Existence and multiplicity of positive radial solutions for singular superlinear elliptic systems in the exterior of a ball

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Abstract

We prove the existence and multiplicity of positive radial solutions to the nonlinear system

$$\begin{cases} -\Delta u_i = \lambda K_i(|x|)f_i(u_j) \text{ in } \Omega, \\ d_i \frac{\partial u_i}{\partial n} + \tilde{c}_i(u_i)u_i = 0 \text{ on } |x| = r_0, \\ u_i(x) \to 0 \text{ as } |x| \to \infty, \end{cases}$$

for a certain range of $\lambda > 0$, where $i, j \in \{1, 2\}, i \neq j$, $\Omega = \{x \in \mathbb{R}^N : |x| > r_0 > 0\}, N > 2, d_i \geq 0$, $K_i : [r_0, \infty) \to (0, \infty)$, $\tilde{c} : [0, \infty) \to [0, \infty), f_i : (0, \infty) \to \mathbb{R}$ are continuous with possible singularity $\pm\infty$ at 0 and satisfy a combined superlinear condition at ∞.