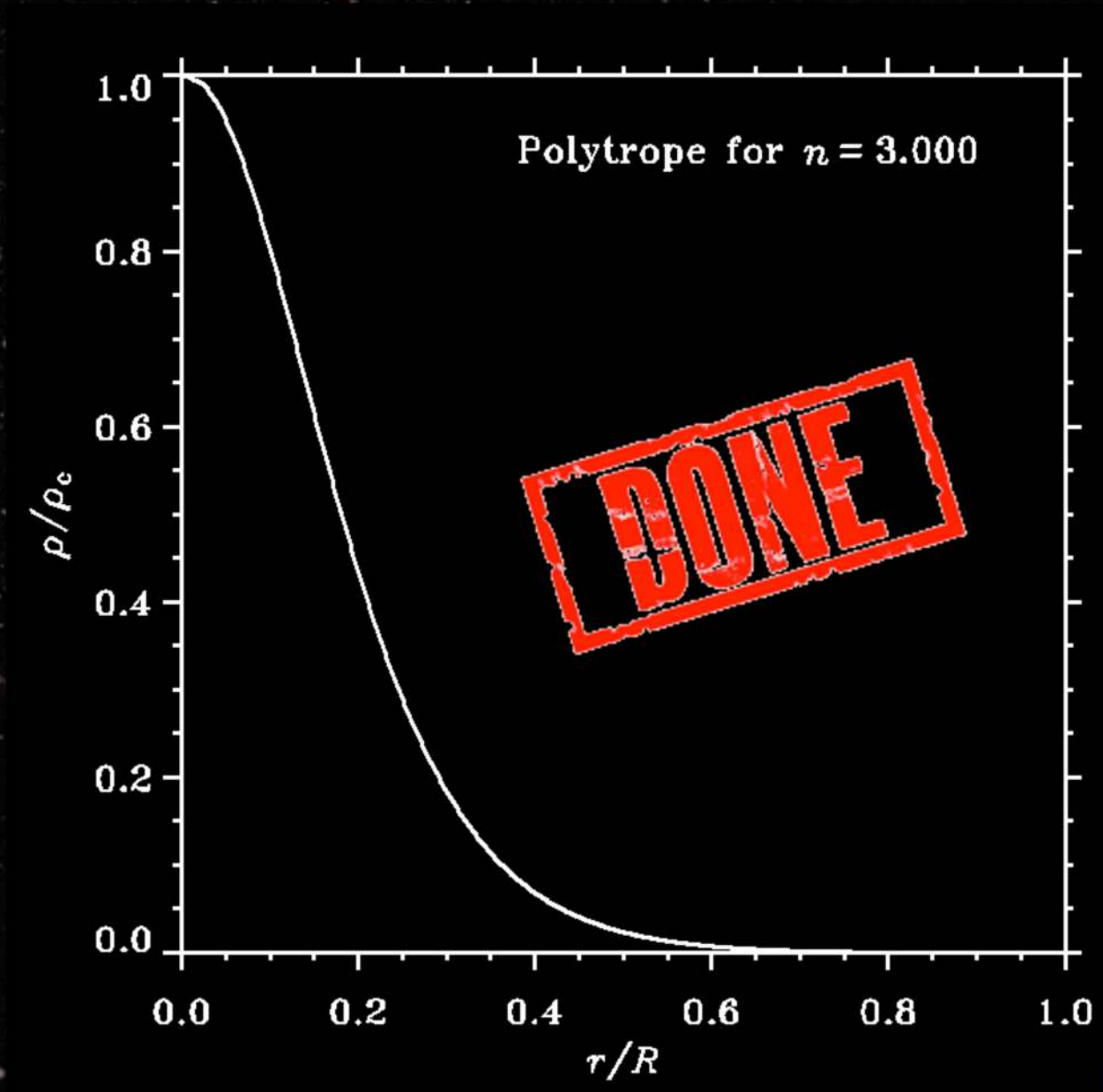
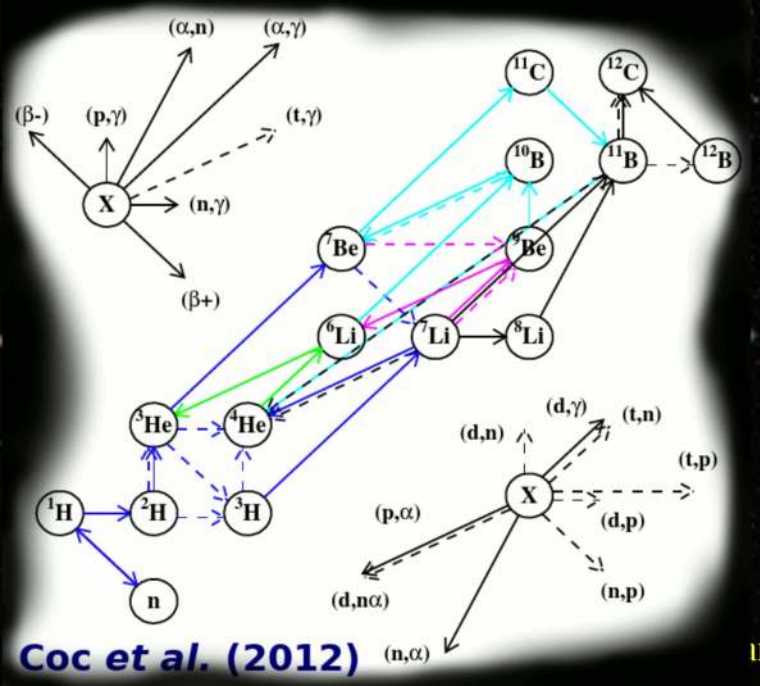
Intro: Isn't the Sun just a polytrope?



