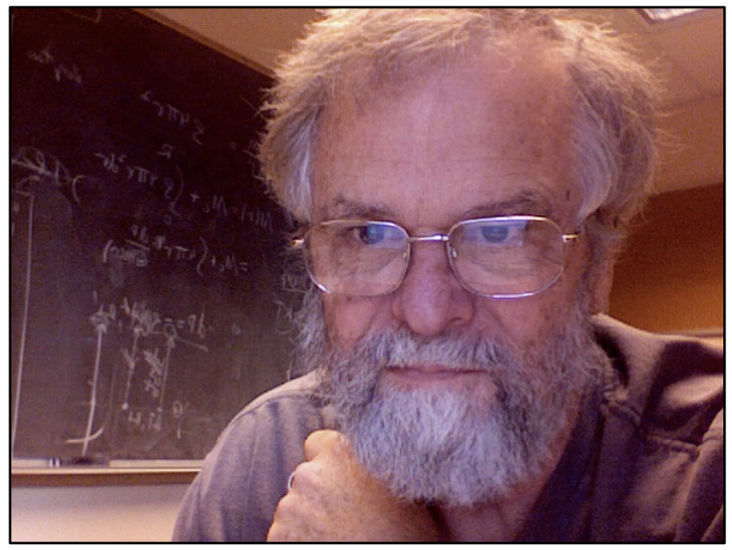
MESA

Modules for Experiments in Stellar Astrophysics

MESA is a state-of-the-art, modular, open source suite for stellar evolution



Bill Paxton, father of MESA

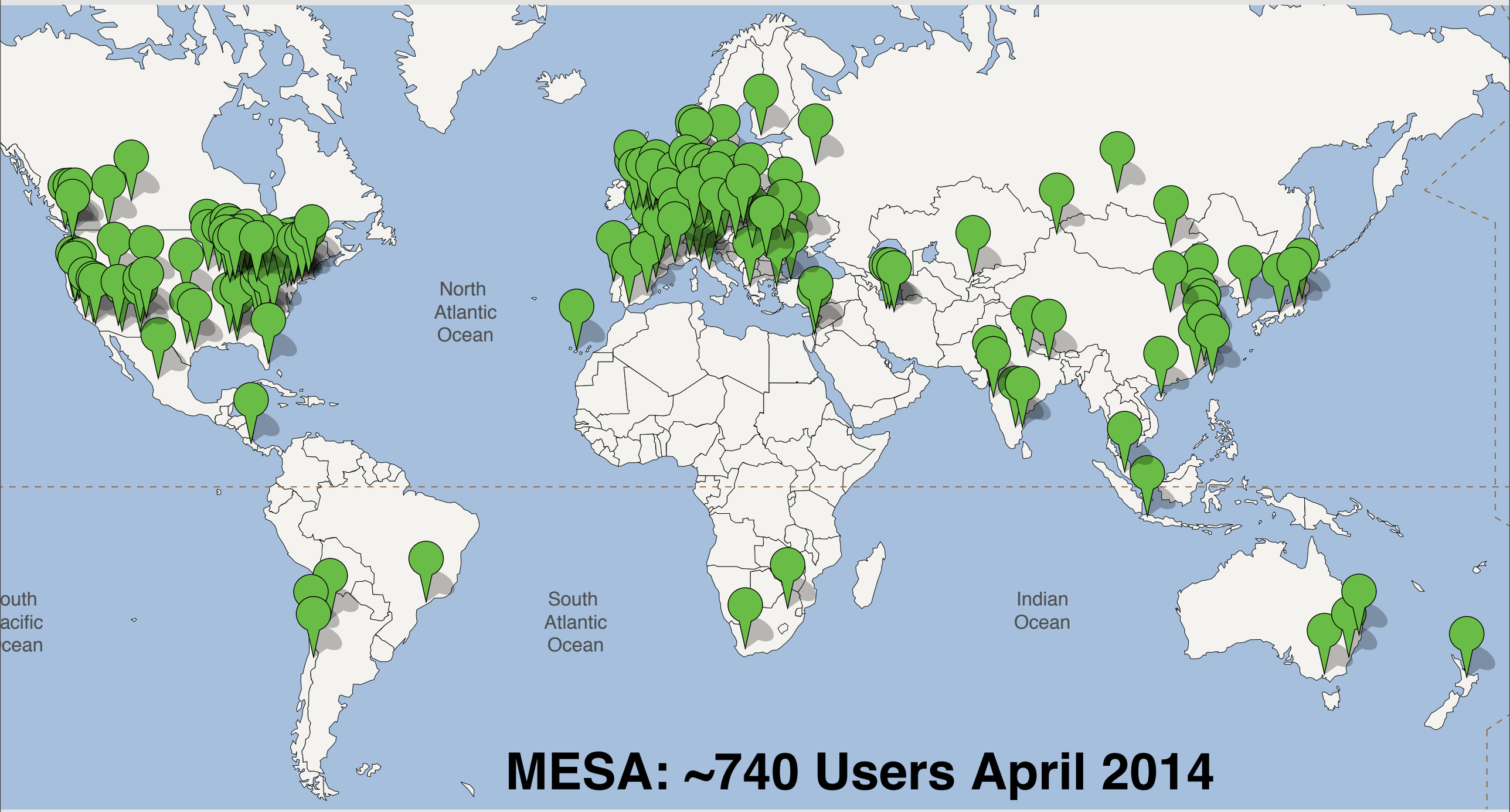
- MESA Stellar Evolution Code: mesa.sourceforge.net
- MESA Instrument Papers (Paxton et al. 2011, 2013)

MESA

- **Openness**: anyone can download sources from the website.
- **Modularity**: independent modules for physics and for numerical algorithms; the parts can be used stand-alone.
- **Wide Applicability**: capable of calculating the evolution of stars in a wide range of environments.
- **Modern Techniques**: advanced AMR, fully coupled solution for composition and abundances, mass loss and gain, etc.
- **Comprehensive Microphysics**: up-to-date, wide-ranging, flexible, and independently useable microphysics modules.
- **Performance**: runs well on a personal computer and makes effective use of parallelism with multi-core architectures.

