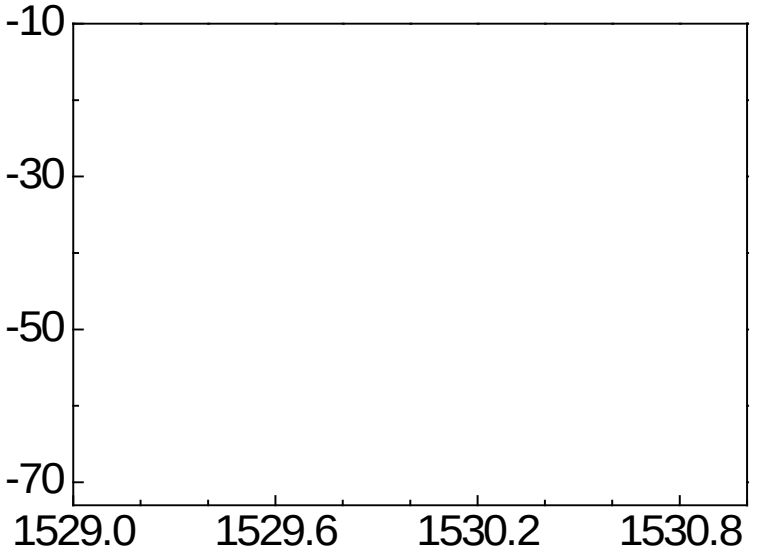
April 09, 2015



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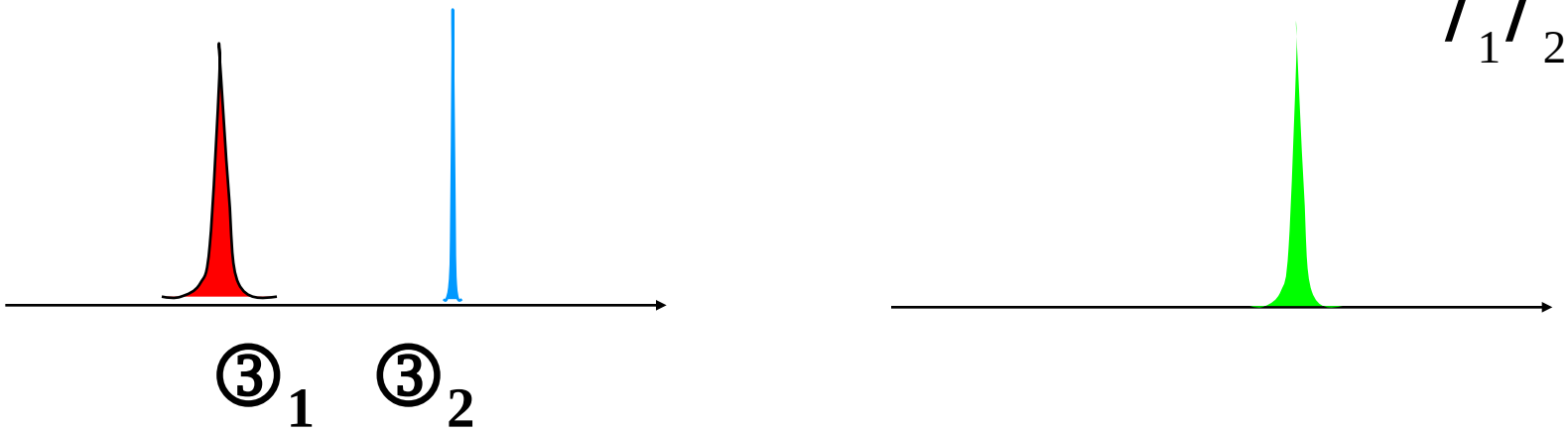
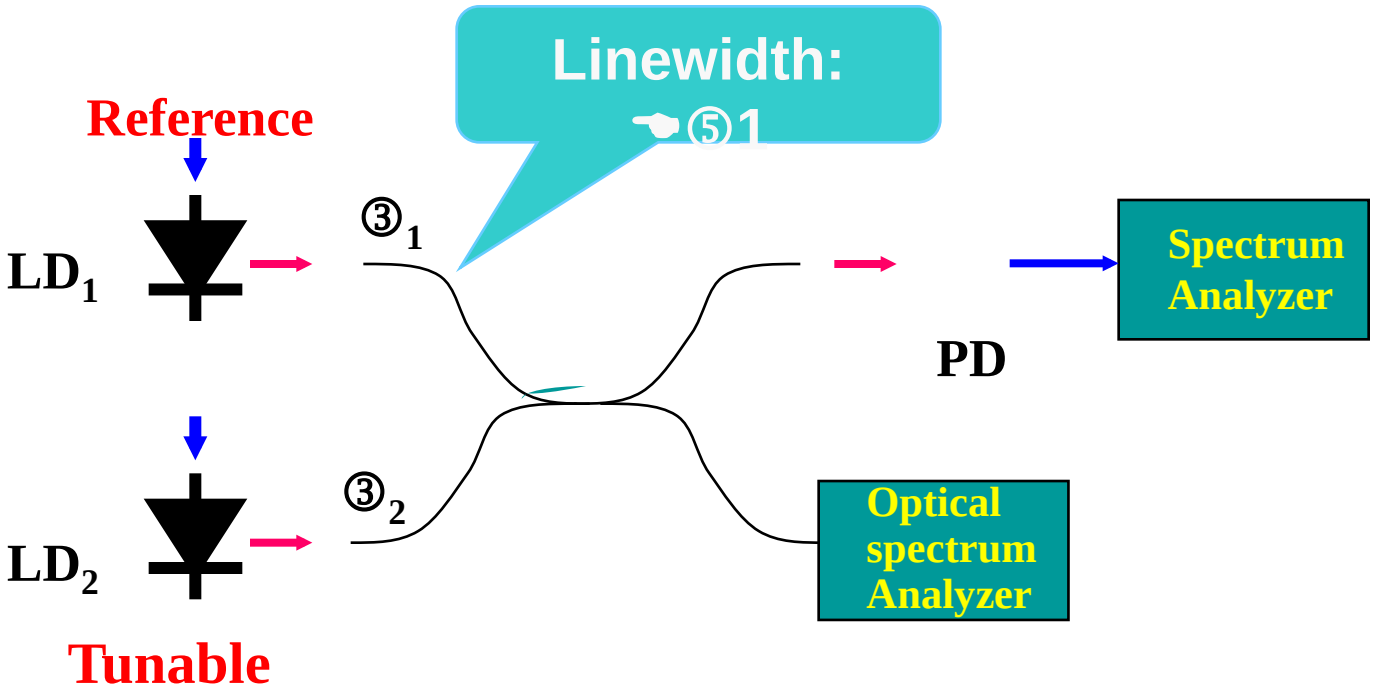
@ ④