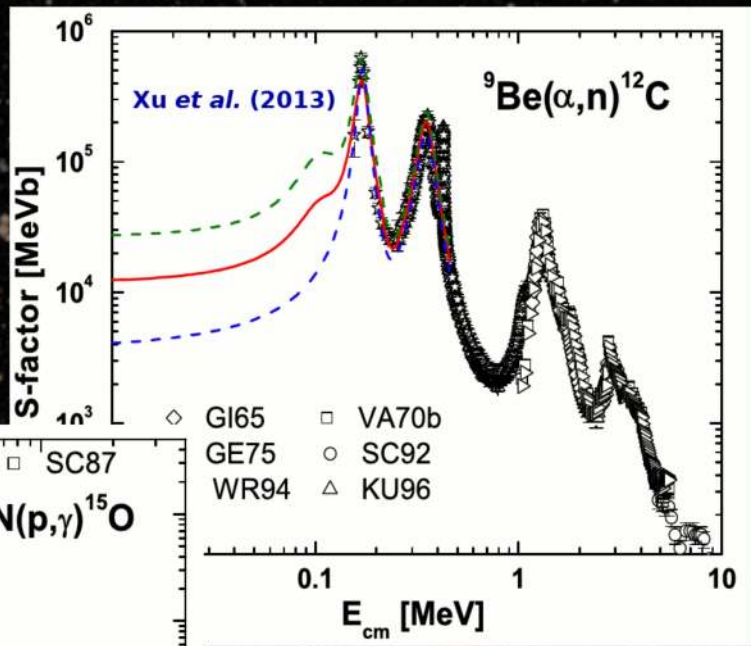
Well, - no!

