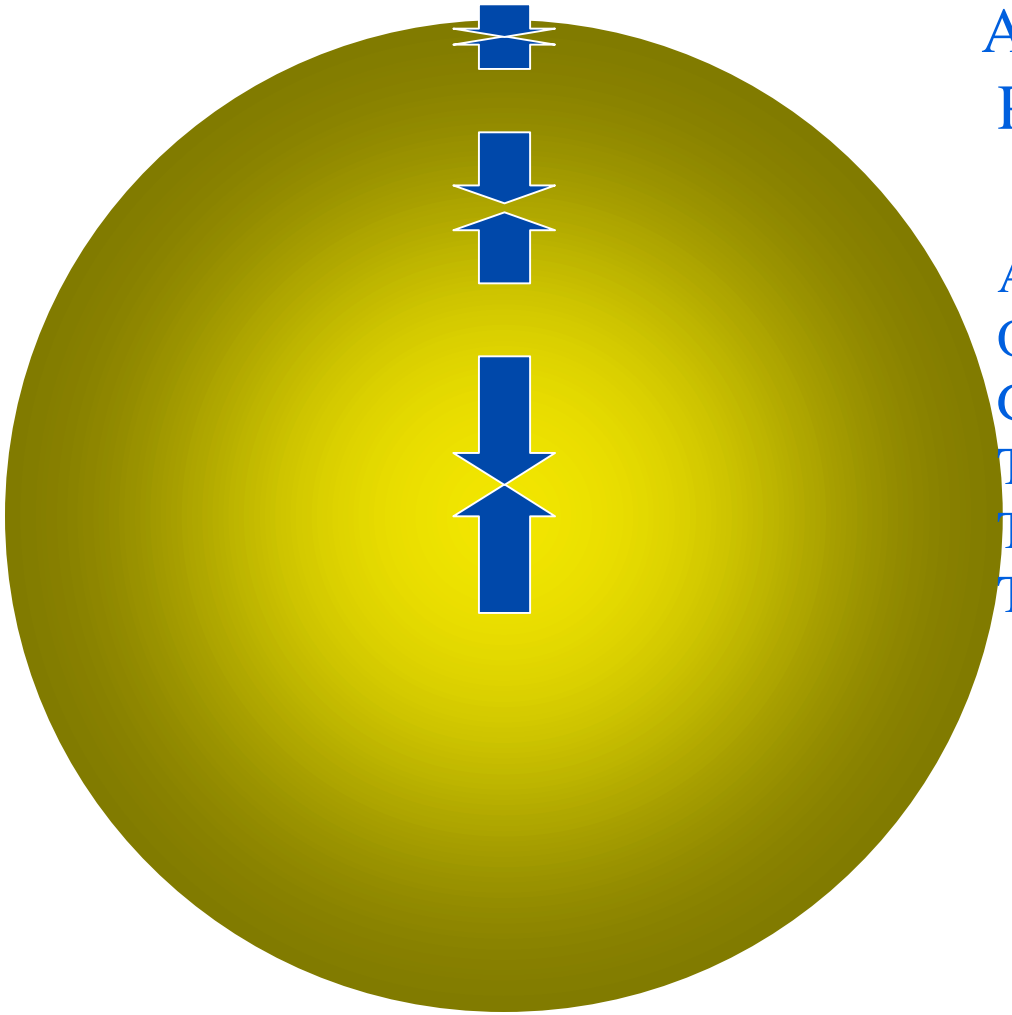
- Next section:
  - Central Temperature of Stars
  - Stellar Energy Sources
  - Stellar Lifetimes
  - Properties of the Sun
  - Star Formation
  - Evolution of low-mass Stars

Stellar Structure and Central Temperature

- We can determine another property of stars by using a model of Stellar Structure.
- The basic principle is that stars are in

