Master 2 “Photonics, Complex and Quantum Systems (PhoCQS)”: Research Training 2023-2024

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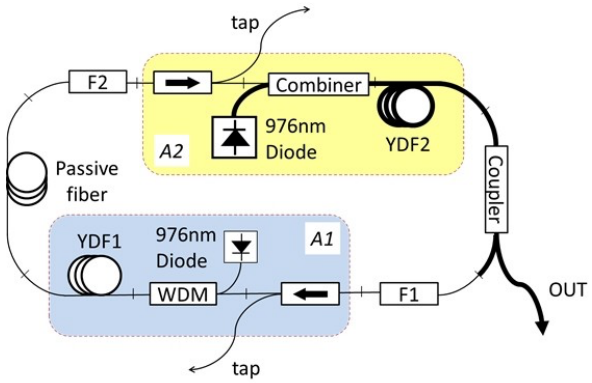
Topic: Nonlinear guided optics

Study of Mamyshev oscillators

A Mamyshev oscillator is a laser architecture for which the mode-locking is achieved through non-linear broadening and spectral filtering. Basically, a Mamyshev oscillator is a ring that contains two fiber amplifiers (YDF1 and YDF2 in fig. 1) and two filters with different central wavelengths (F1 and F2 in fig. 1). This kind of laser allows to obtain short and powerful pulses (>100 nJ for a 50 fs-pulse).

Figure 1: typical architecture of a Mamyshev oscillator



Although this architecture seems simple, the conditions to obtain a robust pulse in the fundamental regime (one pulse per cavity revolution) are currently not well-known and depend on numerous parameters: amplifiers pump power, nonlinear coefficient of fibers, filter shape, etc. Two works can be done during the internship:

1/ an experimental work: the realization of a Mamyshev oscillator to compare the characteristics of the pulse experimentally obtained with the numerical results given by the code developed in the laboratory. This oscillator will also be used to experimentally better understand the formation of the pulse and to find the key-parameters which allow operation in the fundamental regime.

2/ a numerical work: the numerical methods usually used to simulate a Mamyshev oscillator can only predict the steady state of the oscillator. We propose to use the method described in reference 4 to simulate the transient regime of the oscillator to better understand the formation of the pulse observed in the steady state. This numerical work can be done in Matlab or Julia.

Bibliography:

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Key words: Nonlinear propagation, fiber amplifier, fiber laser