

中文題目:利用光纖雷射產生高功率似噪音脈

英文題目:Generation of high-power noise-like pulses by a Yb-doped dispersion-mapped fiber laser

中文摘要:

在本論文中，我們設計及架設一台利用雙級摻鏡光纖放大器的主振盪器功率放大器結構之高功率似噪音脈衝 (noise-like pulse)產生裝置。種子光源架設為映射色散光纖雷射 (dispersion-mapped fiber laser)，前級放大器是以光纖纖核直徑為 10 μm 的摻鏡光纖放大器，主要放大器為光纖纖核直徑為 30 μm 的摻鏡光纖放大器。種子光源 (波長=1064 nm) 經過兩級光放大器後，平均輸出功率可達 14.7 W，脈衝重複率~ 15 MHz，脈衝能量 0.98 μJ ，頻譜半高寬 46.5 nm。

似噪音脈衝在時間尺度上是由相對寬的波包(次奈秒等級)以及相對較窄的內部結構(次皮秒等級)組成，其脈衝振幅與寬度是隨機分布。同時其帶寬於頻域上相當的寬，這樣特性使其得以在介質中傳播很長一段距離仍不會失真。經過前級放大器後，波包不會隨著能量提升而有顯著的變化，較窄的內部結構會隨著能量提升，其脈衝寬度有明顯的下降，再經過主放大器後，波包與較窄的內部結構特性及變化趨勢與前級放大器結果相似。為了進一步了解似噪音脈衝放大行為，我們利用非線性薛丁格方程式及速率方程式來模擬及分析，理論模擬結果與實驗數據的趨勢吻合。

英文摘要:

We designed constructed and analyzed a dual-stage fiber amplifier to amplify noise-like pulses (NLP) from a dispersion-mapped fiber laser. The dual-stage amplifier system was composed of a 10- μm -core Yb-doped fiber as pre-amplifier and a 30- μm -core Yb-doped fiber as the main amplifier. We achieved an amplified NLP of the highest output average power of 14.7 W with a repetition rate of 15 MHz, and the pulse energy of 0.98 μJ .

NLP exhibits a very smooth and broadband spectrum, a double-scale autocorrelation trace with a sub-picosecond peak riding and a wide sub-nanosecond pedestal. Light sources generating pulse with such narrow autocorrelation and broadband spectra, capable of propagating without distortion over a long distance. After the pre-amplifier, the pedestal duration increased slightly when the pump power increased, while the spike duration decreased dramatically. After the main amplifier, the trend of the pedestal and the spike duration is very similar to the pre-amplifier. The numerical result of the pedestal duration based on the nonlinear Schrodinger equation (NLSE) also changed slightly and the spike duration decreased when the pump power increased, which had the same tendency as the experimental results.