All normal fiber laser design for 714MHz laser wire

20120510

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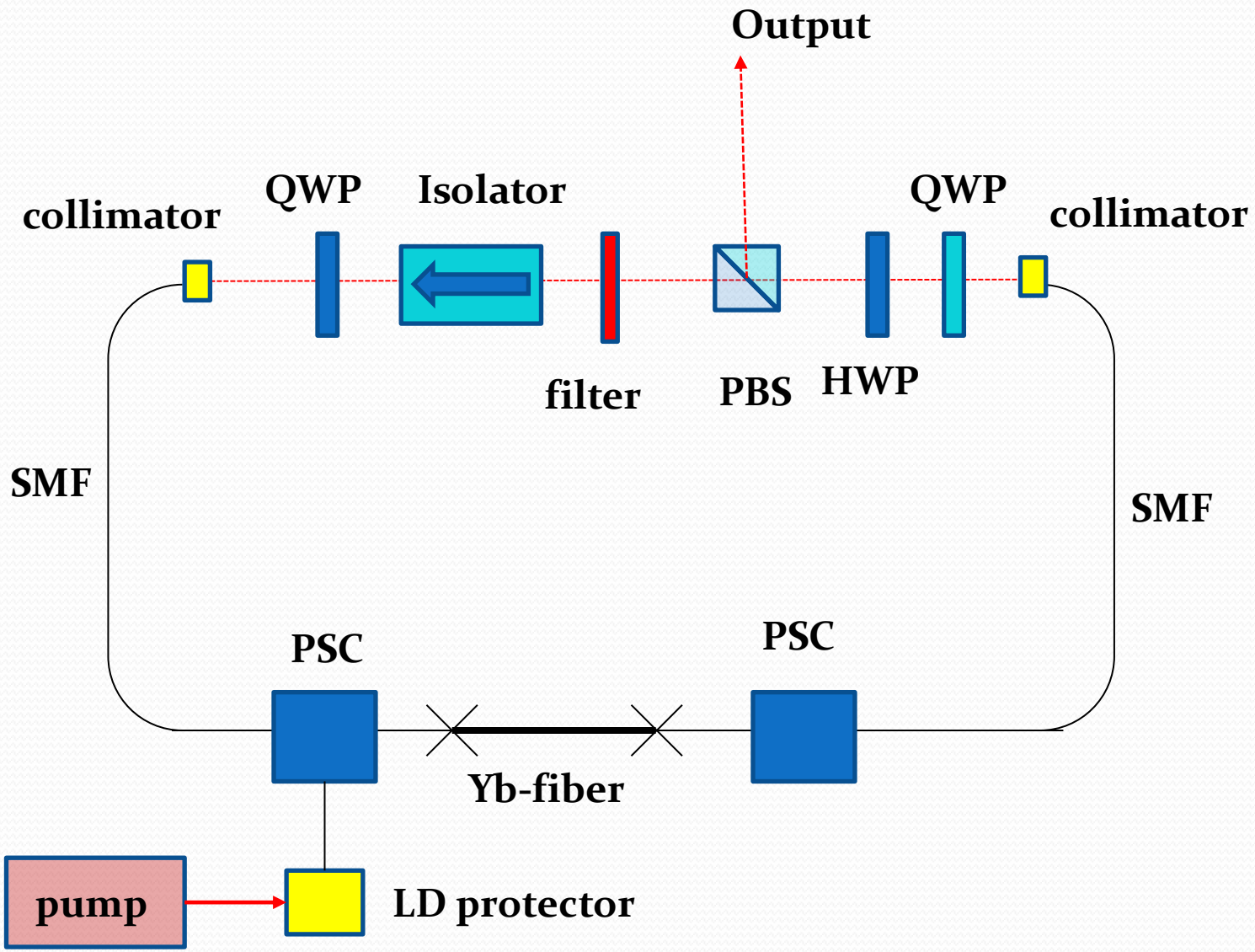
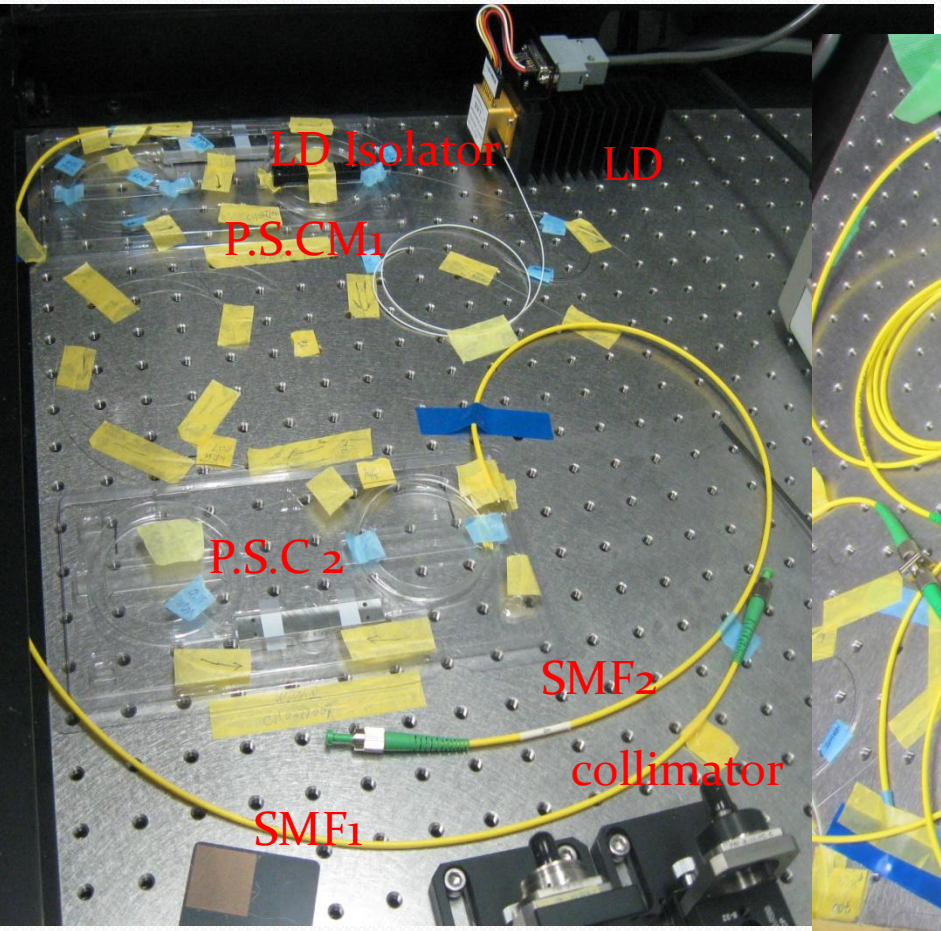
- Construct 714MHz fiber laser design

