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Small scale formations in the incompressible porous media equation

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The incompressible porous media (IPM) equation describes the evolution of density transported by an incompressible velocity field given by Darcy's law. Here the velocity field is related to the density via a singular integral operator, which is analogous to the 2D SQG equation. The question of global regularity vs finite-time blow-up remains open for smooth initial data, although numerical evidence suggests that small scale formation can happen as time goes to infinity. In this talk, I will discuss rigorous examples of small scale formations in the IPM equation: we construct solutions to IPM that exhibit infinite-in-time growth of Sobolev norms, provided that they remain globally smooth in time. As an application, this allows us to obtain nonlinear instability of certain stratified steady states of IPM. This is a joint work with Alexander Kiselev.

References

[1] A. Kiselev and Y. Yao, Small scale formations in the incompressible porous media equation, to appear in *Arch. Ration Mech. Anal.*, arXiv:2102.05213, 2021.

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