1kHz 1Hz 1mHz

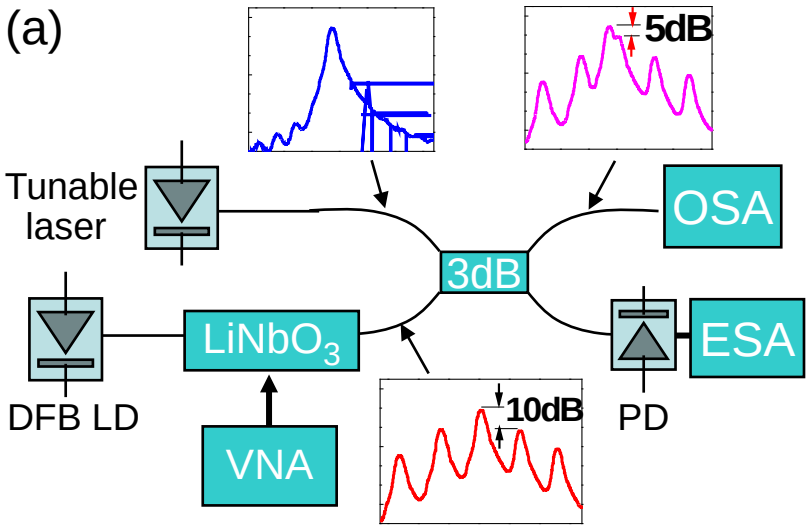
100km

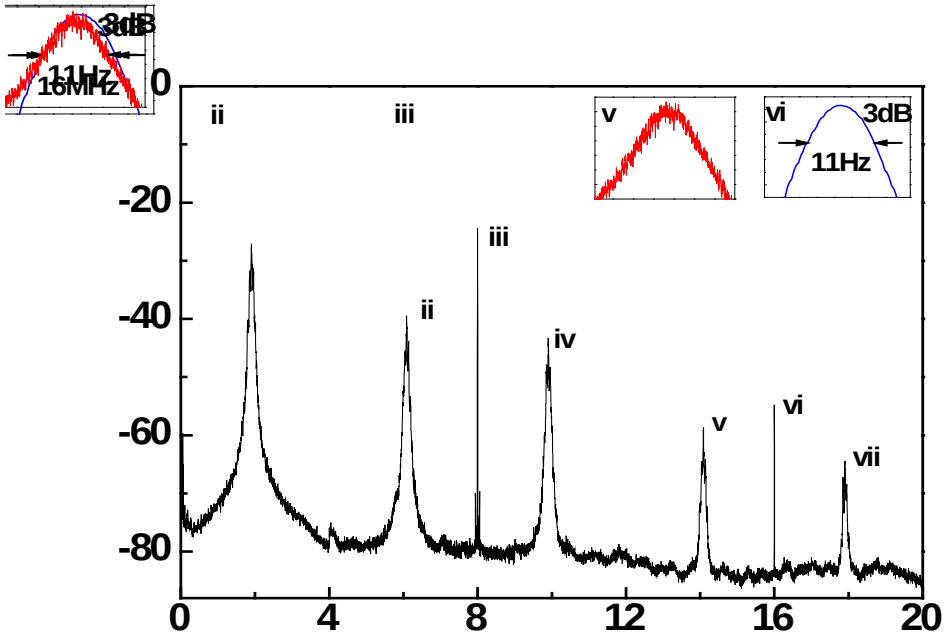
$$f_m = \frac{I_2 - I_1}{I_1 I_2} c$$

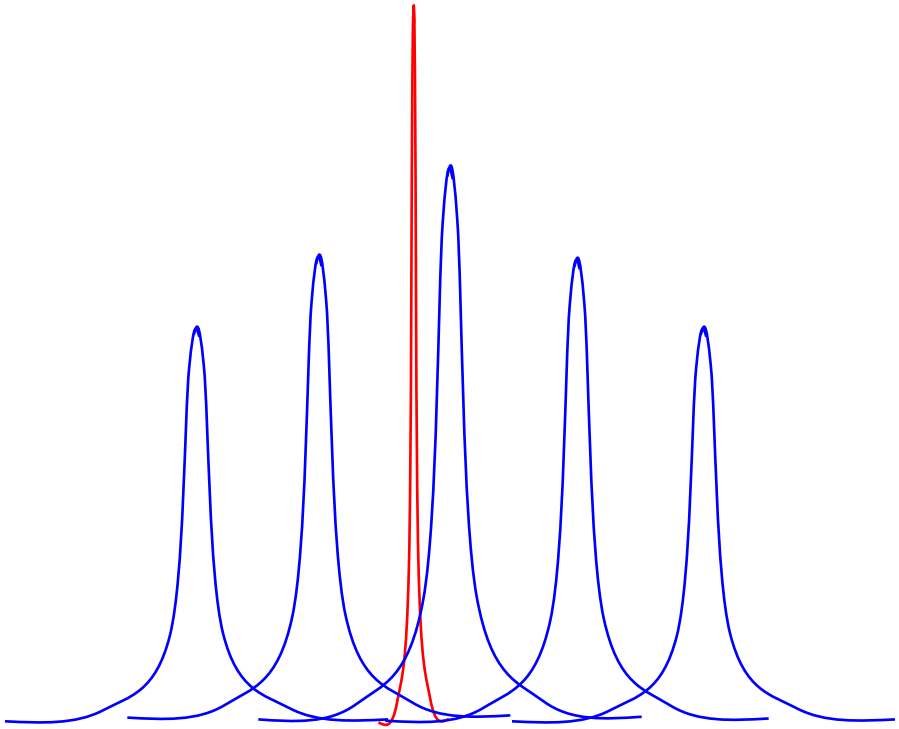


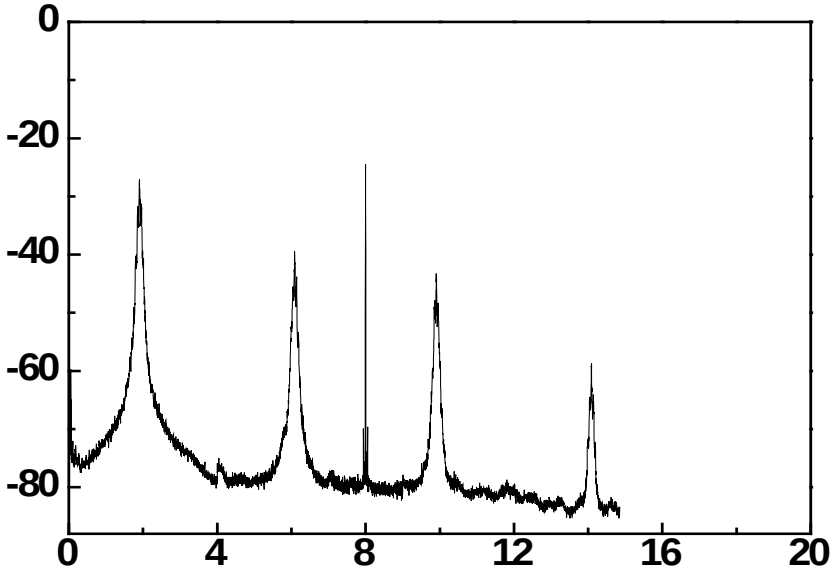


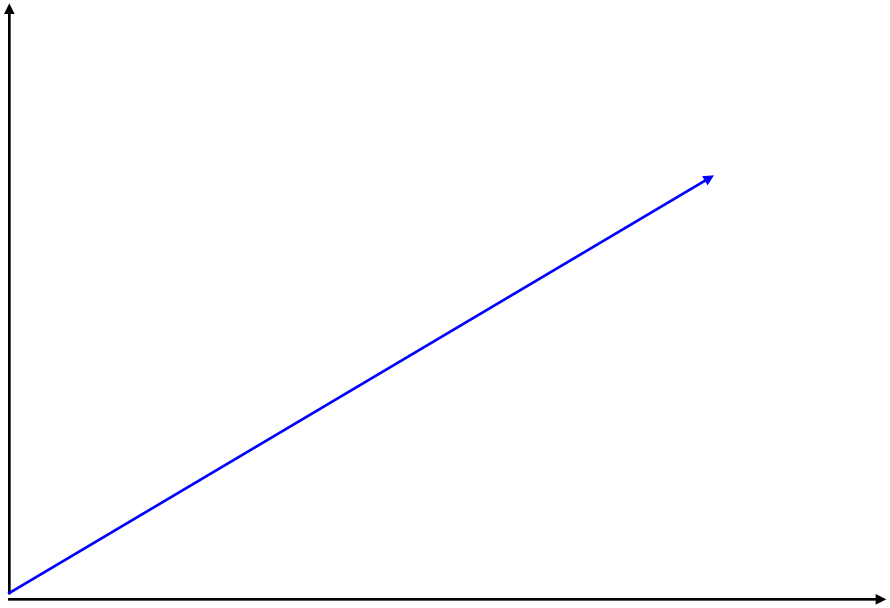
Microwave linewidth: ⑩☚⑤1+☚⑤2

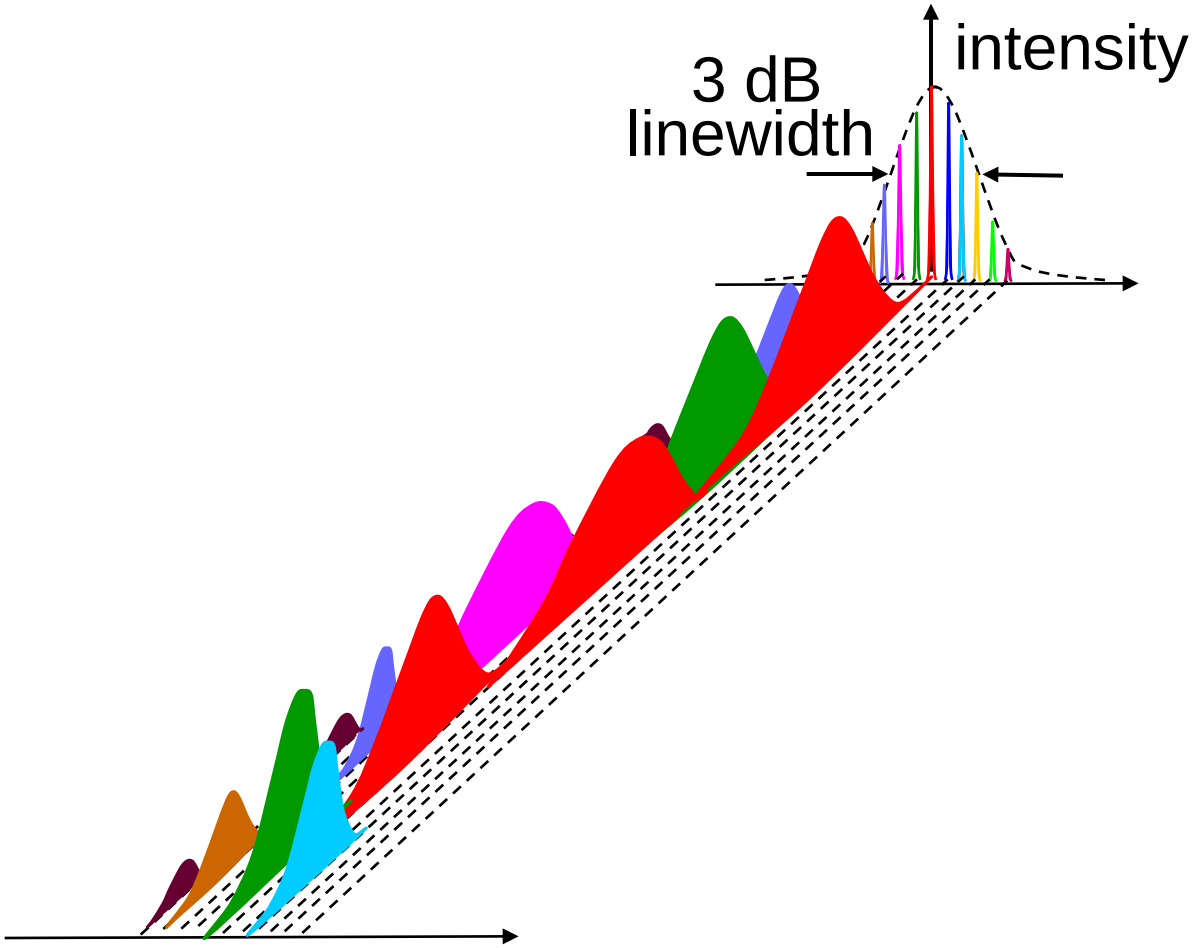

