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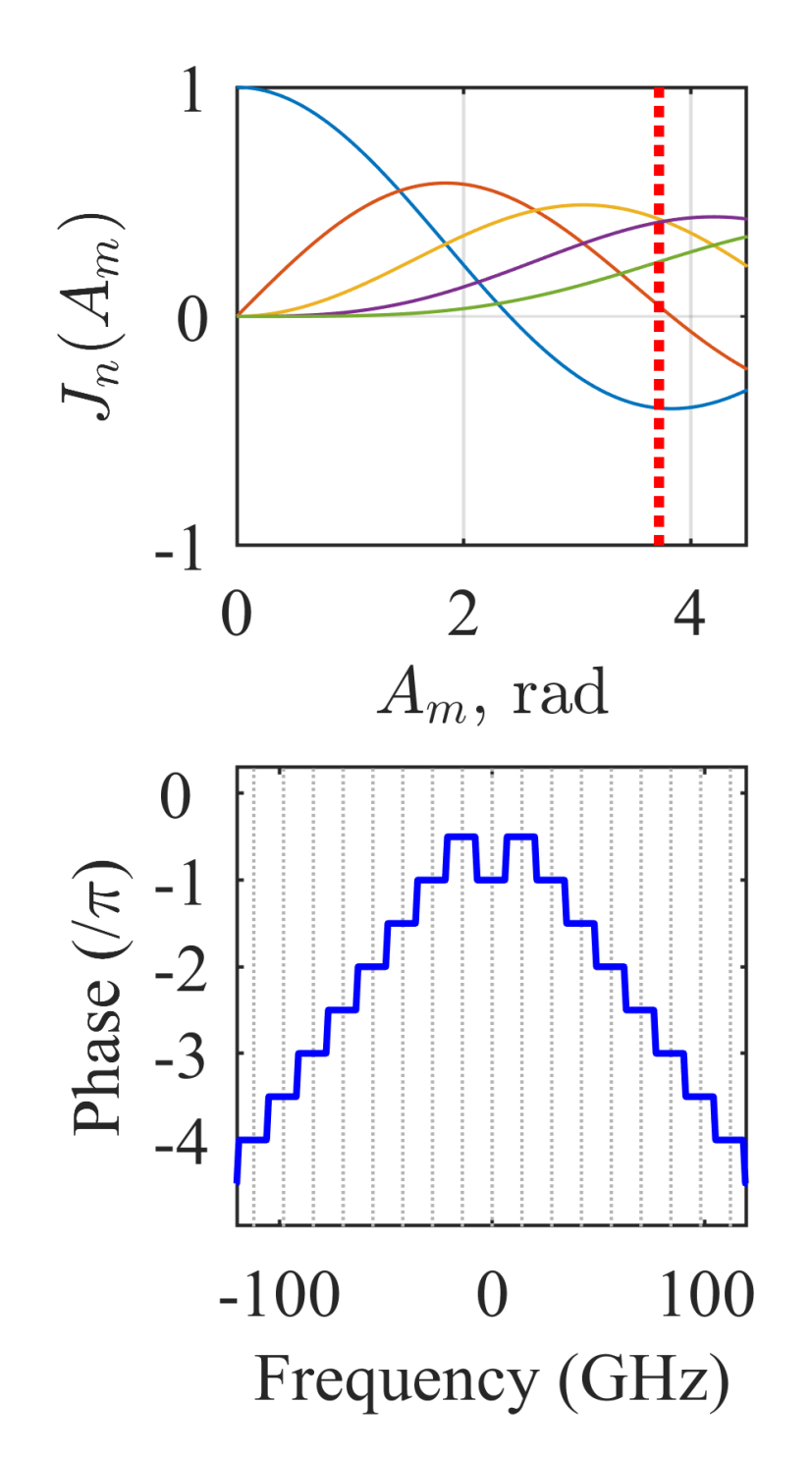
# All-fibered high-quality 28 GHz to 112 GHz pulse sources based on nonlinear compression of optical temporal besseles

