

# Vector kinetic approximations to fluid-dynamics equations

Roberta Bianchini, Roberto Natalini

Ecole Normale Supérieure de Lyon, UMPA, UMR CNRS-ENSL 5669, 46, allée  
d'Italie, 69364-Lyon Cedex 07, France  
Istituto per le Applicazioni del Calcolo, Consiglio Nazionale delle Ricerche, via dei  
Taurini 19, 00185 Rome, Italy  
`roberta.bianchini@ens-lyon.fr`, `roberto.natalini@cnr.it`

**Keywords.** Kinetic numerical schemes, Naviers-Stokes Equations, Hyperbolic problems

A singular semilinear hyperbolic approximation to the Euler and the incompressible Navier-Stokes equations in 2D, inspired by the kinetic theory, is considered. This approximation is interesting for numerical reasons, but also as a fully hyperbolic approximation.

In the first part of the talk, I will illustrate the structure of this approximation and its numerical advantages, already presented in [3]. Then, I will present a result of convergence of the vector-BGK to the incompressible Navier-Stokes equations in the diffusive scaling, see [1, 2].

This result deeply relies on the dissipative properties of the system and on the use of an energy which is provided by a symmetrizer whose entries are weighted in a suitable way with respect to the diffusive parameter. This convergence is valid for smooth solutions and it is global in time.

## References

- [1] Bianchini, Roberta; Natalini, Roberto. Convergence of a vector-BGK approximation for the incompressible Navier-Stokes equations. *Kinet. Relat. Models* 12 (2019), no. 1, 133–158.
- [2] R. Bianchini, Strong convergence of a vector-BGK model to the incompressible Navier-Stokes equations, to appear on *Journal Math. Pures et Appl.* (2019).
- [3] Bouchut, Francois; Jolic, Yann; Natalini, Roberto; Ocelli, Ren; Pavan, Vincent. Second-order entropy satisfying BGK-FVS schemes for incompressible Navier-Stokes equations. *SMAI J. Comput. Math.* 4 (2018),
- [4] M. Carfora, R. Natalini, A discrete kinetic approximation for the incompressible Navier-Stokes equations, *ESAIM: Math. Modelling Numer. Anal.* **42** (2008), 93-112.