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A calibration approach to one-phase free boundary problems

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The study of one-phase free boundary problems of Bernoulli type is a classical topic in the Calculus of Variations and PDEs. While the theory of calibrations and fields of extremals is a well-known method to prove minimality for standard elliptic functionals, it has rarely been applied to free boundary problems.

This talk will be devoted to presenting a novel calibration approach adapted to the p -Laplacian one-phase functional

$$\mathcal{E}(w) = \int_{\Omega \cap \{w > 0\}} \left(\frac{1}{p-1} |\nabla w(x)|^p + Q(x)^p \right) dx,$$

acting on nonnegative functions, where Ω is a regular domain, $p \in (1, +\infty)$, and Q is a nonnegative weight.

First, I will review the classical theory of calibration from the Calculus of Variations. Next, I will explain how to extend this theory to the one-phase setting. Finally, I will show that this tool allows us to recover viscosity properties of minimizers (a fundamental step for free boundary regularity).

This is a joint work with Iñigo U. Erneta (Rutgers University)