Mobility properties of 2D cavity solitons in systems with delayed feedback

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Significant advances have been made recently in the study of transverse localized structures of light known also as dissipative optical solitons. This was largely due to the potential applications of optical localized structures as bits for information storage and processing. Although in general their properties are relatively well understood, the investigation of the effect of the delayed feedback on the dynamics of optical systems, which exhibit transverse dissipative solitons, is a relatively new area of research [1-4].

In this communication, we investigate numerically and analytically the influence of delayed feedback on the mobility properties of 2D cavity solitons. We consider a passive cavity filled with a two-level medium and driven by a coherent injection beam. We report on a new type of instability leading to a spontaneous drift of dissipative solitons. We show that when the product of the delay time and the feedback amplitude exceeds a certain threshold, a single circularly symmetric localized structure starts to move in an arbitrary direction (see Fig.1a, bottom row, left column). When two cavity solitons are bounded together they exhibit, in addition to a forward motion, a rotation around the point corresponding to the "center of mass" of two solitons (see Fig.1a, bottom row, right column). Furthermore, we have calculated analytically the speed of the uniformly moving circularly symmetric cavity soliton and derived a system of three ordinary differential equations governing the slow motion and rotation of a localized solution with broken circular symmetry. Different solutions of this system corresponding to moving and rotating localized patterns are found (see Fig1b).

(a) (b)

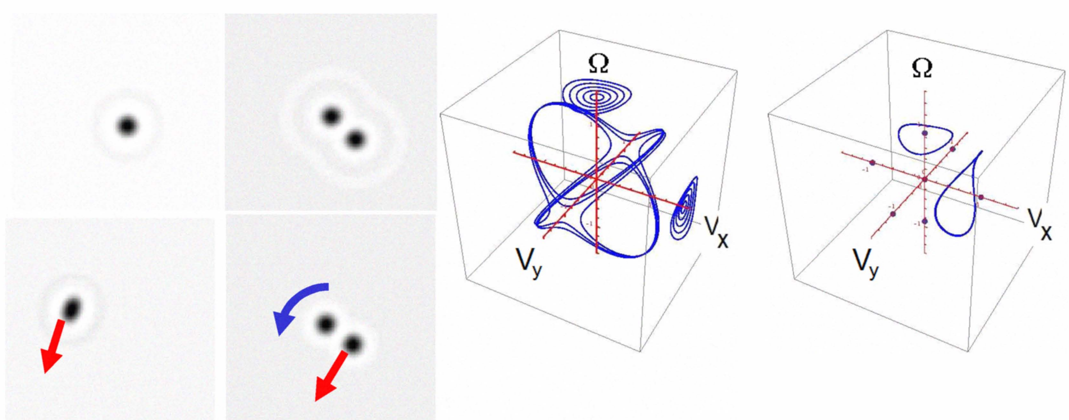

Fig. 1 (a) Moving and rotating localized structures Top row: no delayed feedback. Bottom row: with delayed feedback. (b) Phase trajectories of the reduced systems describing mobility properties of localized patterns with broken circular symmetry.

References

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