User Base

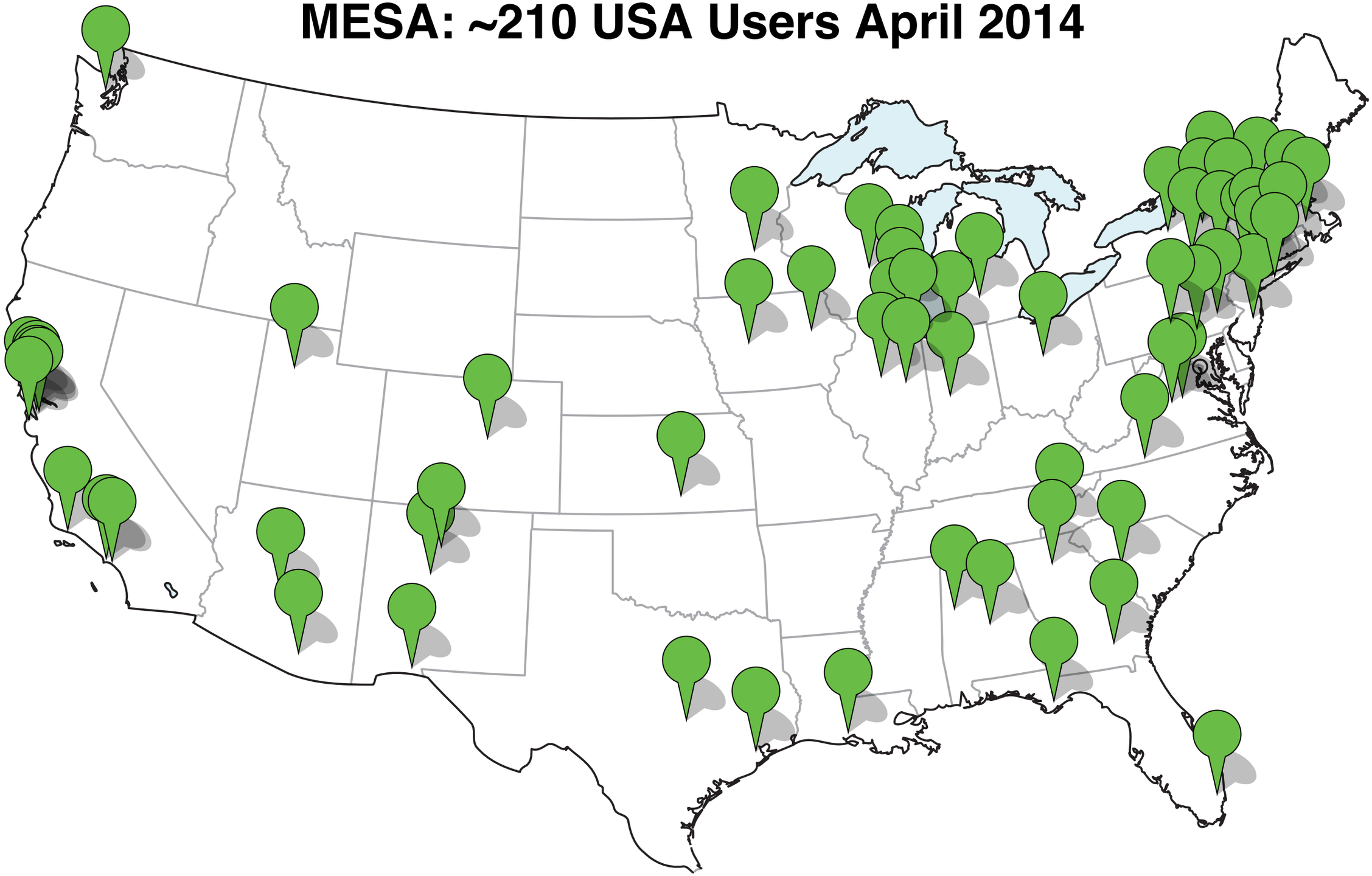
MESA



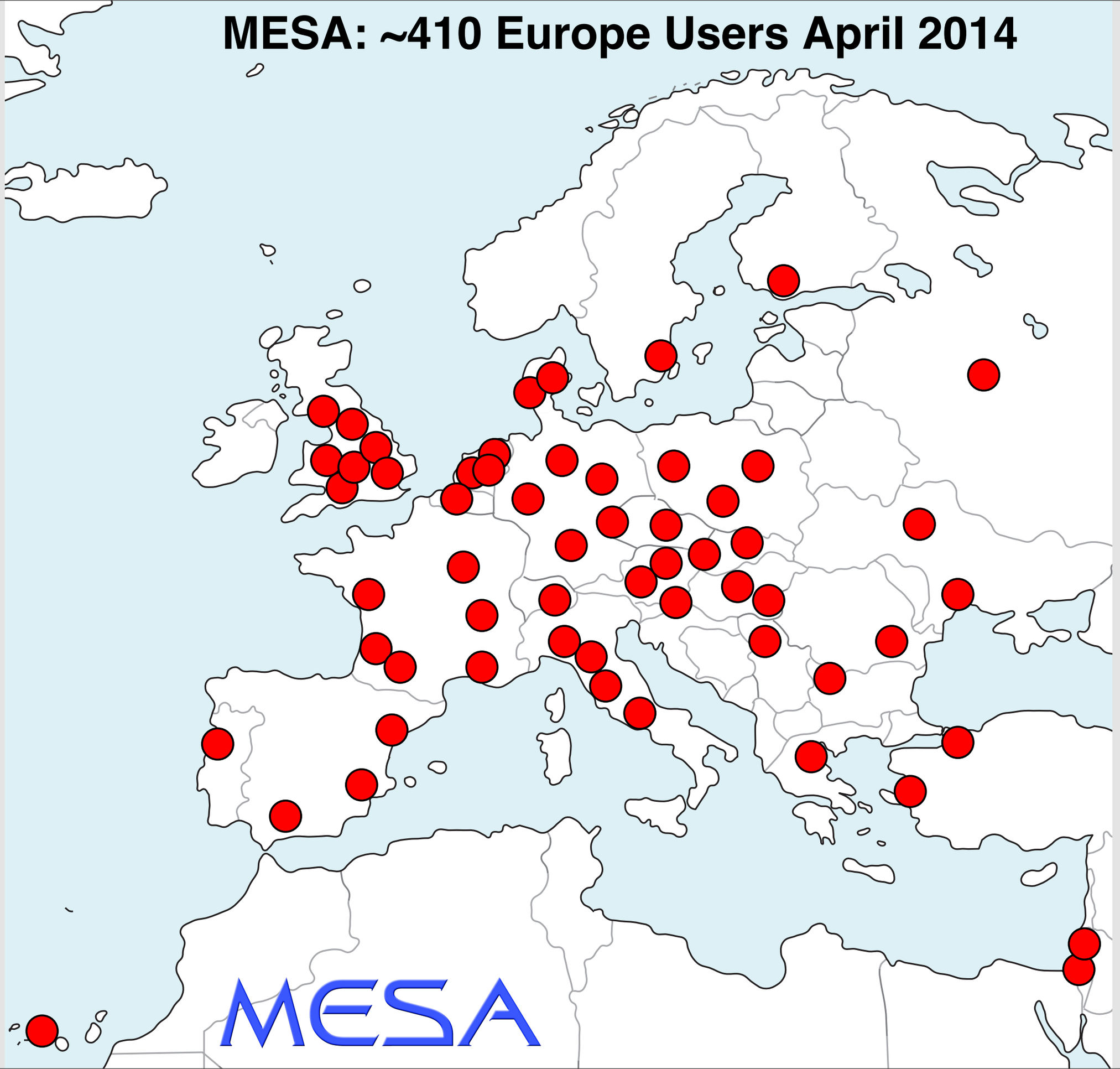
MESA: ~740 Users April 2014

MESA

MESA: ~210 USA Users April 2014



MESA: ~410 Europe Users April 2014



MESA Capabilities

MESA Capabilities

- Mass loss/gain, Schwarzschild/Ledoux, double diffusion, gravitational settling, radiative levitation...

