

# **Mode-locked pulse dynamics from Yb-doped fiber laser within anomalous dispersion region**

班級:四光三

學號:100650310

姓名:鍾武育

指導教授:林家弘

Title : Mode-locked pulse dynamics from Yb-doped fiber laser within anomalous dispersion region

In this work, we investigate the dynamics of mode-locked pulse from ring cavity configuration of yb-doped fiber. By the nonlinear polarization rotation mechanism with the wave-plates and isolator in free space, the mode-locked pulse was experimentally demonstrated. Besides, the grating pairs was inserted inside cavity to make the total cavity dispersion of laser within anomalous region so that Kelly sideband could be seen in optical spectrum at mode-locked state. After proper adjustment the wave-plate, our laser can be operated at various states including bunched pulse, multiple pulses and even harmonic mode-locked state. As laser operated at bunched pulse state, the splitting pulse within several tenth of picosecond was experimentally measured from autocorrelator. The maximum number of splitting pulse about 4 and the shortest pulse-width around 5 ps was achieved from our laser. In addition, harmonic mode-locked state, we can achieved from a 1<sup>st</sup> harmonic 35MHz to 6<sup>th</sup> harmonic 210MHz was observed

Abstract(摘要): 我們的研究是以摻鎂光纖作為雷射系統的增益介質，並且用某種方式使之成為短脈衝雷射。在這個實驗中，我們是藉由 PBS 以及偏振相關的光隔離器來達成非線性極化旋轉(NPE)的鎖模機制，使原來 CW 輸出的泵激光，變成 comb 型式的超短脈衝。實驗使用中心波長位於 974 奈米的二極體雷射做為泵激光源，並且使用 40 公分的單模摻鎂光纖作為增益介質。藉由光柵對補償由光纖造成的色散，使得整體共振腔色散控制在稍負色散的情況。然後經由適當地調整極化控制器，可以得到不同的操作狀態，包括 bunch pulse、多脈衝與諧頻鎖模的狀態。當雷射操作在這種情況下我們觀察到脈衝操作在邊波(bunch pulse)的狀態，此時光譜呈現多根邊頻(Kelly sideband)的情況產生，此時的輸出脈衝的寬度最短可以達到 4.5ps。然而，藉由調整波板的方向，我們的實驗發現有多重諧波的情況，從基頻重複頻率為 35MHz，最多可以觀察到五階諧頻的狀況