Simulating CEP fringes for Salle Noire 2.0

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Chapter 1

Gaussian spectra

In this chapter we consider the laser pulses to have a gaussian spectral shape and a flat spectral phase, except for a small amount of GDD introduced to simulate the exit window of the compression chamber.

1.1 Fundamental field

The fundamental electric field is expressed by :

$$E_{fund}(\omega) = e^{-\frac{a^2}{2}(\omega-\omega_0)^2} e^{-i\Phi(\omega)}$$

with $\Phi(\omega) = k_{00} + k_{10}(\omega - \omega_0) + \frac{k_{20}}{2!}(\omega - \omega_0)^2 + \frac{k_{30}}{3!}(\omega - \omega_0)^3 + \frac{k_{40}}{4!}(\omega - \omega_0)^4$

ω_0 is the central frequency and corresponds to 790nm. k_{00} is the CEP. k_{20} is the GDD or 'chirp'.

1.2 SHG field

The fringeezz analyzes the CEP fringes in the spectrum around 480nm.

We use a BBO crystal to frequency double the red components.

Let's assume the SHG field is a gaussian centered around $\omega_{0,blue}$, corresponding to 480nm :

$$E_{SHG}(\omega) = \sqrt{att}\; e^{-\frac{a_{blue}^2}{2}(\omega-\omega_{0,blue})^2} e^{-i2\Phi(\omega)}$$

This wave has twice the spectral phase and has a width a_{blue} which depends on the BBO thickness and the fundamental spectral intensity.

att is an attenuation factor representing the SHG efficiency and the attenuation by the polarizing beam splitter in the f-2f interferometer, used to maximize the contrast of the fringes.

I'm sure we can do better than this, not very clear so far why the SHG field should be expressed like that.

1.3 CEP fringes

The total detected spectral intensity is expressed by :

$|E_{fund}(\omega) + E_{SHG}(\omega)|^2$

Chapter 2

Measured spectrum and spectral phase (using d-scan measurements)