Scientific Report

Ultra-short laser pulse characterization using dispersion scans

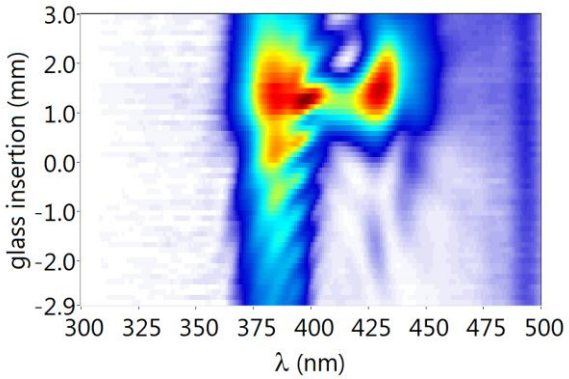
ESF - Short Visit Grant ref number 4596
Activity Title : Super-intense laser-matter interactions
Applicant: Miguel Miranda, Porto, Portugal
Host: Rosa Weigand, Madrid, Spain

Purpose of the visit

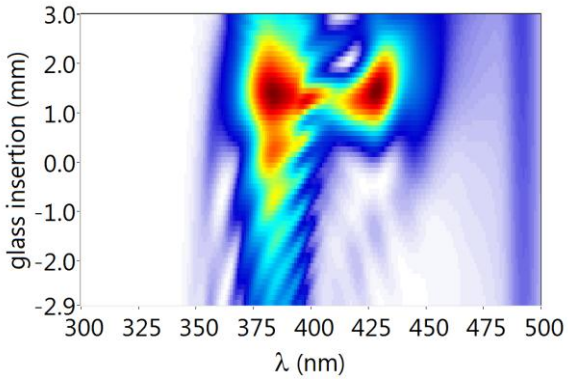
The purpose of the visit was to take advantage of a unique laser system available at the host university. A simple and inexpensive method for the characterization of ultrashort laser pulses has been developed in collaboration with Lund University (Sweden) and has been successfully tested in Porto with the existing laser system. It is particularly suited to the regime of few cycle lasers. A manuscript has already been submitted and accepted for publication in the *Optics Express* journal.
The laser system in Madrid provided an opportunity to test the technique on a broader and more complex spectrum.

Description of the work carried out during the visit

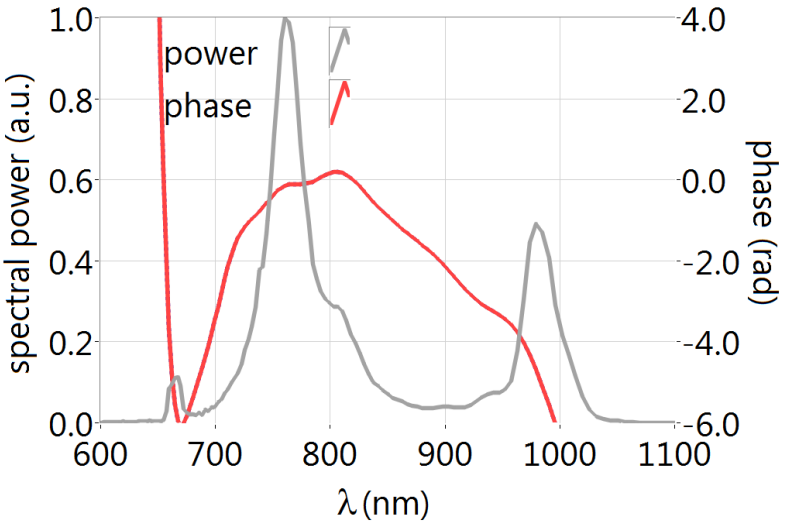
The work carried at the host institution consisted on setting up the system, performing data measurements, and running numerical analysis on the data.
The method consists on taking a set of spectral measurements of the second harmonic while varying the dispersion, and, using an iterative numerical algorithm, reconstruct the pulse spectral phase.
A description of the method can be found at:
http://arxiv.org/abs/1110.2964
An example of a measured and retrieved scan, together with measured spectrum and retrieved phase is shown below:



measured scan



retrieved scan



measured spectral power and retrieved spectral phase

Description of the main results obtained

We successfully measured the spectral characteristics of the laser oscillator. Considering its broad spectral width and its complex spectral amplitude and phase, this was an important test for the accuracy and reliability of the technique. The numerical methods for phase retrieval are currently being improved to make the technique faster and more reliable.

Projected publications to result from the work carried

We expect to be able to publish an article (probably on *Optics Express*) partly based on the work carried out in Madrid. More measurements based on the technique are currently being performed in Porto, using different ultrashort laser sources, and using different numerical retrieval methods, which we hope to improve.