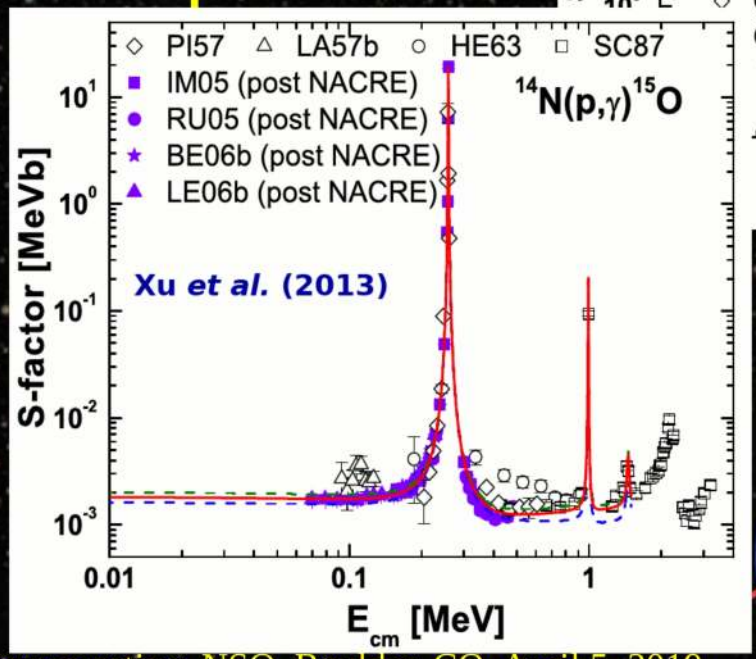
We Need Nuclear Physics

- To power the nuclear furnace of our stellar models
- To drive stellar evolution
- To enrich the interstellar matter
- To drive galactic chemical evol.
- To make rocky planets possible



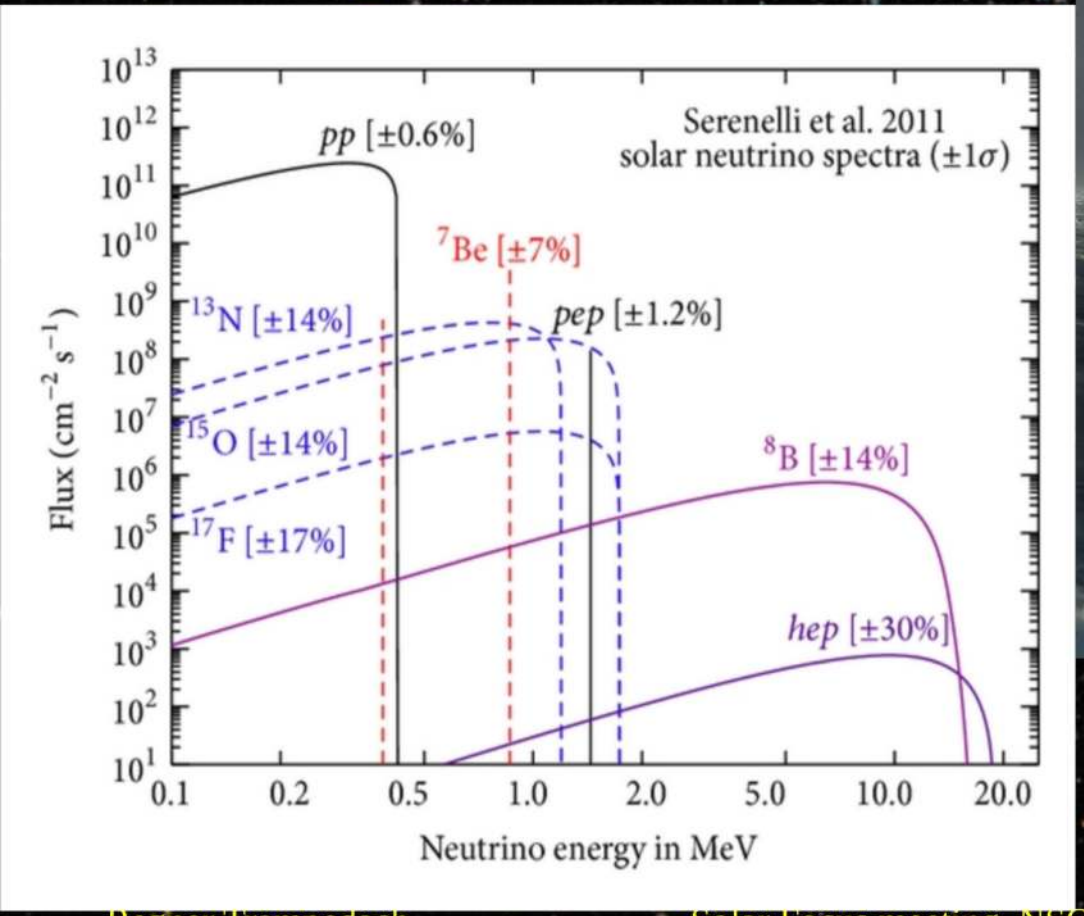
Coc *et al.* (2012)

