Chirped-pulse WDM

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Applications

Telecom

- Mux/Demux

Analog-to-Digital Conversion

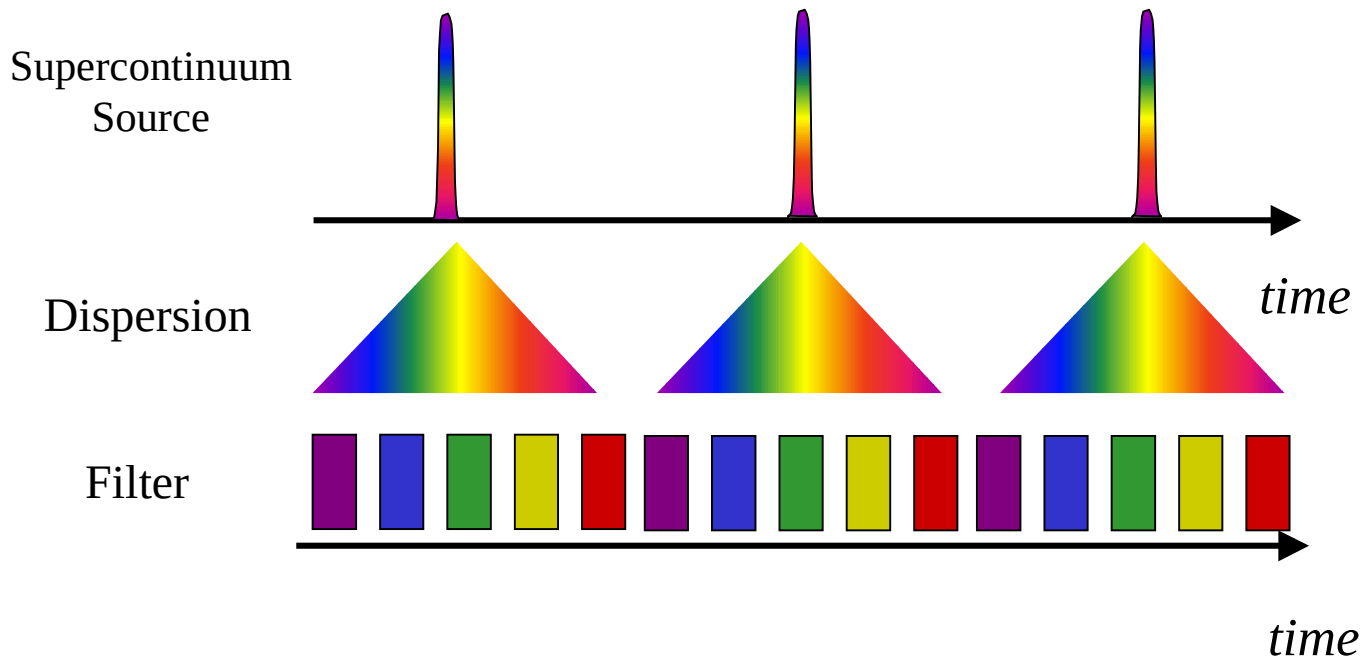
- Sampler
- Time Stretch

Spectroscopy

- Time domain spectral measurements

Other?

