"Lattice Boltzmann: a short history"
by Uriel Frisch, november 2009

The study of the Boltzmann equation with discrete velocities was started by J. Broadwell, H. Cabannes and R. Gatignol in the seventeens. The idea of making both velocities and locations discrete by using a von Neumann cellular automaton (now called Lattice Gas Automaton = LGA) is due to Hardy, de Pazzis and Pomeau (1973). The first LGA with proven Navier-Stokes dynamics is due to Frisch, Hasslacher and Pomeau (1986) [Wolfram made a lot of general studies of cellular automata but did not contribute anything original to LGA]. Immediately everybody became aware of the possibility to use such an LGA within the Boltzmann approximation (Lattice Boltmann Approximation = LBA) [cf. for example the review paper by Frisch-d'Humieres-Hasslacher-Lallemand-Pomeau-Rivet in Complex Systems vol. 1, 649-707 (1987) and the H theorem for the LBA, a standalone Appendix in the aforementionned paper]. For a while the LBA looked quite academic because it was thought by many that the pure Boolean character of LGA would be an advantage over LBA, which requires floating point calculations.

Then McNamara and Zanetti [1988 Phys. Rev. Lett. 20, 2332] showed that LBA had an advantage by being free of Monte-Carlo noise. Higuera and Jimenez [1989 EPL 9, 345] showed that the LBA approach can be simplified by using a linearized form of the collision operator. Higuera, Succi and Benzi [1989 EPL 9, 345] went a step further in relaxing the constraint that the collision operator should be associated to implementable collision rules for the lattice gas, thereby being able to very significantly increase the accessible Reynolds numbers, a prerequisite for realistic simulations. Succi and Benzi then started a string of works actually tackling a variety of such flows [see e.g. Succi's 2001 Oxford Univ. monograph "The lattice Boltzmann equation for fluid dynamics and beyond"]. This and many further improvements opened the road for the actual industrial use of LBA [e.g. at Exa, Burlington, MA]