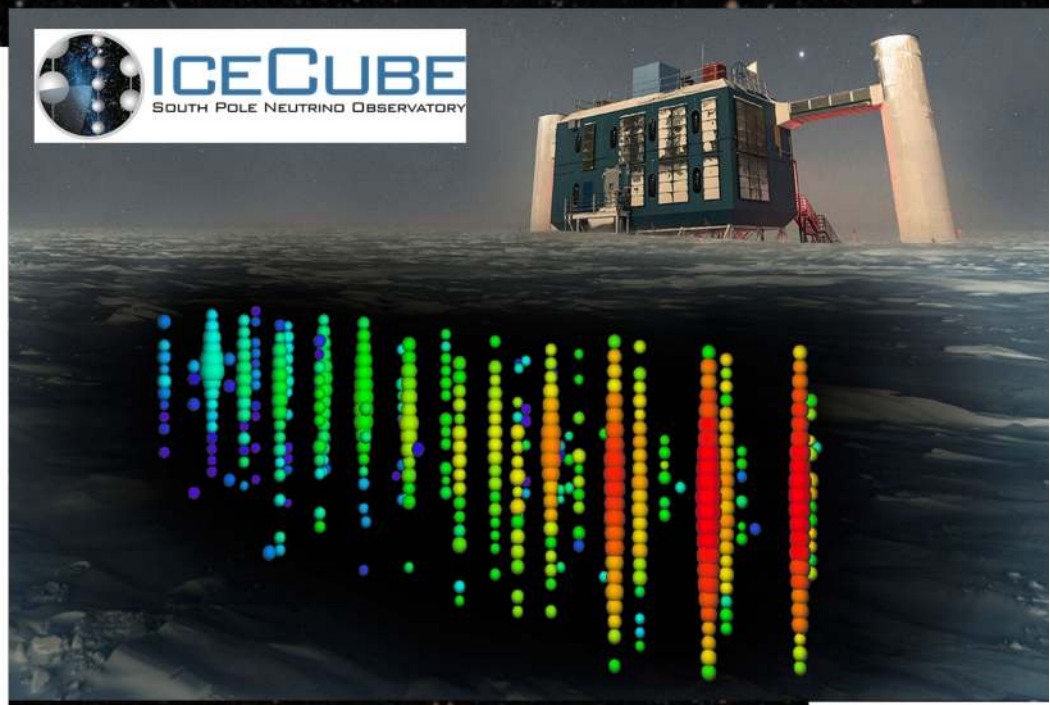




We Need Neutrino Physics

- For direct observations of solar core + SN!
- Learnt nuclear/neutrino physics from the Sun!
  - They oscillate!





