Multiple nodal solutions for the Schr\”odinger-Poisson system with an asymptotically cubic term

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Abstract

This paper deals with the following Schr\“odinger-Poisson system \begin{equation}\left\{\begin{aligned} &-\Delta u+u+ \lambda\phi u=f(u)\quad\mbox{in }\mathbb{R}^3,\\ &-\Delta \phi=u^{2}\quad\mbox{in }\mathbb{R}^3, \end{aligned}\right.\end{equation where $\lambda>0$ and $f(u)$ is a nonlinear term asymptotically cubic at the infinity. Taking advantage of the Miranda theorem and deformation lemma, we combine some new analytic techniques to prove that for each positive integer $k,$ system \eqref{zhaiyaofc} admits a radial nodal solution U_k^{λ}, which has exactly $k+1$ nodal domains and the corresponding energy is strictly increasing in k. Moreover, for any sequence $\{\lambda_n\}\to 0_+$ as $n\to\infty,$ up to a subsequence, $U_k^{\lambda_n}$ converges to some $U_k^0\in H_r^1(\mathbb{R}^3)$, which is a radial nodal solution with exactly $k+1$ nodal domains of \eqref{zhaiyaofc} for $\lambda=0 $. These results give an affirmative answer to the open problem proposed in [Kim S, Seok J. Commun. Contemp. Math., 2012] for the Schr\”odinger-Poisson system with an asymptotically cubic term.

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