Modelling the M-S-C Giants
Spectral Sequence

FRANCE ALLARD¹, PETER H. HAUSCHILDT²,
DAVID R. ALEXANDER¹, MARTIN COHEN³,
and GORDON C. AUGASON⁴

¹ Wichita State University, Wichita KS, U.S.A.
² Arizona State University, Tempe AZ, U.S.A.
³ Radio Astronomy Laboratory, University of California
  Berkeley CA, U.S.A.
⁴ NASA/Ames Research Center, Moffett Field CA, U.S.A.

We present pressure-dependent line-by-line LTE model atmospheres for
cool red giants (T_{eff} < 4000 K) in spherical geometry. The models are com-
puted using the atmospheric code PHOENIX, and they constitute an extension
to the pressure regimes of red giants. The grid covers C/O ratios ranging from
0.27 to 1.02 with otherwise solar metallicity. We find our models compara-
tible to those of Kurucz in regimes where the plane-parallel approximation is
valid, with the exception of the predicted strength of TiO bands as expected
from the use of different TiO opacity sources. Departures from LTE in the
Ti I lines are investigated for some selected models across the grid, but only
modest NLTE effects are found in the abundance of the important absorber
TiO. The models are used to construct a spectral sequence of M, S and C type
giants for which both optical and infrared spectra are available. Colors of the
combined dwarf and giant model grids are presented in the Wing eight-color
system which reveals a clear separation of dwarf and giant stars, and of giants
in carbon abundance and gravity, providing ideal grounds for the study of the
chemical evolution of giants.

Model atmospheres, synthetic spectra and colors presented here will be
made available upon request. This research is partially supported by grant
AST-9217946 from the National Science Foundation.