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Singular SDEs with critical and super-critical drifts

In this talk, I will discuss recent progress on weak and strong well-posedness of SDEs with critical and super-critical singularities in the drift. In particular, I will talk about the minimal value of thermal excitation needed to overcome blow ups due to the presence of attracting singularities in the drift that arise e.g. in the Keller-Segel type interacting particle systems immersed in a turbulent flow. The PDE and the probabilistic instruments include a variant of De Giorgi's method in L_p with p chosen in a way that allows to reach the critical magnitude of the singularities of the drift, and a modification of the approach of Rockner-Zhao needed to prove strong well-posedness. The talk is based in part on joint papers with K.R.Madou, Yu.A.Semenov and R.Vafadar.