Spectral Slicing of Chirped Supercontinuum Pulses



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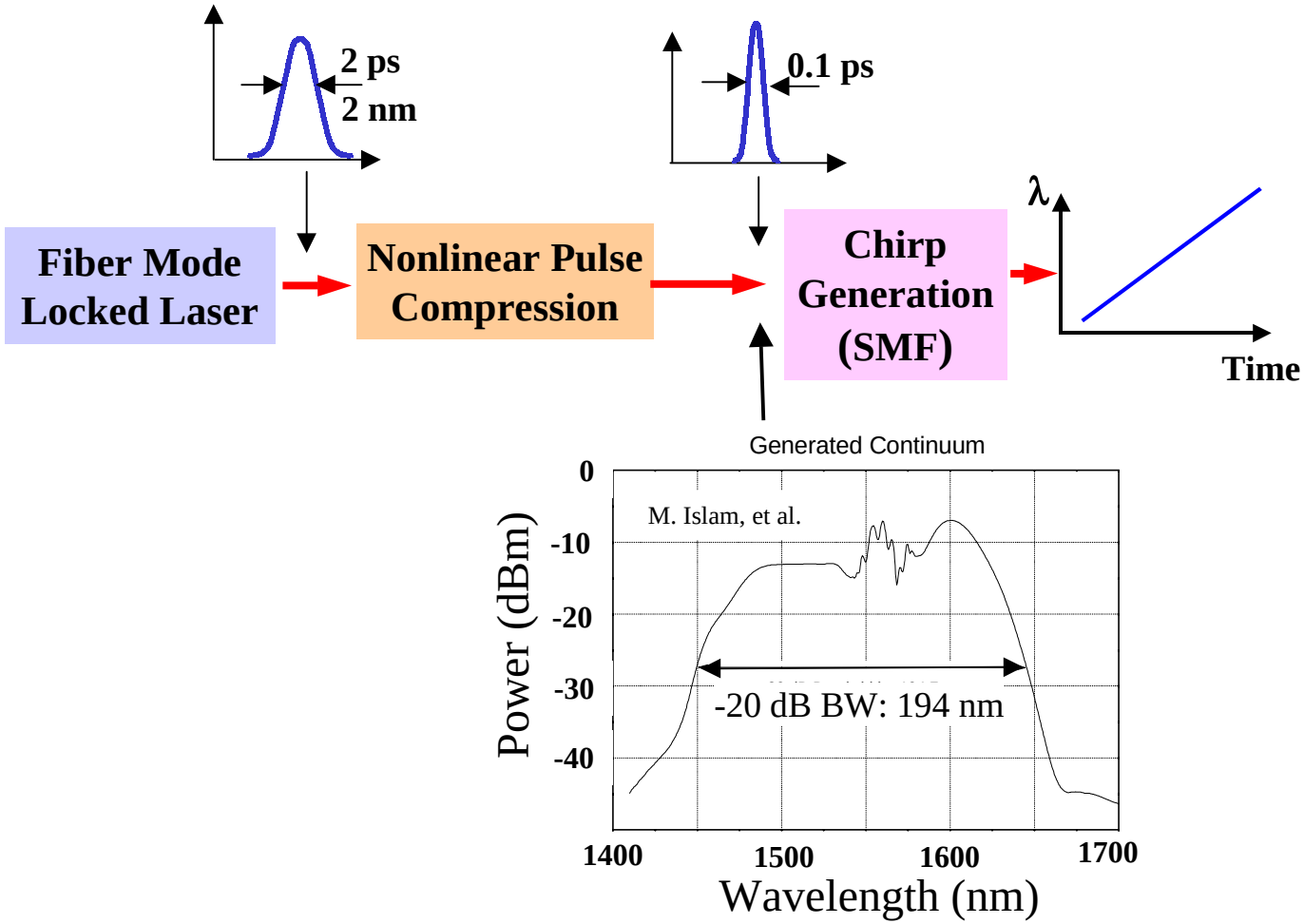
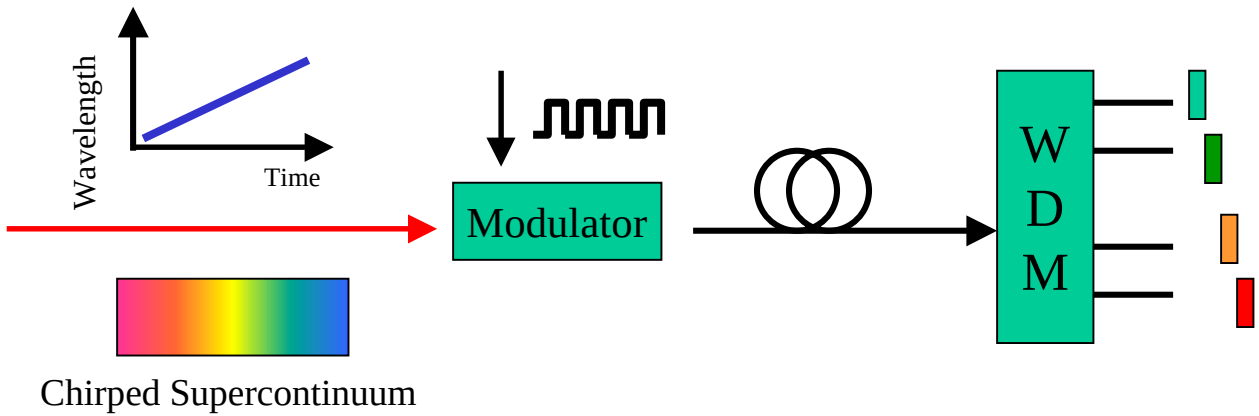
Supercontinuum Generation