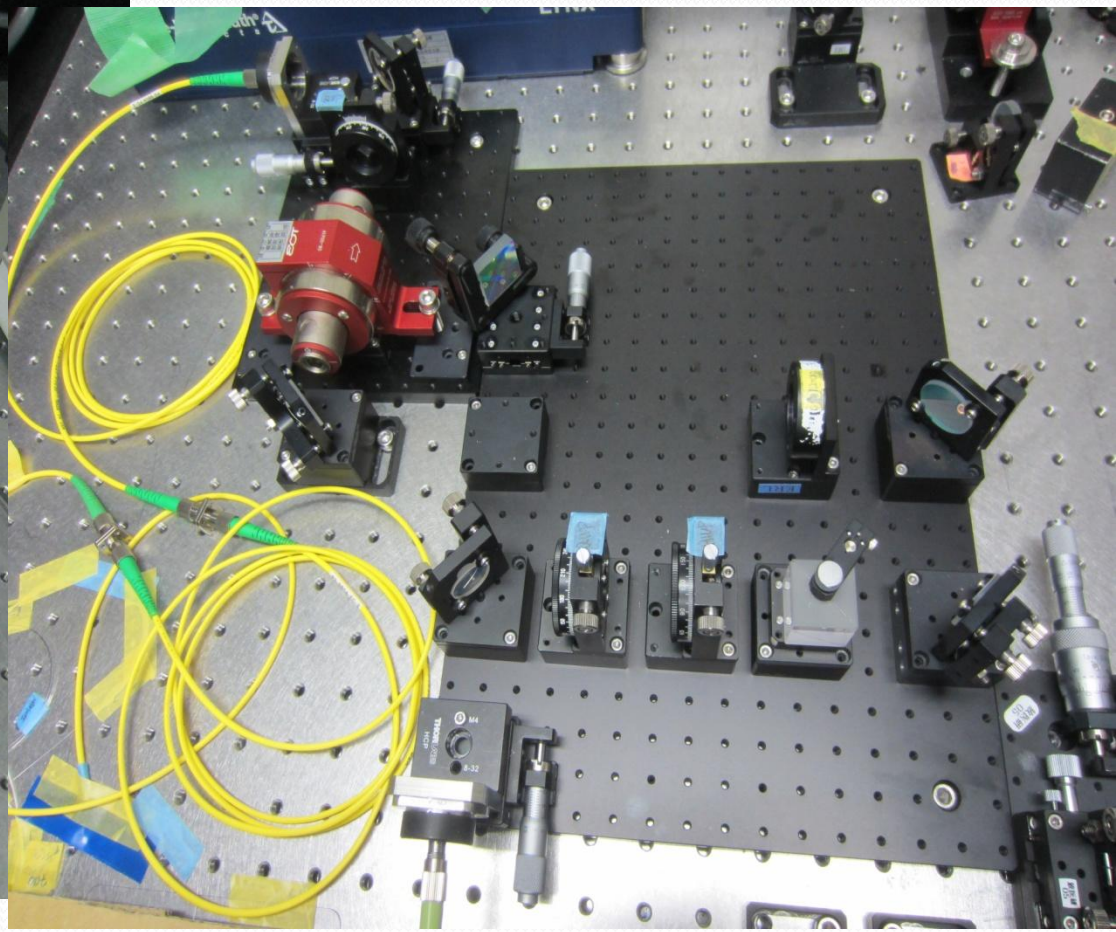
Fiber laser experimental setup



Setup

- LD+LD Isolator+WDM1+Yb-doped fiber +WDM2+
- SMF2+free space+SMF1





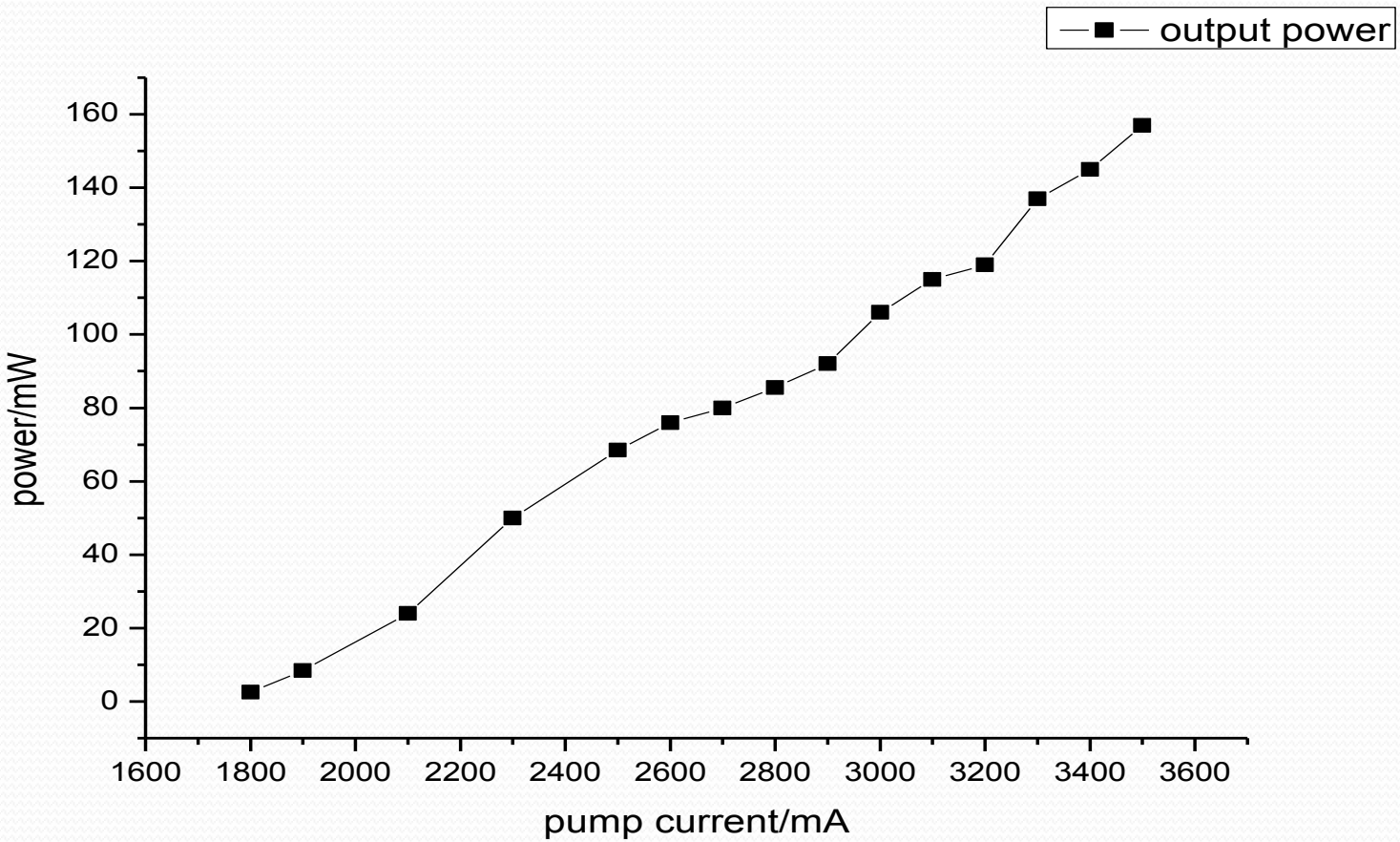
Parameters of setup

- Yb -doped fiber length ~1 m
- Total SMF ~7.5m
- Filter: 12nm, 1040nm
- Free space: 133cm
- Coupling rate of collimator ~45%
- SMF after Yb-doped fiber is ~1.5m
- SMF before Yb-doped fiber is ~6m

