MEASUREMENT OF ULTRASHORT LASER PULSES USING NONLINEAR OPTICS METHODS

Fabio M. S. Souza (IC), Juan A. Castañeda (??) e Lázaro A. Padilha (PQ).

Abstract
The main objective of the project was to study linear and nonlinear optics effects and build methods for measuring ultrashort pulses. These systems are based on techniques of second harmonic generation and pump and probe. At the end of the project, we obtained two effective methods for ultrashort laser pulses autocorrelation and we could apply them in different conditions.

Key words: Nonlinear optics, Ultrashort, Laser.

Introduction
In any experiment involving pulsed lasers with pulse width of tens of femtoseconds (10^{-14}s) it is essential to know the temporal pulse width as this measure is directly related to the results obtained. However, there is no method for direct measurement of such short times, as electronic methods do not achieve the accuracy required here. You must then use an optical media for the temporal characterization of these pulses.

Results and Discussion
Two different models of autocorrelator were designed. First, we developed a system based on second harmonic generation in the case where the laser operated at repetition rates around 80MHz (MIRA). This model took a long time to be built, because the alignment was really laborious and delicate.

The other model was designed and constructed using the method of pump and probe for the case where the laser was operating at a low repetition rate, around 1kHz (LEGEND). The results for this system are shown in Figure 1.

In the latter model, we still made measurements of the pulse width of a compression system, designed by the PhD student Juan Andrés for application on MIRA and produced pulses around 30fs.

Conclusions
The project was well developed and the results were consistent with the proposed. Currently, both systems are in operation in the laboratory and are very useful tools for students and researchers.

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Figure 1 – Autocorrelation trace for the pump and probe system with different pulses.