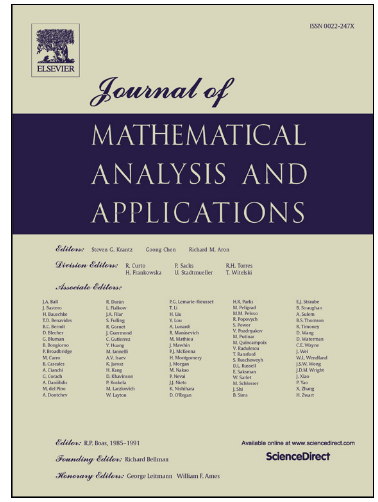
Accepted Manuscript



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PII: S0022-247X(18)30164-1
DOI: https://doi.org/10.1016/j.jmaa.2018.02.039
Reference: YJMAA 22051

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

Received date: 24 May 2017

Please cite this article in press as: Q. Shi, S. Wang, Nonrelativistic approximation in the energy space for KGS system, *J. Math. Anal. Appl.* (2018), https://doi.org/10.1016/j.jmaa.2018.02.039

Nonrelativistic Approximation in the Energy Space for KGS System

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Abstract

In this paper we study the nonrelativistic limit of the Cauchy problem for the damped and the conserved Klein-Gordon-Schrödinger (KGS) system, respectively. We prove that any finite energy solution to the damped KGS system converges to the one of Yukawa-Schrödinger(YS) system in the energy space $H^1 \oplus H^1$, and the solution to the conserved system goes to the corresponding one of a nonlinear Schrodinger(NLS) equation as well.

Keywords: KGS system; Nonrelativistic limit; Uniqueness; Energy convergence.

1 Motivation

Klein-Gordon-Schrödinger (KGS) system in $\mathbb{R}^{3+1}$ describes the dynamics of a nucleon field interacting with a neutral meson field through the Yukawa coupling [16]. It has the form

$$i\partial_t\psi^c + \triangle\psi^c = -\phi^c\psi^c, \tag{1.1}$$

$$\square_c\phi^c + \gamma\partial_t\phi^c + \phi^c = |\psi^c|^2, \tag{1.2}$$

where $\triangle = \partial^2_{x^1} + \partial^2_{x^2} + \partial^2_{x^3}$ and $\square_c = \frac{1}{c^2}\partial_t^2 - \triangle$ are Laplacian and d'Alembertian, respectively. $\psi^c(x,t)$ is the conserved complex nucleon field, and $\phi^c(x,t)$ is the real meson field. c represents the speed of light and $\gamma \geq 0$ is a damping constant. For the detailed rescaling process with physical constants, one can also refer to [1, 3]. For a fixed $0 < c < \infty$, there is an abundant literature devoted to this system (see [2, 4–7, 9–13]).

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