

WORKSHOP ON SUBMANIFOLD THEORY AND GEOMETRIC ANALYSIS

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Existence of multiple constant mean curvature boundaries of small enclosed volume in compact Riemannian manifolds

ABSTRACT. In this paper we want to give a result on the existence and the number of constant mean curvature hypersurfaces being the boundary of domains enclosing a small amount of volume inside a compact Riemannian manifold M^n without boundary. We give a lower bound on this number in terms of the topological invariants of M . We do it using the classical relation between constant mean curvature hypersurfaces and the solutions of the Van der Waals-Cahn-Hilliard two phase transition equation with volume constraint, i.e., the following nonlinear problem: for fixed $V, \varepsilon \in \mathbb{R}^+ =]0, +\infty[$, find a pair $(u_{\varepsilon,V}, \lambda_{\varepsilon,V})$ with $u_{\varepsilon,V} \in H^1(M)$, and $\lambda_{\varepsilon,V} \in \mathbb{R}$ such that

$$-\varepsilon \Delta u_{\varepsilon,V} + \frac{1}{\varepsilon} W'(u_{\varepsilon,V}) = \lambda_{\varepsilon,V}, \tag{P_{\varepsilon,V}}$$

$$\int_M u_{\varepsilon,V}(x) dv_g = V > 0,$$

where M^n is a compact Riemannian manifold without boundary of dimension n , W is a double well potential regular enough and satisfying suitable growth conditions at infinity. Then the abstract topological method of photography is applied to the Problem $(P_{\varepsilon,V})$, for small $0 < \varepsilon, V \ll 1$. Finally we send the temperature parameter $\varepsilon \rightarrow 0^+$ for a fixed small $0 < V$ to find suitable limit characteristic BV -functions of sets of finite perimeter with suitable boundary regularity properties such that the modulus of the generalized mean curvature vector is constant. This is a joint work with Vieri Benci (Univ. Pisa), Luis Eduardo Osorio Acevedo (IME-USP), Paolo Piccione (IME-USP).

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