

3:30pm - 4:00pm (Invited)
NLO7.1

OBSERVATION OF TWO-DIMENSIONAL SPATIAL SOLITARY WAVES IN A $\chi^{(2)}$ MEDIUM

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While stable filaments have been observed to propagate in atomic vapors, the latter observations require very near resonant conditions and thus are associated with electromagnetic losses to the atomic medium. Such an observation has been impossible in condense media. Indeed the necessary self-focusing which can cancel diffraction appears in all media and if it is the only nonlinear optical process present results in unstable propagation behavior of 2D transverse beams and eventually optical beam collapse. A possible way to stabilize a 2D transverse beam is to find a material with either a saturable nonlinear response or equivalently higher order nonlinear responses present. Unfortunately in most condense media optical damage seems to appear before such higher order processes come into play.

Cascaded second order nonlinear processes offer a new range of opportunities in that sense. Indeed we have shown that under near phase matching conditions, the associated nonlinear phase distortion to the fundamental wave depletion follows a linear dependence with the optical field strength and not the optical intensity, Fig.1. Equivalently in such a regime cascaded self focusing effects are inherently equivalent to a saturated intensity dependent phase distortion, hence multi-dimensional soliton like beams should be observable in transparent $\chi^{(2)}$ nonlinear optical media. The electromagnetic field propagates then in a strongly coupled regime where both the fundamental portion of the field and the second harmonic are locked together, not only beating diffraction but walk-off induced by the natural birefringence of most $\chi^{(2)}$ media, Fig.2.

We believe the observation of such stable propagating modes of second order nonlinear processes is opening the door to a new realm of opportunities in the design of parametric converters in addition to a new family of optical phenomena in light wave manipulation, among them all optical soliton beam steering has already been observed.

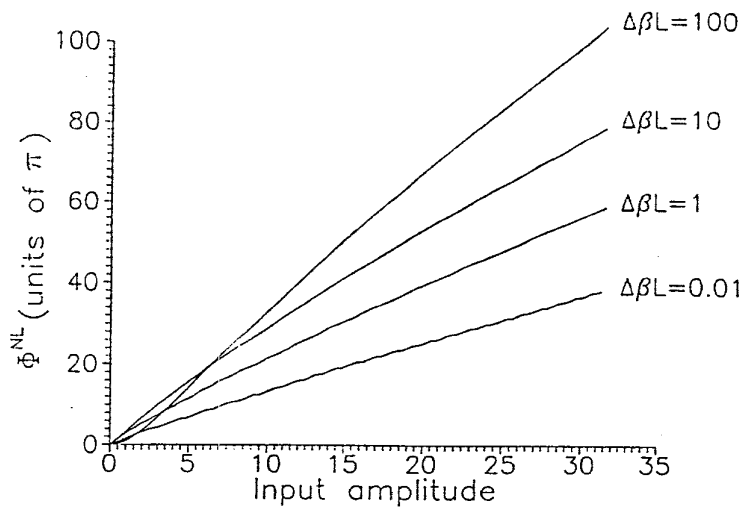


FIGURE # 1

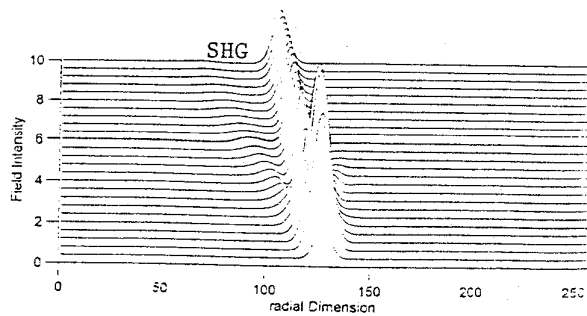
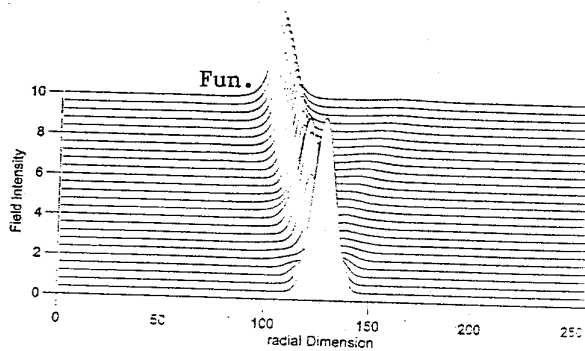
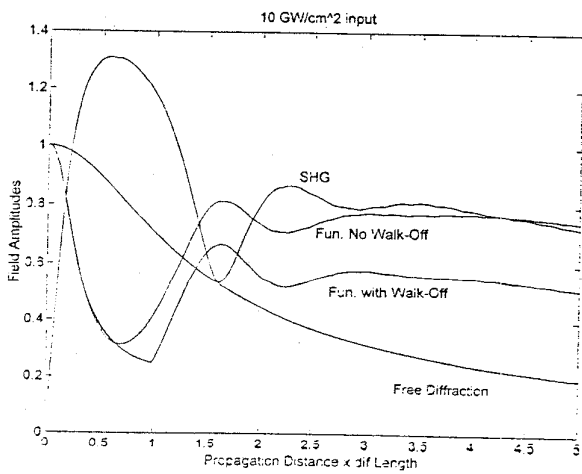


FIGURE #2 20