Global regularity for the fractional Euler alignment system

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We study a pressureless Euler system with a non-linear density-dependent alignment term, originating in the Cucker-Smale swarming models. The alignment term is dissipative in the sense that it tends to equilibrate the velocities. Its density dependence is natural: the alignment rate increases in the areas of high density due to species discomfort. The diffusive term has the order of a fractional Laplacian of power $a<1/2$. The corresponding Burgers equation with a linear dissipation of this type develops shocks in a finite time. We show that the alignment nonlinearity enhances the dissipation, and the solutions are globally regular for all $0<a<1/2$. To the best of our knowledge, this is the first example of such regularization due to the non-local nonlinear modulation of dissipation. The talk is based on work joint with Tam Do, Lenya Ryzhik, and Changhui Tan.