Hydrostatic Equilibrium

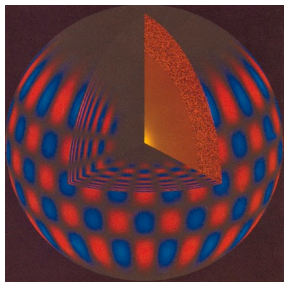
Hydrostatic Equilibrium



At each radius

$P_{grav}=P_{thermal}$

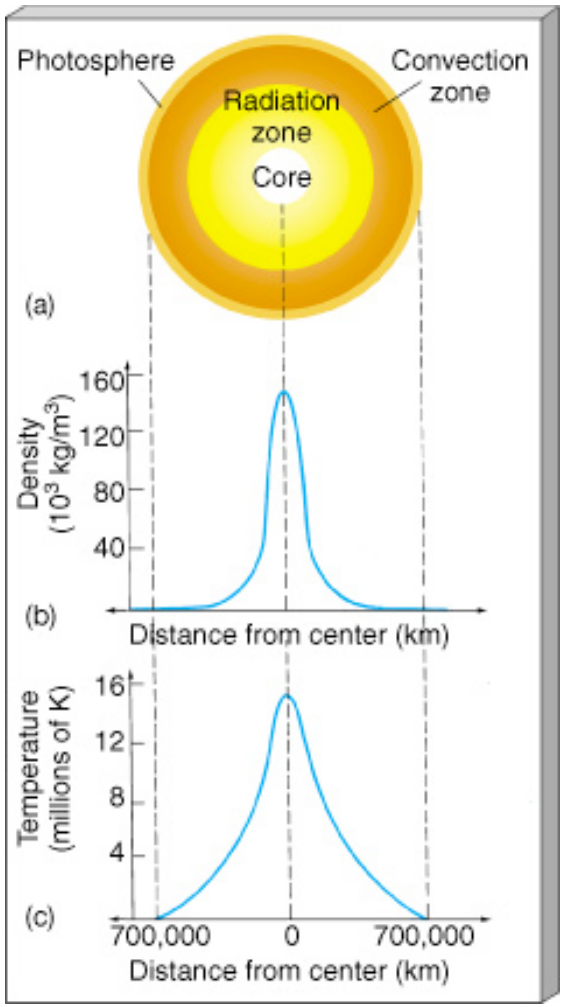
As the weight of
Overlying material
Goes up, the
Temperature needs
To go up to keep
To pressure balance



The Structure of the Sun

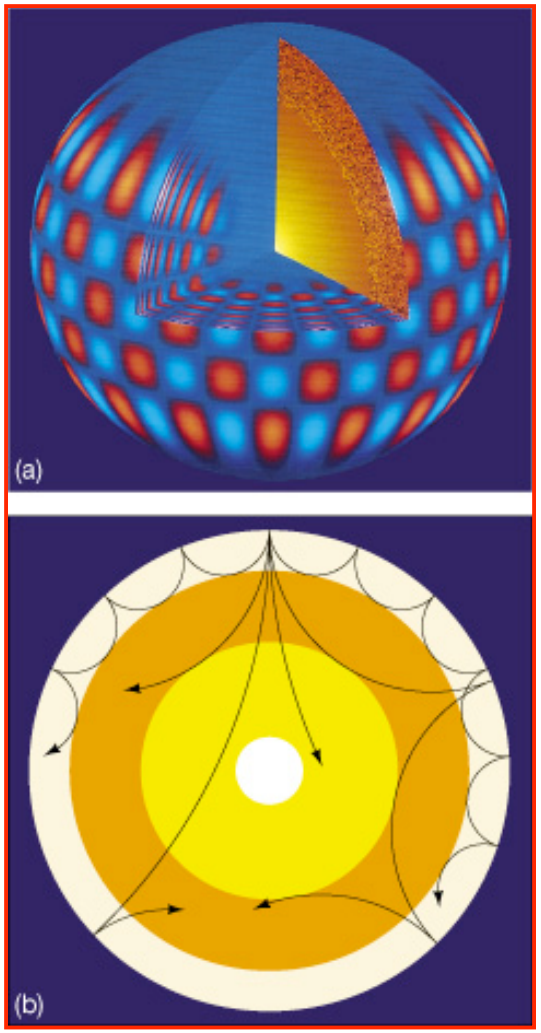
- Build a model of the Sun in hydrostatic equilibrium and you will predict the *Temperature* and *Density* as a function of radius. You need to have a relationship between pressure, temperature and density -- this is called the Equation of State.
- The first stellar structure models were constructed in the late 1950s. With computers you can do this surprisingly easily. In the upper division Astronomy course called `Stellar Structure and Evolution' all the students build their own stellar model.

