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Electron Impact Excitation of Fe-peak Ions of Astrophysical Interest

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Electron-impact collision strengths and corresponding effective collision strengths are of crucial importance in the interpretation of spectra of low-ionisation stages of the iron peak elements Fe, Co and Ni, which occur in numerous laboratory and astrophysical plasmas. However, accurate calculation of these quantities is complicated by the open d-shell structure of these ions, which give rise to many low-lying target states that are strongly coupled. This, in turn, leads to a large number of coupled channels which must be retained in the model, posing a formidable computational challenge. Recently a new parallel R-matrix package, PRMAT [1], has been developed to address this problem, and we are in a position to study successfully much larger collision problems than previously possible. In particular, we have a unique opportunity to gain a deeper insight into the role of configuration interaction effects in both the $(N+1)$-electron collision wavefunction, as well as the N-electron target state wavefunction.

Previous studies on Fe II [2] and Fe III [3] have illustrated the importance of the inclusion, in the CI expansion, of electronic configurations allowing for 'two-electron' excitation from the $3p$ to the $3d$ shell. In addition, recent work on Ni V [4] has demonstrated the rôle of broad 'two-particle-one-hole' resonance features, arising from the intermediate states of Ni IV. These features can act to significantly affect the collision strength results. Latest findings for ions of Fe, Ni and Co will be presented at the conference.

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