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DEGREE	Doctor of Philosophy in Physics
FULL NAME	Niall Benjamin Tyndall
THESIS TITLE	A detailed study of important atomic collision processes for the analysis of astrophysical plasmas

SUMMARY: (max. 300 words)

In this thesis, we present a number of atomic transitions associated with three astrophysically important systems S^{9+}, Ar^{2+}, and Co^{2+}. The latter is especially prominent in the study of particular classes of Supernovae (SNe). We also provide an additional collisional-radiative modelling procedure to analyze electron collisions involving Co^{2+} by implementing an isolated atom approximation. We consider typical temperature and density diagnostics to constrain properties such as SNe evolution and mass-loss processes.

Large evaluations for these three systems have been considered using the well studied R-matrix method, where appropriate parallel computer codes DARC and BP have been used to incorporate relativistic effects accordingly. We have studied in detail the photoionization of S^{8+}, both valence and L_2-shell photoionization of Ar^{+}, above threshold photoionization of Co^{+} and the applicable extension to the electron-impact excitation of Co^{2+} required for the computation of Maxwellian averaged collision strengths.

To describe these systems, we have considered various approaches to model such many-body problems. Two computer packages CIV3 and GRASP0 have been executed to solve the target state problem, and we apply the theory of configuration-interaction to include sufficient correlation effects to enhance the wavefunctions. Energy levels, oscillator strengths and transition probabilities have been presented here and comparisons are conducted with other works.

A systematic analysis has been carried out, and theoretical predictions for our current set of scattering results agree well with other theoretical and experimental measurements. Therefore, we conclude that in this thesis we have presented accurate and extremely useful atomic data for transitions involving electrons and photons essential for spectral modelling.

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CERTIFICATION OF SUBMITTED WORK

I hereby certify that this is the final accepted copy of the submitted work and that any required amendments have been completed and submitted within the deadline.

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