Part I Experiments results

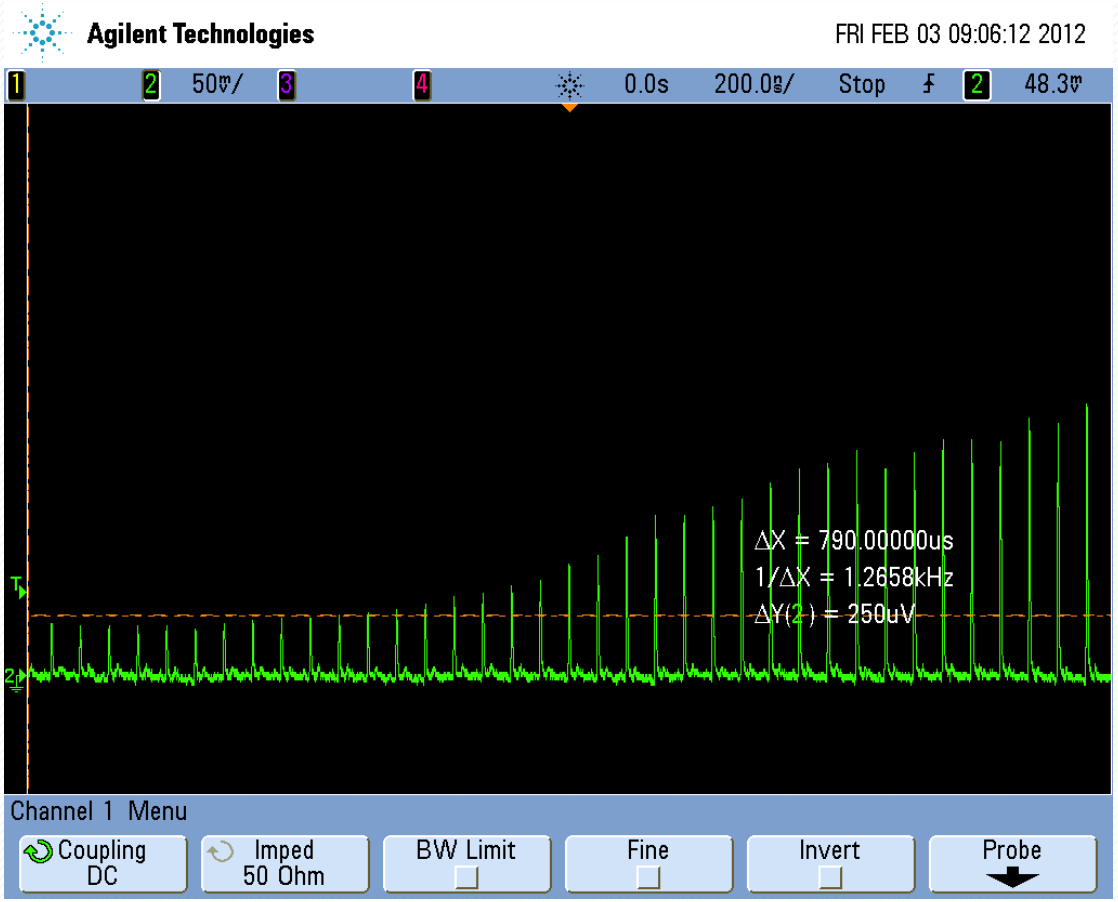
Output power vs pump current

- Mode-locking threshold 2900mA



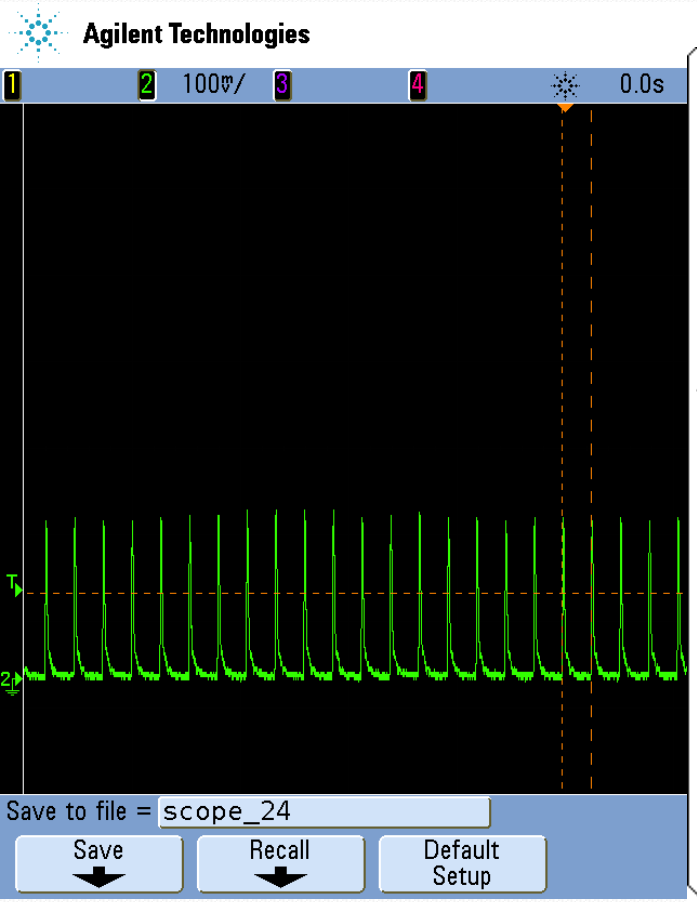
12nm filter

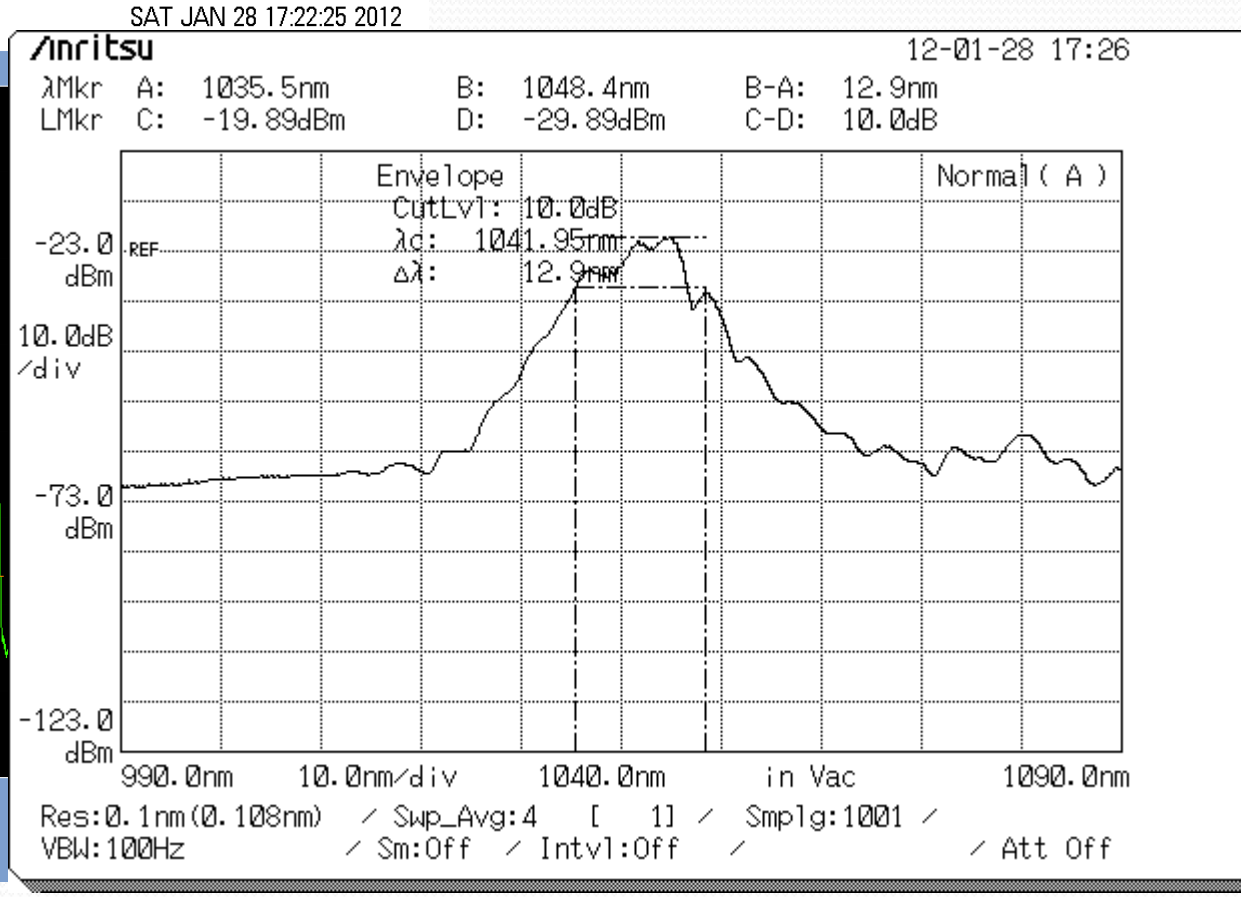
