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Dr Piotr Biler is a professor at the University of Wrocław, Poland. He studied mathematics at the University of Wrocław and obtained his PhD there in 1984. He subsequently became a full professor (1996) and Dean of Mathematics and Computer Science Faculty (2008-2016) at the same university. He was a recipient of J. Marcinkiewicz, K. Kuratowski, S. Zaremba prizes of the Polish Mathematical Society and W. Orlicz' Medal, and has been a member of the Polish Academy of Sciences since 2016. He is an expert on asymptotics of solutions of partial differential equations, with recent interests in biological phenomena of chemotaxis, i.e. movement of microorganisms mediated by chemicals secreted by themselves, physically equivalent to mean field models of self-interacting particles such as either massive attractive or charged repulsive ones.

Title: Parabolic systems with cross-diffusion: global existence versus finite time blowup

Abstract:
Two toy models, both consisting of parabolic systems with nonlinear cross-diffusion terms, obtained after a slight modification of the nonlinearity of the usual doubly parabolic Keller--Segel system

$$u_t = \Delta u - \nabla \cdot (u \nabla \varphi),$$

$$\tau \varphi_t = \Delta \varphi + u,$$

are studied. For these toy models, with the same structure of steady states as is for the nonlinear heat equation $u_t=\Delta u+u^2$, we establish that for data which are, in a suitable sense, smaller than the diffusion parameter τ in the equation for the chemoattractant, global solutions exist. For data larger than τ, a finite time blowup occurs. In this way, we check that our size condition for the global existence is sharp for large τ. Results are based on papers in collaboration with Grzegorz Karch, Dominika Pilarczyk, Hiroshi Wakui. and in particular on this with Alexandre Boritchev (Lanar), Lorenzo Brandolese, {\it Sharp well-posedness and blowup results for parabolic systems of the Keller--Segel type}, Methods and Applications of Analysis {\bf 30} (2023), 53--76.