

Cavity solitons in semiconductor microcavities and their properties.

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Cavity Solitons (CSs) are localized intensity peaks that develop in the transverse plane of a nonlinear optical cavity due to the interaction with an injected field (*holding beam, HB*). CSs can be switched on and off by a local beam (*writing beam, WB*) hence they behave as potential 'pixels' for reconfigurable arrays or all-optical processing units. We demonstrate here the existence of CS in a semiconductor optical cavity consisting of a broad-area VCSEL (150 μm diameter) operated as amplifier and driven by a coherent HB. The emission profile of the VCSEL depends on the HB intensity (I) and frequency detuning (θ) with respect to the VCSEL cavity resonance. For critical values of the parameters a modulational instability appears and the intensity profile exhibits a patterned state. Numerical simulations show that CSs can exist in the neighborhood of the modulational instability, where the homogeneous solution is still stable. In these conditions, we inject the WB and we are able to write two CSs independently. CSs, once created, remain stable and they can be erased individually by applying again a WB de-phased by π with respect the HB.

We show how CSs originate from patterns when I is lowered and the pattern solution gets unstable, and we study the switch-on time t of the CS after application of the WB. The switch-on time of CS is analyzed both experimentally and theoretically. This time has two contributions: a time of lethargy following the application of the pulse used to switch the CS and a characteristic build-up time. While the latter is not significantly affected by the control parameters, the former one depends crucially on the control parameters. Finally, we address the possibility of CSs positioning by introducing a phase gradient in the holding beam: the results are promising for implementing in the future the idea of shift-register memories based on CSs arrays.