- Pump 2800mA, unstable mode-locking



12nm filter

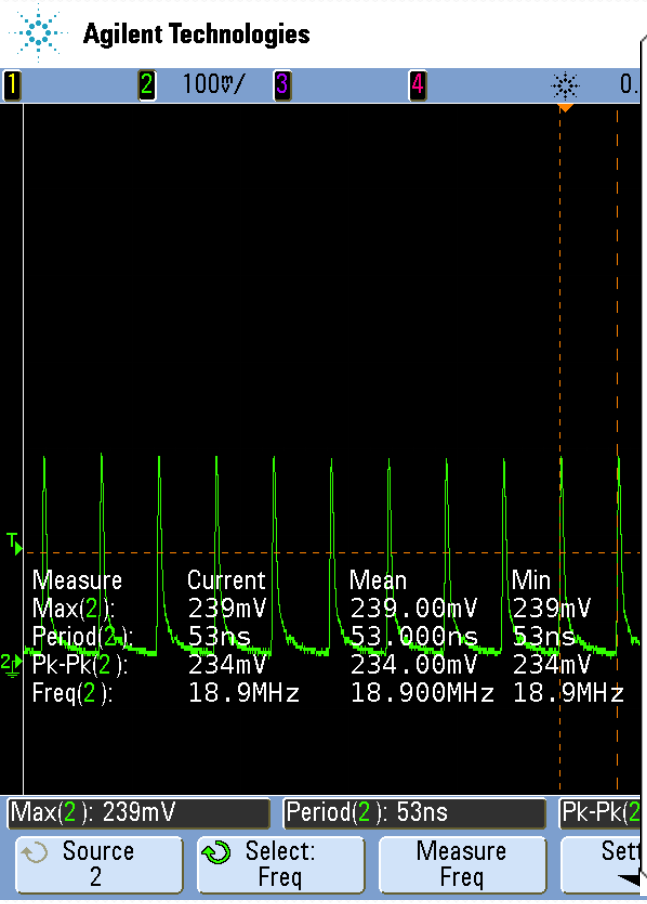
- Pump current 3000mA, 125mW

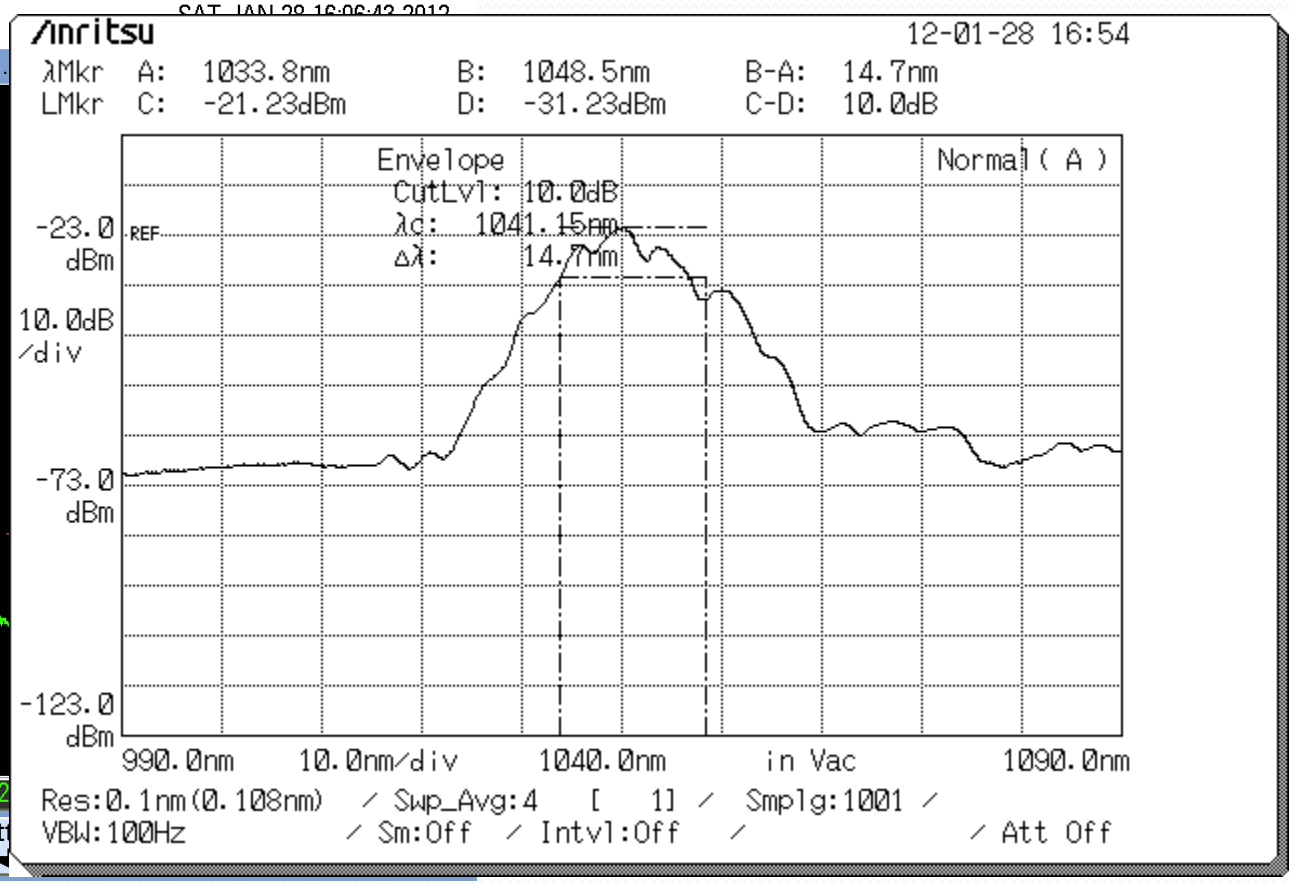




12nm filter

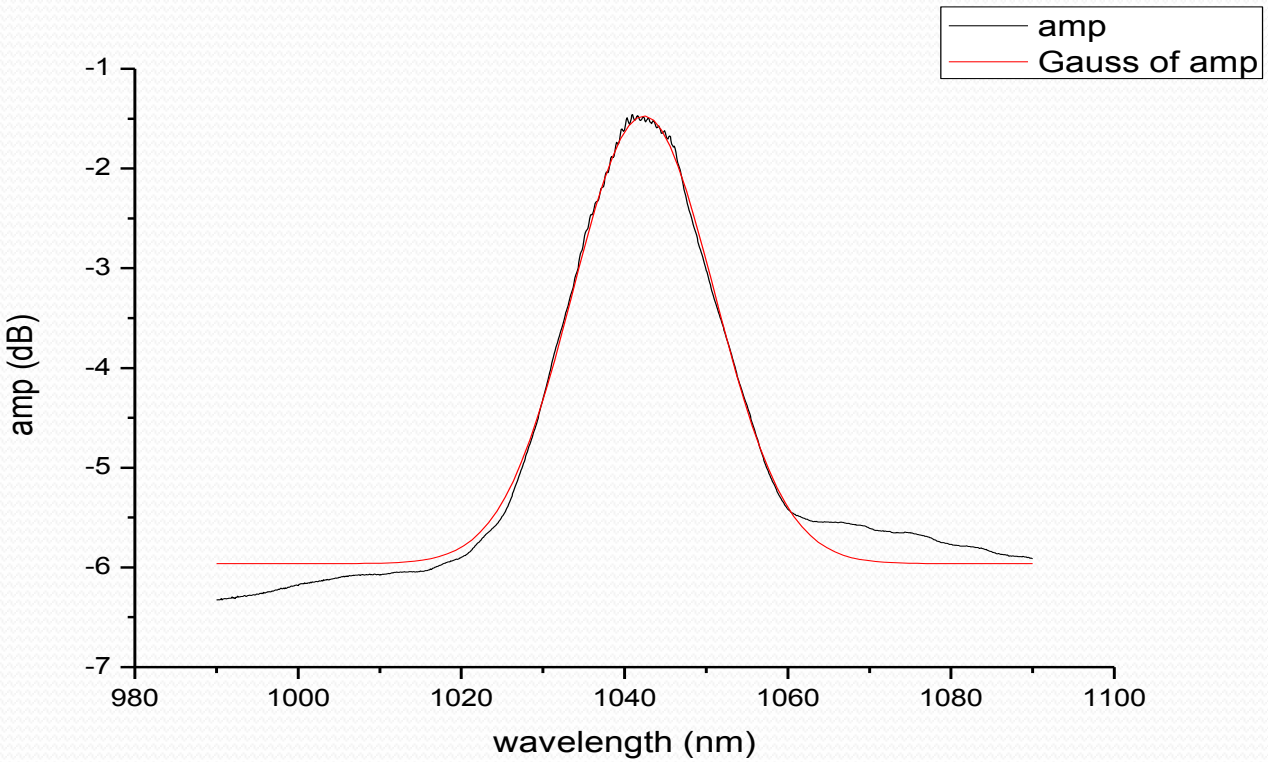