- It includes the physics of **rotation** (in a diffusion approximation) and of dynamo generated **magnetic fields** in radiative zones

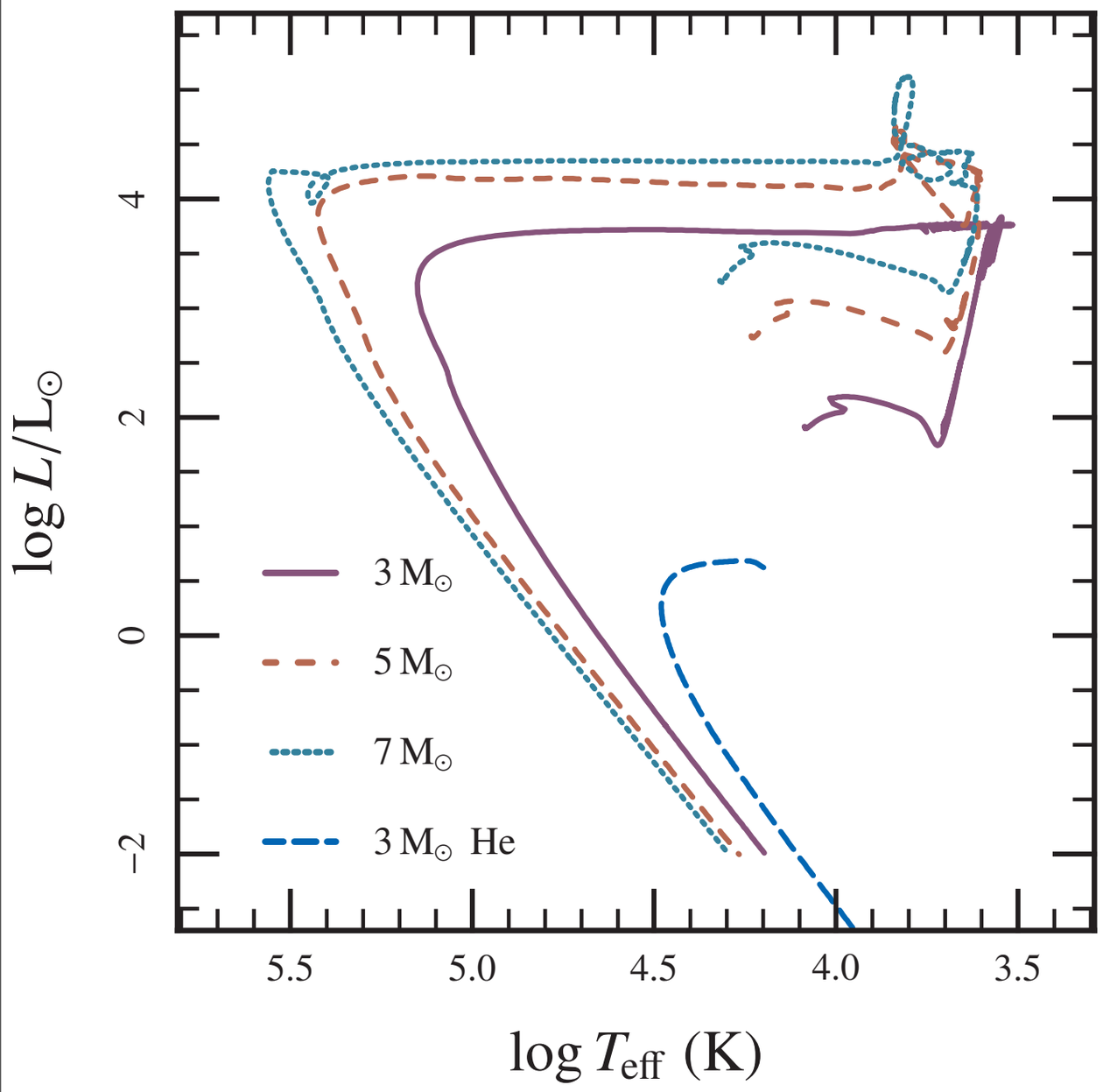
- **Asteroseismology :** MESA is natively coupled with two oscillations codes: **ADIPLS** (J. Christensen-Dalsgaard 2008) and the non-adiabatic code **GYRE** (Townsend & Teitler 2013)

