Quantitative Spectroscopy of Massive Stars

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The quantitative spectral analysis of hot massive stars was pioneered by Albrecht Unsöld in his study of τ Scorpii in 1942. In the following decades progress in atomic physics, model atmospheres and observational instrumentation allowed this to be developed into a quite mature field. We concentrate on the discussion of stars with masses less than about 20 M8, for which atmospheric and fundamental parameters as well as abundances for a wide range of chemical species can nowadays be derived at high accuracy and precision.

Analyses of samples of unevolved single massive stars have shown that the extended solar neighbourhood in the Milky Way is chemically highly homogeneous at present day, with wide-ranging implications for the efficiency of mixing processes in the interstellar medium, and for our understanding of the composition of interstellar dust. A comparison of these cosmic abundances with the solar elemental composition allows even new constraints on the origin of the solar system to be derived. Here, challenges for the future are the quantitative spectroscopy of binary stars, which consist the majority of massive stars, of fast-rotating objects, and – closely related to these – of Be stars.

Finally, analyses of evolved massive stars in their supergiant phase facilitate predictions from stellar evolution models to be tested observationally. Despite the large progress made leading to the current state-of-the-art evolution models, numerous evidence is found that our understanding of massive star evolution is far from complete. We emphasize the effects of magnetic fields, which came into focus in the context of massive stars only recently.