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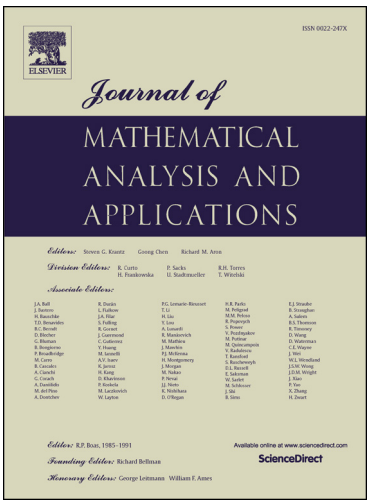

Semiclassical ground states for quasilinear Schrödinger equations with three times growth

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Semiclassical ground states for quasilinear Schrödinger equations with three times growth*

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Abstract: In this paper, we study the quasilinear Schrödinger equation

$$-\epsilon^2\Delta u + V(x)u - \epsilon^2 u\Delta(u^2) = Q(x)u^3,\ u \in H^1(\mathbb{R}^3),$$

where $\epsilon > 0$ is a parameter, V and Q are positive bounded functions. For the equation with three times growth, we establish the existence of ground states for ϵ small using the method of Nehari manifold. We also describe the concentration phenomena of ground states as $\epsilon \to 0$.

Keywords: Quasilinear Schrödinger equation; Concentration; Nehari manifold; Semiclassical state.

1 Introduction and main results

As models of physical phenomena, quasilinear Schrödinger equations of the form

$$i\epsilon\partial_t z = -\epsilon^2\triangle z + W(x)z - l(x,|z|^2)z - \kappa\epsilon^2\triangle h(|z|^2)h'(|z|^2)z, \tag{1.1}$$

have been extensively studied in recent years, where $z : \mathbb{R}\times\mathbb{R}^N \to \mathbb{C}$, $W : \mathbb{R}^N \to \mathbb{R}$ is a given potential, ϵ is a positive parameter, $l, h : \mathbb{R}^+ \to \mathbb{R}$ are suitable functions, and κ is a real constant. For example, $\kappa = 0$, corresponding to semilinear Schrödinger equations, which has been widely investigated, we refer the readers to [2, 20, 24]. The case $h(s) = s$, as a model of the time evolution of the condensate wave function in super-fluid film, has been studied by Kurihara in [16]. While for $h(s) = \sqrt{1+s}$, the equations are the models of the self-channeling of a high-power ultra short laser in matter.

Here we are interested in the case $h(s) = s$ and $\kappa = 1$. Looking for standing wave solutions of (1.1), that is, solutions of the form

$$z(t,x) = e^{-iEt}u(x), E \in \mathbb{R},$$

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