Chirped Pulse WDM

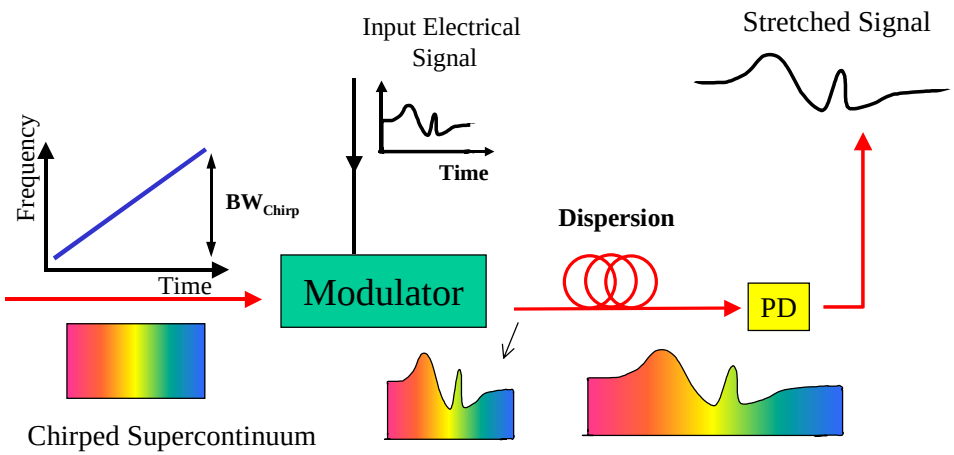


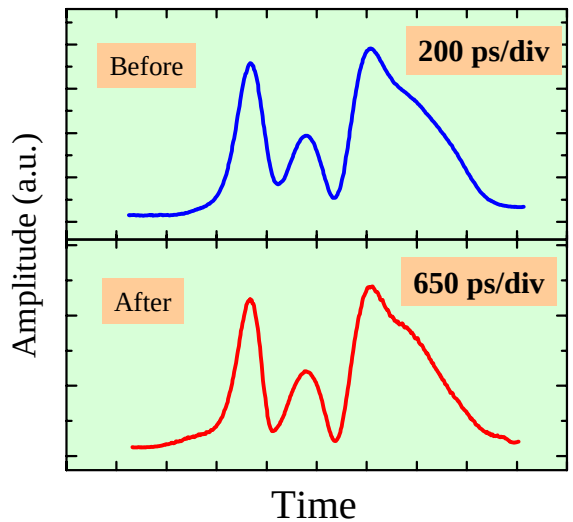
Multiplexing / Demultiplexing:

•Morioka, T.; Kawanishi, S.; Takara, H.; Saruwatari, M. *Electron. Lett.*, 1994, vol.30, (no.23), pp.1959-60

•Cundiff, S.T., Knox, W.H., and Nuss, M.C. *Electron. Lett.*, 1997, **33**, (1), pp.10 – 11

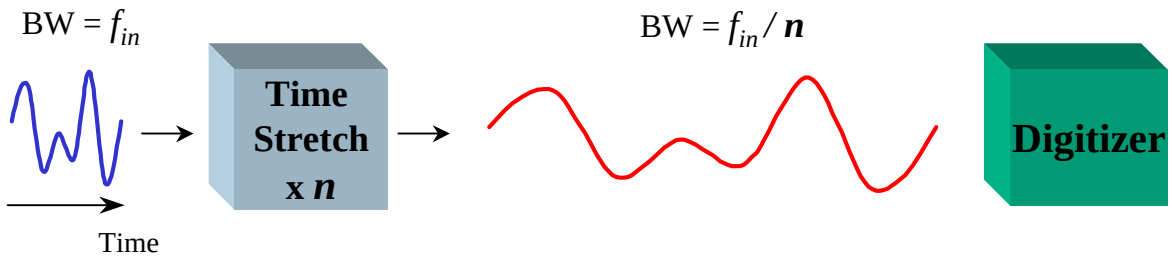
Time Stretching



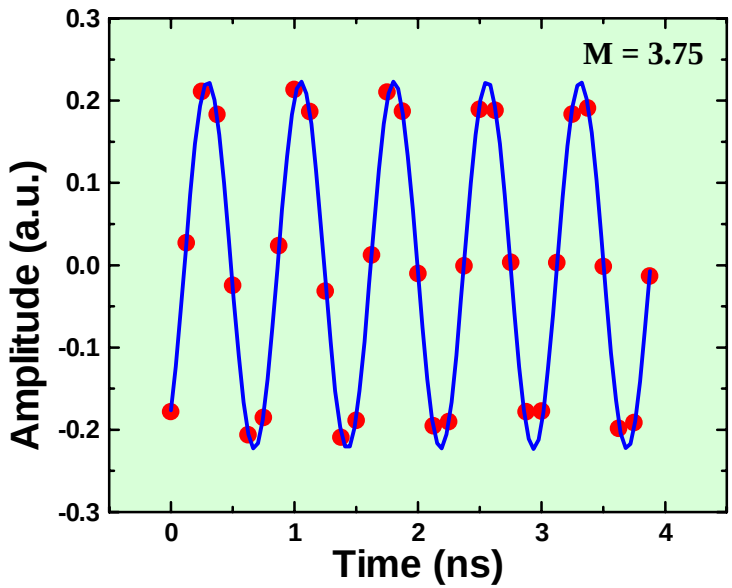


F. Coppinger, A. Bhsuah, B. Jalali, *Electronics Letters*, 34 (4), 1998.

Time Stretch ADC (TSADC)



30 GSample/s, 5 GHz input, 4 bit



A.S. Bhushan et al., CLEO 2000.

