The Spectrum of TX Psc

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TX Psc is one of the very few carbon stars for which spectroscopic data from the blue toward the near infrared can be found in the literature. We present calculations of the first synthetic spectra that are in agreement with all the major spectral features in the observed spectrum, including the H^- peak and the 3 μm band. The spectra are calculated on the basis of available observational estimates of the basic stellar parameters and model atmospheres that include absorption from HCN, C_2H_2 and C_3 in the opacity calculation.

Three papers have dealt with the comparison of synthetic spectra with the observed spectrum of TX Psc (Johnson et al., Ap.J., 270, L63, 1983 and Ap.J., 292, 228, 1985; Lambert et al., Ap. J. Suppl., 62, 373, 1986). These point out the difficulties in fitting the H^- peak at 1.65 μm by model atmospheres with diatomic molecules alone, the discrepancies between observed and calculated H_2 quadrupole lines, and show that inclusion of HCN and C_2H_2 opacity in the model atmosphere overcomes much of these problems but show a far too strong 3 μm band of HCN and C_2H_2.

The strength of the 3 μm feature cannot be reduced by assuming that the calculated absorption coefficient should be systematically overestimated, since the absorption coefficient used for the fundamental (3μm band) is in agreement with laboratory values. Reducing the absorption coefficient from the part of the bands that are not experimentally verified will only strengthen the 3 μm band. This happens also if only diatomic molecules are considered in the opacity calculation. Reducing the hydrogen abundance also does not reduce the strength of the 3 μm band.

Because bands from polyatomic molecules are generally formed higher in the atmosphere than the diatomic bands and the metallic lines, these bands are much more sensitive to basic stellar parameters. We present results of calculations of the 3 μm band for different choices of parameters, and conclude that the parameter set Teff = 3100 K (from lunar occultation measurements), log(g) = -0.5 and Log(C/O) = 0.01 (which are all in agreement with the parameter set adopted by Lambert et al. within the errors quoted by them) gives good agreement between calculated and observed 3 μm band. This parameter set also predicts a spectrum that matches well with the rest of the gross features of the observed spectrum, including the H^- peak and the H_2 lines.

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