- Pump 3400mA,outpower=160mW





No background and stable pulses

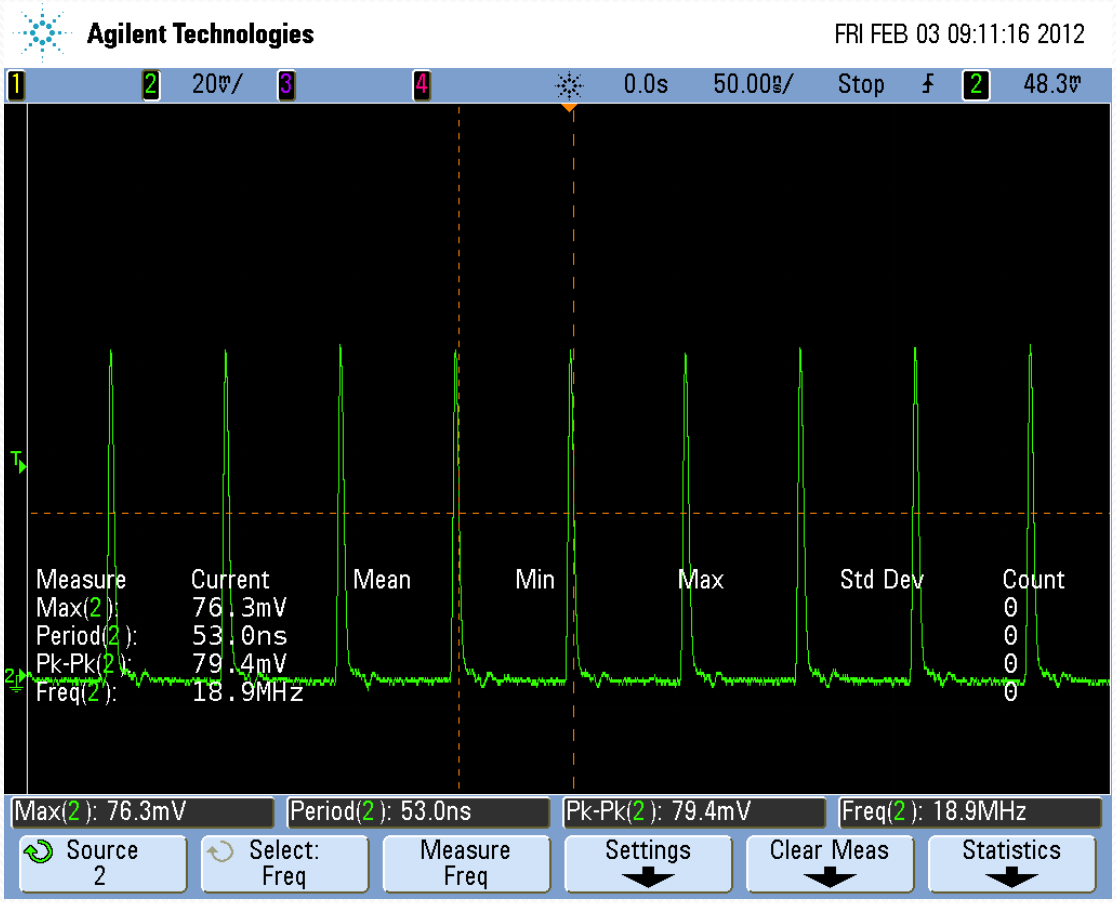
Oscillator output spectrum



- FWHM BW=20.44nm, center wavelength=1042nm,
- Fourier transform limited pulse duration is ~78fs.

