Existence of solutions for a nonlinear Schrödinger equation coupled with the Maxwell's equations

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Abstract. We seek to make a more detailed study of most of the ideas and results set forth in David Ruiz's [2]. For this, the following system of partial differential equations in $\mathbb{R}^3$ was considered

$$\begin{cases} -\Delta u + u + \lambda\phi u = u^{p-1} \\ -\Delta\phi = u^2, \quad \lim\limits_{|x|\to\infty} \phi(x) = 0 \end{cases} \tag{1}$$

where Δ is the Laplacian operator, $\lambda > 0$ is a real parameter and $p \in (2, 6)$. The system (1) is obtained by coupling a nonlinear Schrödinger equation with Maxwell's equations of electromagnetism (see [1] and references therein).

As the name suggests, the article deals with the Schrödinger-Poisson equation, which is a combination of two know equations: a Schrödinger equation - basis of quantum mechanics - and a Poisson equation, where a nonlinear place term u^p (or more often $f(u)$) has been added to this equation. These nonlinear terms are often used in the Schrödinger equation to model an interaction between particles. We give existence and nonexistence results, depending on the power p and parameters λ.

References

[1] D'AVENIA, P. Non-radially symmetric solutions of nonlinear Schrödinger equation coupled with Maxwell equations. *Adv. Nonlinear Stud.*, v. 2, n. 2, p. 177–192, 2002.

[2] RUIZ, D. The Schrödinger-Poisson equation under the effect of a nonlinear local term. *J. Funct. Anal.*, v. 237, n. 2, p. 655–674, 2006.