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# Stellar Astrophysics

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## Editorial

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## EDITORIAL NOTE

The study of stars and stellar evolution relies heavily on the analysis of stellar spectra. The necessity for atomic line data from the ultraviolet to the infrared regions is bigger now than ever. Within the past twenty years, the time since the launch of the Hubble Space Telescope, great progress has been made in acquiring atomic data for UV transitions. The optical wavelength region, now expanded by progress in detector technology, continues to supply motivation for brand spanking new atomic data. Additionally, investments in new instrumentation for ground-based and space observatories has cause the supply of high-quality spectra at IR wavelengths, where the necessity for atomic data is most crucial.

Stellar physics and evolution calculations enable a broad range of research in astrophysics. Modules for Experiments in Stellar Astrophysics (MESA) may be a suite of open source, robust, efficient, thread-safe libraries for a good range of applications in computational stellar astrophysics. A one-dimensional stellar evolution module, MESA star, combines many of the numerical and physics modules for simulations of a good range of stellar evolution scenarios starting from very Low Mass to massive stars, including advanced evolutionary phases. MESA star solves the fully coupled structure and composition equations simultaneously. It uses adaptive mesh refinement and complicated time step controls, and supports shared memory parallelism supported Open MP. State-of-the-art modules provide equation of state, opacity, natural process rates, element diffusion data, and atmosphere boundary conditions. Each module is made as a separate Fortran 95 library with its own explicitly defined public interface to facilitate independent development. Several detailed examples indicate the extensive verification and testing that's continuously performed and demonstrates the wide selection of capabilities that MESA possesses.

These examples include evolutionary tracks of very Low Mass stars, brown dwarfs, and Jovian planet planets to very old ages; the entire evolutionary track of a 1 MΘ star from the Pre-Main Sequence (PMS) to a cooling white dwarf; the solar sound speed profile; the evolution of intermediate-mass stars through the He-core burning phase and therefore thermal pulses on the He-shell burning asymptotic giant branch phase; the inside structure of slowly pulsating B Stars and Beta Cepheids; the entire evolutionary tracks of massive stars from the PMS to the onset of core collapse; mass transfer from stars undergoing Roche lobe overflow; and the evolution of helium accretion onto a star .

The discovery on stars of coronae and of X-ray emission from flares within the 1970's opened the investigation of stellar activity. Solar-stellar astrophysics has now become a street. The rich detail of the Sun provides a close-up view of physical phenomena, while the stellar observations provide how to, in effect, vary the otherwise fixed solar parameters. During this way we will study the evolution of the Sun, the dependence of activity on rotation, and therefore the degree of autonomy between magnetic fields and such fundamental parameters as mass and age.