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CThC7 25 nJ Passively Mode-Locked Fiber Laser at 1080 nm

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CThC7
25 nJ Passively Mode-Locked Fiber Laser at 1080 nm

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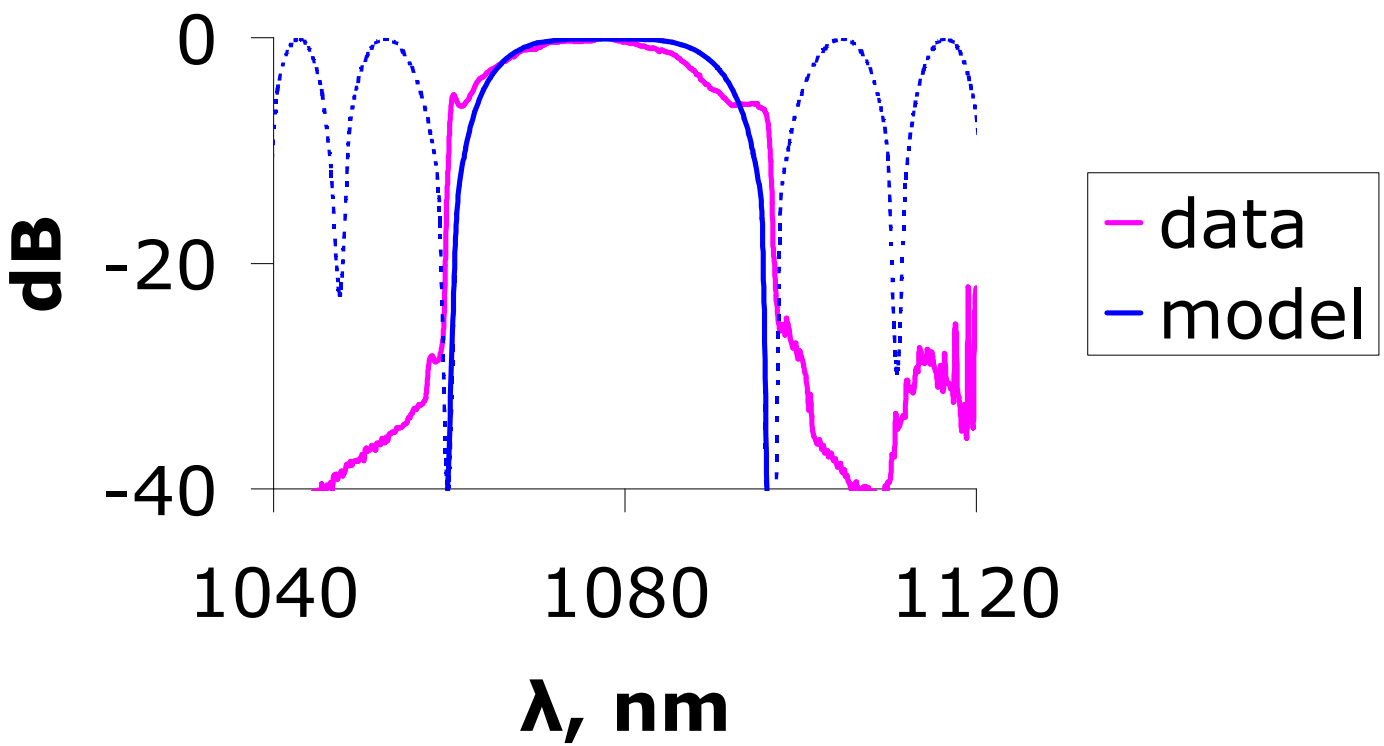
25^{+} nJ Fiber-Based Oscillators

- Exceeds current reports by 2×
- Two cladding-pumped designs:
  - Conventional & grating-less

Nonlinear Jones Matrix Analysis

- Fiber acts as single-order half-wave switch
  - Stolen, Optics Lett **7** 512 (1982)
  - Man, JOSA B **17** 28 (2000)
- Parameters:
  - Fiber: L = 8 m, MFD = 6 μm
  - Pulse: 25 nJ, 150 fs

