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An inverse problem arising from magnetohydrodynamics

Given the semilinear equation $\Delta u = f(u)$ in $\Omega$, where $\Omega$ is a two-dimensional bounded domain, with $u = 0$ on $\partial \Omega$, we consider the problem of determining the nonlinear term $f \geq 0$ from knowledge of the normal derivative of $u$, $\frac{\partial u}{\partial n}$, on $\partial \Omega$. It is easy to see that the identification of $f$ fails if $\Omega$ is a ball. We review some uniqueness results for analytic $f$’s in classes of non-smooth domains $\Omega$ and we describe a result of uniqueness in a class of smooth domains $\Omega$ obtained recently with M. Vogelius and S. Vessella via a regularity result for the (free) boundary $\partial \Omega$. 