NASA

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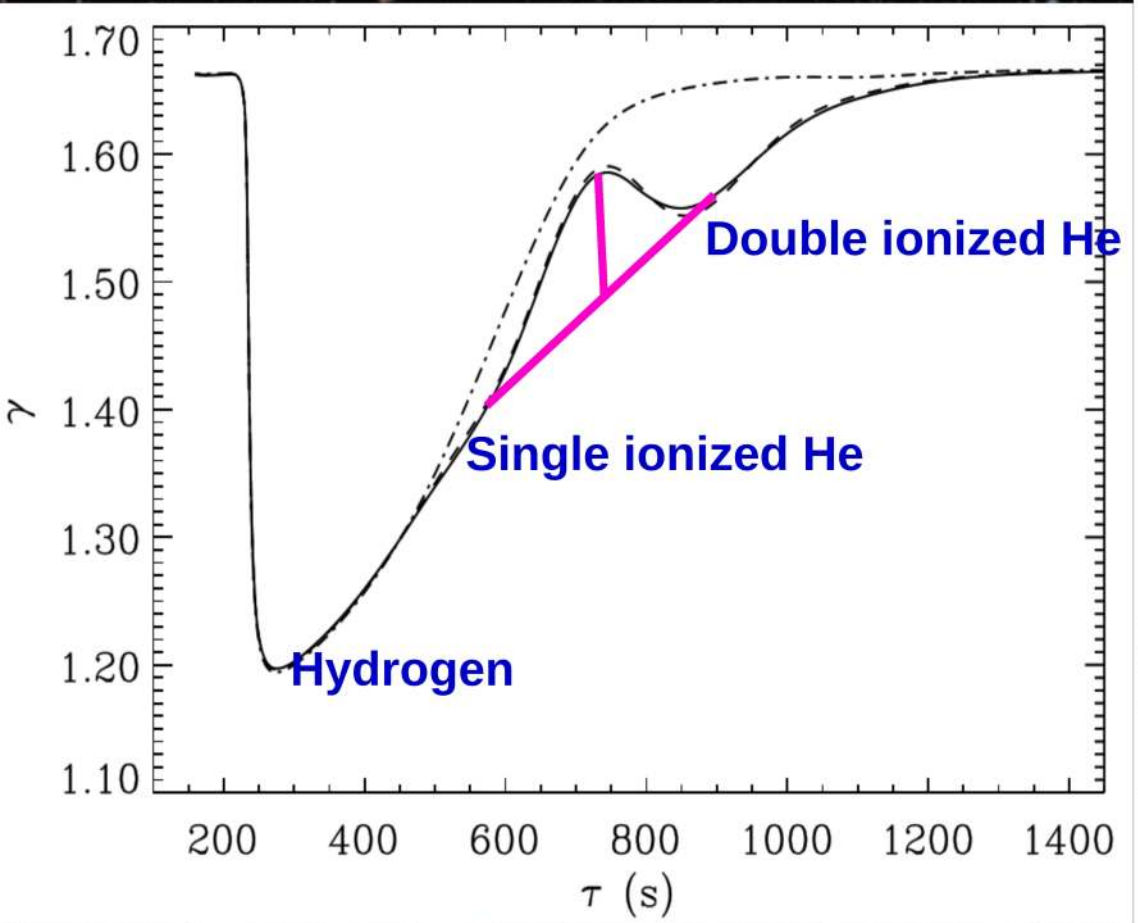