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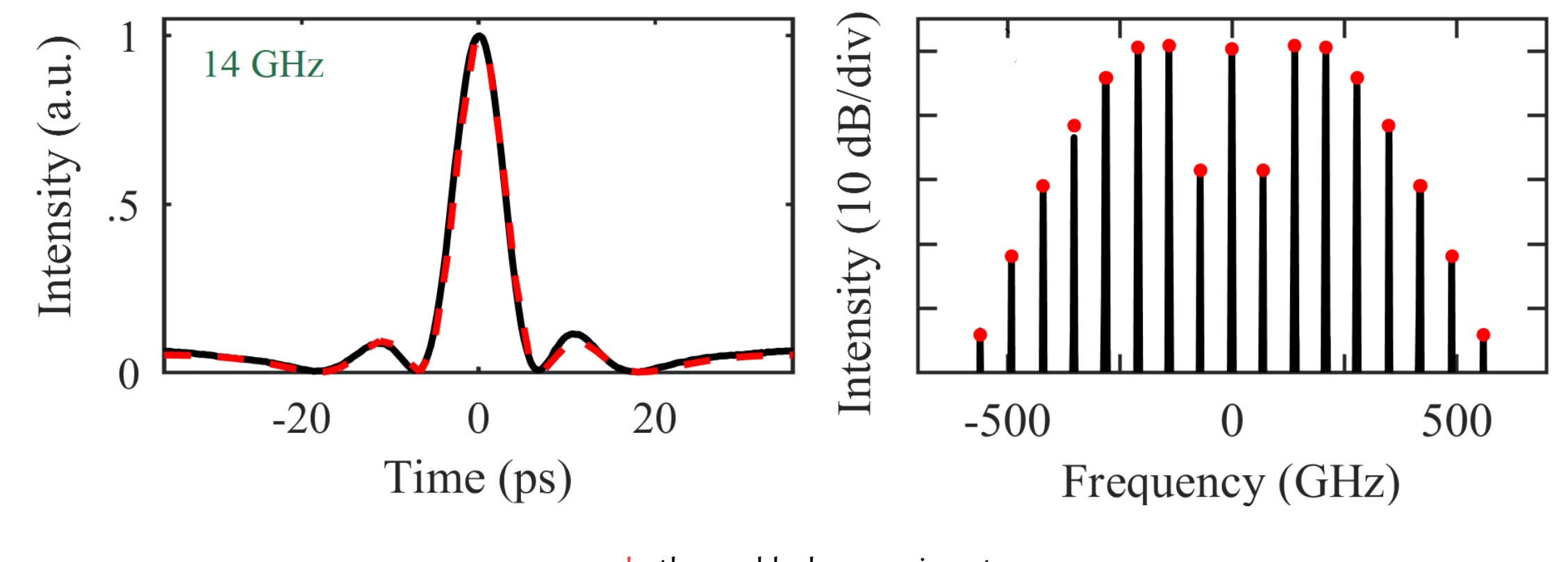
## Introduction

**GOAL** : generation of high-quality pulse trains at high repetition rates

- Besselon** waveform [1] :
- CW + temporal sinusoidal phase  
 $\psi(t) = \exp(iA_m \cos(\omega_m t))$   
 $\Rightarrow$  Jacobi-Anger expansion :  
 $\psi(t) = \sum_{-\infty}^{\infty} J_n(A_m) \exp(in\omega_m t)$   
 $\omega_m = 2\pi f_m$  - repetition rate  
 $A_m$  - modulation amplitude (rad)  
 $J_n$  - Bessel function of the first kind of order  $n$   
 $\Rightarrow$  subsequent spectral lines have a  $\pi/2$  phase shift
  - Triangular spectral phase to cancel out the phase offset [2]  
 $\Rightarrow$  Fourier transform limited waveform  
 $\Rightarrow$  high extinction ratio  
 $\Rightarrow$  full theoretical description available



