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Atomic collision processes for modelling cool star spectra

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The abundances of chemical elements in cool stars are very important in many problems in modern astrophysics. They provide unique insight into the chemical and dynamical evolution of the Galaxy, stellar processes such as mixing and gravitational settling, the Sun and its place in the Galaxy, and planet formation, to name a just few examples. Modern telescopes and spectrographs measure stellar spectral lines with precision of order 1 per cent, and planned surveys will provide such spectra for millions of stars. However, systematic errors in the interpretation of observed spectral lines leads to abundances with uncertainties greater than 20 per cent. Greater precision in the interpreted abundances should reasonably be expected to lead to significant discoveries, and improvements in atomic data used in stellar atmosphere models play a key role in achieving such advances in precision. In particular, departures from the classical assumption of local thermodynamic equilibrium (LTE) represent a significant uncertainty in the modelling of stellar spectra and thus derived chemical abundances. Non-LTE modelling requires large amounts of radiative and collisional data for the atomic species of interest. I will focus on inelastic collision processes due to electron and hydrogen atom impacts, the important perturbers in cool stars, and the progress that has been made. I will discuss the impact on non-LTE modelling, and what the modelling tells us about the types of collision processes that are important and the accuracy required. More specifically, processes of fundamentally quantum mechanical nature such as spin-changing collisions and charge transfer have been found to be very important in the non-LTE modelling of spectral lines of lithium, oxygen, sodium and magnesium.