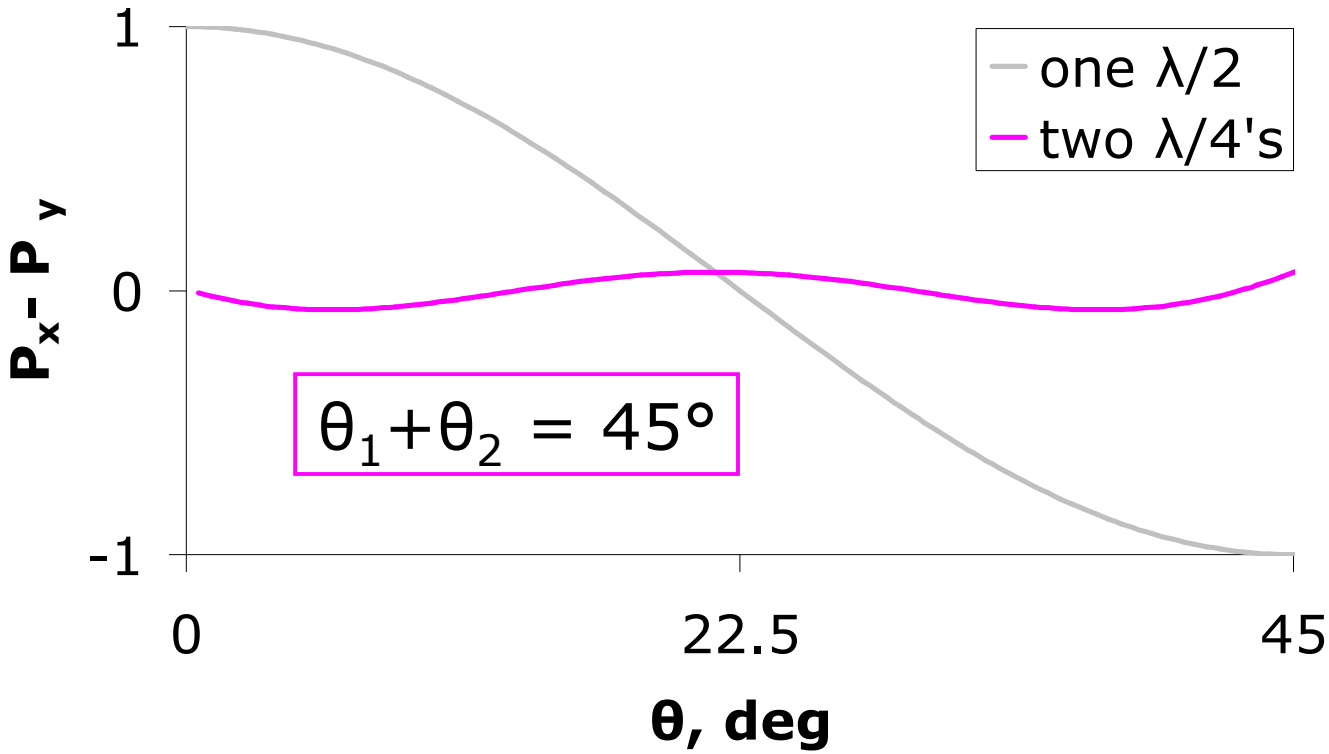
Analysis: T vs. λ



λ-plates encourage parabolic* spectrum

* Fermann, Phys Rev Lett **84** 6010 (2000)

