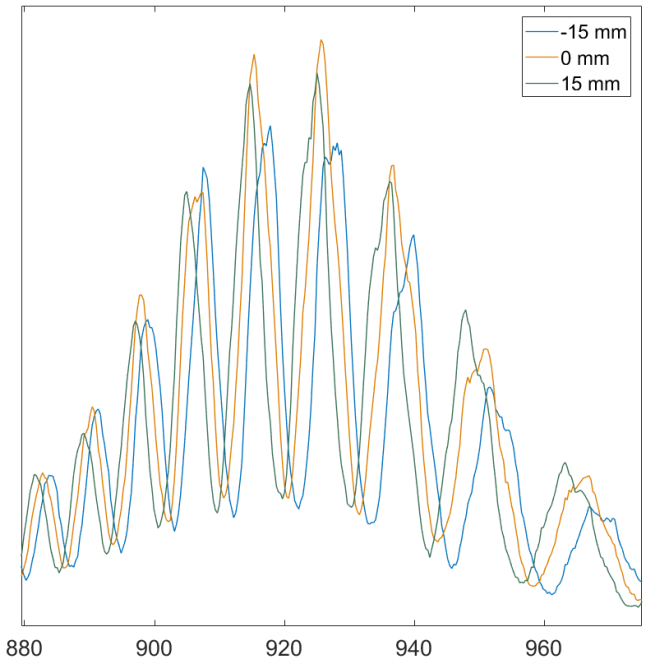

Figure 2: Measured spectra corresponding to different values of T_1.

NOTE: To minimize the variation of T_2 during a scan of T_1, you can finely tune the two rotation mounts on the top of the GEMINI 2D Interferometer (after removing the plastic cover as shown in Figure 3). You can find the optimal alignment by repeating the described measurement until you find a configuration in which the fringes do not move during a scan of T_1.

Figure 3: Pictures of the top of the GEMINI 2D, showing how to access the two mounts to fix the arrival time of the vertical replica during a scan of T_1.