Journal of Statistical Physics, Vol. 16, No. 4, 1977

Erratum

Approximate Kinetic Theory of Hard-Sphere Fluids Near Equilibrium

P. Résibois[1] and J. L. Lebowitz[2]

Received October 5, 1976

The authors recently proposed a systematic approximation scheme which can be described as an expansion in a formal parameter ϵ, with the Enskog theory as the lowest order result, to describe the dynamics of dense hard-sphere systems.(1) With further assumptions, this scheme was shown to lead to a reasonable understanding of the computer data on the velocity autocorrelation function $\Gamma(t)$.(2)

In Ref. 1, we extracted a few general properties of this ϵ expansion and, in particular, we claimed that, to order ϵ^n, the first $2n$ time derivatives of the one-particle d.f. at $t = 0$ were given correctly. The same method of estimation led, in Ref. 2, to a vanishing contribution of the so-called "ring events" to the second derivative $\ddot{\Gamma}(0)$.

As pointed out recently by De Schepper and Cohen,(3) these claims are wrong: The reason is that our formal proof treated the hard-sphere collision operator K_{ij} as regular, with the implicit assumption that its singular part (a Dirac delta function expressing the fact that interaction takes place at contact between the spheres only) was always "smoothed out" in the integrations over phase space coordinates. That this is not so was proved by the explicit calculation of $\ddot{\Gamma}(0)$ given in Ref. 3; in particular, there are nonvanishing contributions to $\ddot{\Gamma}(0)$ due to the "ring events," which, in our classification, involve terms of order ϵ^1 and ϵ^2.

Our erroneous statement does not invalidate, however, the applicability of our approximation scheme and it has little influence on the numerical

[1] Faculté des Sciences, Université Libre de Bruxelles, Bruxelles, Belgique.
[2] Belfer Graduate School of Science, Yeshiva University, New York, New York.

Table I

V/V_0	$G(0)$ exact	ϵ^1 Approximation
1.83	−0.0078	−0.0081
1.69	−0.0243	−0.0263

figures. To check this point, we have evaluated $\ddot{\Gamma}(0)$ at two inverse densities V/V_0 where good numerical data for the triplet correlation function are available. Writing, in the reduced units of Ref. 2, $\ddot{\Gamma}(0) = 0.455659 + G(0)$, where 0.455659 is the result of the Enskog theory, we found the results displayed in Table I for the exact $G(0)$, as obtained from Ref. 3, and for our first-order ϵ calculation [with now a proper handling of the (singular) ϵ^1 contribution due to "ring events"]. The difference [which exactly vanishes to order $(V_0/V)^2$ in the density] is seen to be of little significance even at high density. Finally, the hydrodynamic approximation displayed in Ref. 2 is not affected by these short-time effects.

ACKNOWLEDGMENTS

We thank Drs. I. De Schepper and E. Cohen for fruitful discussions.

REFERENCES

1. P. Résibois and J. L. Lebowitz, *J. Stat. Phys.* **12**:483 (1975).
2. P. Résibois, *J. Stat. Phys.* **13**:393 (1975).
3. I. De Schepper and E. Cohen, *Phys. Lett.* **55A**:385 (1976).