Corrigendum

Volume 32 Number 3 Pages 231–54

An investigation of the accuracy of numerical solutions of Boltzmann's equation for electron swarms in gases with large inelastic cross sections

Ivan D. Reid

An error has been found in the computer codes used in the Monte Carlo simulations. The correction for this error alters some of the values of $D_\perp$ by up to several per cent. The conclusions presented in the paper are however not affected.

The error occurs in all isotropic scattering cases. The method chosen to generate the new random direction after a collision does not lead to an isotropic scattering distribution. Rather, it gives a distribution in which scattering is preferred about the directions whose cosines are

$$\pm c_x = \pm c_y = \pm c_z = \pm\sqrt{\tfrac{1}{3}}.$$

This has the effect of enhancing the radial spread of the electrons, thus increasing $D_\perp$. In general, correcting this error led to significant changes in $D_\perp$ only when it was already significantly lower than the result given by the two-term Boltzmann analysis. The correction lowered the value of $D_\perp$ further in these cases, while v_{dr} and $\langle\varepsilon\rangle$ remained unaffected.

Several authors have used either the results presented in the original paper or copies of the Monte Carlo program in further investigations. These have generally been as benchmarks for more sophisticated analyses (Pitchford *et al.* 1981; Haddad *et al.* 1981; Pitchford and Phelps 1982) or alternative simulations (Skullerud, personal communication 1981; Braglia, personal communication 1981). It was the discrepancies between reported values of $D_\perp$ and those from these last studies which ultimately led to the discovery of the error. In the light of this error, comparisons using the original results or the Monte Carlo code must now be examined for significant effects resulting from it.

In the case of the 'ramp' inelastic cross section model, with $k = 10{\cdot}0\ \text{Å}^2\,\text{eV}^{-1}$ and $E/N = 24$ Td, the result for $D_\perp$ has dropped from $1{\cdot}194$ to $1{\cdot}144\times10^5\ \text{cm}^2\,\text{s}^{-1}$. This corrected value now agrees well with other simulations of the same model by Skullerud and by Braglia. Pitchford *et al.* (1981), applying their extended Boltzmann analysis to this model, obtained a converged value of $1{\cdot}130\times10^5\ \text{cm}^2\,\text{s}^{-1}$ which also agrees with the amended result to within the estimated uncertainties. Pitchford and Phelps (1982) observed a 'larger difference in the transverse diffusion coefficient calculated by the two techniques' (i.e. Monte Carlo and extended Boltzmann) in N_2 at 100 Td. This discrepancy would also appear to be caused by the error in the isotropic scattering code since the value obtained for $D_\perp$ from their Boltzmann analysis is $3{\cdot}5\%$ lower than that given by the simulation and $7{\cdot}7\%$ below the two-term result.

In the comparison by Haddad *et al.* (1981) isotropic scattering was only considered in case A. Here, the discrepancy between the Monte Carlo and two-term results for $D_\perp$ is only 2%, so that one would not expect significant errors in the Monte Carlo

result. In fact the agreement with the moment theory result of Haddad *et al.* is better than 0·1%.

The author is grateful to Dr R. O. Watts for bringing this error to his attention and to Dr G. N. Haddad for carrying out tests with the corrected program.

References

Haddad, G. N., Lin, S. L., and Robson, R. E. (1981). *Aust. J. Phys.* **34**, 243.
Pitchford, L. C., O'Neil, S. V., and Rumble, J. R. (1981). *Phys. Rev.* A **23**, 294.
Pitchford, L. C., and Phelps, A. V. (1982). *Phys. Rev.* A **25**, 540.