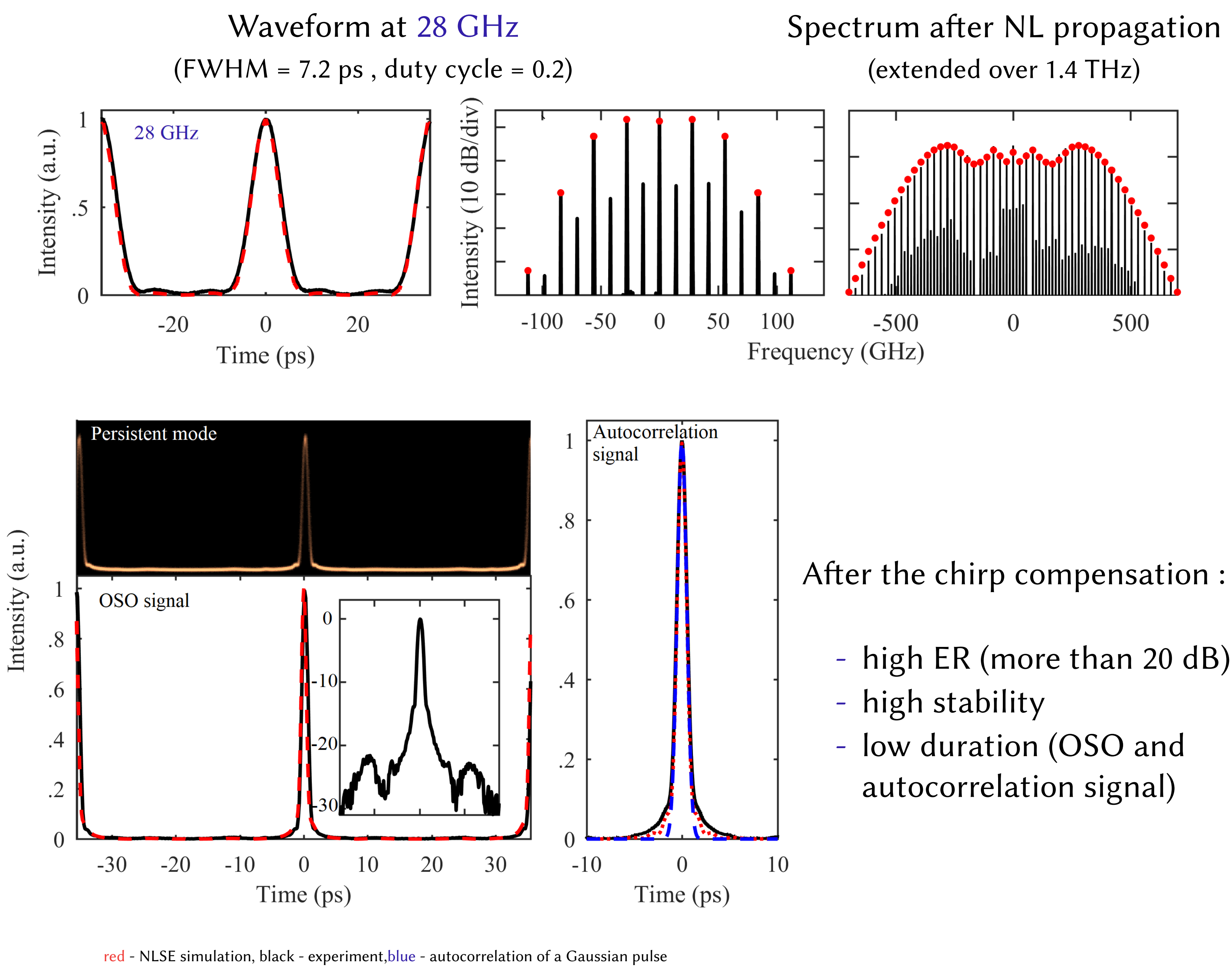
Besselon waveform generated at 14 GHz and  $A_m = 3.72$  rad (FWHM = 7.2 ps, duty cycle = 0.2)



