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Nonlinear Optics with Ultrashort Mid-Infrared Laser Pulses

The amplification of intense laser pulses is a complex process, as they can easily damage the optical components they pass through. Not only that, but the creation of intense ultrashort pulses in the Mid-Infrareds has always been limited by the inexistent of good gain materials. Optical Parametric Chirped Pulse Amplification (OPCPA) is a technique that combines OPA and CPA, solving both of these problems. CPA won the Nobel prize in 2018, and it allows amplifying intense pulses by stretching them temporally, mitigating the damage caused during the manipulation of these pulses, and compressing them back after amplification. OPA is the amplification method based on nonlinear effects. It has the advantage of high gains in short lengths and over large bandwidths, without heat deposition. The main disadvantage of OPCPA is the complexity of the setups needed, when compared to simpler methods like mode locking. The aim of this project is to study the processes involved in OPCPA and how to optimise them, as well as building the system needed for amplifying a 1030 nm laser pulse and posteriorly a 3000 nm laser pulse.

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