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# A nonlinear PDE with two Hardy-Sobolev critical exponents with one dimension singularity.

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For $N \geq 4$, we let $\Omega$ be a bounded domain of $\mathbb{R}^N$ and $\Gamma$ be a closed curve contained in $\Omega$. We study existence of positive solutions $u \in \mathbb{H}_0^1$ to the equation

$$\Delta u + hu = \lambda \rho_\Gamma^{-s_1} u^{2^*_{s_1}-1} + \rho_\Gamma^{-s_2} u^{2^*_{s_2}-1} \qquad \text{in } \Omega \tag{0.1}$$

where $h$ is a continuous function, $\lambda$ is a real parameter and $0 < s_2 < s_1 < 2$ and $\rho_\Gamma$ is the distance function to $\Gamma$. We prove the existence of a mountain pass solution for this Euler-Lagrange equation depending on the local geometry of the curve and the potential $h$.

In this paper, we also study existence, symmetry and decay estimates of the positive entire solutions of (0.1) with $\Omega = \mathbb{R}^N$ and $\Gamma$ the real line.