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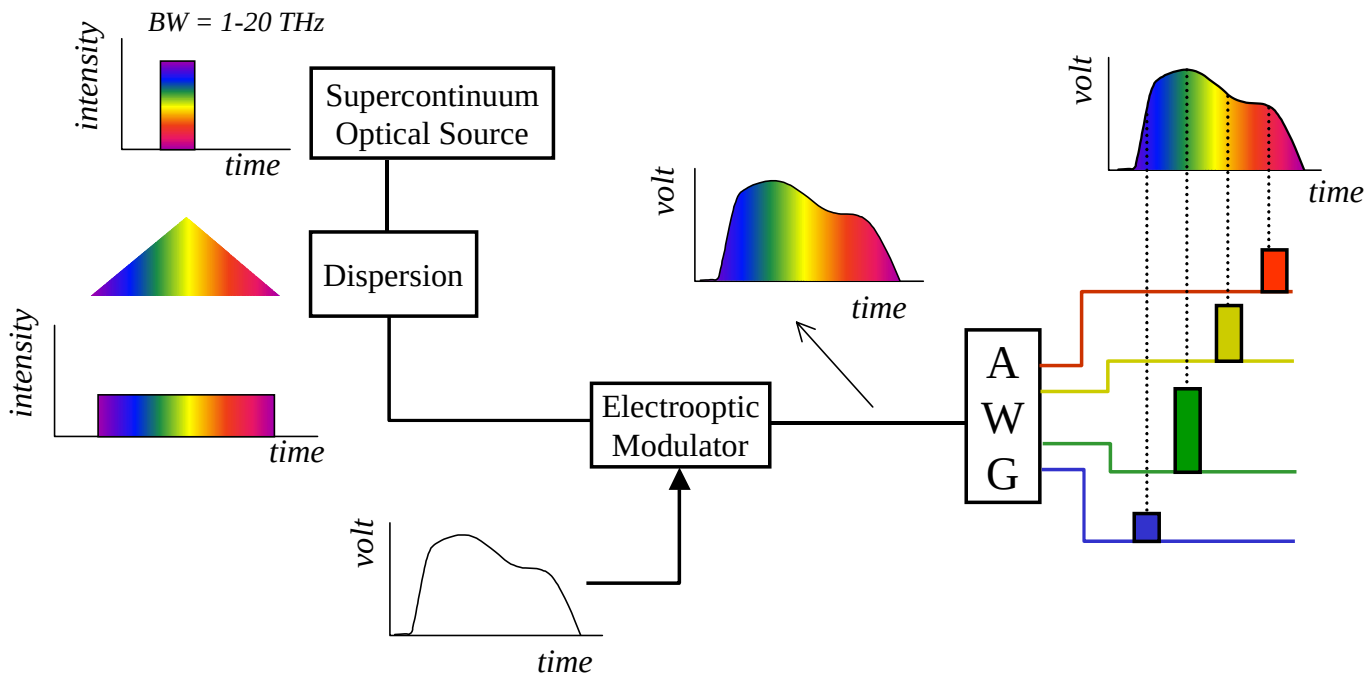
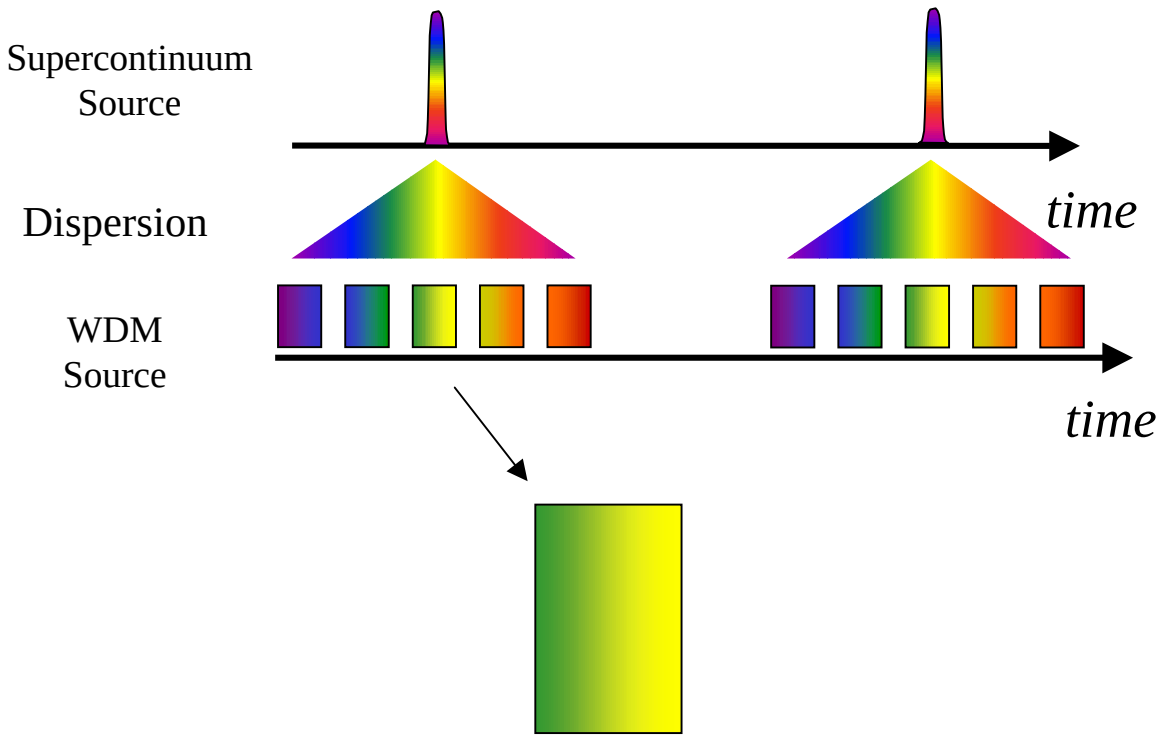
Wavelength Division Sampling



