Thesis title: Pulsed Fiber Lasers Employing Diverse Saturable Absorbers and Chirped Pulse Amplification Technique

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Abstract

This thesis contains the performance of four distinct saturable absorbers to generate stable femtosecond pulse maintaining an all fiber configuration. Out of four, two are physical saturable absorbers (fiber saturable absorber (FSA) & semiconductor saturable absorbing mirror (SESAM)) and other two are artificial saturable absorbers (nonlinear amplifying loop mirror (NALM) & Mamyshev regenerator). During the experiment, depending on the dispersion map of the architecture several types of stable pulses are observed such as stable Q-switched, all normal dissipative soliton, dispersion managed dissipative soliton. Beside the stable solution, quasi-stable state like noise-like pulse (NLP), unequal multi-pulse states are also observed. Few states are diagnosed which are far away from stable region, contains extreme pulsation, in literature they are named chaotic states. All these states are captured and characterized in detail by performing dispersive Fourier transform (DFT), relative intensity noise (RIN). In case of NALM based laser, dual gain segment based figure-9 architecture is explored and a novel pulse dynamics of NLP is captured. A new architecture of Mamyshev oscillator is proposed where an all-fiber Lyot filter is utilized as one of the spectral filter. The efficiency of the proposed cavity is checked numerically by solving generalized non-linear Schrodinger equation (GNLSE). At the end, the output from most stable state is considered for amplification via chirped pulse amplification (CPA) technique. For this, two different architectures are implemented. The first setup is capable to deliver sub-300 fs pulses with 160 nJ of pulse energy. In the second architecture, the repetition rate is reduced by incorporating a pulse-picking setup. final It can deliver pulses of 2.2 μJ at 1.09 MHz of repetition rate.

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