red - theory, black - experiment

## Results at 28 GHz, 56 GHz and 112 GHz

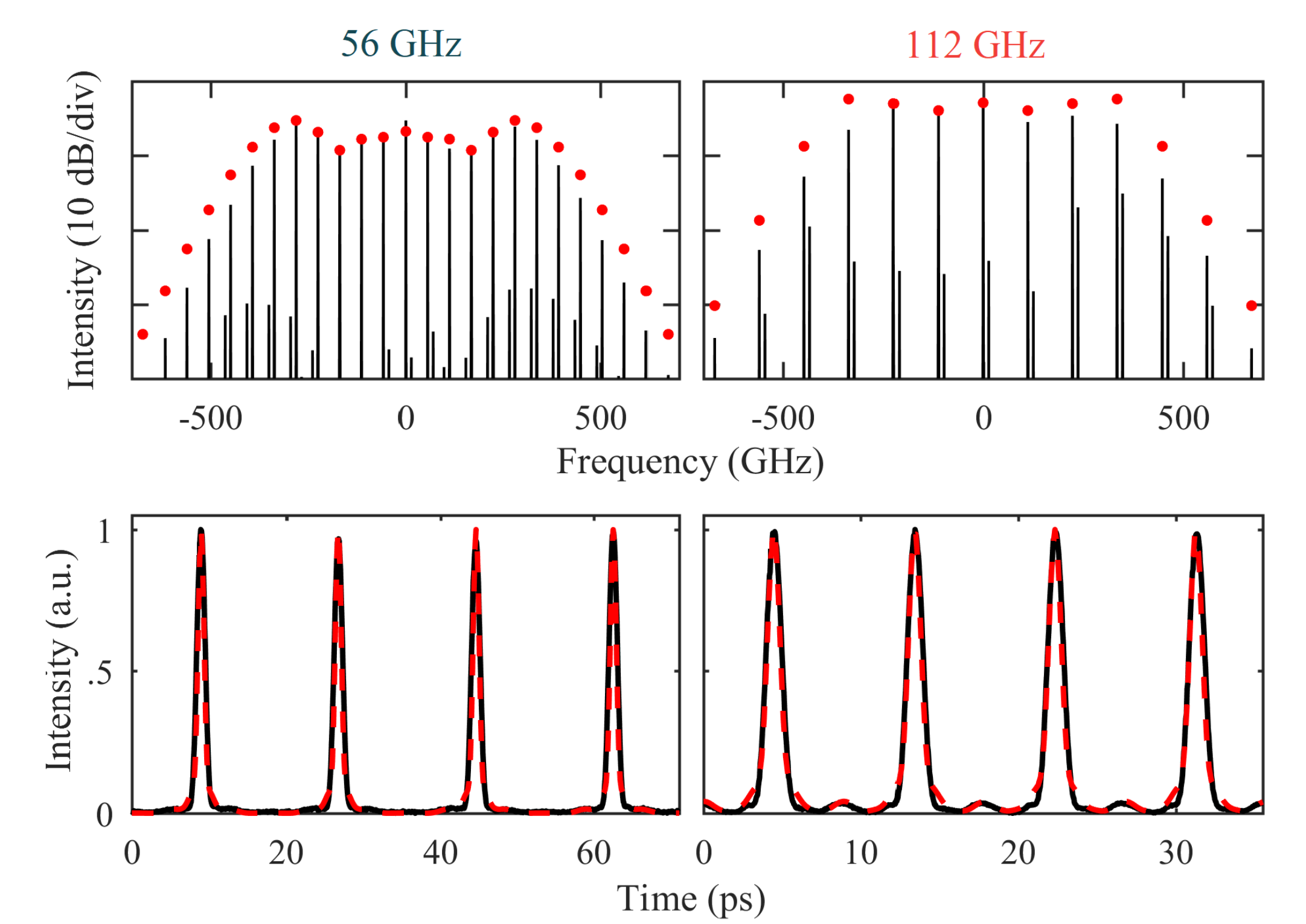
1. Phase-notch filter to multiplex the repetition rate before the nonlinear stage [3]



- After the chirp compensation :
- high ER (more than 20 dB)
  - high stability
  - low duration (OSO and autocorrelation signal)

red - NLSE simulation, black - experiment, blue - autocorrelation of a Gaussian pulse

