Talk at Splinter Meeting

Splinter F

Carbon and Oxygen Enhancement and Chemistry in Cool Stars and Stellar Systems

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Carbon and oxygen are the most abundant heavier elements, or "metals", in standard stellar compositions, and the first to form with the onset of helium burning in massive stars. Accordingly they dominate the metal budget, e.g. the total metal fraction by mass Z, rather more pronouncedly so in low-metallicity populations, where oxygen and the other α-process elements are enhanced relative to iron and other metals, and carbon frequently shows enhancement in metal-poor stars as well. They gain further importance in cool stars as the building blocks of the most common molecules, carbon monoxide and water. As these compounds become dominant opacity sources in the red optical and near infrared, it becomes crucial to include their contribution to radiative heating and cooling fully self-consistently in atmosphere models to correctly reproduce the atmospheric thermal structure and thus provide the right fundament for detailed abundance studies.

The role of these two elements continues into the substellar domain, where at still lower temperatures hydrocarbons of varying complexity can form, and oxygen takes part in the condensation of refractory elements. These products account for the main observables in directly imaged extrasolar planets. In particular, the carbon/oxygen ratio has been widely adopted as a crucial parameter for tracing the formation history of a planet, since the two elements are subject to different fractionation processes in the protoplanetary disk. However the final elemental abundances in the planetary atmosphere are still also dependent on the initial bulk composition of the disk, confirming again the importance of an accurate determination of the abundances in the stellar photosphere.