reaches a constant value $\alpha(1-|S_{11}|^2-|S_{12}|^2)(|S_{11}|^2+|S_{21}|^2)$. For $z$ larger than the characteristic decay length $l_d = 1/\sigma$, the correlation $\mathcal{P}(\delta;z)$ vanishes at the dip $\delta=0$, i.e. when signal and idler wave packets are temporally overlapped, according to the analysis of Sec.III.B.

## IV. CONCLUSIONS

In this work we have theoretically investigated propagation of classical and nonclassical light in a waveguide-based photonic structure that provides an optical analogue of population trapping in the continuum encountered in atomic physics. For classical light waves, coupled-mode equation analysis, previously studied in Ref.[9], shows that Fano interference between different light leakage channels is responsible for the appearance of a trapped state embedded in the continuum. To study propagation of nonclassical light, a second quantization model for the scalar wave equation, in the paraxial and quasi-monochromatic approximations, has been adopted. As for input beam excitation in a coherent state the classical picture of light propagation is retrieved, quantum interference effects with no classical counterpart have been highlighted for photon number state excitation of the waveguide structure. In particular, the tendency of photon pairs to bunch when decaying into the continuum has been predicted. Such an effect, which is similar to the two-photon Hong-Ou-Mandel interference in a beam splitter [18], may be observed as a dip in photon coincidence measurements. Our results indicate that photonic structures originally designed to mimic with optical waves the classical analogues of quantum-mechanical phenomena encountered in atomic, molecular or condensed-matter physics [5], may exhibit themselves a strictly quantum behavior when single photon level is reached.


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