Fast reaction limit with nonmonotone reaction function

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Abstract

I will discuss two recent papers [1, 2] on the reaction-diffusion system

$$\partial_t u^\varepsilon = \frac{v^\varepsilon - F(u^\varepsilon)}{\varepsilon},$$
$$\partial_t v^\varepsilon = \Delta v^\varepsilon + \frac{F(u^\varepsilon) - v^\varepsilon}{\varepsilon},$$

with nonmonotone reaction function F. As speed of reaction tends to infinity ($\varepsilon \to 0$), the concentration of non-diffusing component u^ε exhibits fast oscillations. We identify precisely its Young measure which, as a by-product, proves strong convergence of the diffusing component v^ε, a result that is not obvious at all from a priori estimates. Our work is based on analysis of regularization for forward-backward parabolic equations by Plotnikov [3]. We rewrite his ideas in terms of kinetic functions which clarifies the method, brings new insights, relaxes assumptions on model functions and provides a weak formulation for the evolution of the Young measure. Finally, in [2] we refine method of Plotnikov by application of classical Radon-Nikodym theorem.

This is a joint work with Benoît Perthame (Sorbonne University, Paris).

References

[1] B. Perthame, J. Skrzeczkowski. *Fast reaction limit with nonmonotone reaction function.* To appear in Communications on Pure and Applied Mathematics, arXiv: 2008.11086.

[2] J. Skrzeczkowski, Fast reaction limit and forward-backward diffusion: a Radon-Nikodym approach. arXiv preprint: 2105.11218.

[3] P. I. Plotnikov. *Passage to the limit with respect to viscosity in an equation with a variable direction of parabolicity.* Differ. Uravn., 30:4 (1994), 665–674; Differ. Equ., 30:4 (1994), 614–622.