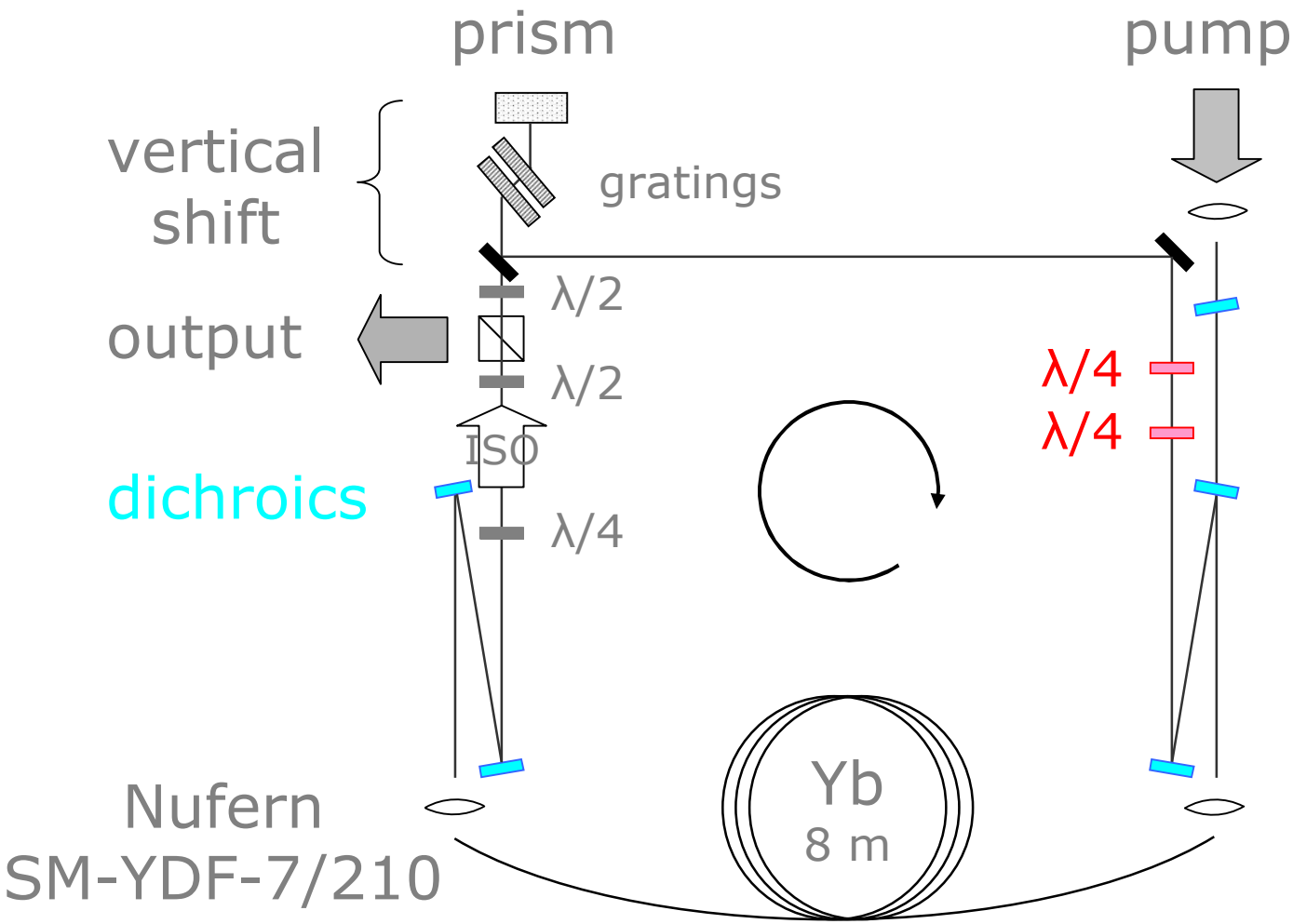
Analysis: Dual λ/4's



Dual λ/4's improve