

Title: Linear Boltzmann Equation and Fractional Diffusion

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Abstract: Consider the linear Boltzmann equation of radiative transfer in a half-space, with constant scattering coefficient σ . Assume that, on the boundary of the half-space, the radiation intensity satisfies the Lambert (i.e. diffuse) reflection law with albedo coefficient α . Moreover, assume that there is a temperature gradient on the boundary of the half-space, which radiates energy in the half-space according to the Stefan-Boltzmann law. In the asymptotic regime where $\sigma \rightarrow +\infty$ and $1 - \alpha \sim C/\sigma$, we prove that the radiation pressure exerted on the boundary of the half-space is governed by a fractional diffusion equation. This result provides an example of fractional diffusion asymptotic limit of a kinetic model which is based on the harmonic extension definition of $\sqrt{-\Delta}$. This fractional diffusion limit therefore differs from most of other such limits for kinetic models reported in the literature, which are based on specific properties of the equilibrium distributions (“heavy tails”) or of the scattering coefficient as in [U. Frisch-H. Frisch: Mon. Not. R. Astr. Not. **181** (1977), 273–280].