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A Pulsed squeezed-light generation in a waveguide with second-subharmonic generation and periodic corrugations

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A quantum model of pulsed second-subharmonic generation in a nonlinear waveguide with a periodic linear corrugation has been developed. Assuming a strong fundamental field, the model has been solved for lower second-subharmonic field intensities using perturbation approach generalized to back-scattered fields. More intense second-subharmonic fields with negligible inter-mode dispersion have been treated by the Fourier-transform approach that allows to find partly analytical solutions. Numerical approach has been applied in the general case. Using the Bloch--Messiah reduction spectral eigenmodes suitable for squeezed-light generation have been revealed. Scattering by the corrugation has been found more efficient in the fundamental field than in the second-subharmonic one. Although scattering by the corrugation makes the second-subharmonic spectra narrower, it broadens the spectral eigenmodes. It also leads to a larger number of populated eigenmodes. Phase relations in the nonlinear interaction imposed by the corrugation also cause splitting of the temporal second-subharmonic pulse. In a sufficiently long waveguide, the corrugation dramatically increases the number of generated photons and, hand in hand, suppresses quantum amplitude fluctuations. A periodic corrugation thus represents a very important and efficient tool for tailoring properties of nonclassical light generated in modern nonlinear photonic structures.