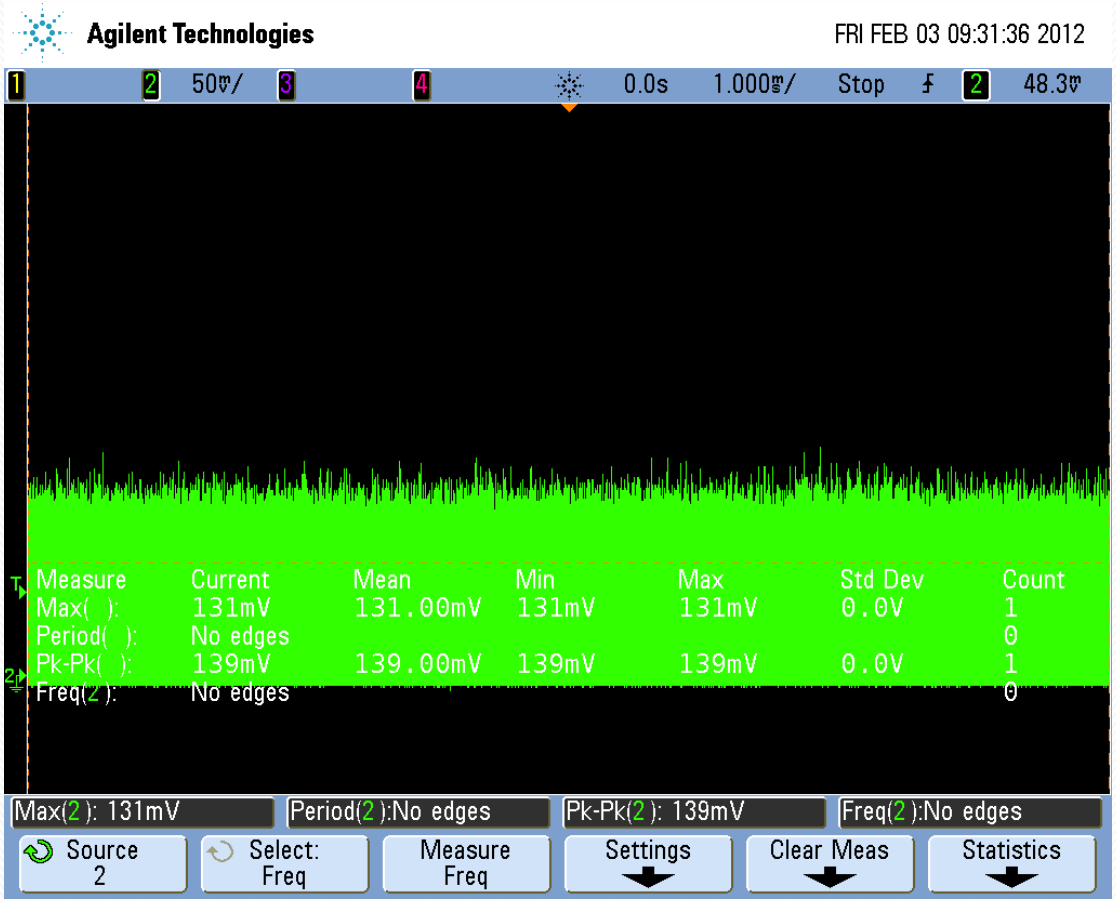
10nm filter

- Pump 3000mA, stable mode-locking,output power 118mW



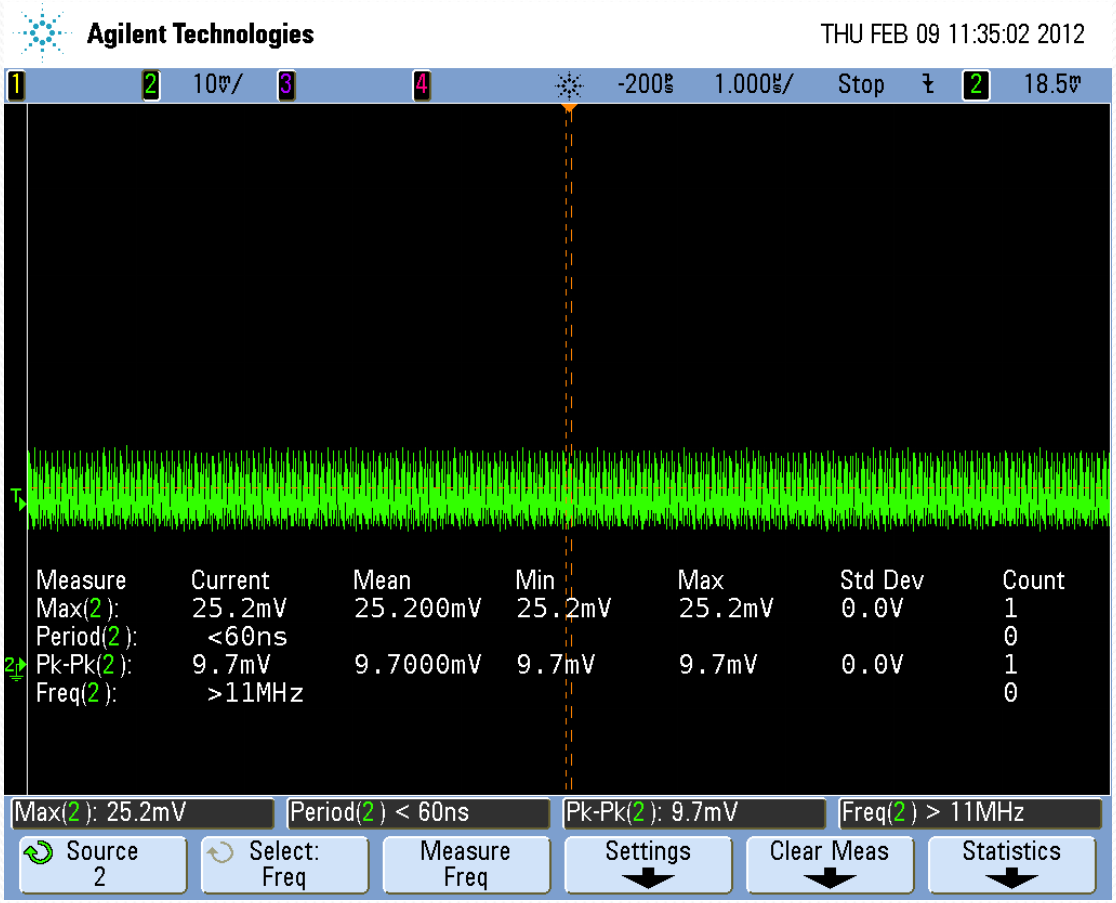
10nm filter

- pump 3400mA, 154mW



8nm filter

- It is impossible to find out mode-locking regime when the filter is 8nm

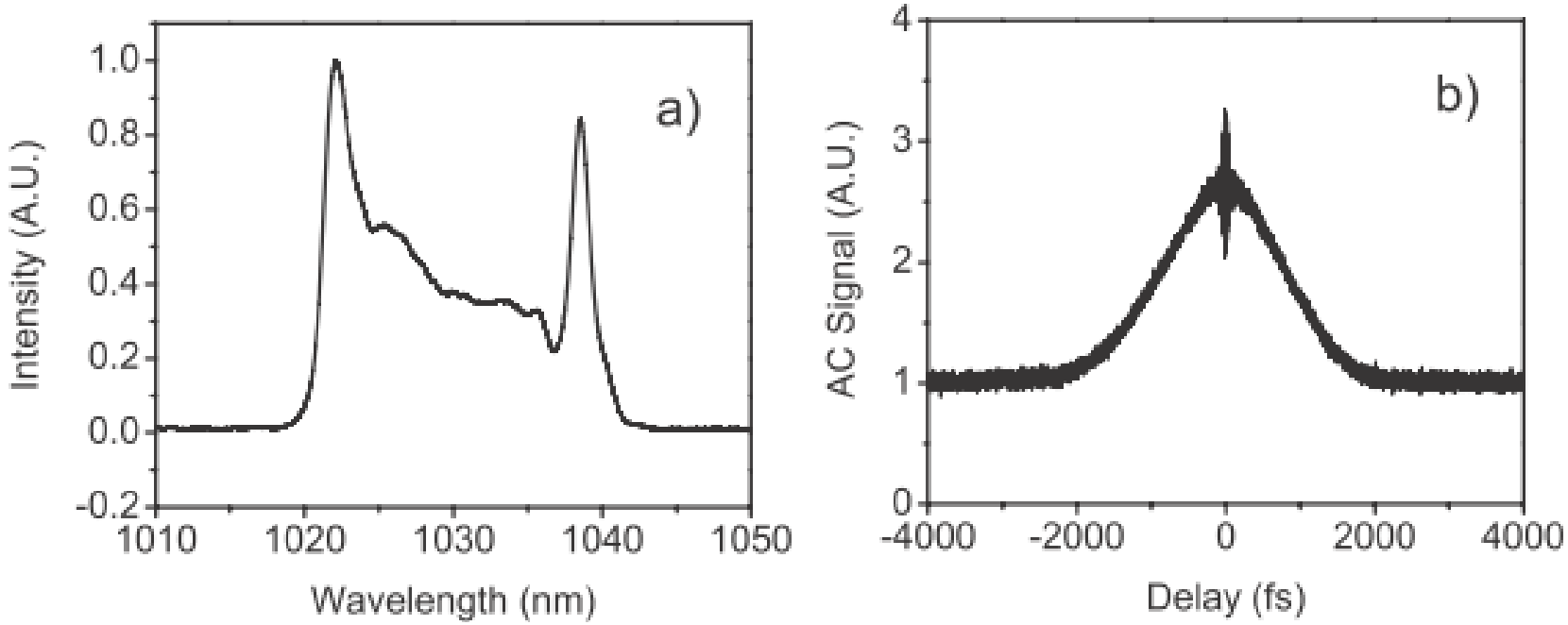


Andy Chong's setup VS mine

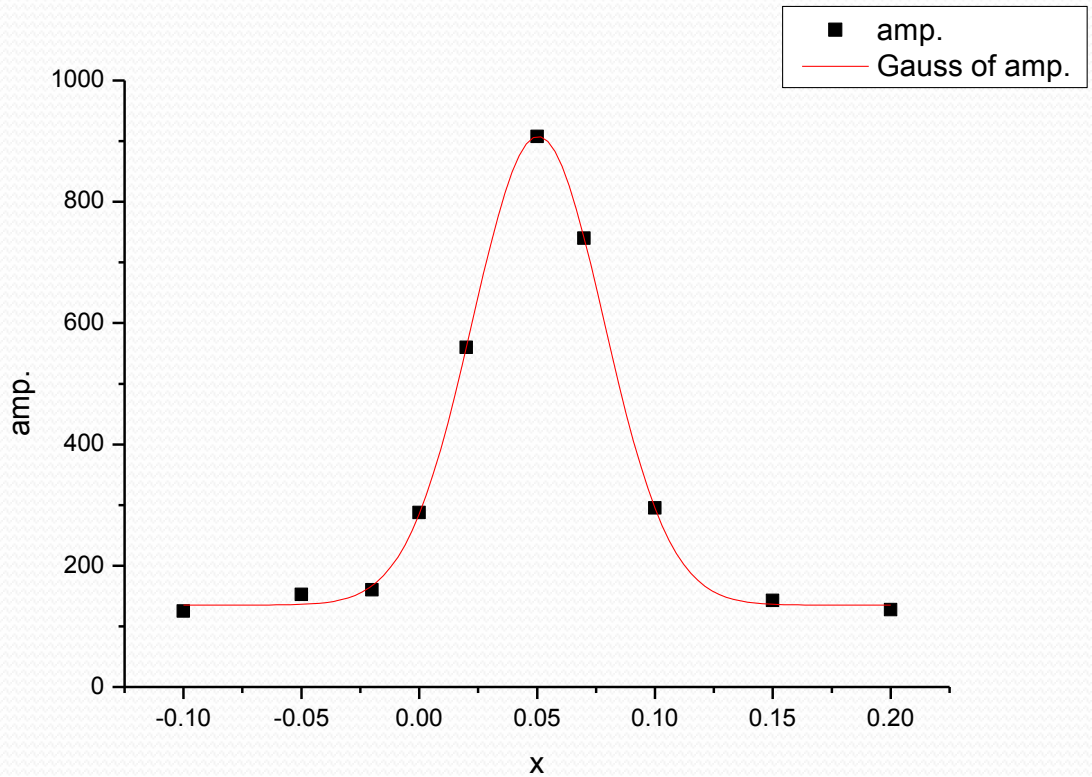
	Andy Chong	My filter setup
Pump diode	Low power LD, SMF	High power LD, MMF
Filter	10nm@1030nm	12nm, 10nm, 8nm @1040
Output wavelength	1030nm	1042nm
Spectrum shape	parabolic	Gaussian