Problem with Dispersive Chirp Generation



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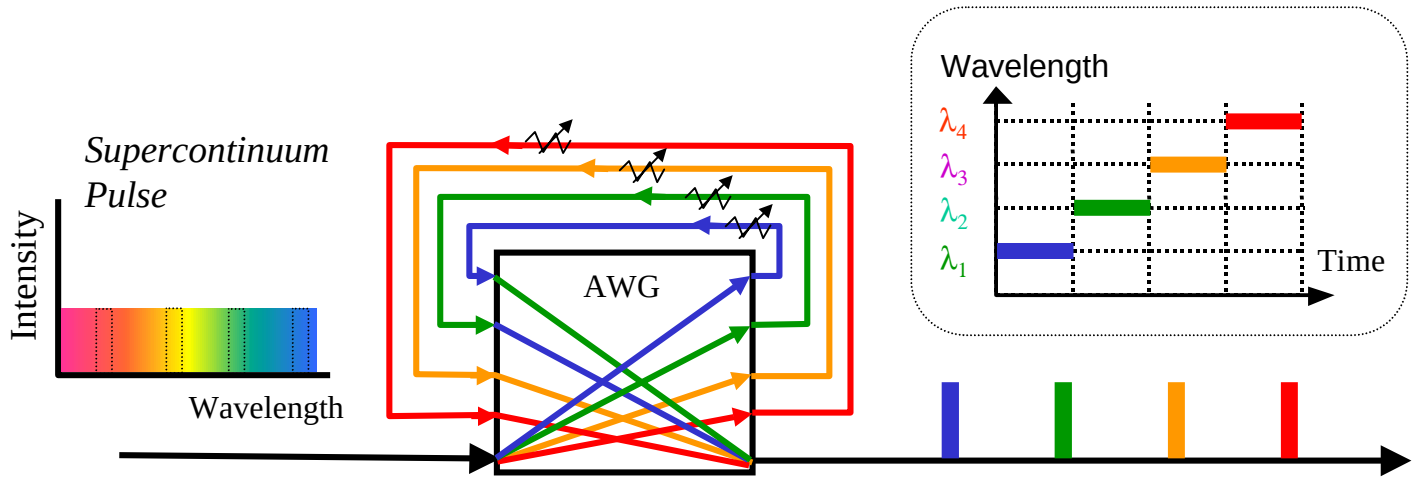
Chirp-Free WDM Source Using True Time Delay



Jalali and Yegnanarayanan, US Patent No. 5,793,907

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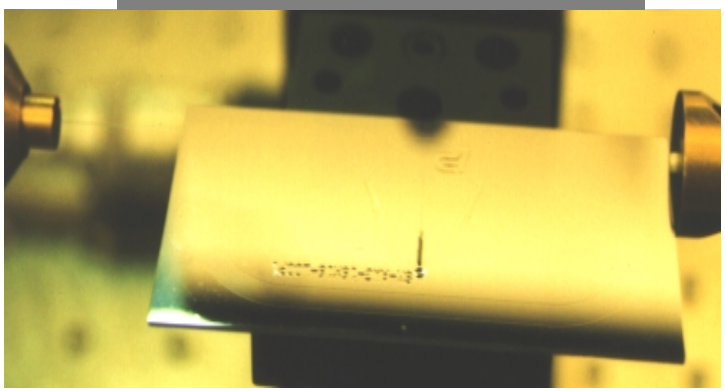
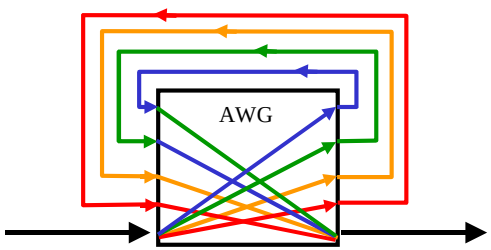
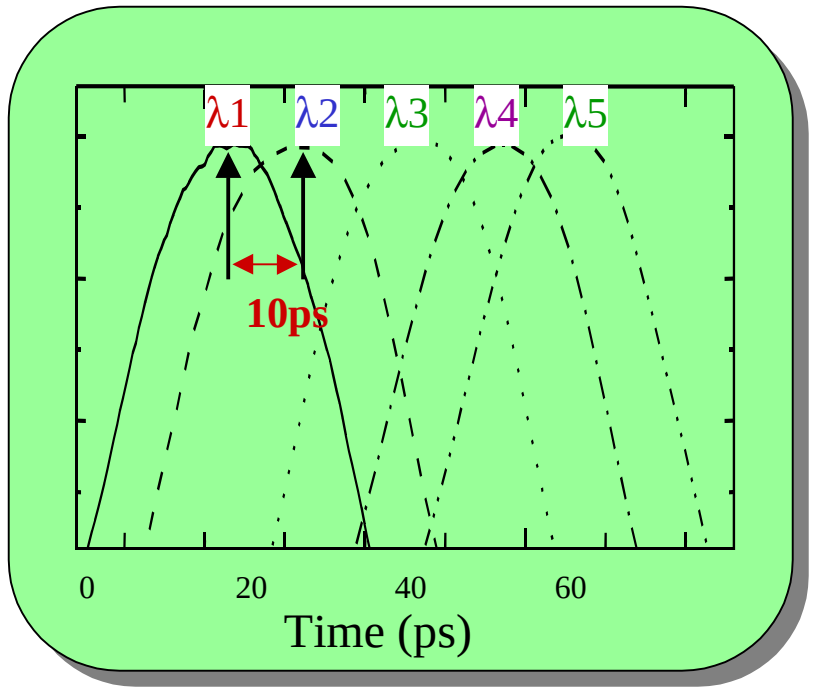
Experimental Results

