# Bistable soliton from nonlienar two-waves coupling

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The nonlinear Schrödinger equation (NLSE) often unveils complex dynamics and a plethora of interesting solutions for a wide range of applications. Damped and passively driven NLSE systems represent a key enabling configuration to generate optical frequency comb (OFC) sources and cavity solitons (CSs). A crucial and long lasting question is how to easily select and excite stable solutions. This is answered by setting up novel schemes to achieve the complete control of the CSs formation [1].
Here, we propose a two-wave systems with nonlinear coupling. A physical reference example is that of a second harmonic generation Kerr cavity [2].

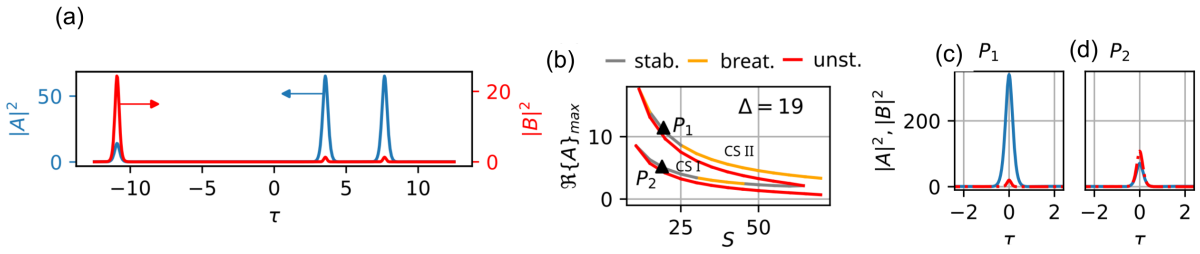


**Figure 1.** (a) Coexisting CSs excited by dinamical simulations. (b) Phase diagram spanned by the parameters $\Re\{A\}_{max}$ vs $S$ and (c,d) the corresponsindg bistable CSs solutions.

The nonlinear interaction of the two waves $A$ and $B$ can result in bistable CSs excitation which emerge from a chaotic dynamics [3] (Figure 1 (a)). Typically, the two bistable solutions can be recast into two families, which we will recall CSI and CSII. For CSII, most of the energy is carried by the fundamental (FF) wave $A$, while for CSI the second harmonic (SH) dynamics dominates. In Figure 1 (b) we present a bifurcation diagram spanned by the parameters $\Re\{A\}_{max}$ (i.e. the real envelope peak) and $S$ (i.e. the driving field). We highlight stable, unstable and breathing regimes for the two families CSI and CSII, while in panel (c,d) we plot two representative CSs solutions.

## Références

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2. Talenti FR, Lovisolo L, Gerini A, Parra-Rivas P, Hansson, T, Wabnitz S, Vivian L., Alonso-Ramos C., Leo G., Frequency comb generation dynamics in $\chi^{(2)} + \chi^{(3)}$ AlGaAs microresonators, *EDP-Sciences*, **309**, (2024).
3. Talenti FR, Wabnitz S, Sun Y, Hansson, T, Lovisolo L, Gerini A, Leo G., Vivian L., Koos C., Peng H., Parra-Rivas P, Bistable soliton optical frequency combs in a second harmonic generation Kerr cavity, *under peer review.*