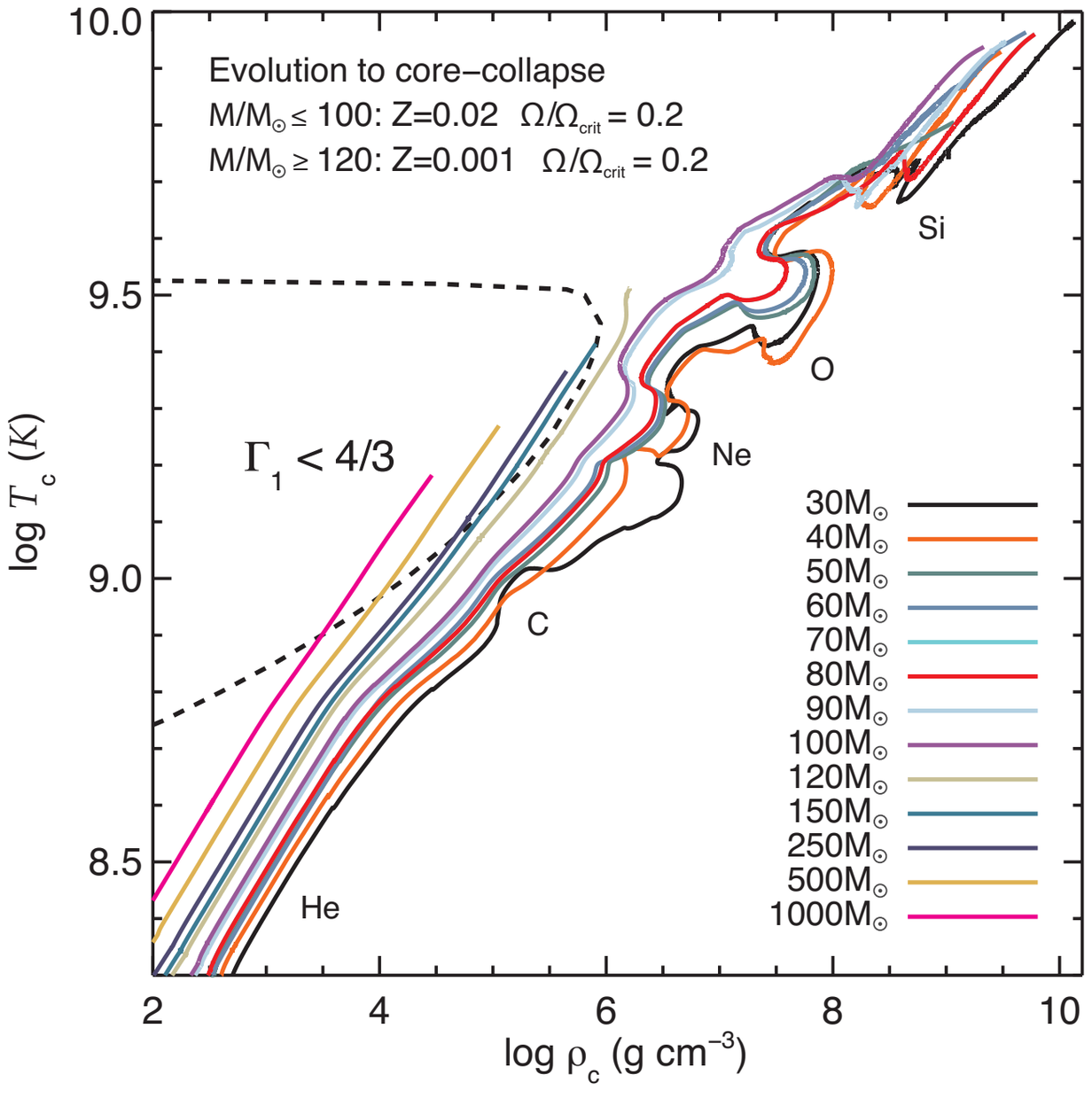
- **Giant planets**, Low-mass stars, Massive Stars, Compact Objects, Asteroseismology, Accretion / Massloss...

(Paxton+ 2011, 2013)