sensitivity by 5×

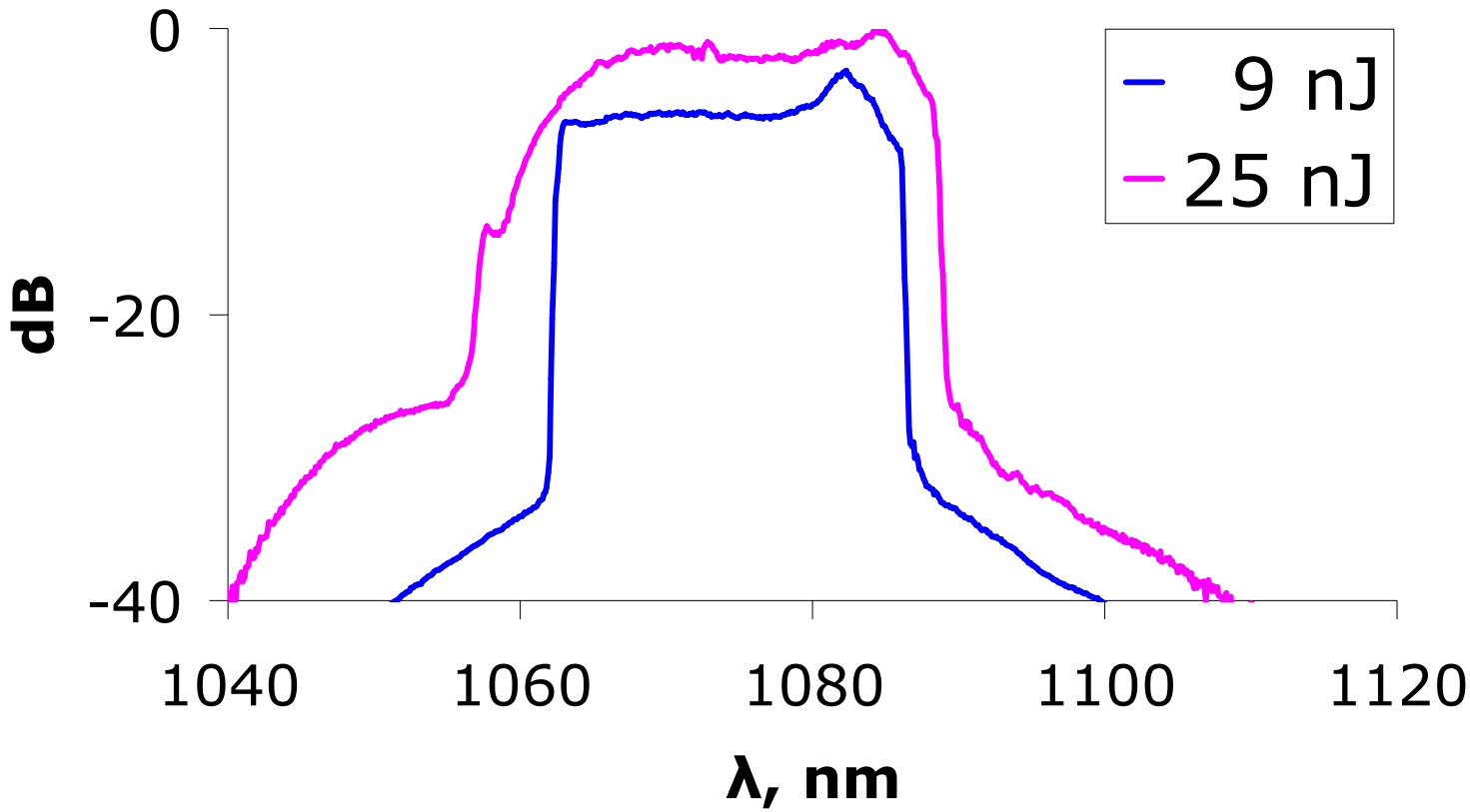
(also used by others)