Pulse shape/ duration	Gassian	Gaussian
Pulse duration	1.4ps---170fs(dechirped)	~315fs----(78fs)
Yb fiber	Single-clad	double-clad
Yb fiber length	~20cm	~150cm
Pump method	WDM	Pump signal combiner
SMF after Yb fiber	~1m	~1.5m
Pulse energy/nJ	2.7	3.5-9nJ(65-170mW@18.9MHz)

2006.Andy Chong

Andy Chong's results



pulse duration measurement



- Pulse duration 315fs,
- fs pulse directly without internal compression!

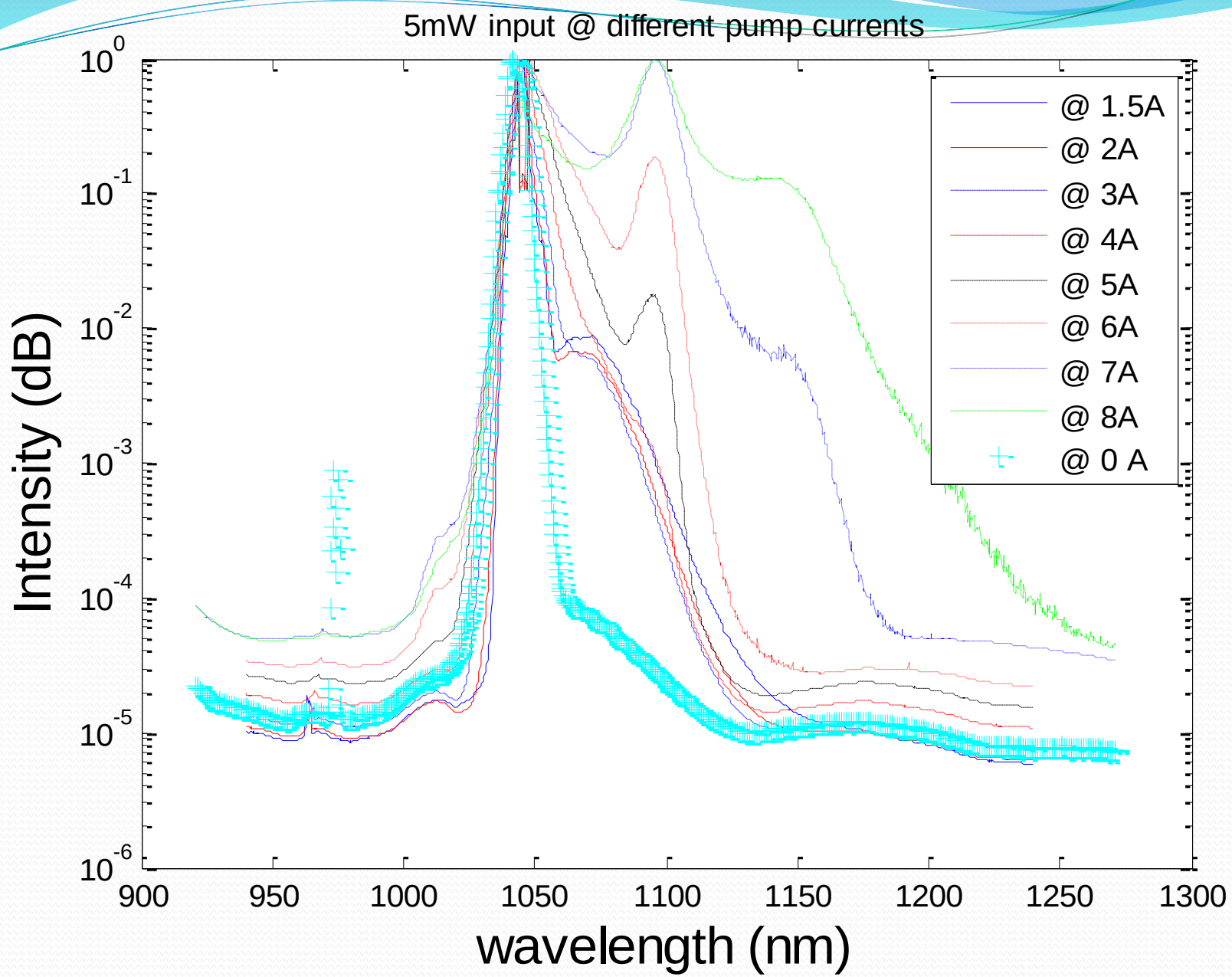
Pulse duration at diff.pump currents

Pump current/mA	3000	3100	3200	3300	3400	3500
Pulse width/ps	306	314	303	304	291	307