Single stars with MESA

- Uninterrupted evolution to WD and core-collapse

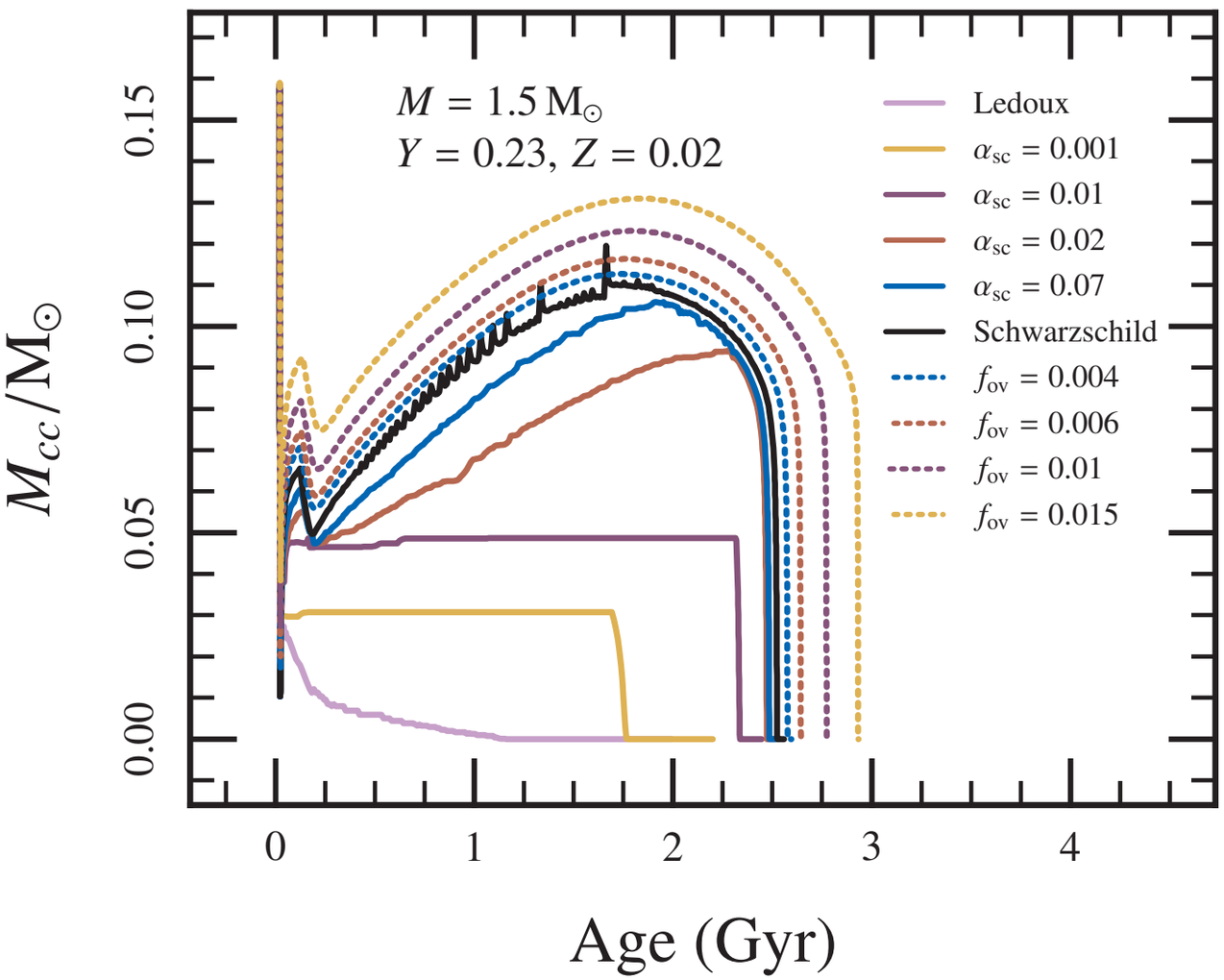


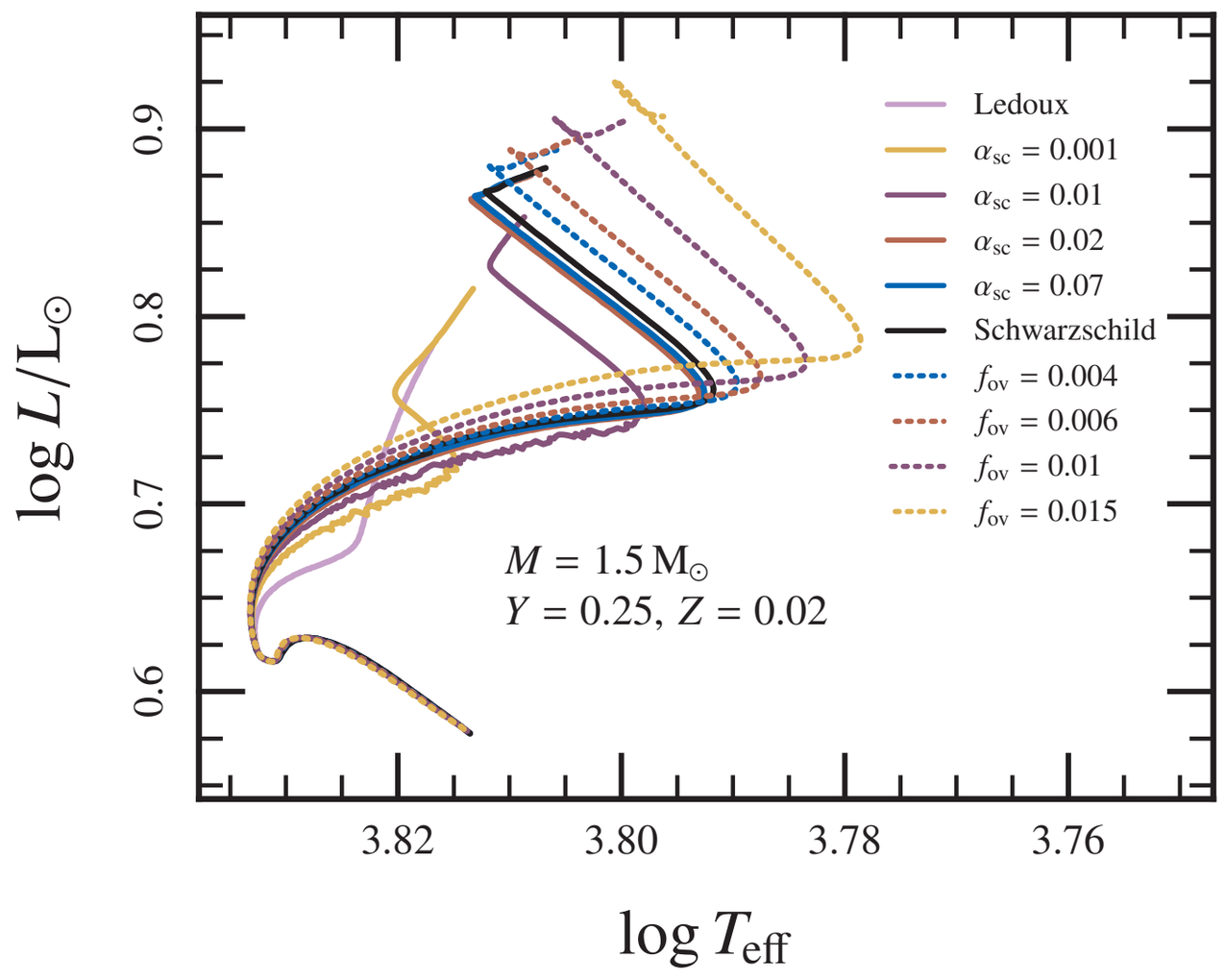


(Paxton+ 2013)

Single stars with MESA

- Mass loss/gain, Schwarzschild/Ledoux, overshooting, double diffusion, gravitational settling, radiative levitation...





(Paxton+ 2013)

