Djehuty: A Code for Modeling Whole Stars in Three Dimensions


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Djehuty: A Code for Modeling Whole Stars in Three Dimensions


Lawrence Livermore National Laboratory, Livermore, CA, USA

Abstract. The DJEHUTY project is an intensive effort at the Lawrence Livermore National Laboratory (LLNL) to produce a general purpose 3-D stellar structure and evolution code to study dynamic processes in whole stars.

1. Introduction

Stellar models in 1-D work remarkably well for most stars. However, stars are three dimensional objects and the computing power is now at a point where we can do better than 1-D models for modeling the large array of physical processes occurring in stars for which spherical symmetry is no longer a valid approximation. With a 3-D stellar code one can tackle the problems linked to rotation, turbulent motions and convection, magnetism, binarity, and explosive phases of stellar evolution in a consistent and physically meaningful way.

The DJEHUTY code is an evolution of a radiation hydrodynamics code developed over decades at LLNL. It is our goal to provide the astrophysical community with the first general purpose 3-D stellar structure and evolution code suitable to study the whole gamut of dynamical processes occurring in stars.

2. The DJEHUTY code

At the heart of DJEHUTY is an Arbitrary Lagrangian-Eulerian (ALE; Barton 1985) code for radiation hydrodynamics which treats radiation transport in the diffusion approximation. Microscopic physics appropriate for stars has been added. The opacities used are those of OPAL (Iglesias & Rogers 1996) for high temperatures and Alexander (Alexander & Ferguson 1994) for low temperatures. A set of Planck opacities computed from the OP data (Seaton et al. 1994) is being used within the hydro code to couple the radiation to the

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1This work was performed under the auspices of the U.S. Department of Energy, National Nuclear Security Administration by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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