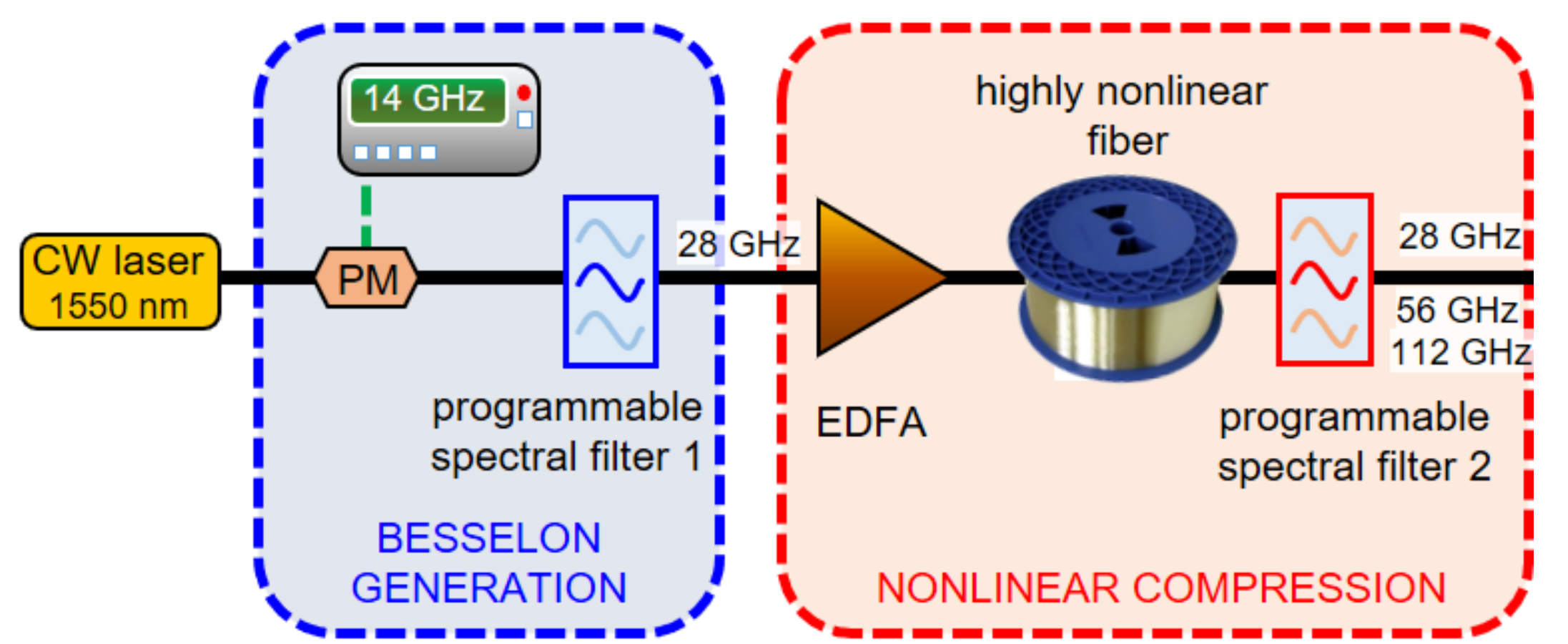
2. Attenuation of spectral lines of the NL-broadened spectrum to further multiplex