Single stars with MESA

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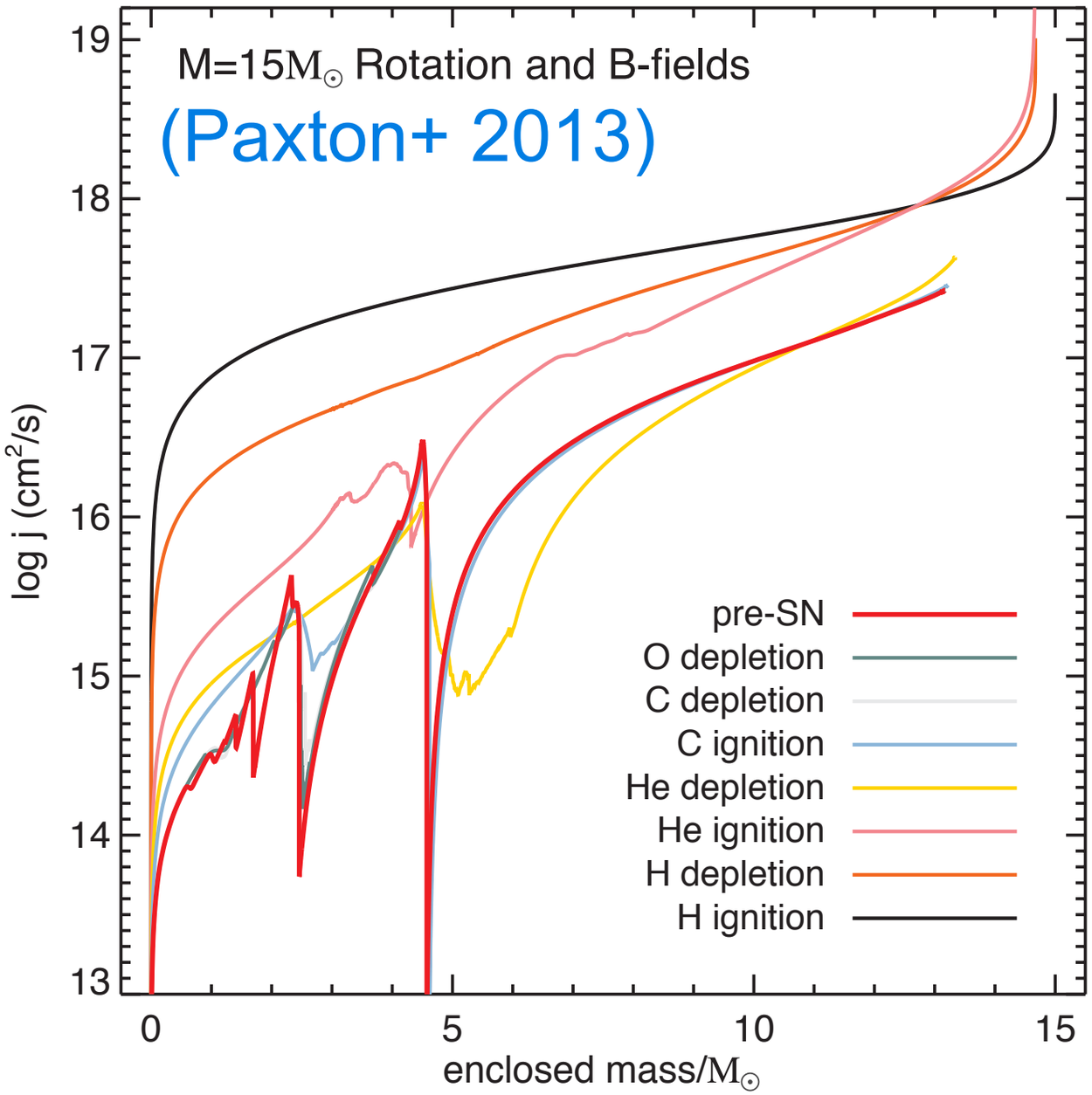