Oscillator 1

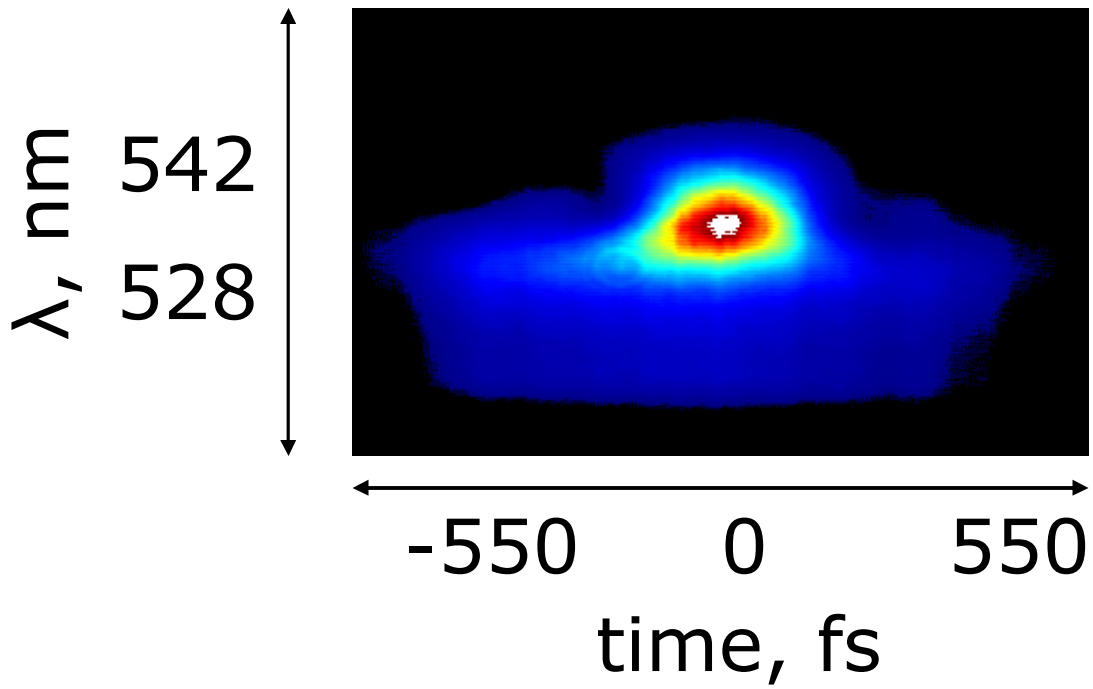


Pulse Spectra

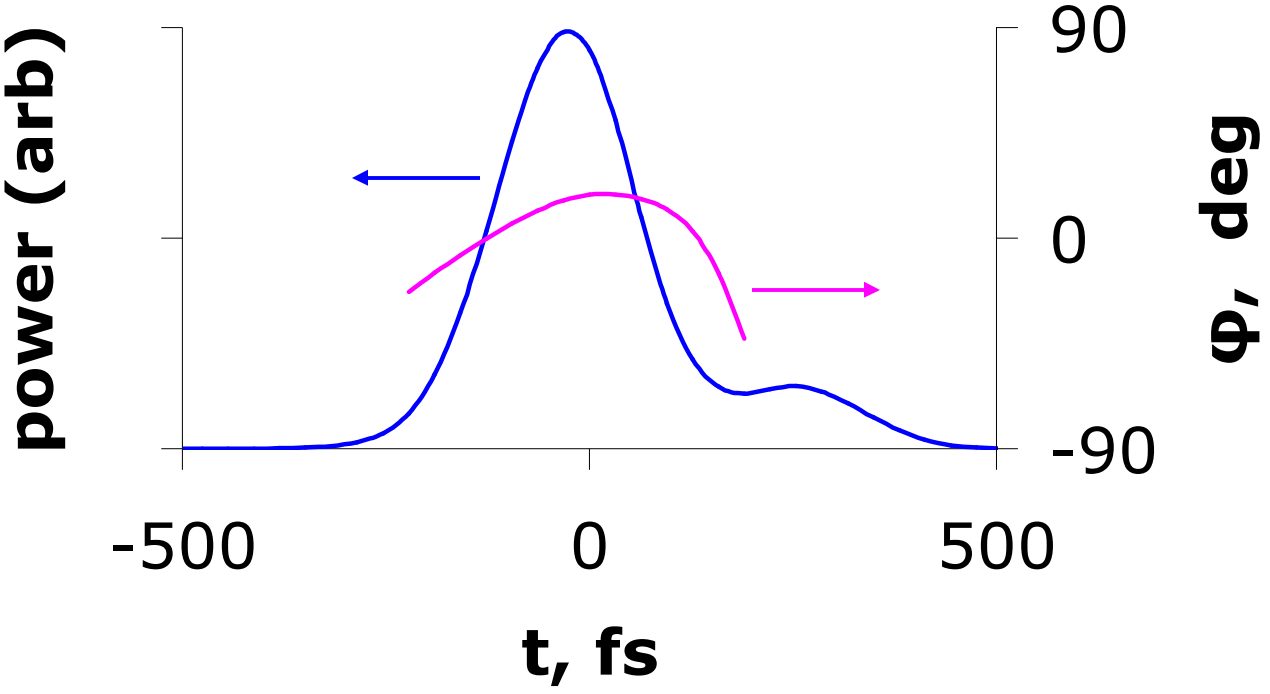
f = 16.7 MHz



25 nJ Compressed Pulse (FROG)

