Singular reaction diffusion equations where a parameter influences the reaction term and the boundary condition (I)

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Abstract

We analyse positive solutions to the steady state reaction diffusion equation:

$$\begin{cases} -u'' = \lambda h(t) f(u); \ (0,1) \\ -du'(0) + \mu(\lambda) u(0) = 0 \\ u'(1) + \mu(\lambda) u(1) = 0 \end{cases}$$

where $\lambda > 0$ is a parameter, $d \geq 0$ is a constant, f is a C^2 increasing function on $[0, \infty)$ such that $f(0) = 0$ and $\lim_{s \to \infty} \frac{f(s)}{s} = 0$, h is a C^1 nonincreasing function on $(0, 1]$ with $h(1) > 0$ and there exist constants $d_0 > 0$, $\alpha \in [0, 1)$ such that $h(t) \leq \frac{d_0}{t^\alpha}$ for all $t \in (0, 1]$, and μ is an increasing continuous function on $[0, \infty)$ such that $\mu(0) \geq 0$. We will discuss existence and multiplicity results via the method of sub-supersolutions. Further, we will discuss uniqueness results for $\lambda \gg 1$.

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