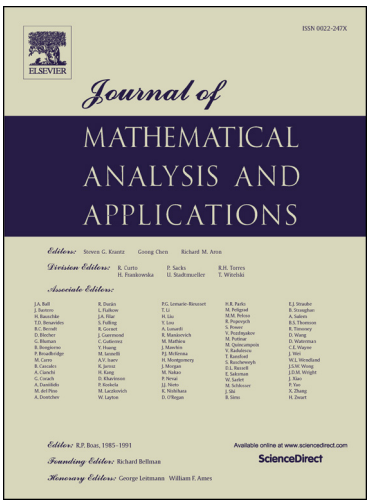
Accepted Manuscript



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PII: S0022-247X(18)30338-X
DOI: https://doi.org/10.1016/j.jmaa.2018.04.040
Reference: YJMAA 22194

To appear in: *Journal of Mathematical Analysis and Applications*

Received date: 17 January 2018

The existence and nonexistence of entire large solutions for a quasilinear Schrödinger elliptic system by dual approach

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Abstract. In this paper, we establish some new results on the existence and nonexistence of radial large positive solutions for a modified Schrödinger system with a nonconvex diffusion term by a successive iteration technique and the dual approach. The necessary and sufficient condition for the existence of radial large positive solutions is established. Our results improve and extend many previous work in this field of research.

Keywords. Necessary and sufficient condition, Modified Schrödinger elliptic system, Entire large solution, Existence and nonexistence.

1 Introduction

The quasilinear Schrödinger equation

$$i\frac{\partial \psi}{\partial t} + \triangle \psi - W(x)\psi + \kappa \Delta(h(|\psi|^2))h'(|\psi|^2)\psi + g(x,\psi) = 0,\ x \in \mathbb{R}^n, \tag{1.1}$$

is an important model for many mathematical and physical phenomena, where $W(x)$ is a given potential, κ is a real constant and g, h are real functions. If $h(s) = s$, Eq. (1.1) describes the time evolution of the condensate wave function in superfluid film for plasma physics in Kurihara [1]. With $h(s) = (1+s)^{\frac{1}{2}}$, Kosevich et.al [2] and Quispel et. al [3] used Eq. (1.1) to model the self-channeling of a high-power ultrashort laser in matter. The model (1.1) has also been used to deal with some phenomena in Heidelberg ferromagnetism and magnus theory [4, 5], in condensed matter theory [7] and in dissipative quantum mechanics [6]. For further physical background of the model, we refer the reader to [8–10] and their references.

Many existing researches focus on the standing wave solution $\psi(t,x) = e^{-i\beta t}u(x)$ of equation (1.1) for which by the change of variable $\psi(t,x) = e^{-i\beta t}u(x)$, the quasilinear Schrödinger equation (1.1) is transformed to the following modified form

$$\triangle u + u\triangle(u^2) = f(x,u) \tag{1.2}$$

for suitable W, h and g. Then by applying the dual approach together with the critical point theory, various results on the existence of multiple solutions for the above equation have been established [12–14].

On the other hand, for achieving further information of natural phenomena, some analytical tools and techniques were also developed to solve various differential equations, such as iterative techniques [15, 16, 30–38], variational methods [39–45] and fixed point theorem [46–49]. In this paper, by developing a new iterative technique and combining suitable estimation, we establish the existence of the entire radial large solution for the

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[2] The authors were supported financially by the National Natural Science Foundation of China (11571296).