

# Asymptotics and Boundary Conditions\*

François Dubois<sup>abc</sup>

April 26, 2021

<sup>a</sup> Laboratoire de Mathématiques d'Orsay, bâtiment 307, F-91405 Orsay, France.

<sup>b</sup> Conservatoire National des Arts et Métiers, LMSSC laboratory, F-75003 Paris, France.

<sup>c</sup> Centre National de la Recherche Scientifique, IRL-CRM, Montréal (QC), Canada.

This short course is based on previous contributions of the author, in collaboration with Pierre Lallemand and Mahdi Tekitek.

First, the extension “ABCD” [1] of the Taylor expansion method [2] allows to derive in a very simple way the equivalent partial differential equations of any nonlinear lattice Boltzmann scheme with multiple relaxation times.

Secondly, an analysis of the incomplete case when boundary conditions occurs is presented, for bounce-back [3, 4] and for anti bounce-back [5].

## References

- [1] F. Dubois. Nonlinear fourth order Taylor expansion of lattice Boltzmann schemes, *Asymptotic Analysis*, to appear; hal-0208111, arxiv-1903.12417, January 2021.
- [2] F. Dubois. “Equivalent partial differential equations of a lattice Boltzmann scheme”, *Computers and Mathematics with Applications*, volume 55, p. 1441-1449, 2008.
- [3] F. Dubois, P. Lallemand, M. Tekitek. “Taylor expansion method for analyzing bounce-back boundary conditions for lattice Boltzmann method”, *ESAIM: Proceedings and Surveys*, volume 52, pages 25-46, 2015.
- [4] F. Dubois, P. Lallemand, M. Tekitek. “Generalized Bounce Back boundary condition for the nine velocities two-dimensional lattice Boltzmann scheme”, *Computers and Fluids*, volume 193, article 103534, 2019.
- [5] F. Dubois, P. Lallemand, M. Tekitek. “On anti bounce back boundary condition for lattice Boltzmann schemes”, *Computers and Mathematics with Applications*, volume 79, pages 555-575, 2020.

---

\* Short Course, 17th ICMMES Conference, University of Tunis, Hammamet, Tunisia, July 12-16, 2021.