(a)
5dB
Tunable laser
OSA
3dB
LiNbO3
ESA
DFB LD
VNA
10dB
PD

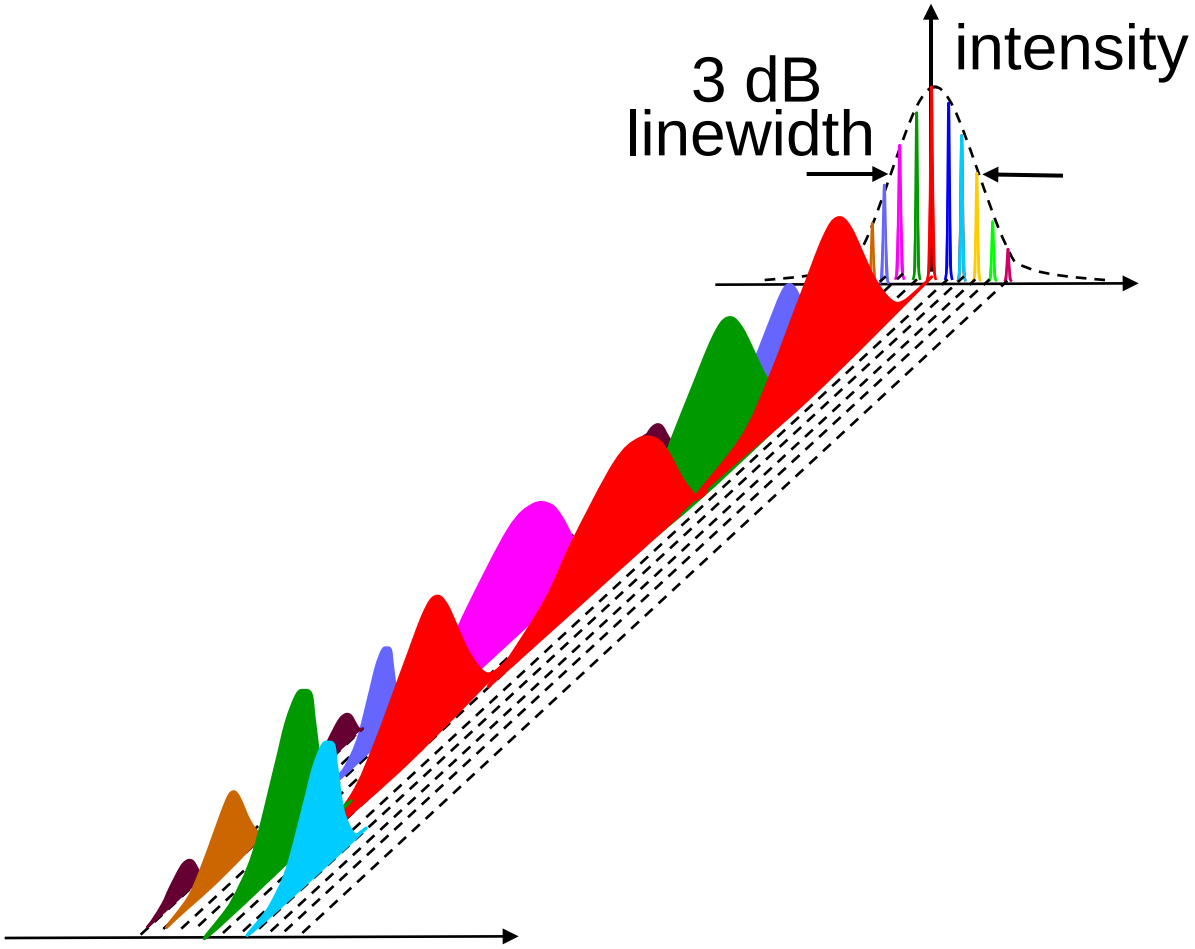

3dB
11Hz
16MHz
0
-20
-40
-60
-80
ii
iii
iv
v
vi
vii
0
4
8
12
16
20

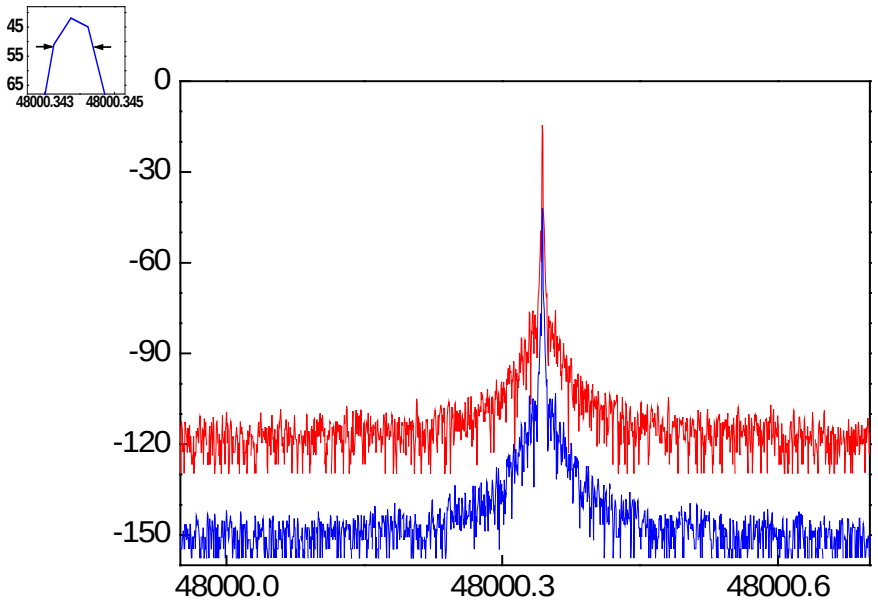


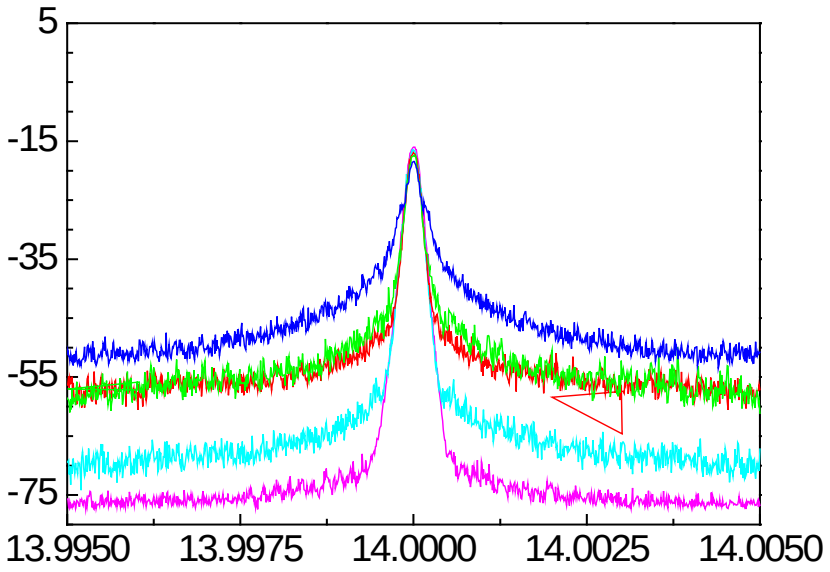

0
-20
-40
-60
-80
0
4
8
12
16
20



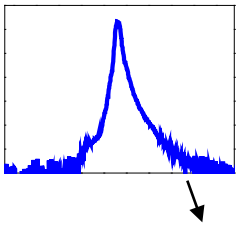

