

Interference effects in noncollinear and frequency-nondegenerate spontaneous parametric down-conversion

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By considering the process of noncollinear and frequency-nondegenerate Spontaneous Parametric Down-Conversion (SPDC), we derive rather simple analytical formulas connecting the degrees of noncollinearity and nondegeneracy. Based on this, we suggest to use angular selection of SPDC photons for controlling the degree of nondegeneracy. At a given degree of nondegeneracy SPDC photons propagate along two different cones, the outer one for lower-frequency photons and the inner cone for higher-frequency ones. In the simplest case of measurements in a given plane (containing the pump propagation axis) the angular selection can be provided by appropriately installed two or four slits. For such selected photons their wave functions are found depending either on two frequencies of photons or on two temporal variables interpreted as the arrival times to detectors or any other devices. Interference effects arising in such states can be tested in the frame of the Hong-Ou-Mandel scheme with selected SPDC photons sent to the beamsplitter from two sides and with the varying delay time in one of two incoming channels. The temporal pictures arising after the beamsplitter are found to demonstrate extremely strong interference exhibiting itself in formation of finite-size temporal combs filled with multiple oscillations. Parameters of combs depend on the degree of nondegeneracy or, equivalently, on location of slits to be installed.