- 16 Channel Filter
- Integrated Delay Lines
- 10 ps Incremental delay





100 Gbit/s



$\Delta\tau\,\Delta f = 0.49$

(Autocorrelation)

A.S. Bhushan, F. Coppinger, S. Yegnanarayanan and B. Jalali, *Optics Letters*, vol. 24, (11), 1999.

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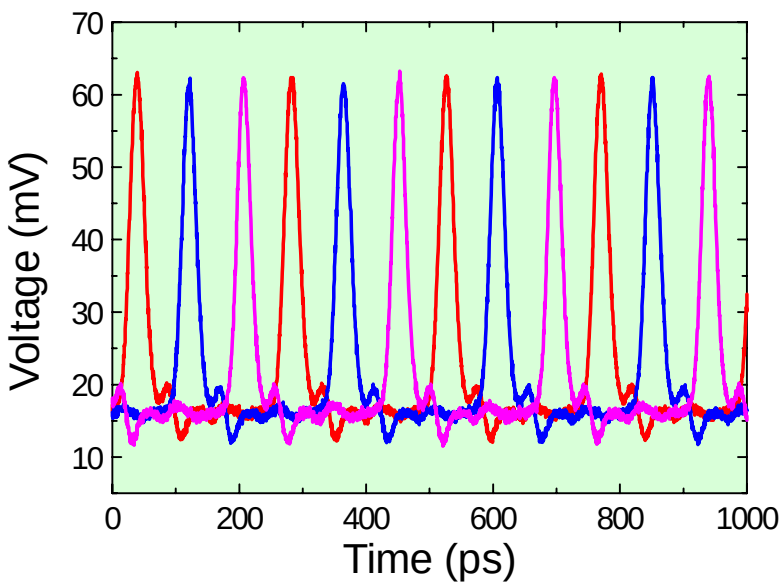
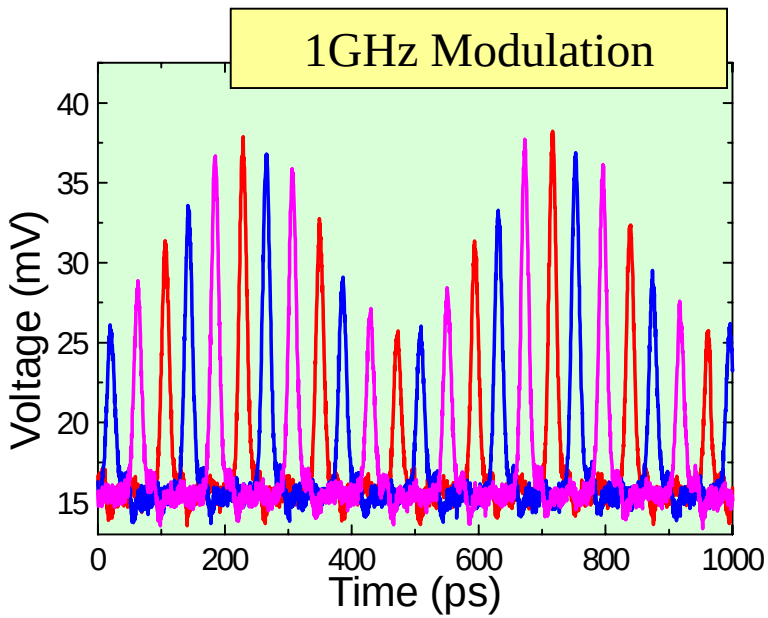
Wavelength Division Sampling

