

β UMi / HR 5563: K4 III

The model is based on the following parameters:

Unblanketed atmospheric spectrum, covering 0.5 μ m - 200 μ m at a resolution of 0.005 μ m. Consists of the MARCS generated model up to 200 μ m.

The original theoretical spectrum was calculated at a resolution of $\Delta\lambda = 0.5$ Angstrom, and then degraded to a resolution of 0.005 μ m applying a gaussian convolution.

Stellar atmosphere model and theoretical spectrum are generated using the MARCS theoretical stellar atmosphere code (Gustafsson et al., 1975, A&A, 42, 407 and further updates; Gustafsson et al. 2003, Modelling of Stellar Atmospheres, Poster Contributions. Proceedings of the 210th Symposium of the International Astronomical Union held at Uppsala University, Uppsala, Sweden, 17-21 June, 2002. Edited by N. Piskunov, W.W. Weiss, and D.F. Gray. Published on behalf of the IAU by the Astronomical Society of the Pacific, 2003, p.A4) and the TURBOSPECTRUM synthetic spectrum code (Plez et al., 2003, Modelling of Stellar Atmospheres, Poster Contributions. Proceedings of the 210th Symposium of the International Astronomical Union held at Uppsala University, Uppsala, Sweden, 17-21 June, 2002. Edited by N. Piskunov, W.W. Weiss, and D.F. Gray. Published on behalf of the IAU by the Astronomical Society of the Pacific, 2003., p.A2). Stellar parameters (and uncertainties thereon) have been derived by Decin et al (2003, A&A, 400, 709).

For $\lambda > 200 \mu\text{m}$, the temperature T of the flux forming region where $\tau_{\lambda} = 1$ is determined for each wavelength point, based on the logarithmic extrapolation of $T(\tau_{\lambda} = 1)$ in the 50 to 200 μ m wavelength range.

The flux density at each wavelength point is then approximated by the black-body flux at that temperature T (Dehaes et al 2011, A&A, 533, A107).

For the theoretical spectrum of β UMi, the following stellar parameters are used:

- * Effective temperature $T_{\text{eff}} = 4085$ K
- * Gravity $\log g[\text{cm/s}^2] = 1.6$
- * Mass $M = 2.49 M_{\odot}$
- * Microturbulent velocity = 2.0 km/s
- * Metallicity $[\text{Fe}/\text{H}] = -0.15$
- * Carbon abundance: $C = 8.25$
- * Nitrogen abundance: $N = 8.16$
- * Oxygen abundance : $O = 8.83$
- * $^{12}\text{C}/^{13}\text{C}$ ratio = 9

[other atomic abundances are solar scaled with metallicity]

The outermost depth point of the theoretical atmosphere model was taken at $\log(\tau_{\lambda}) = -7.2$ with λ being $2.2\mu\text{m}$. The atmosphere model was calculated with a spherically symmetric geometry, under the assumption of radiative and hydrostatic equilibrium, local thermodynamic equilibrium (LTE) and homogeneous layers.

Uncertainties on the theoretical spectrum predictions are discussed in depth in Decin & Eriksson (2007; A&A, 472, 1041).

Absolute flux calibration is based on the K-band magnitude (Johnson) by Faucherre et al., 1983, A&A 120, 263 : $K_{\text{mag}} = -1.22$

Using the appropriate conversion factor (Selby et al), this corresponds to a K-band magnitude of

$K_{\text{mag}} = -1.280$ in the Selby system (Selby et al., 1988; A&AS, 74, 127)

The Zero-point is determined on the basis of an ideal 'Vega', i.e. the K-band photometry of Vega is corrected for a flux excess of 1.29% (cf Absil et al. 2006; A&A, 452, 237).

The determined Selby et al K-band zeropoint is $4.0517 \times 10^{-10} \text{ W/m}^2 \mu\text{m}$

The derived angular diameter based on the K-band photometry is 9.36 milli-arcsec.

The estimated absolute flux uncertainty is 1%