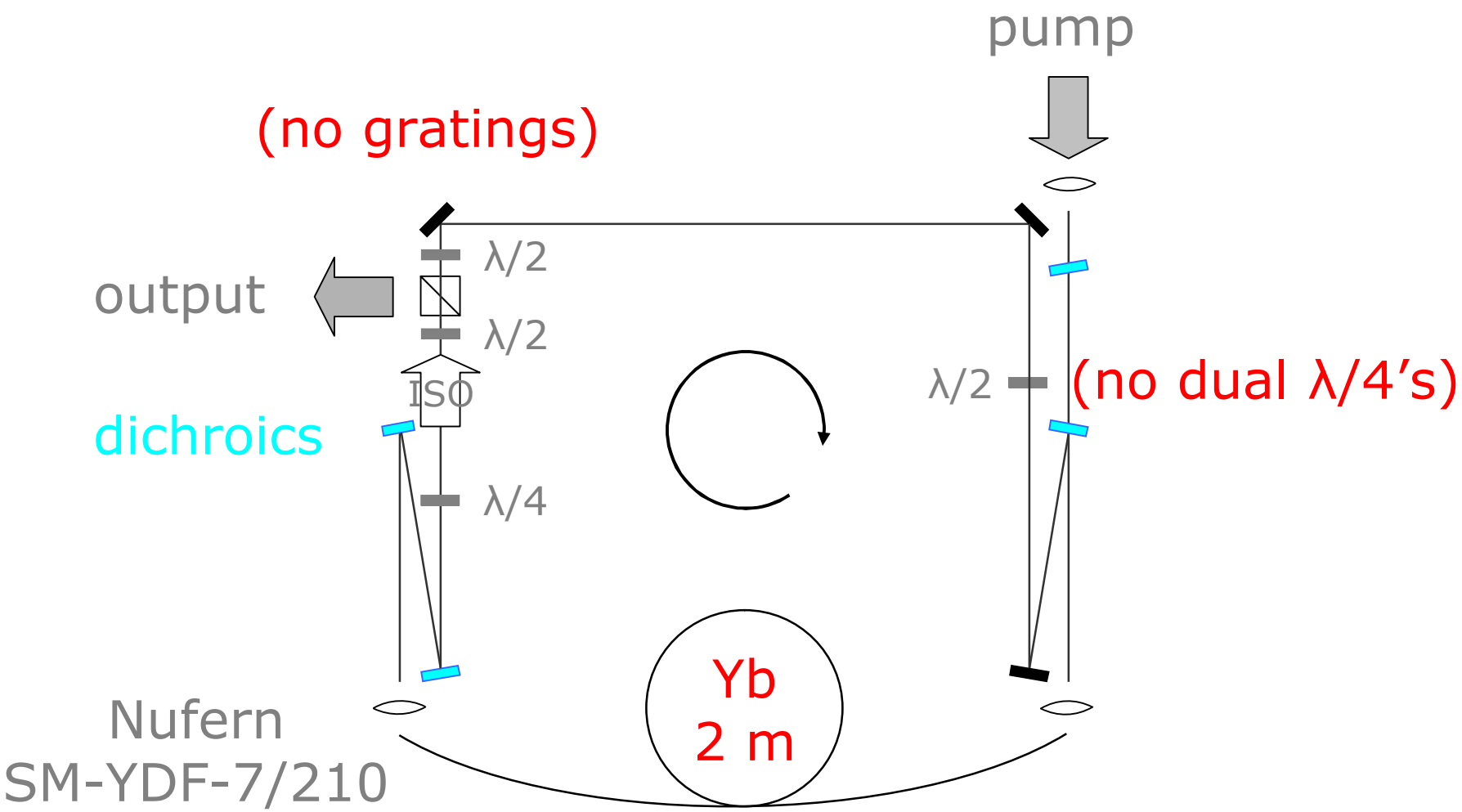


25 nJ Compressed Pulse



Δt = 120 fs, bandwidth limited

Oscillator 2

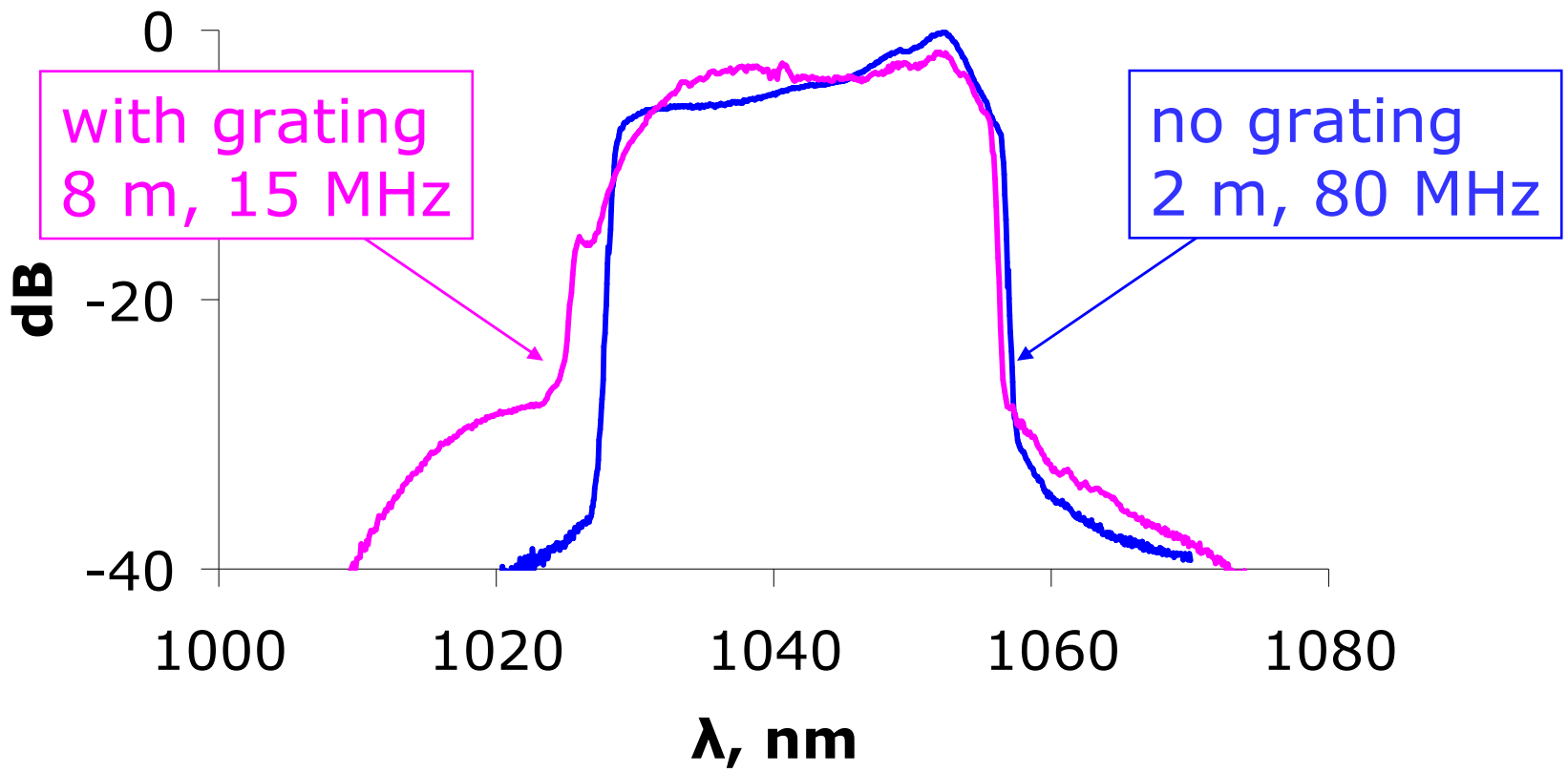


No Gratings…

- Why *can* we?
  - Uncomp'd length similar to other reports