Experimental 12 Gs/s
continuous-time sampling

1547.8nm
1548.6nm
1549.4nm



1GHz Modulation



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12 Gsample/s Wavelength Division ADC

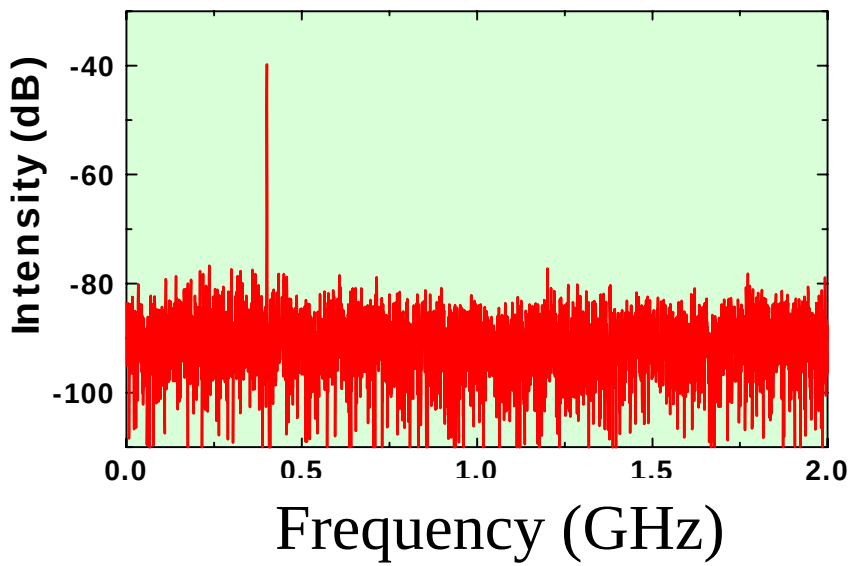
Modulation Frequency: 3600MHz

Aliased peak 400MHz

SFDR: 40dB

SNR: 32dB (5 bits)

FFT of one channel of digitized data



F. Coppinger, A.S. Bhushan, B. Jalali, IEEE Microwave Photonics Conference, MWP 1999

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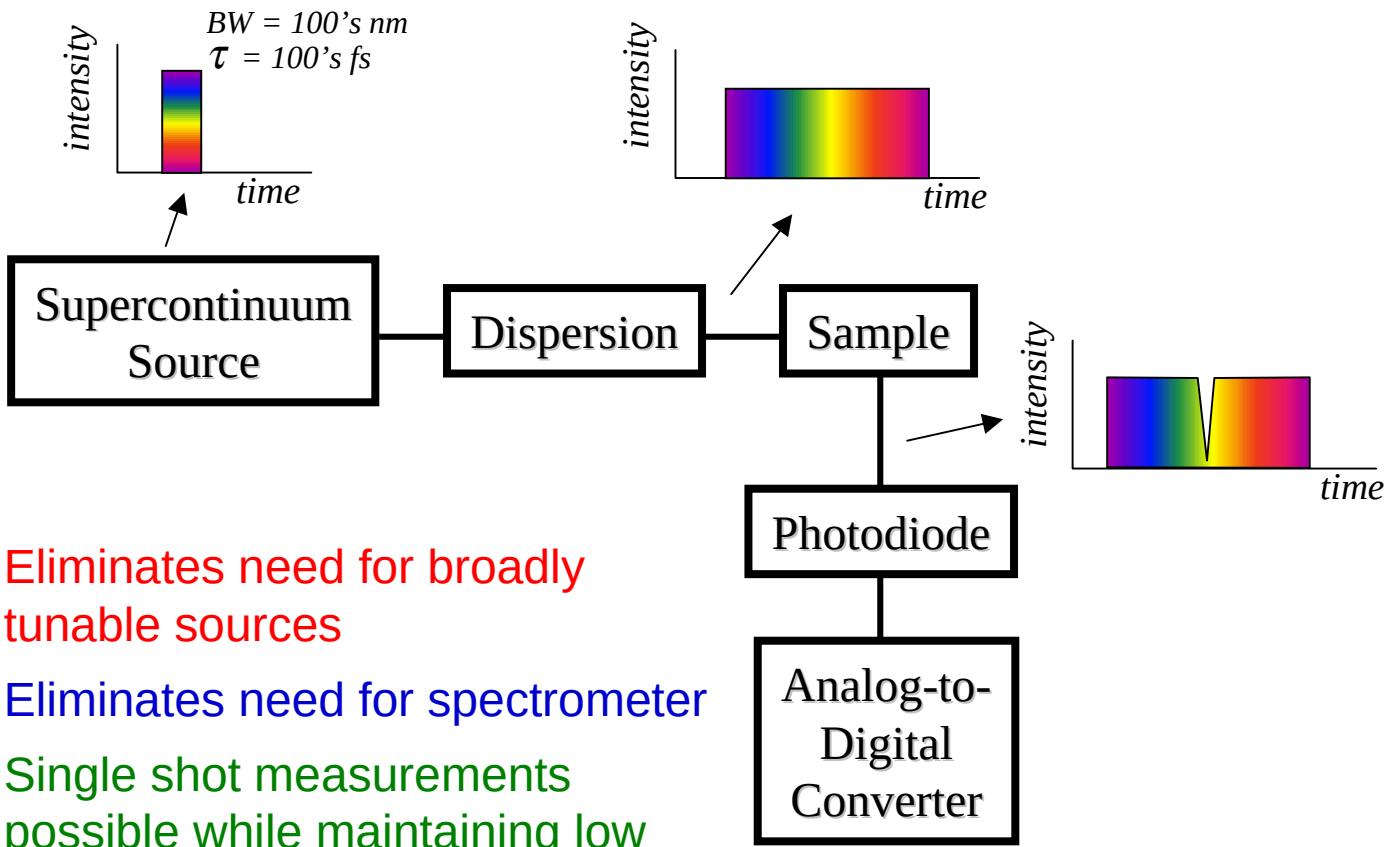
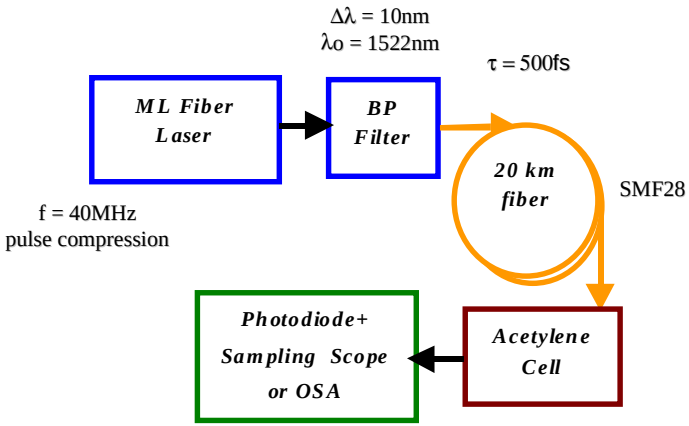
Time Domain Spectroscopy

