

GENERATION OF REGULAR LASER PULSES IN A BACKWARD WAVE OPTICAL PARAMETRIC OSCILLATOR PUMPED BY INCOHERENT PULSES

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Backward-wave optical parametric oscillators (BWOPOs) are unique nonlinear crystals that enable precise laser wavelength tuning with exceptional stability and spectral purity [1]. Previous studies have shown that, within a BWOPO crystal, the forward-propagating wave inherits the spectral modulation of the pump pulse; by contrast, the backward-propagating wave remains essentially transform-limited [2-4].

In this work, we simulate a numerical BWOPO model [5] to show that when a BWOPO crystal is pumped by a broadband incoherent pulse, the generated backward wave is regular and narrowband (Fig. 1). As shown in Fig. 1d, the forward wave spectrum closely follows the broadband spectrum shape of the pump, whereas the backward wave spectrum remains narrow. We further support this result by deriving analytical solutions for the forward and backward wave amplitudes in the linear regime using the Riemann's integration method that is presented in [6]. Our results establish a route to generating high-coherence, narrowband laser pulses using incoherent, broadband pump sources.

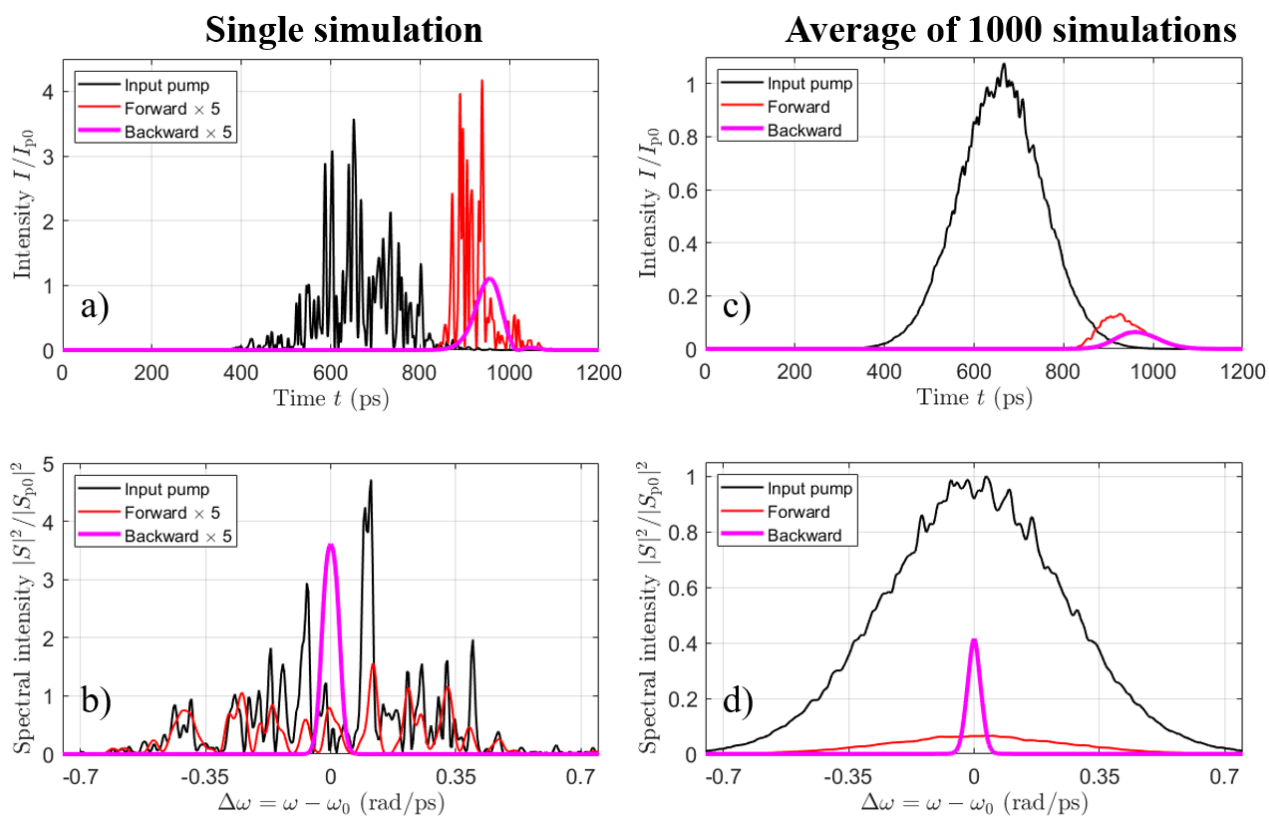


Fig. 1. Temporal pulse profiles (a, c) and angular-frequency spectra (b, d) of the input pump and the generated forward and backward waves. Panels (a, b) show results from a single simulation, while panels (c, d) present averages over 1000 simulations. The pump is incoherent, with pulse energy $E_p = 20 \mu\text{J}$ and central wavelength $\lambda_p = 532 \text{nm}$.

Keywords: Backward Wave Optical Parametric Oscillator (BWOPO), Incoherent Pump, Coherence Gain, Nonlinear Optics

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