

## **On the kinetic and hydrodynamic regimes of the Czirák-Vicsek model**

V.L. Kulinskii and O.O. Chepizhko

*Department for Theoretical Physics, Odessa National University,  
Dvoryanskaya 2, 65026 Odessa, Ukraine*

We consider the dynamics of the system of self propelling particles modelled via Czirák-Vicsek algorithm in continuum time limit. It is shown that the alignment process for the velocities can be subdivided into two regimes: “fast“ kinetic and “slow“ hydrodynamic ones. In fast kinetic regime the alignment of the particle velocity to the local neighborhood takes place with characteristic relaxation time. So that the bigger regions arise with the velocity alignment. These regions align their velocities thus giving rise to hydrodynamic regime of the dynamics. We propose the mean-field like approach in which we take into account the correlations between density and velocity. The comparison of the theoretical predictions with the numerical simulations is given. The relation between Vicsek model in the zero velocity limit and the Kuramoto model is discussed. Also we give simple estimation for the critical level of noise in the “mean-field“ approximation for the vector and scalar types of noise.