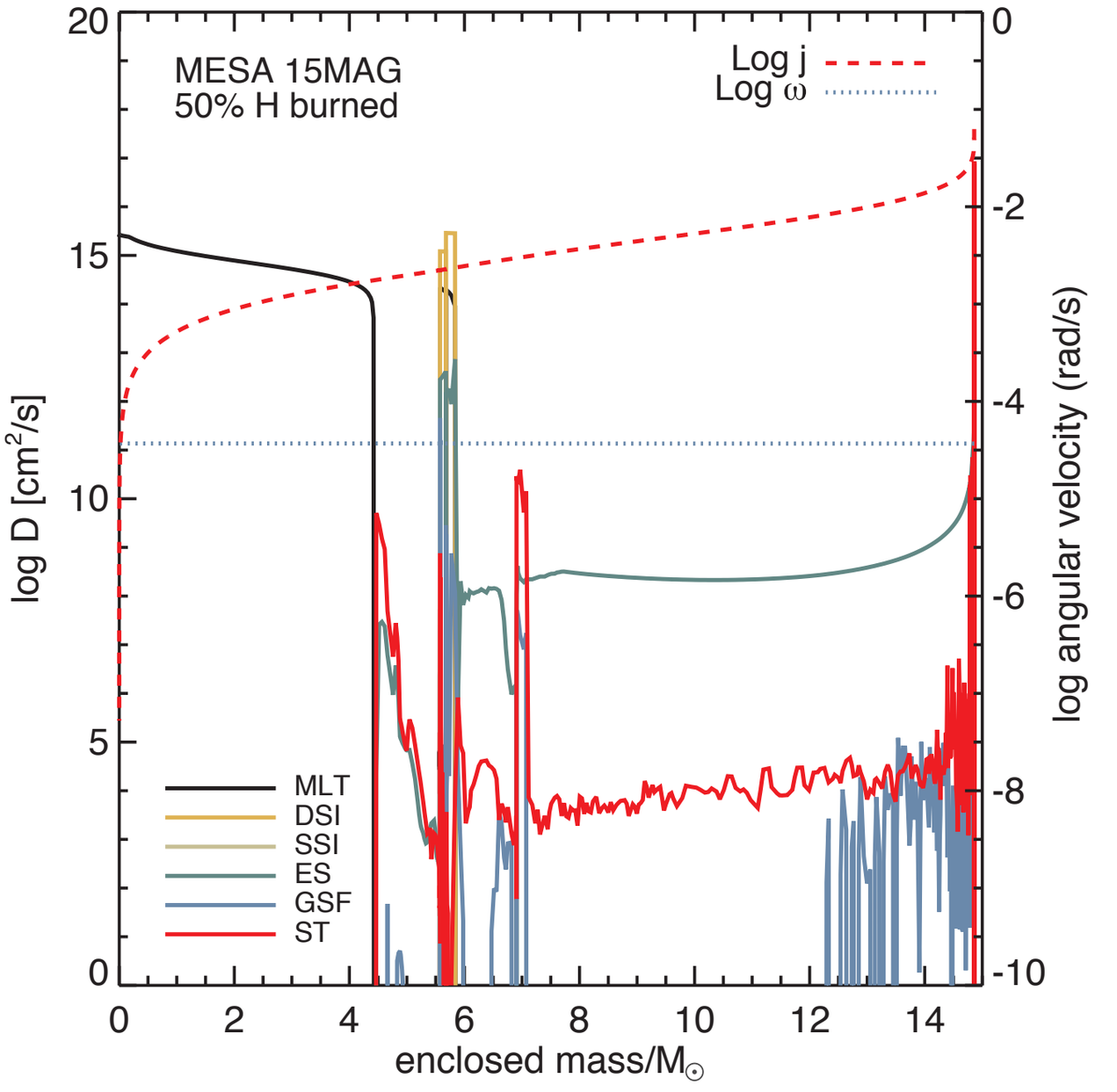
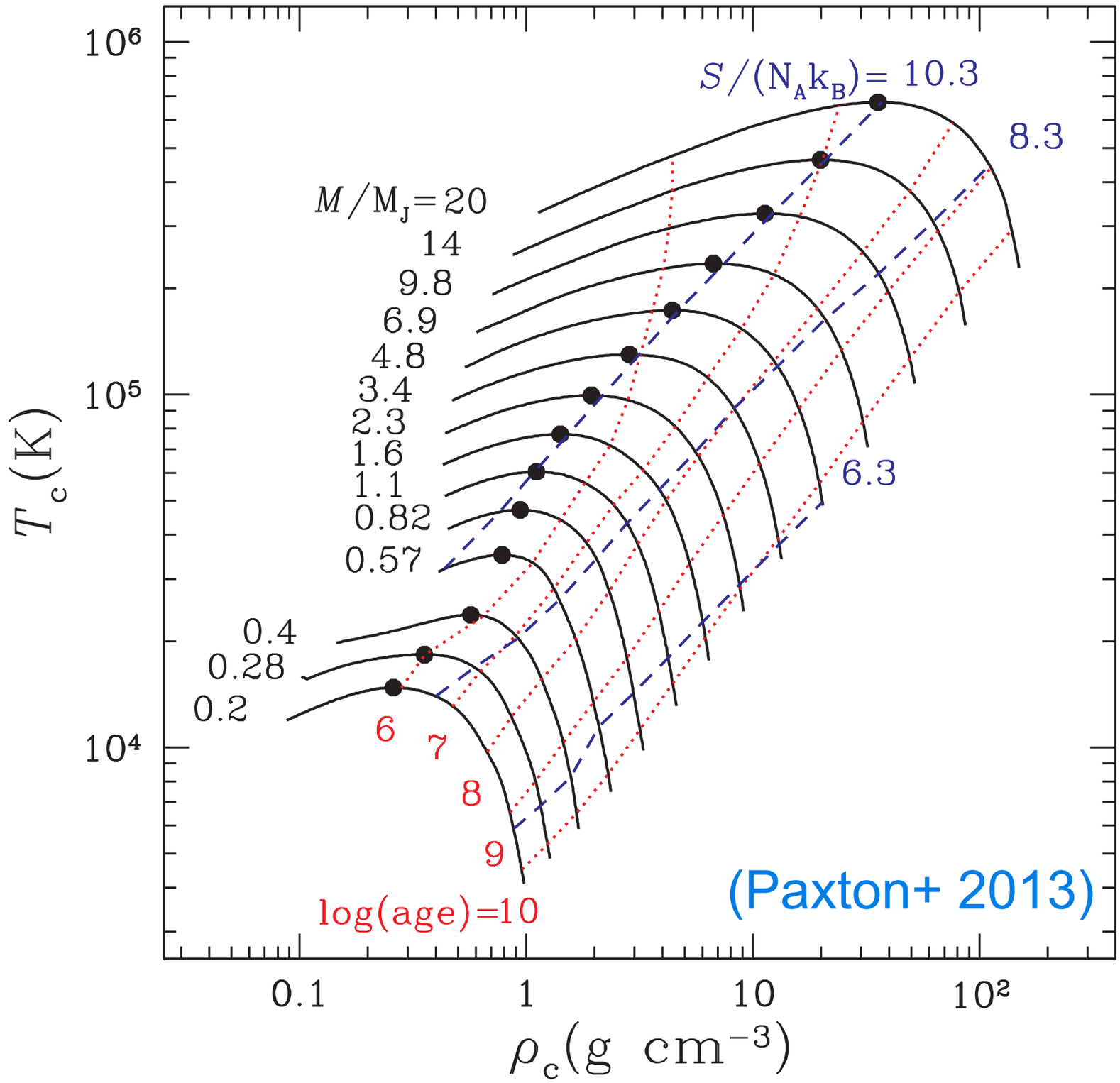
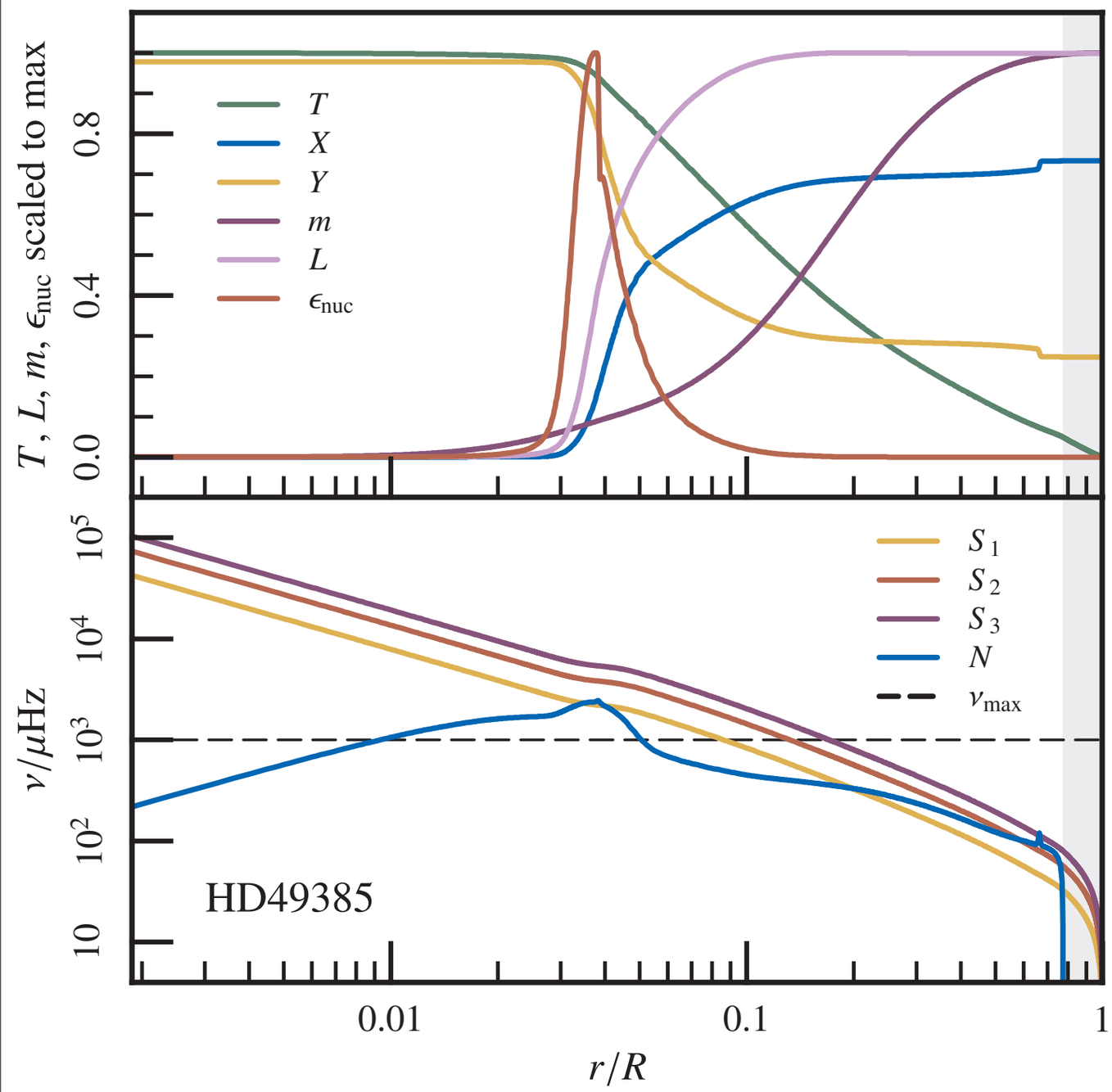