3 dB
linewidth
intensity

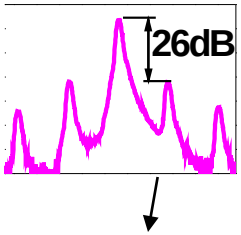

3 dB
linewidth
intensity


45
55
65
48000.343
48000.345
0
-30
-60
-90
-120
-150
48000.0
48000.3
48000.6

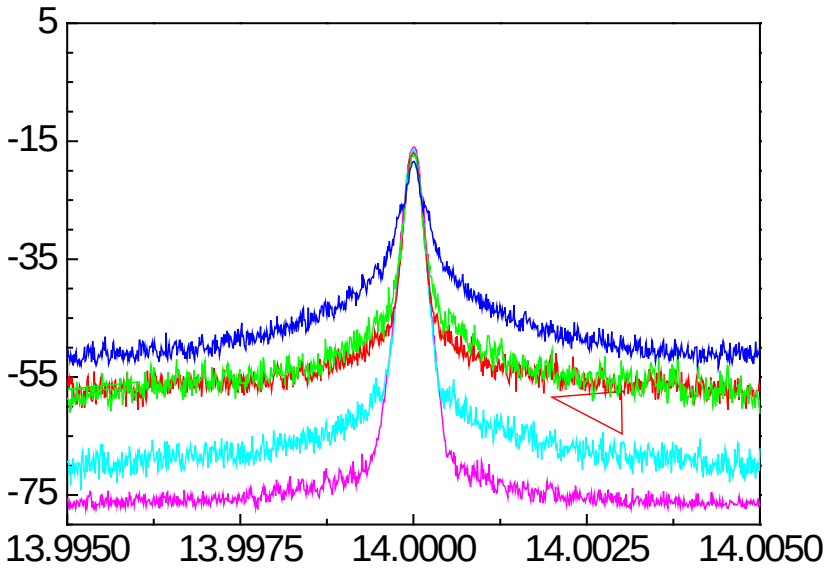

5
-15
-35
-55
-75
13.9950
13.9975
14.0000
14.0025
14.0050

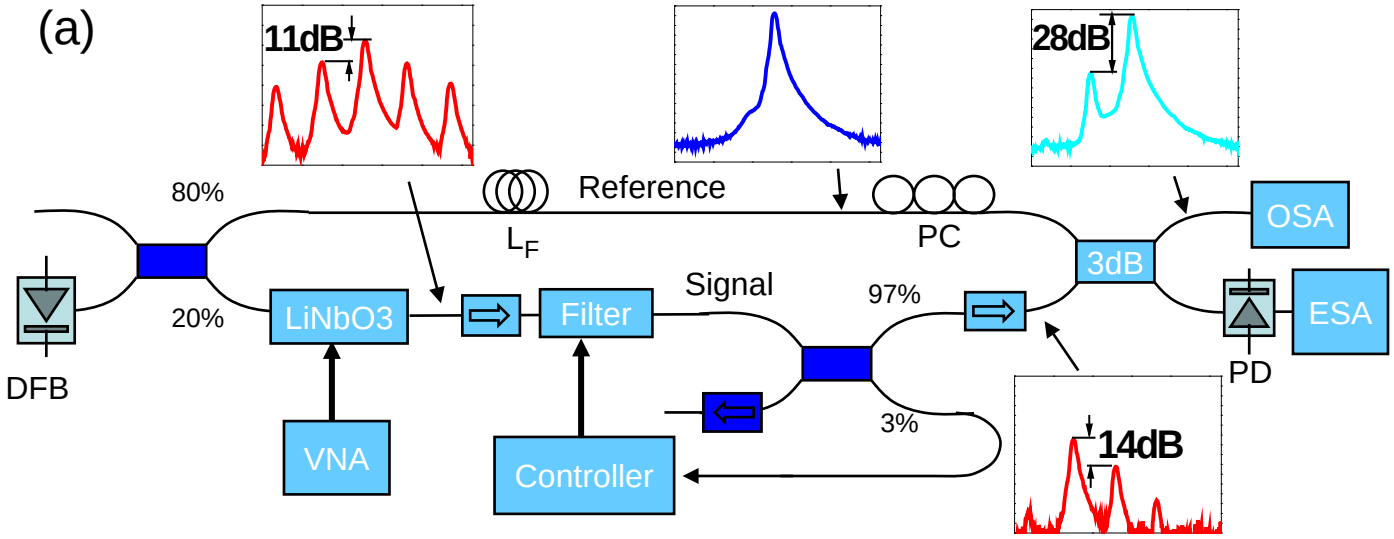
(a)

