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Dark-bright soliton perturbation theory for the Manakov system

A direct perturbation method for studying dynamics of dark-bright solitons of the Manakov system in the presence of perturbations is presented. We combine multiscale expansion method, perturbed conservation laws, and a boundary layer approach, which breaks the problem into an inner region, where the bulk of the soliton resides, and an outer region, which evolves independently of the soliton. We show that a shelf develops around the dark soliton component, with speed of the shelf proportional to the background intensity. Conservation laws of the Manakov system are used to determine the properties of the shelf and perturbed solutions. Our analytical predictions are corroborated by numerical simulations.