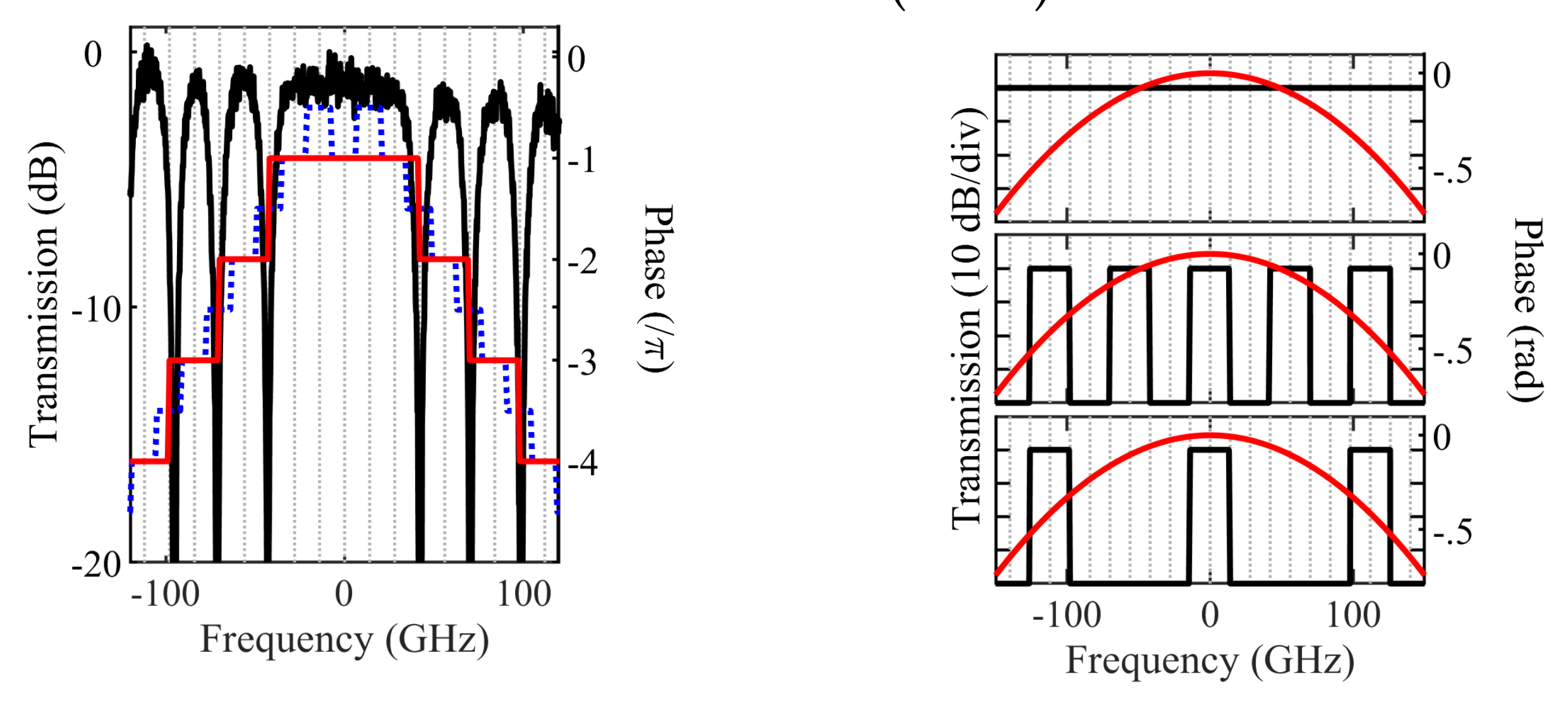
red - NLSE simulation, black - experiment

	28 GHz	56 GHz	112 GHz
FWHM, ps	0.78	0.83	0.94
Duty cycle	0.022	0.074	0.105

## Experimental setup



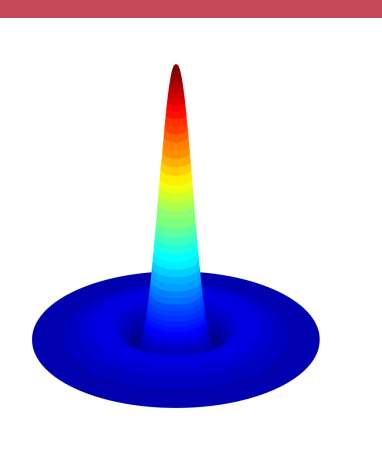
- WaveShaper 1**
- Only phase profiles for 14 GHz (blue) or for 28 GHz (red)
  - black - ASE signal
- WaveShaper 2**
- Quadratic spectral phase for chirp compensation (red)
  - Filters used for multiplexing (black)



HNLF :  $L = 1$  km,  $\gamma = 10$  /W/km,  $\beta_2 = 0.89$  ps<sup>2</sup>/km,  $\alpha = 0.5$  dB/km

## Conclusion

- high repetition-rate source
- simple setup (single phase modulator)
- high-quality pulse trains at 14 GHz, 28 GHz, 56 GHz and 112 GHz



## References

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