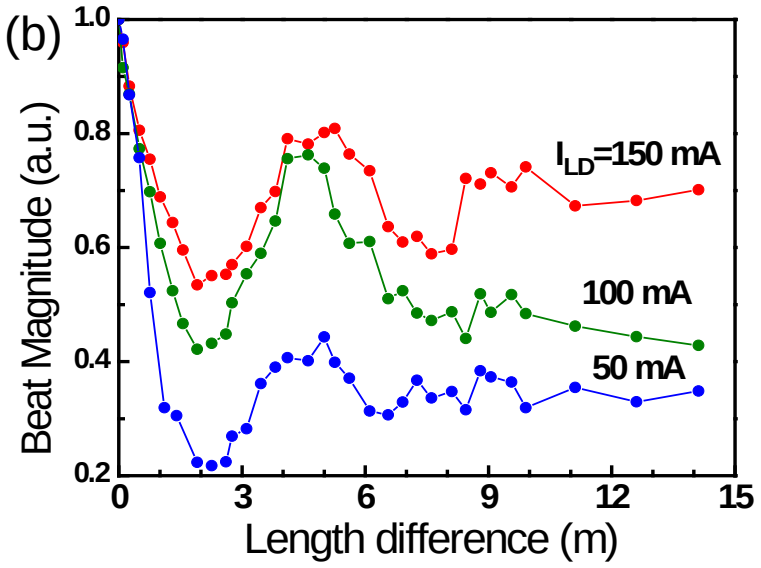




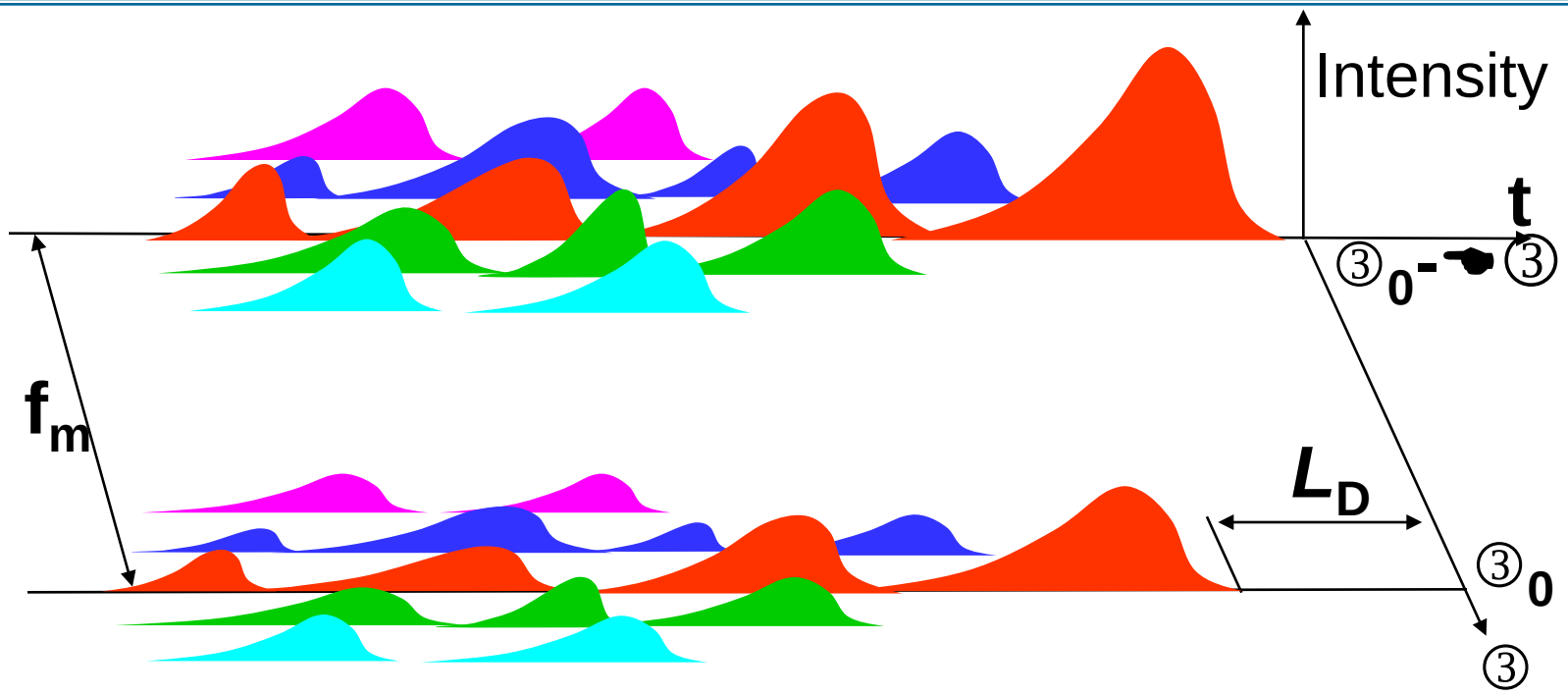
11dB

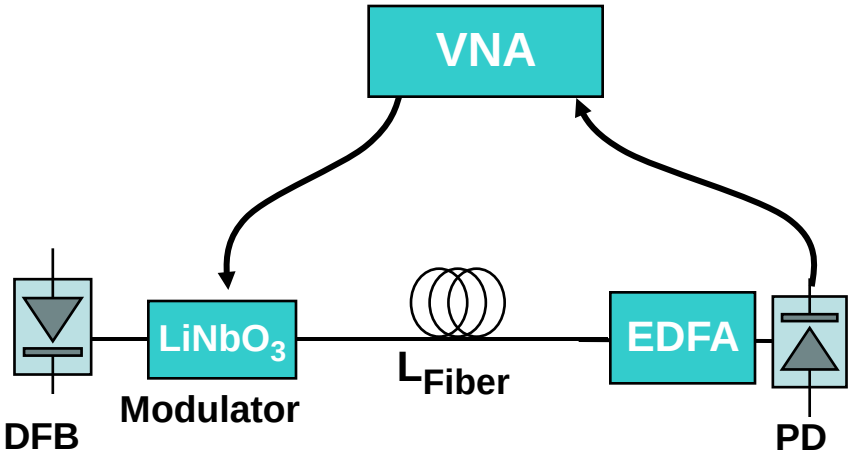


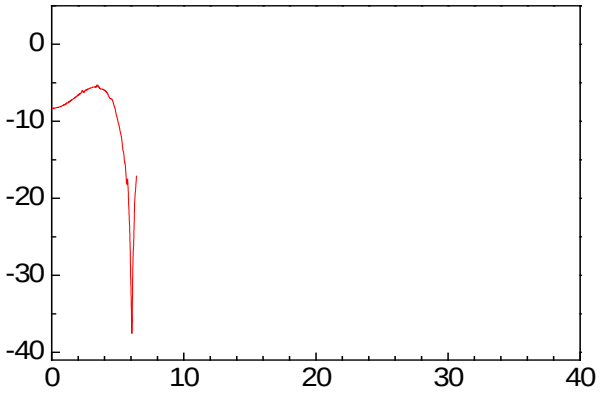

(a)
11dB
28dB
14dB
80%
20%
Reference
L_F
PC
OSA
3dB
ESA
PD
DFB
LiNbO3
Filter
Signal
97%
3%
VNA
Controller

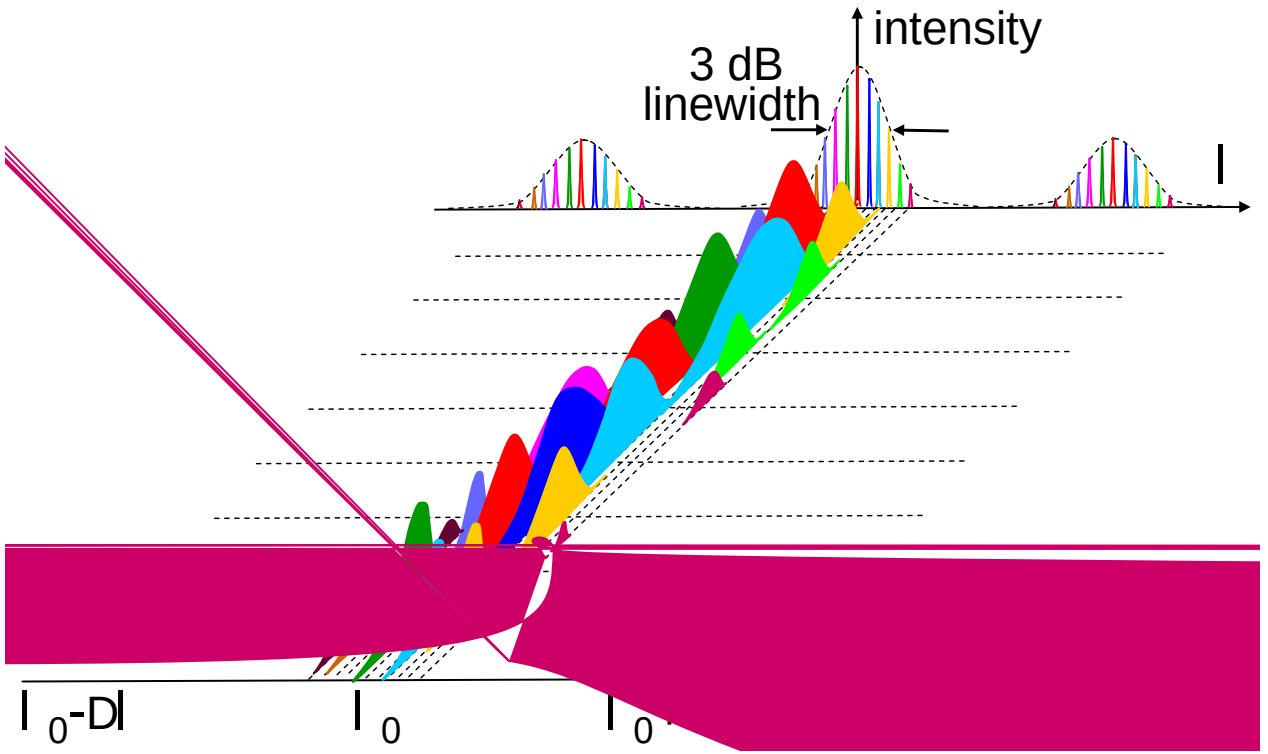

(b)
Beat Magnitude (a.u.)
Length difference (m)
I_{LD}=150 mA
100 mA
50 mA
1.0
0.8
0.6
0.4
0.2
0
3
6
9
12
15

