Kinetic and macroscopic diffusion models for gas mixtures in the context of respiration

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In this talk, I will first discuss shortly the context of respiration, and in particular the need to describe accurately the diffusion of respiratory gases in the lower part of the lung. At the macroscopic level, diffusion processes for mixtures are often modelled using cross-diffusion models. In order both to determine the regime in which such models are valid, and to compute the binary diffusion coefficients, it is of particular interest to derive these models from a description at the mesoscopic level by means of kinetic equations.

More precisely, we consider the Boltzmann equations for mixtures with general cross-sections (i.e. for any kind of molecules interactions), and obtain the so-called Maxwell-Stefan equations by performing a Hilbert asymptotic expansion at low Knudsen and Mach numbers. This allows us to compute the values of the Maxwell-Stefan diffusion coefficients with explicit formulae with respect to the cross-sections. We also justify the specific ansatz we use thanks to the so-called moment method.

This is a joint work with Laurent Boudin and Vincent Pavan.