VIII SERBIAN CONFERENCE ON SPECTRAL LINE SHAPES IN ASTROPHYSICS
6-10 June 2011, Divčibare, Serbia
Book of Abstracts, Eds. L. Č. Popović, D. Jevremović and D. Ilić
Astronomical Observatory Belgrade, 2011

Invited lecture

HABITABLE ZONES AROUND MAIN SEQUENCE STARS: APPROXIMATIONS FOR THE SPECTRAL ENERGY DISTRIBUTION

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The habitable zone (HZ) around a given central star is defined as the region within which an Earth-like planet might enjoy the moderate surface temperatures required for advanced life forms. At present, there are several models calculating the habitable zone. One class of models utilises climatic constraints for the existence of liquid water on a planetary surface. Our approach is based on an integrated Earth system analysis that relates the boundaries of the HZ to the limits of photosynthetic processes. We start with the calculation of the HZ for the solar system and extend it to other central stars different from the Sun. During a star's main sequence lifetime there is usually an increase in luminosity and changes in effective temperature. The change in star's effective temperature has the following effect: for two stars with the same bolometric luminosity the redder will have a greater proportion at infrared wavelengths and is more effective in raising the planetary surface temperature. This effect is taken into account by a parabolic relation between the stellar flux and the star's effective radiation temperature. In this way, we are able to calculate the HZ for central stars of different masses, including F- and M-stars. We apply our model to calculate the HZ around the M-type star Gliese 581 and discuss the possible existence of two habitable planets: Gliese 581d at the outer edge of the HZ and Gliese 581g at an almost perfect Goldilock position.