INSTABILITIES IN A POLYTROPIC ATMOSPHERE

H.M. Antia and S.M. Chitre
Tata Institute of Fundamental Research
Bombay, India

Abstract

The density in the outer layers of stars varies by several orders of magnitude
and it is desirable to include the full effects of compressibility in any study of
instabilities arising in stellar convection zones. In an unstable compressible fluid-
layer that is thermally conducting both the oscillatory and non-oscillatory motions
can simultaneously arise. The conditions under which the oscillatory acoustic modes
can be overstabilized in a polytropic atmosphere are examined. It is argued that the
linearized perturbation theory breaks down when applied to an inviscid complete poly-
trope which has vanishing density and temperature at the top for both optically-thin
and optically-thick approximations. However, the linearized theory is demonstrated
to be self-consistent when viscosity and thermal conductivity are included in the
study of complete polytropes.

ON THE DYNAMICS OF THE SOLAR CONVECTION ZONE

Bernard R. Durney and Hendrik C. Spruit
National Center for Atmospheric Research
Boulder, CO 80303 U.S.A.

Abstract

We derive expressions for the turbulent viscosity and turbulent conductivity ap-
plicable to convection zones of rotating stars. We assume that the dimensions of the
convective cells are known and derive a simple distribution function for the turbulent
convective velocities under the influence of rotation. From this distribution func-
tion (which includes, in particular, the stabilizing effect of rotation on convection)
we calculate in the mixing-length approximation: i) the turbulent Reynolds stress

tensor and ii) the expression for the heat flux in terms of the superadiabatic gradient. The contributions of the turbulent convective motions to the mean momentum and energy equation are treated consistently, and assumptions about the turbulent viscosity and heat transport are replaced by assumptions about the turbulent flow itself. The free parameters in our formalism are the relative cell sizes and their dependence on depth and latitude.

THERMAL AND CONTINUUM DRIVEN CONVECTION IN B-STARS

George Driver Nelson

CODE CB, Johnson Space Center

Houston, Texas, 77058

Abstract

Two regions of convective instability are present in the photosphere of a typical B-star (T_{eff} = 30,000 K Log g = 4.0). One is the usual thermal instability caused by the helium ionization. The other is driven by the continuum radiation pressure in a thermally stable layer. Mixing length and anelastic modal representations of these unstable regions show that the rapid radiative cooling of temperature fluctuations limits the velocities to an amplitude of a few meters per second, much too small to account for the observed line broadening and asymmetries.