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一类具有Robin条件的奇异椭圆方程无穷多解的存在性

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The Existence of Infinitely Many Solutions for a Singular Elliptic Equation with Robin Boundary Condition

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摘要 探讨了如下的一类具有Robin条件的奇异椭圆方程:

$$-\Delta u-\mu\frac{u}{|x|^2}=f(x,u),\quad x\in\Omega,$$
$$\frac{\partial u}{\partial\gamma}+\alpha(x)u=0,\quad x\in\partial\Omega,$$

其中Ω是R^N中具有C^1边界的有界区域, $0\in\partial\Omega$, $N\geqslant 5$, $2^*(s)=(2(N-s))/(N-2)$ $(0\leqslant s<2)$是 Sobolev-Hardy 临界指数, $0<\mu<\mu^*$, γ 是定义在边界 $\partial\Omega$上的单位外法向量, $\alpha(x)$为非负有界函数且 $\alpha(x)\in L^\infty(\partial\Omega)$. 在 f 的非二次条件下, 利用变分方法和对偶喷泉定理, 证明了: 存在 $\lambda^*>0$, 使得对于 $\lambda\in(0,\lambda^*)$, 该问题有无穷多个解 $\{u_k\}\subset H^1(\Omega)$ 满足 (1) $J(u_k)<0$; (2) 当$k\to+\infty$时, $J(u_k)\to 0$.

关键词: Robin条件 Sobolev-Hardy 临界指数 $(PS)_c^*$条件 对偶喷泉定理 非二次条件

Abstract: This paper deals with the existence of infinitely many solutions of a singular elliptic equation with Robin boundary condition

$$-\Delta u-\mu\frac{u}{|x|^2}=f(x,u),\quad x\in\Omega,$$
$$\frac{\partial u}{\partial\gamma}+\alpha(x)u=0,\quad x\in\partial\Omega,$$

where Ω is a bounded domain in R^N with C^1 boundary, $0\in\partial\Omega$, $N\geqslant 5$. $2^*(s)=(2(N-s))/(N-2)$ $(0\leqslant s<2)$ is the Sobolev-Hardy critical exponent, $0<\mu<\mu^*$, γ denotes the unit outward normal to boundary $\partial\Omega$. Under nonquadraticity conditions of f, by means of a variational method and dual fountain theorem, we show that there exists $\lambda^*>0$ such that for any $\lambda\in(0,\lambda^*)$, the above problem admits a sequence of solutions $u_k\subset H^1(\Omega)$ such that $J(u_k)<0$ and $J(u_k)\to 0$ as $k\to+\infty$.

Key words: Robin problem critical Sobolev-Hardy exponent $(ps)_c^*$ condition dual fountain theorem nonquadraticity condition

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