Stellar parameters at high precision

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Accurate stellar parameters are needed in all fields of modern astrophysics, from studies of planetary systems to stellar physics, and evolution of galaxies. Stellar spectroscopy is the main instrument to characterise a star; it embraces a variety of models and diagnostic techniques for the determination of stellar surface parameters, detailed chemical composition, and evolutionary stage. Research in this field has never been more exciting and important to astronomy: the ongoing and future large-scale stellar spectroscopic surveys, aiming to observe millions of stars, are making gigantic steps along the way towards high-precision stellar, Galactic, and extra-galactic archaeology.

I will review the state-of-the-art in modelling spectra of cool stars, from solar-like stars to red supergiants. I will outline the basic principles underlying the models and introduce the new generation of radiation transport models in stellar atmospheres, which are based upon 3D non-local thermodynamic equilibrium physics. I will then review the methods that are used in the diagnostics of basic stellar parameters and explore the future techniques that have the potential to transform quantitative stellar spectroscopy. Finally, I will show how these improvements impact our knowledge of stellar and galactic physics.