Asymptotic behavior for a nonlocal diffusion equation in domains with holes

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We will present results on the asymptotic behavior of solutions to a non-local diffusion equation, $u_t = J * u - u := Lu$, in an exterior domain, Ω, which excludes one or several holes, and with zero Dirichlet data on $\mathbb{R}^N \setminus \Omega$. When the space dimension is three or more this behavior is given by a multiple of the fundamental solution of the heat equation away from the holes. On the other hand, if the solution is scaled according to its decay factor, close to the holes it behaves like a function that is L-harmonic, $Lu = 0$, in the exterior domain and vanishes in its complement. The height of such a function at infinity is determined through a matching procedure with the multiple of the fundamental solution of the heat equation representing the outer behavior. The inner and the outer behavior can be presented in a unified way through a suitable global approximation.

The study involves a thorough understanding of the stationary solutions of the Dirichlet problem in the exterior domain and a conservation law for the evolution problem that gives the nontrivial final mass.

If time allows, we will comment on the differences in the case of 1 dimension where the local decay factor differs from the global one making the study more involved.

This is joint work with C. Cortázar and M. Elgueta from PUC-Chile and F. Quirós from UAM, Spain.

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