seeding

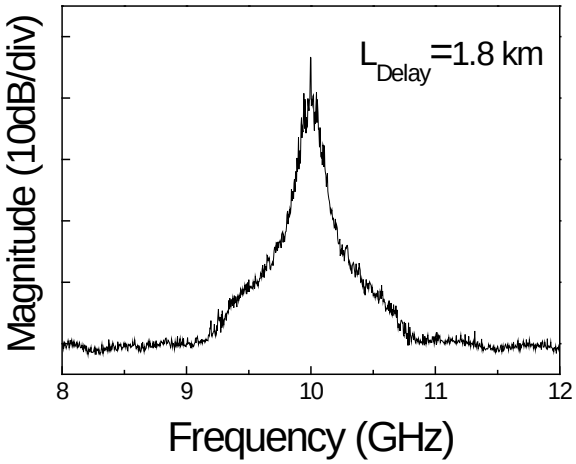

Intensity
t
f_m
L_D

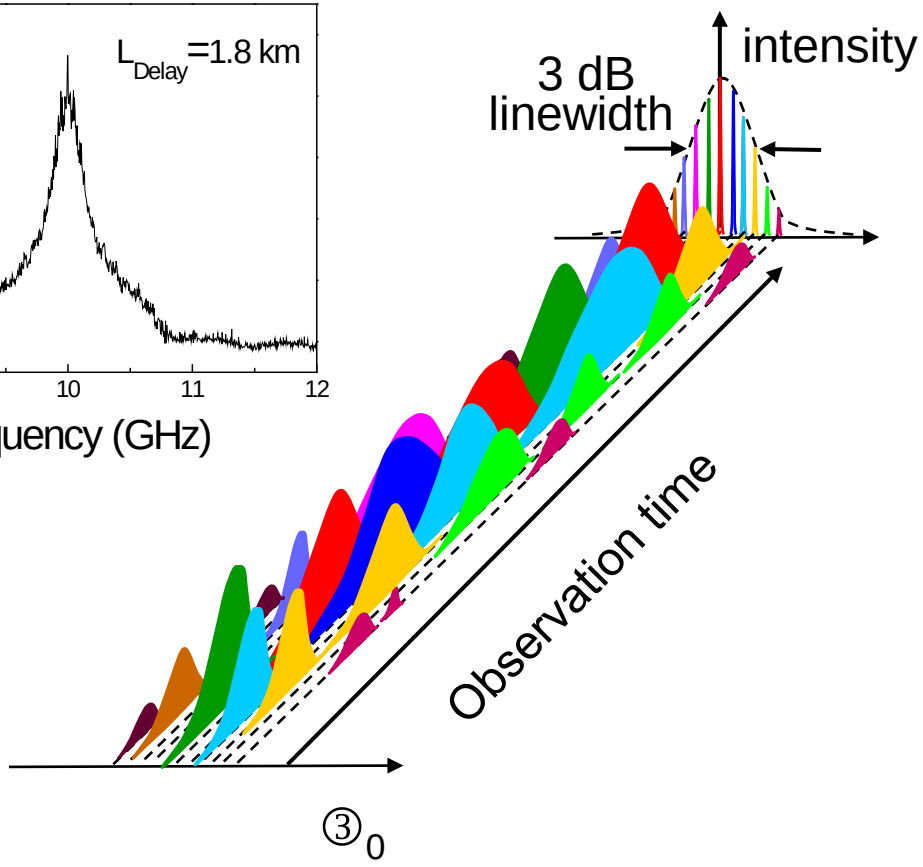

VNA
LiNbO3
Modulator
DFB
LFiber
EDFA
PD


0
-10
-20
-30
-40
0
10
20
30
40

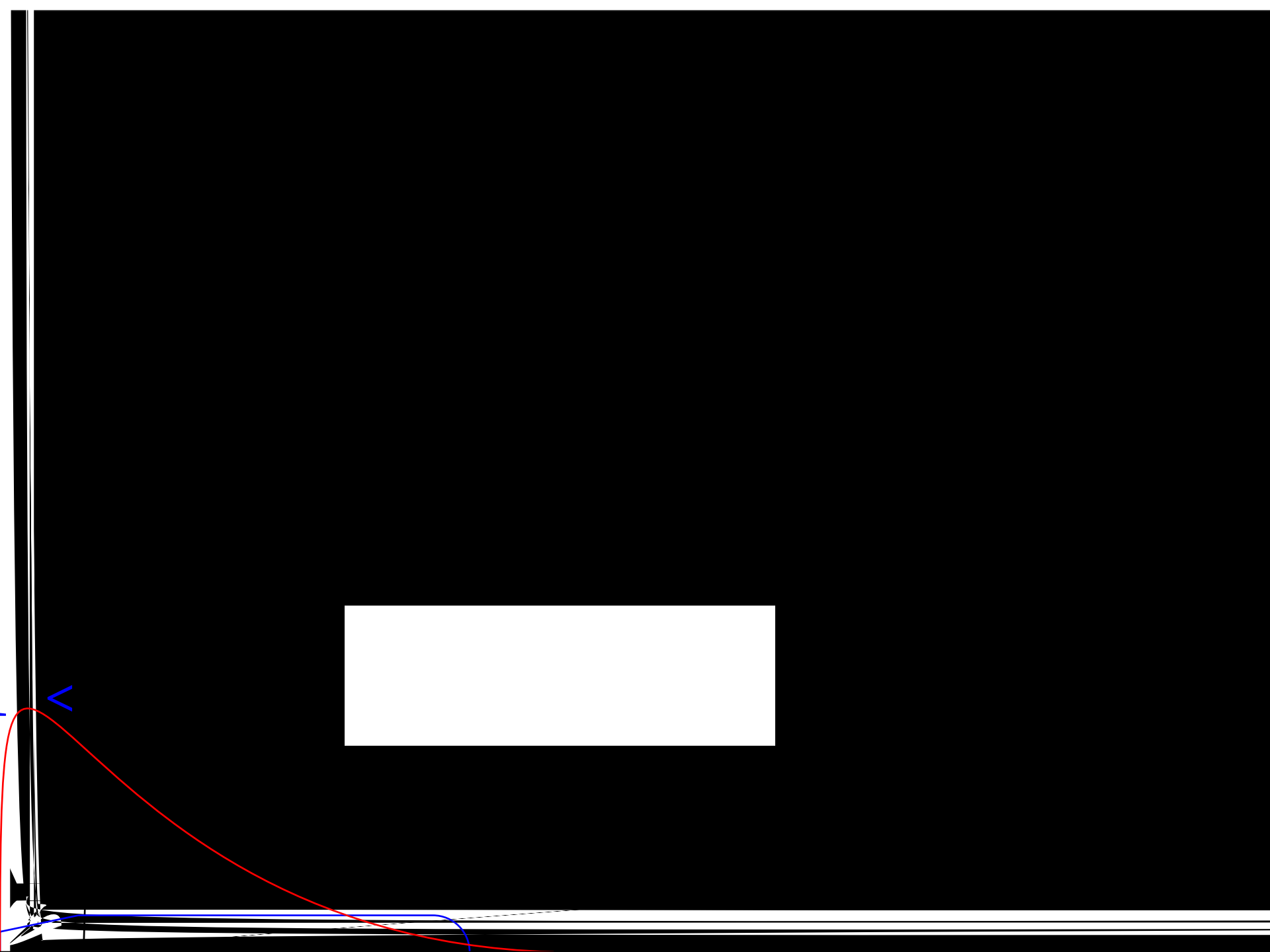


N.H.Zhu, et al., "Hyperfine spectral structure of semiconductor lasers," **Physical Review A**, 76, 063821, 2007





