Hydrogen Deficiency in Peculiar Red Giants

Robert F. Wing Pedro Saizar
Astronomy Department, The Ohio State University

Hydrogen abundances (or H/He ratios) are hard to determine in stars cooler than the Sun because the Balmer lines, when visible at all, are formed largely in the chromosphere, while the bands of CH and NH are often strongly saturated and badly blended with atomic lines. A few stars (the hydrogen-deficient carbon or HdC stars) are known to be extremely hydrogen-deficient, as their G bands of CH are absent despite an overabundance of carbon. A means of detecting less extreme cases of hydrogen deficiency would improve our understanding of red giant evolution. Minor variations in hydrogen content may be expected as the result of the mixing of processed material to the surface, and more radical changes might result from a star's shedding its entire hydrogen-rich envelope, say in the course of binary-star evolution.

The hydrogen negative ion H^- is the primary source of continuous opacity in the optical and infrared regions of most late-type stars, and it has a pronounced effect on the shapes of their infrared energy distributions. Calibrated scans of infrared energy distributions therefore offer the possibility of detecting differences in hydrogen content among late-type stars.

The cooled grating spectrometer at Kitt Peak National Observatory has been used to measure fluxes in 13 narrow bands between 1 and 4 μm chosen to avoid atomic and molecular lines as well as telluric absorption. Data have been obtained for several categories of carbon stars, S stars, barium stars, metal-poor stars, Cepheids, and RV Tauri variables, as well as for sequences of normal dwarfs, giants, and supergiants. The effect of H^- appears as a departure from a blackbody curve and is clearly seen from spectral type F to at least M7, reaching a maximum effect of about 0.4 mag near type M0. The effect is greatly reduced in the HdC star HD 182040. The RV Tau stars R Sct and U Mon also have very little H^-, but this may be a result of their relatively warm photospheric temperatures and low pressures. Barium stars have roughly normal H^- content for their temperatures and gravities.

We intend to analyze the data by comparison with energy distributions calculated from a grid of model atmospheres computed at Indiana University for varying degrees of hydrogen deficiency. These comparisons should enable us to calibrate our measured H^- indices in terms of actual H/He ratios.

https://doi.org/10.1017/S0252921100062813 Published online by Cambridge University Press