    - Buckley et al, Opt Lett **30** 1888 (2005)
  - Ample pump power (up to 70 W)

- Why *do* we?
  - Reduced loss & complexity
  - Shorter fiber relaxes $\lambda/2$ alignment by 5×

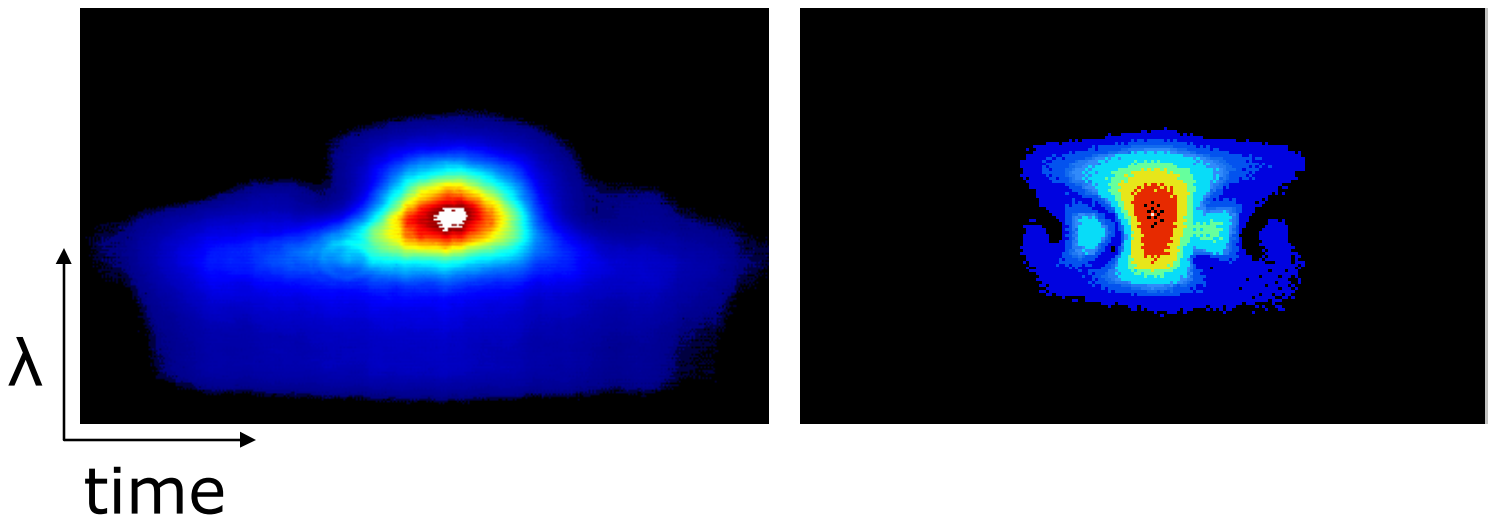
25 nJ Pulse Spectra



25 nJ Compressed Pulses (FROG)