N.H.Zhu, et al., "Lineshape analysis of the beat signal between optical carrier and delayed sidebands," IEEE J. Quantum Electron., 46, 3, 347-353, 2010



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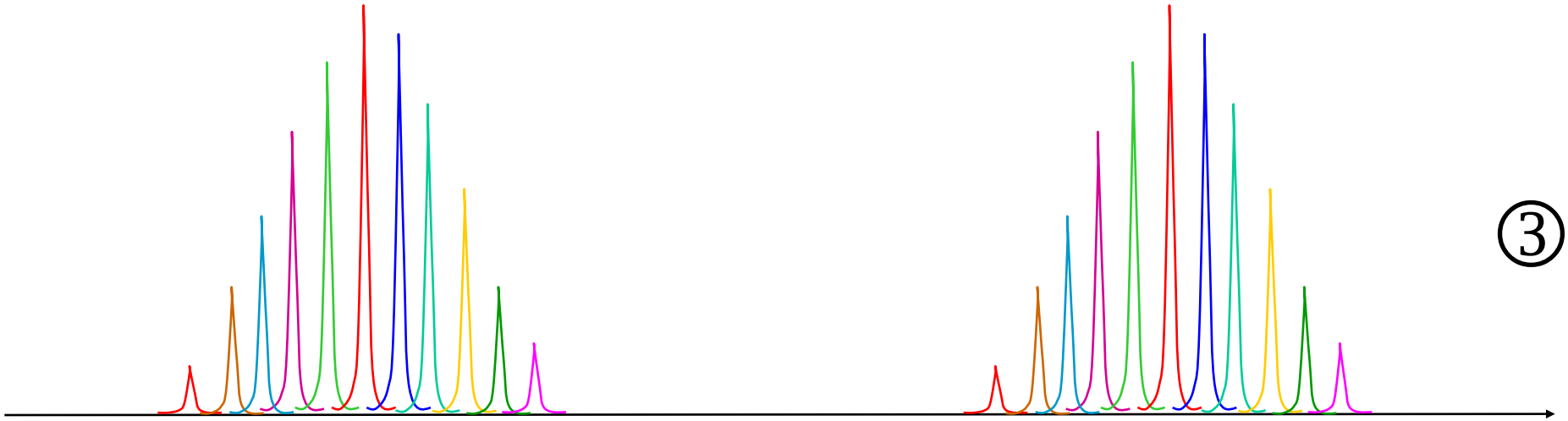
- L. Mandel and E. Wolf, “Coherence Properties of Optical Fields,” Rev. Mod. Phys. vol. 37, pp. 231-287, 1965
- L. Mandel and E. Wolf, “Spectral coherence and the concept of cross-pectral purity,” J. Opt. Soc. Am., vol. 66, pp. 529-535, Jun. 1976

The coherence in the space-frequency domain means the interference of two lightwaves of the same frequency at different points.

$$g(w_1, w_2, t) = \int_0^{+\infty} f_a(w_1, t)\, f_b(w_2, t)\, dw$$

③



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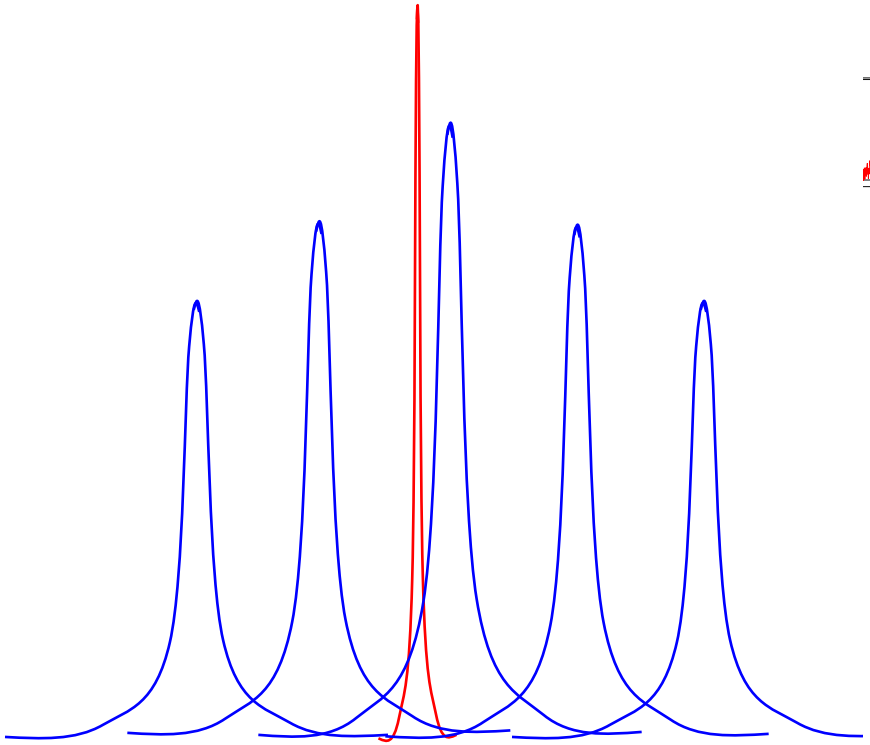
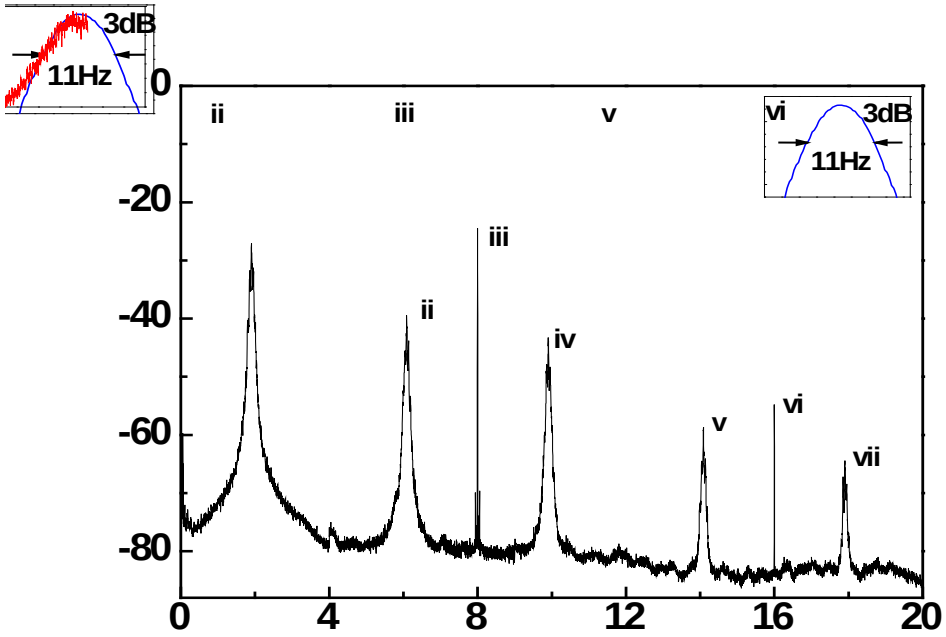
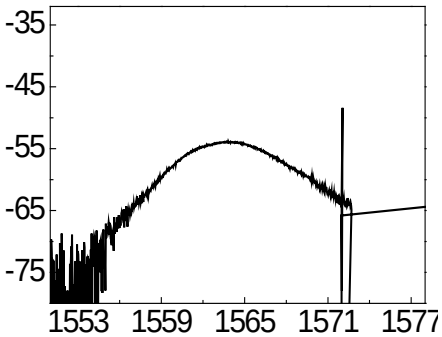
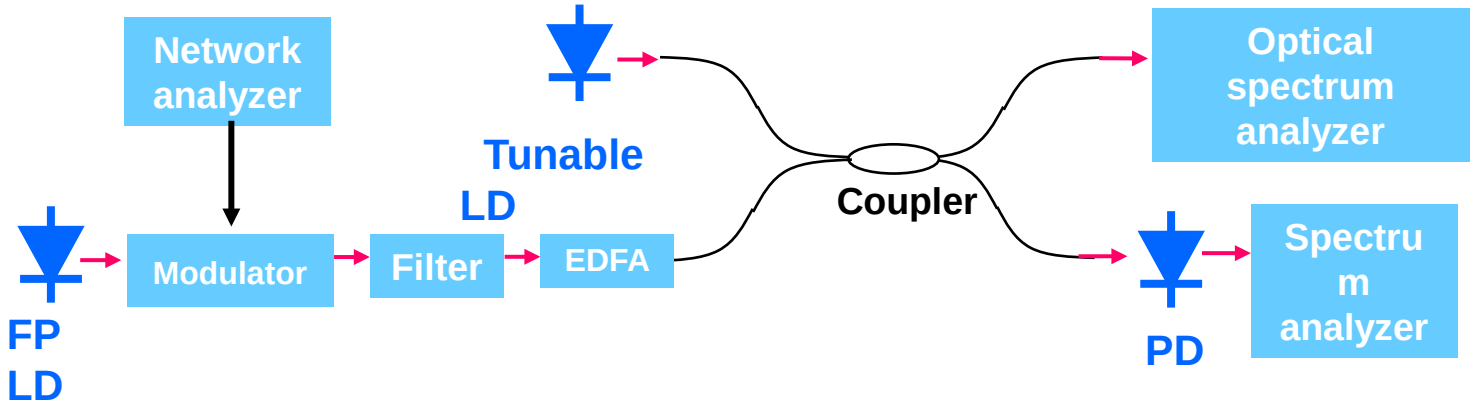