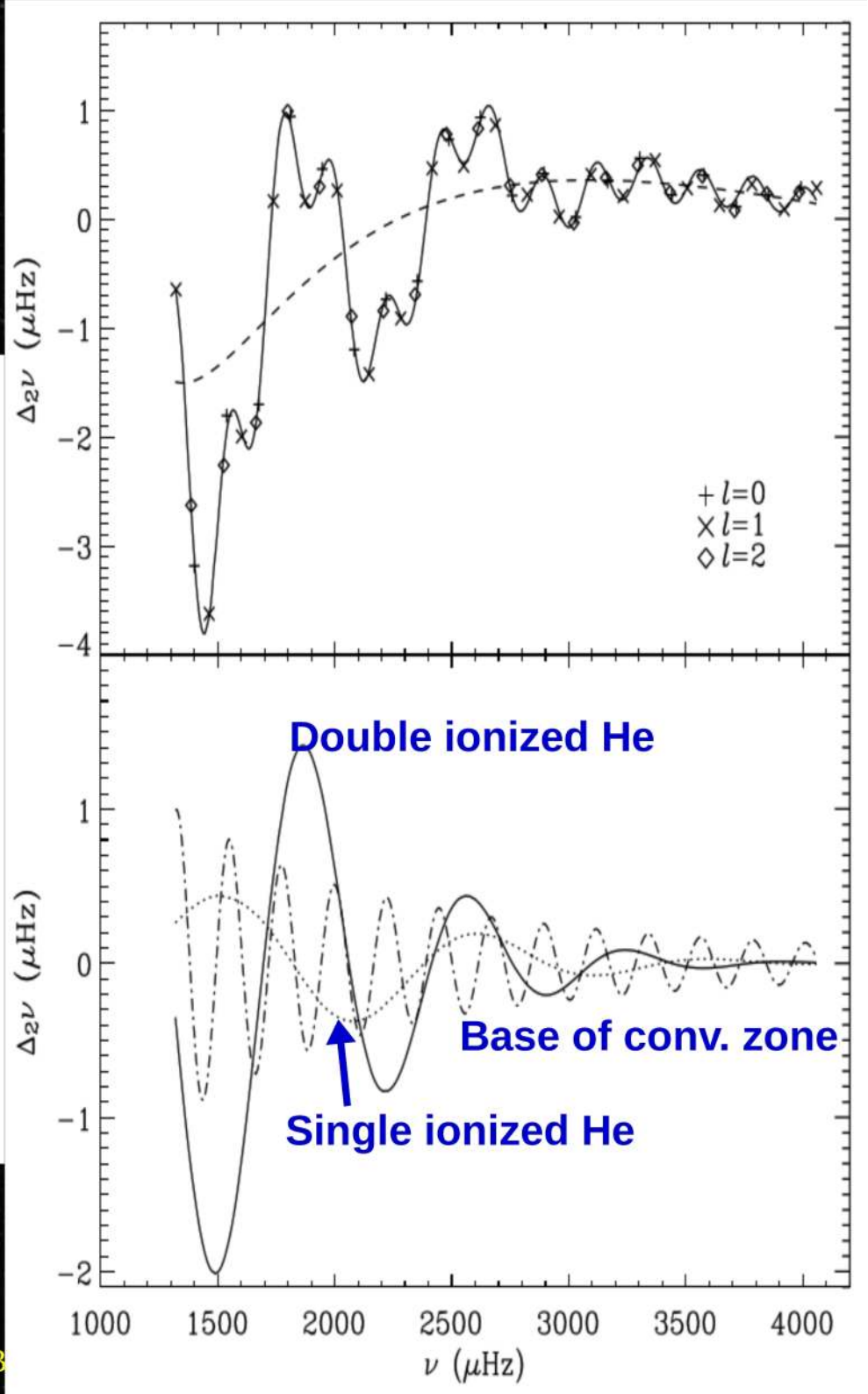
We need an equation of state

