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Spatial beam reshaping and spectral broadening in quadratic crystals

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Nonlinear optics in crystals with quadratic susceptibility has been largely explored along the last decades, with a particular emphasis on spatial solitons [1]. When in the initial part of the propagation, the nonlinear length is much shorter than the diffraction length, rather than solitons, in these crystals it is possible to observe strong beam reshaping and spectral broadening. This mechanism of nonlinear beam evolution can be induced by combining high laser energies and large input diameters, so to reduce the contribution of diffraction in the initial steps of the propagation. Two different examples of experimental results are illustrated in figure 1: panels (a-d) refer to the supercontinuum generation in a 15 mm long PPLN crystal with a laser of 30 ps and maximum intensity of 10 GW/cm^2 at 1064 nm. Around the phase matching point, a nearly monochromatic wide input laser beam is transformed into a polychromatic filament: this filament appears spatially stable for both signs of the phase mismatch, while the spectrum can be freely varied from a continuum (focusing) to a series of discrete peaks (defocusing) by changing the crystal temperature [2]. Panels (e) and (f) refers instead to an experimental evidence of spatial beam cleaning in a 30 mm long KTP crystal, when using an input speckled beam: the output beam remains speckled at low energy, while it is reshaped along the propagation in the KTP crystal (f) [3]. In a further series of experiments, not shown, we have seen how such nonlinear spatial beam reshaping can lead to the generation of spatial extreme waves.

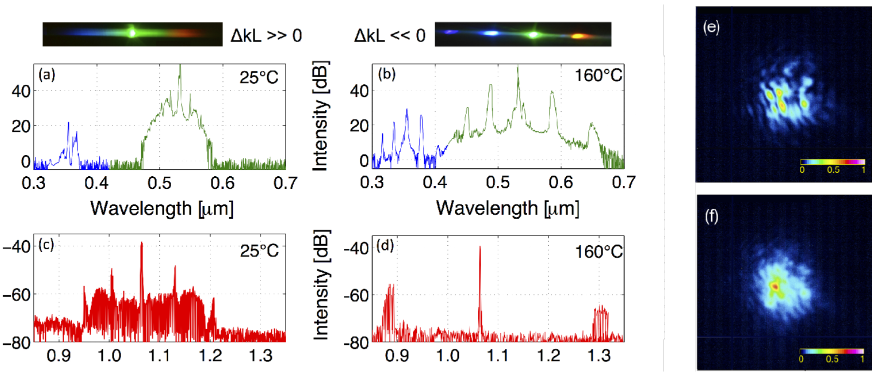

Fig. 1: polychromatic filaments in PPLN: focusing (a,c) and defocusing (b,d). Spatial beam cleaning in KPT. (e): speckled beam at low energy, (f): cleaned beam at high energy

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