Producing Entangled Photon Pairs and Quantum Squeezed States in Plasmas

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Plasma is capable of converting two pump photons into two different photons through relativistic four-wave mixing (FWM) nonlinearity. Spontaneously created photon pairs are emitted in symmetric angles with respect to the colinear pump direction and the emission rate is the largest if they have identical frequency. Two orthogonally polarized pumps interact in a mm-long plasma create polarization entangled photon pairs. Two identically polarized pumps interact in a longer plasma create two-mode squeezed states. With an equal pump amplitude, the noise from Raman scattering can be decoupled from one of the quadrature of the output state, avoiding compromising the squeezing magnitude.

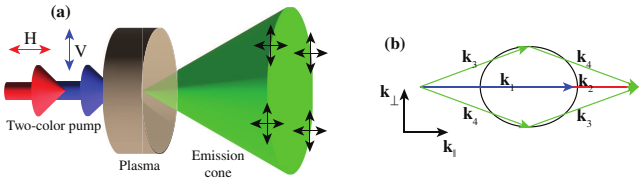

Figure 1: (a) Two-color pump with orthogonal polarization creates polarization entangled photon pairs at symmetric angles. The shades represent the most probable emission angles for given pump polarization. (b) Wavevector relations of the pumps ($\vec{k}_1$ and $\vec{k}_2$) and emitted photon pairs ($\vec{k}_3$ and $\vec{k}_4$)