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Existence and bounds for nonlinear Schrödinger systems with strong competition

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We consider systems of coupled Schrödinger equations which appear in nonlinear optics and binary Bose–Einstein condensation. Namely, we prove that for any $\mu, \nu \in \mathbb{R}$, $a, b > 0$, the system $-\Delta u = \mu u + au^3 - \beta uv^2$, $-\Delta v = \nu v + bv^3 - \beta vu^2$, $u, v \in H_0^1(B_1(0))$, where $B_1(0)$ is the unit ball of $\mathbb{R}^3$, admits a family of radially symmetric positive solutions (u_β, v_β) provided the interaction parameter $\beta > 0$ is sufficiently large. By using a Morse index technique we deduce that these solutions are bounded uniformly in β, hence their limit functions as $\beta \to \infty$ undergo the phenomenon of phase segregation.

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