Mathematics > Analysis of PDEs

The Boltzmann equation, Besov spaces, and optimal time decay rates in the whole space

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(Submitted on 31 May 2012)

We prove that k-th order derivatives of perturbative classical solutions to the hard and soft potential Boltzmann equation (without the angular cut-off assumption) in the whole space, $\threed_x$ with $\DgE$, converge in large-time to the global Maxwellian with the optimal decay rate of $O(t^{-1/2 (k+\ALTsig+\frac{\Ndim}{2}-\frac{\Ndim}{r})})$ in the $L^r_x(L^2_{\vel})$-norm for any $2\leq r\leq \infty$. These results hold for any $\ALTsig \in [0, \Ndim/2]$ as long as initially $\| f_0|_{\dot{B}^{-\ALTsig,\infty}_2 L^2_{\vel}} < \infty$. In the hard potential case, we prove faster decay results in the sense that if $|\FP f_0\|_{\dot{B}^{-\ALTsig,\infty}_2 L^2_{\vel}} < \infty$ and $|{\FI - \FP} f_0|_{\dot{B}^{-\ALTsig+1,\infty}_2 L^2_{\vel}} < \infty$ for $\ALTsig \in (\Ndim/2, (\Ndim+2)/2]$ then the solution decays to zero in $L^2_\vel(L^2_x)$ with the optimal large time decay rate of $O(t^{-1/2\ALTsig})$.

Comments: 58 pages
Subjects: **Analysis of PDEs (math.AP)**; Mathematical Physics (math-ph)
Cite as: **arXiv:1206.0027v1 [math.AP]**

Submission history

From: Robert Strain [view email]
[v1] Thu, 31 May 2012 20:36:38 GMT (59kb)

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