Entanglement by SPDC

Currently, the most prominent method for generating entangled photon pairs is spontaneous parametric down-conversion (SPDC) [61] [62] [63], in which one photon from a pump laser beam is spontaneously converted into two photons, which emerge

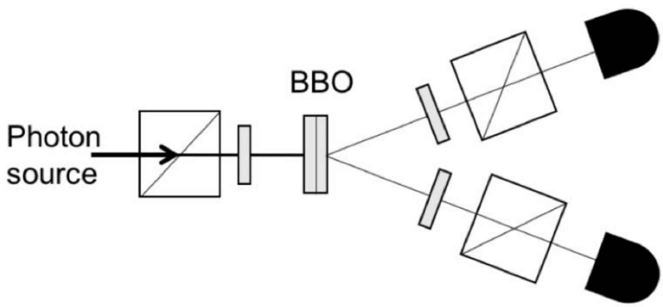

Figure 2.13: Single photon sent into BBO crystal producing entangled photons via spontaneous parametric down conversion [After Kwiat et al. [61]].

simultaneously from a pumped nonlinear crystal such as beta-barium-borate (BBO), Figure 2.13.

Nonlinear interaction of the pump laser pulse with the crystal can split the high frequency pump photon into two lower-frequency photons, called the *signal* and *idler*, and the three photons are constrained to satisfy energy conservation and phase-matching conditions. Generally, the outgoing photons are not collinear. In this method, detection of one photon can also indicate that the second photon has been generated. The down-conversion is Type-I if the signal and idler photons have identical polarizations and Type-II if they have orthogonal polarizations and it is possible to prepare any of the four polarization Bell-states [64]. Many other variations are possible with SPDC, such as the method of path identification of Zou-Wang-

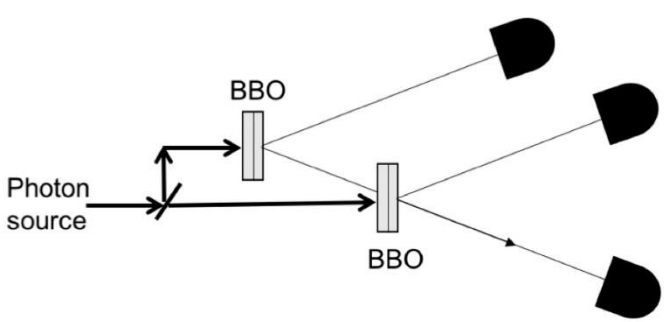

Figure 2.14: Single photon sent into BBO crystals where overlapping paths remove which-crystal information resulting in entanglement [After Krenn et al. [67]].

Mandel [65] [66] [67] in which paths from two pumped BBO’s are overlapped thereby removing the which-BBO-crystal information resulting in entanglement, Figure 2.14.