Solar Model

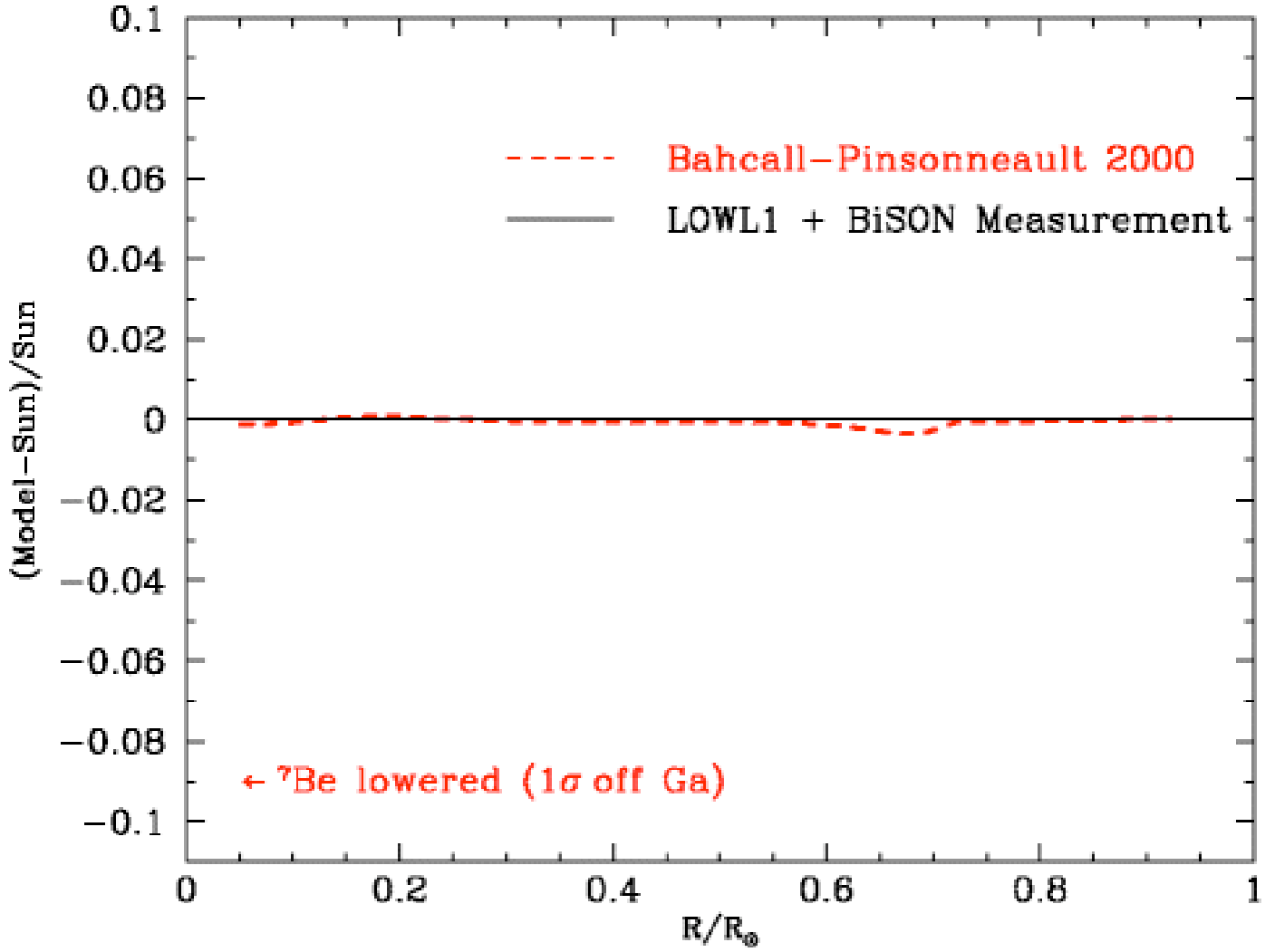


- Hydrostatic models for the Sun predict the central temperature to be about 16 x 10^6K.
- Some interesting things happen at this temperature! On Earth the only time this temperature has been reached is when H-bombs were exploded.

Helioseismology



- There were reasons to believe that we had pretty good solar models but we received unexpected superb confirmation of this in the 1990s when the `five minute' oscillations of the Sun were discovered.


0.1
0.08
0.06
0.04
0.02
0
−0.02
−0.04
−0.06
−0.08
−0.1
(Model−Sun)/Sun
Bahcall−Pinsonneault 2000
LOWL1 + BiSON Measurement
← ⁷Be lowered (1σ off Ga)
0
0.2
0.4
0.6
0.8
1
R/R⊙