Phase transitions, minimal surfaces and symmetry properties for elliptic PDEs

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Interfaces or phase transitions appear very often in physics, chemistry, biology, etc., for instance in interactions fluid–gas or solid–fluid, or in flame propagation in reactors. Due to surface tension, some interfaces tend to minimize its area. This is an interesting connection with the classical and rich theory of minimal surfaces. At the same time, the local study of some interfaces through a blow–up analysis leads to nonlinear elliptic equations in the whole space $\mathbb{R}^n$, and to rich problems on the symmetry properties of their solutions. We will discuss one of such problems; it was posed by E. De Giorgi in 1978 and it is still widely open.