3dB
11Hz
0
-20
-40
-60
-80
ii
iii
v
vi
3dB
11Hz
iii
ii
iv
v
vi
vii
0
4
8
12
16
20


-35
-45
-55
-65
-75
1553
1559
1565
1571
1577

Optical spectrum analyzer
Coupler
FP LD
PD

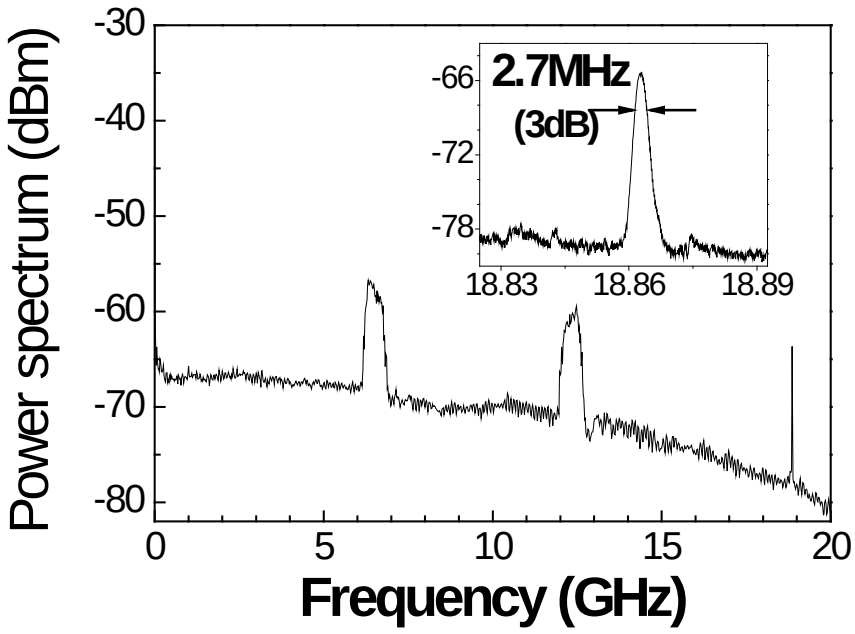


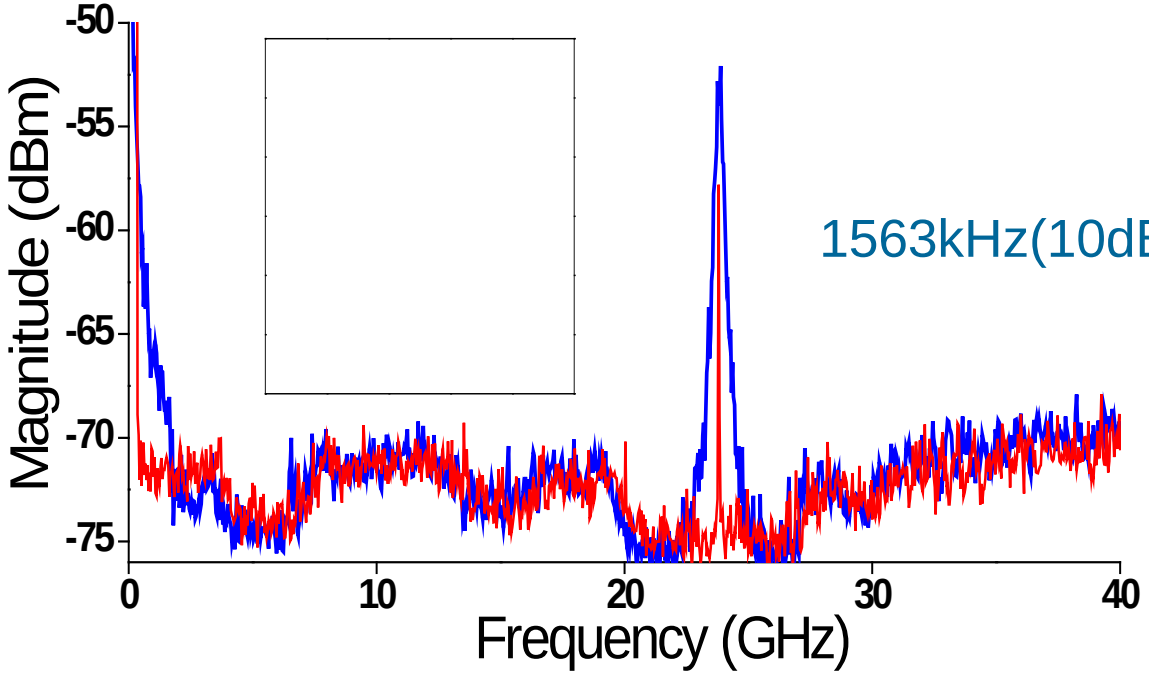
178.86GHz

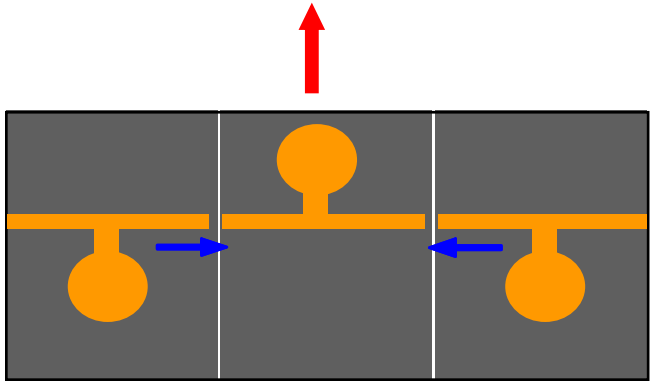
40GHz

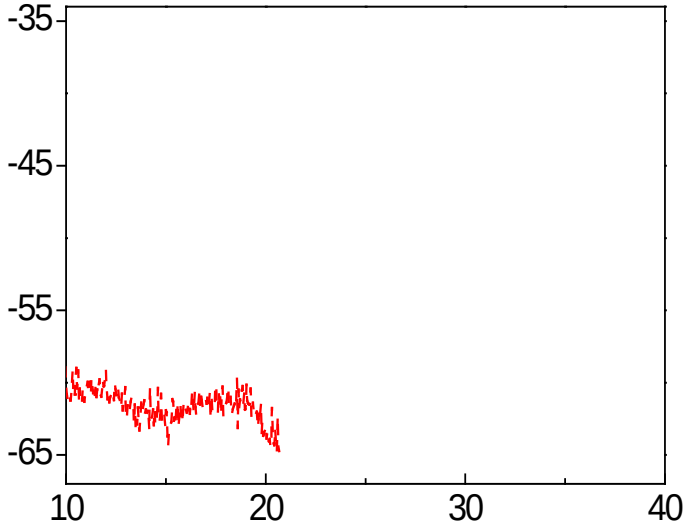
18.86GHz

FP FP




-50
-55
-60
-65
-70
-75
Magnitude (dBm)
0
10
20
30
40
Frequency (GHz)
1563kHz(10dB)





N.H.Zhu, et al., “Microwave generation in an electro-absorption modulator integrated with a DFB laser subject to optical injection,” *Optics Express*, vol.17, no.24, 2009.

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- 100km
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