QUANTUM MECHANICAL CALCULATIONS
OF SELF-BROADENING IN RARE GASES

P. J. LEO¹, D. T. P. MULLAMPHY², G. PEACH¹ and I. B. WHITTINGHAM³
¹Department of Physics and Astronomy, University College London,
Gower Street, London WC1E 6BT, United Kingdom

²Department of Mathematics and Statistics, James Cook University,
Townsville, Australia, 4811

³Department of Physics, James Cook University,
Townsville, Australia, 4811

Full quantum-mechanical calculations of the self-broadening of non-resonant lines
in the spectra of helium and neon will be discussed and the results compared with re-
cent experimental data. The calculations are based on the use of accurate interatomic
potentials and on the impact theory of Baranger. The Born-Oppenheimer approxima-
tion is made in setting up the quantum-mechanical scattering equations and is shown
to be valid for the conditions of interest here, namely temperatures in the range 77K
to 273K. The equations are then integrated numerically using an R-matrix method
which has proved to be very suitable for this purpose since it has the advantage that
once the R-matrices have been set up, results for a large number of different inci-
dent velocities can be obtained at little extra cost. Thus an accurate average over the
Maxwell distribution can be carried out; this is very important when making detailed
comparisons with experiment as the use of a single mean velocity in itself leads to
significant error.