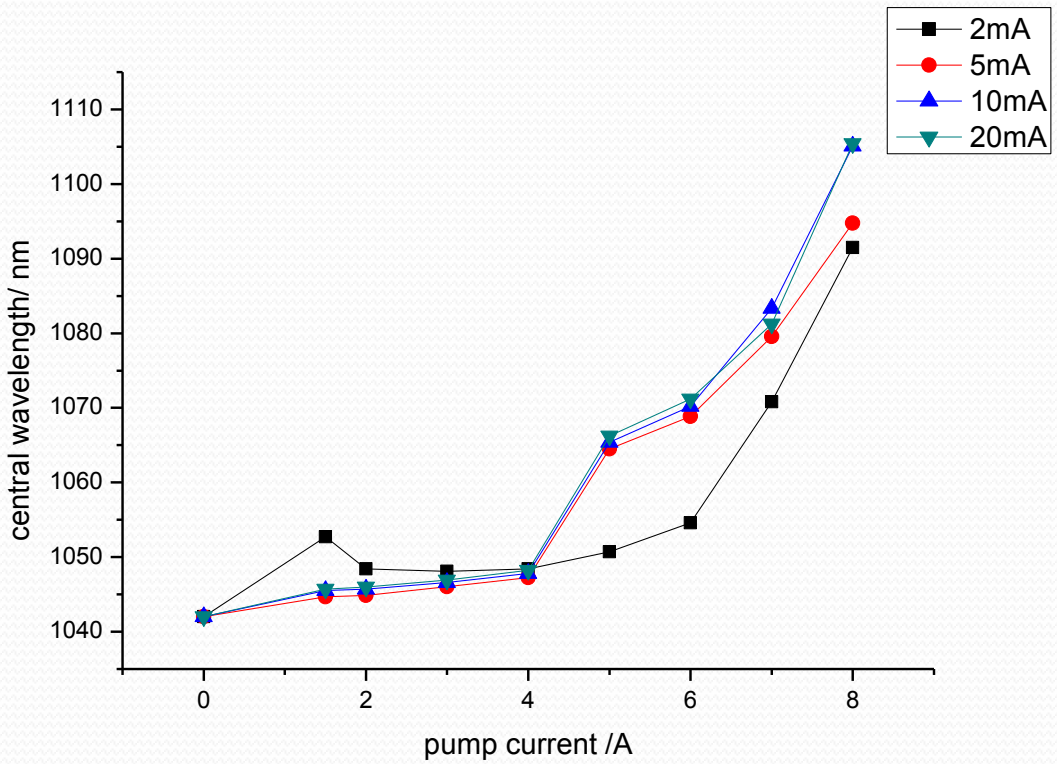
Conclusion

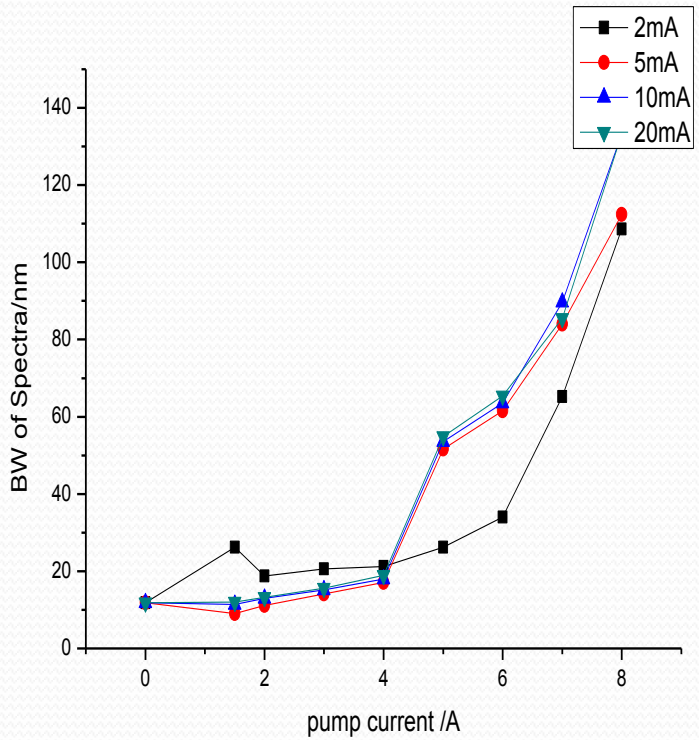
- Different spectrum shape, and pulse duration range with Andy Chong's
- self-starting
- Wave-breaking free
- The higher the pump, the higher output
- Stable mode-locking only when pump current >=2900mA
- Long enough SMF to produce normal GVD
- Bandwidth of the filter should be large enough

Part II Amplified by Yb-PMFA-33


5mW input @ different pump currents
Intensity (dB)
wavelength (nm)
@ 1.5A
@ 2A
@ 3A
@ 4A
@ 5A
@ 6A
@ 7A
@ 8A
@ 0 A
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
900
950
1000
1050
1100
1150
1200
1250
1300

Central wavelength and BW



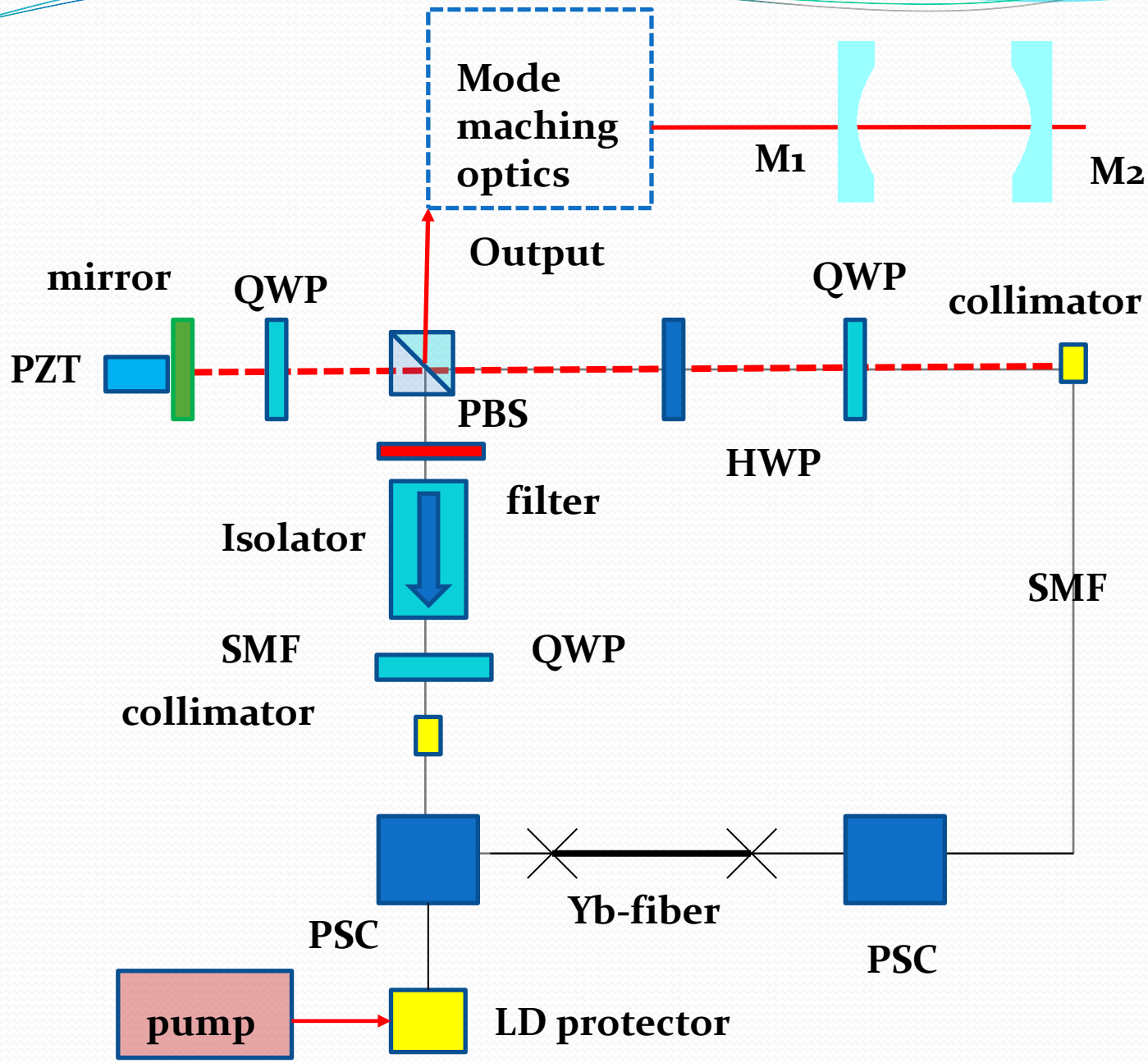


Part III Construct 714MHz fiber laser design

Construct 714MHz fiber laser based on F-P cavity

- 714MHz 2-mirror cavity using the Time band-width 357MHz oscillator.
- construct fiber laser to 17.85 MHz
- combine the above two parts to obtain 714MHz pulse train after the 2-mirror cavity.

Fiber laser & F-P cavity



Problems

- higher finesse F-P cavity support higher side-modes suppression, but higher input power is needed, but lower coupling

- Lower finesse F-P cavity has worse side-modes suppression with lower energy loss, can higher coupling

Thank you!