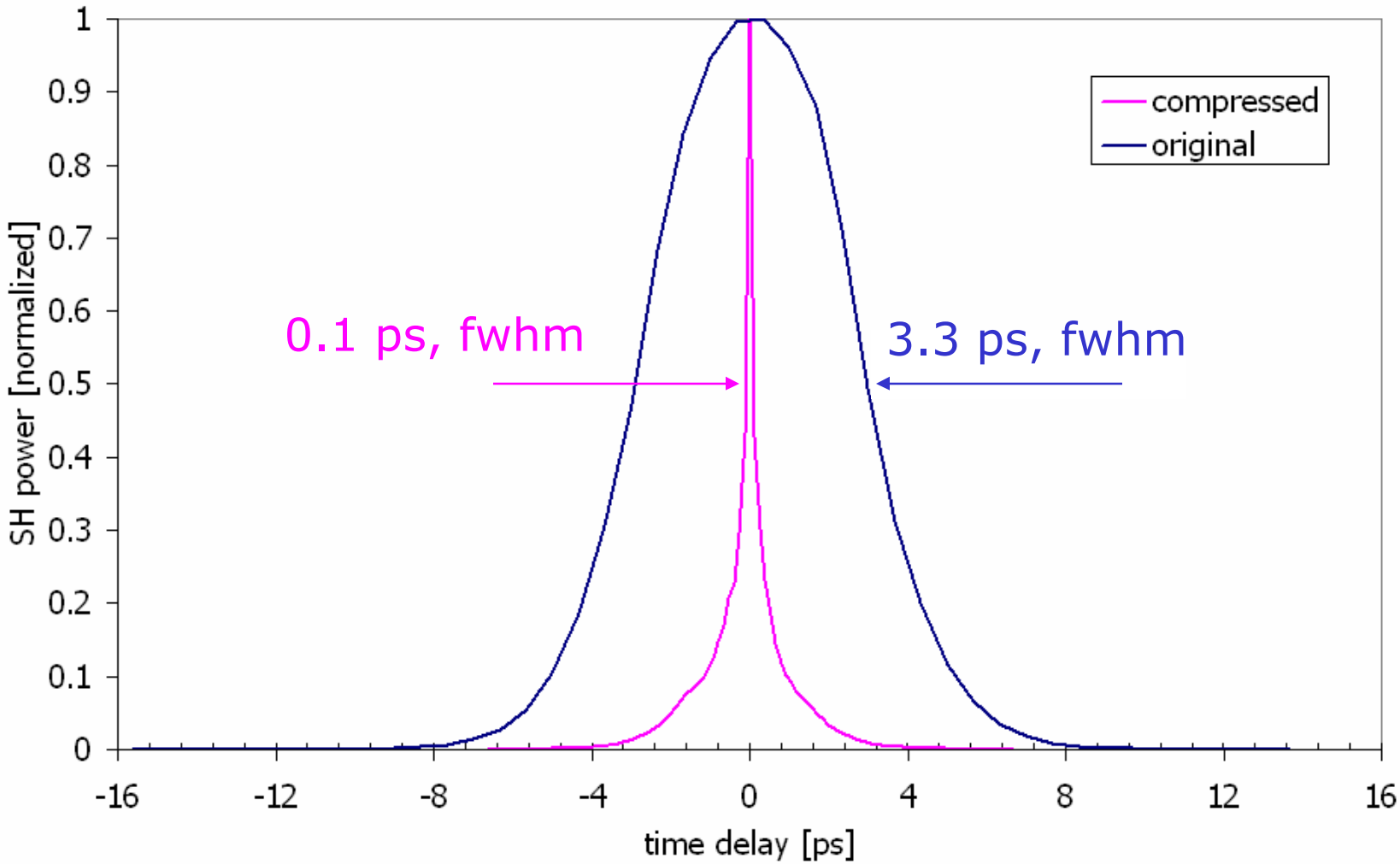
8 m Yb
with gratings in oscillator

2 m Yb
without gratings in oscillator



Δt = 100 fs, bandwidth limited

Autocorrelation Traces



Summary

- 25^{+} nJ pulses from 2 designs
  - 2× higher than current reports
- Conventional:
  - 8 m Yb, with gratings, dual λ/4's
  - un-compensated fiber length ~ 2 m
- Grating-less:
  - 2 m Yb, no gratings in oscillator
  - next step: increase absorption