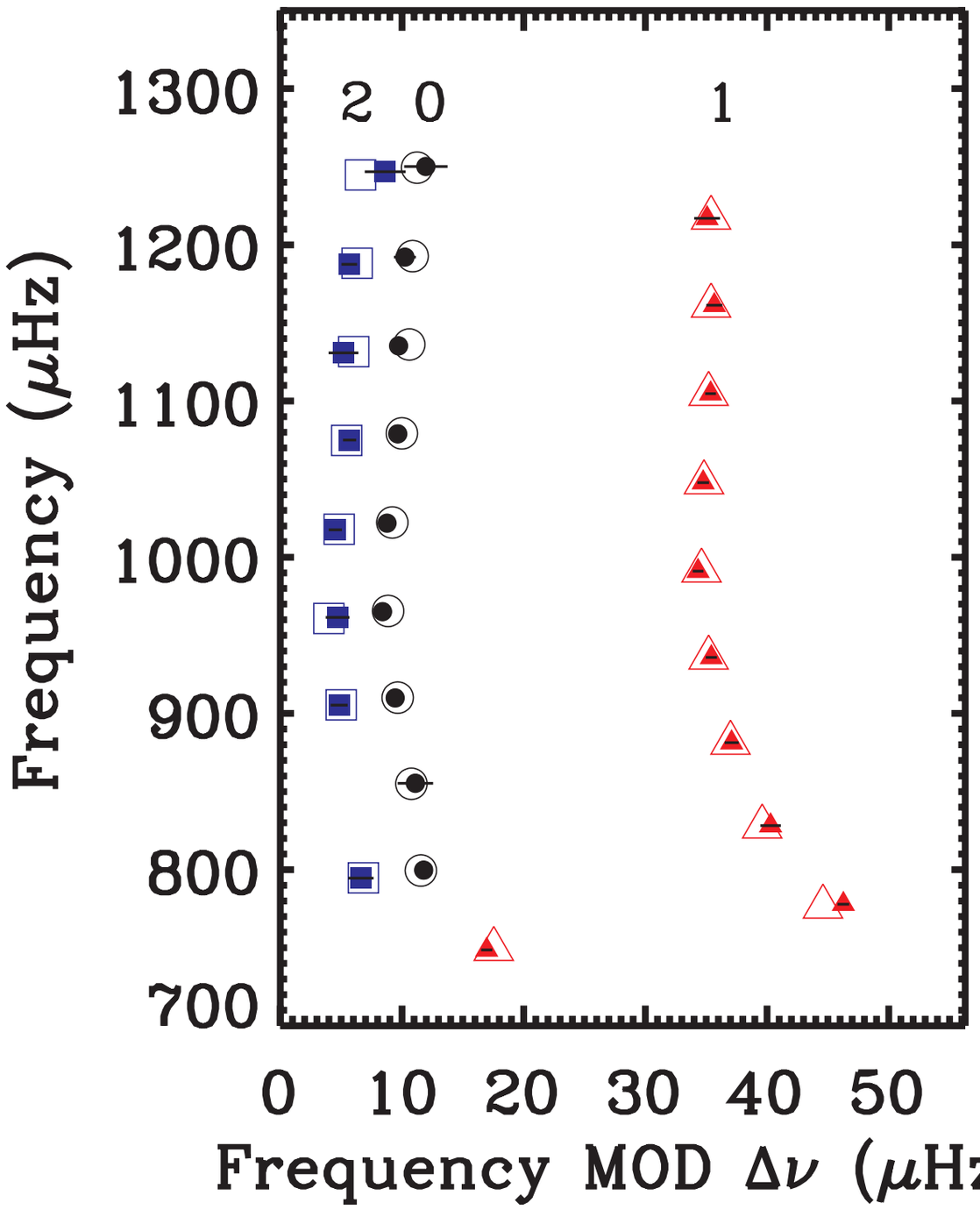


Giant Planets with MESA



Asteroseismology with MESA





(Paxton+ 2013)

Binary Stars with MESA

- 2 stars evolved at the same time
- Implicit mass transfer (“Ritter” formalism)
- Magnetic Braking (Rappaport, Verbunt & Joss 1983)
- GW-Braking
- Irradiation

Ready for “Testing”

- Tides (Zahn 1977, Tassoul & Tassoul)
- Angular momentum accretion
- L-S coupling

Not there yet

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