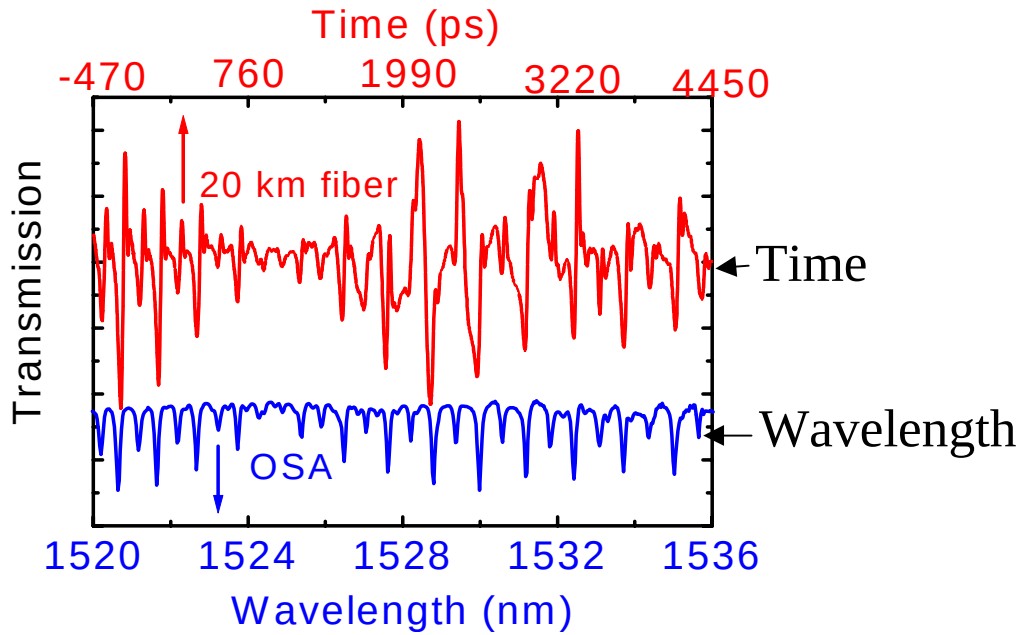


- Eliminates need for broadly tunable sources
- Eliminates need for spectrometer
- Single shot measurements possible while maintaining low peak power

P. V. Kelkar, F. Coppinger, A. S. Bhushan, , B. Jalali, Electronic Letters, Vol 35 (19), p. 1661-1663, (1999).

Experimental Verification





Resolution is comparable to the highest resolution, 0.08 nm, available for HP optical spectrum analyser (OSA).

P. V. Kelkar, F. Coppinger, A. S. Bhushan, , B. Jalali, Electronic Letters, Vol 35 (19), p. 1661-1663, (1999).

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Future Work

- Alternative low cost supercontiuum sources
  - Low cost fiber lasers
  - Alternative sources
  - Low cost, high power optical amplifiers
  - Other wavelength bands
- Beyond telecom, ADC, spectroscopy

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