- For thermodynamics of solar plasma
  - Pressure for hyd. Equil., internal energy, etc.
- For dynamics of p modes
  - Sound speed, adiabatic exponent.
- As foundation for opacity calculations
  - Ionization and dissociation balances
  - Population of excited states
  - Broadening parameters

Seismic Glitches

Helium content and Convection Zone

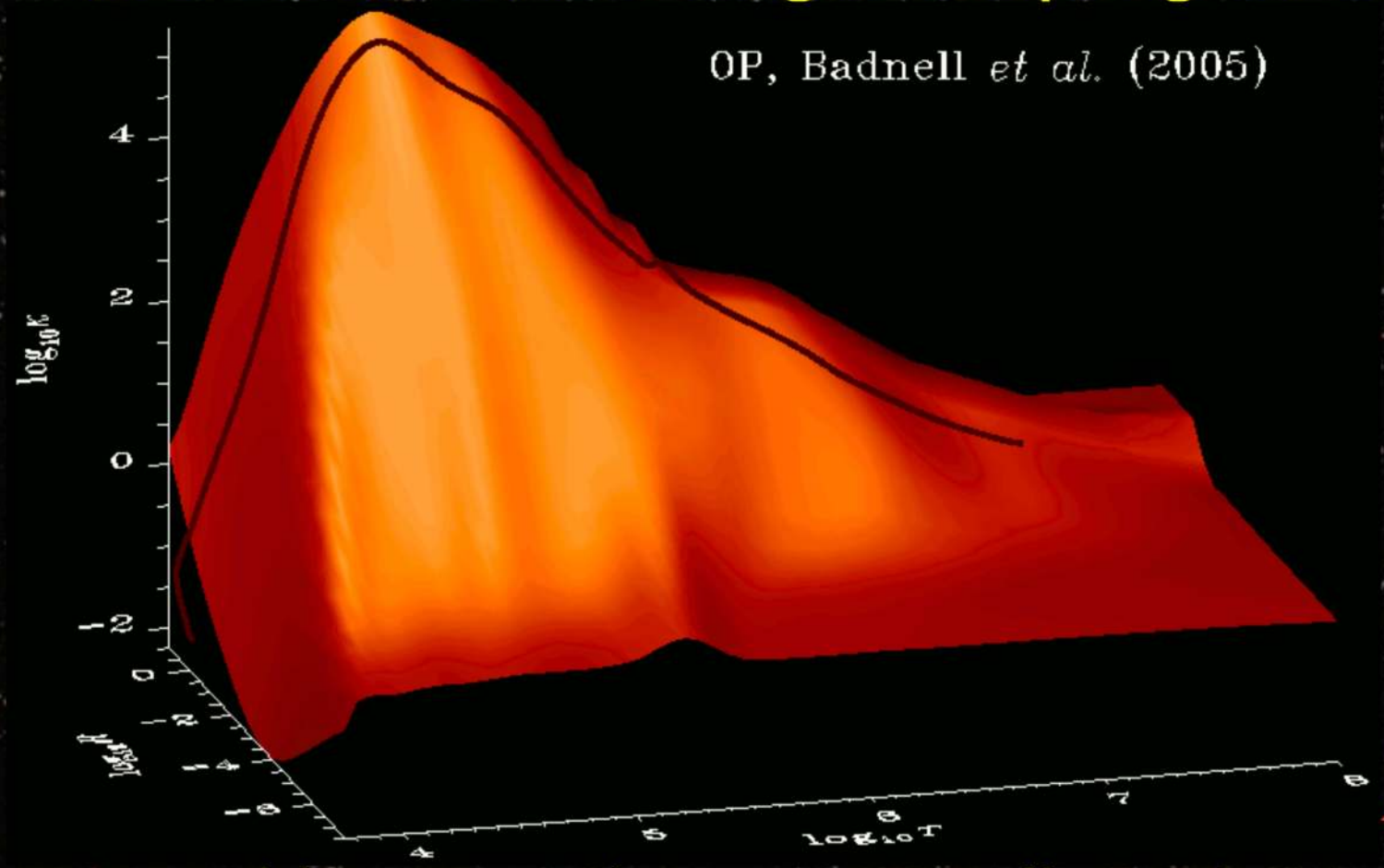




Only way to get solar He abundance

We need Rosseland Opacity

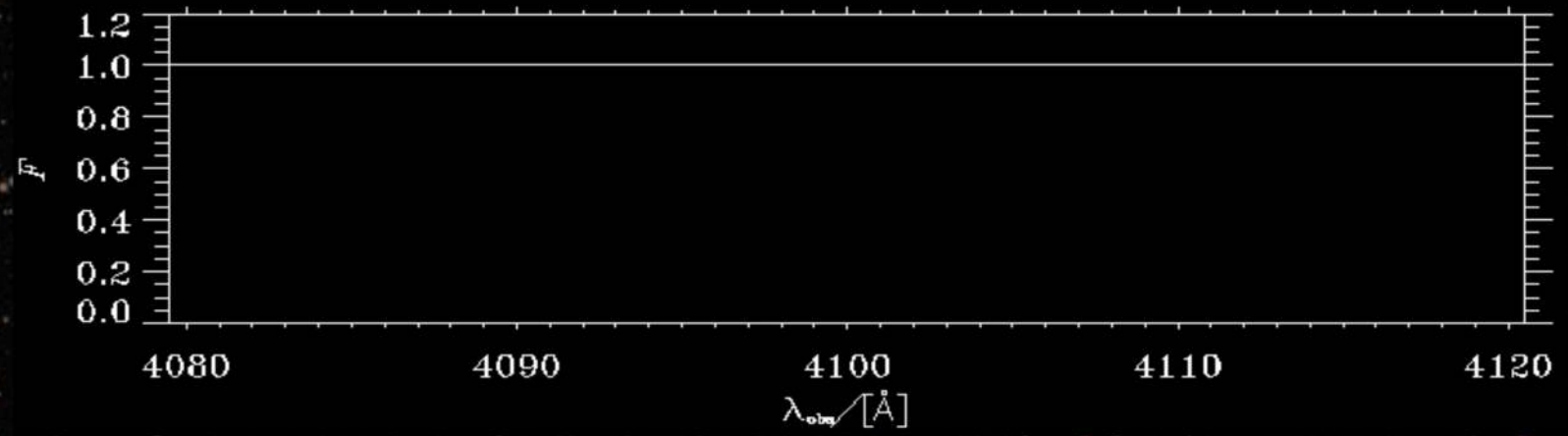
- For structure of radiative zone
- For locating transition to convection
- (one comp. of) Driving/Damping of oscillations



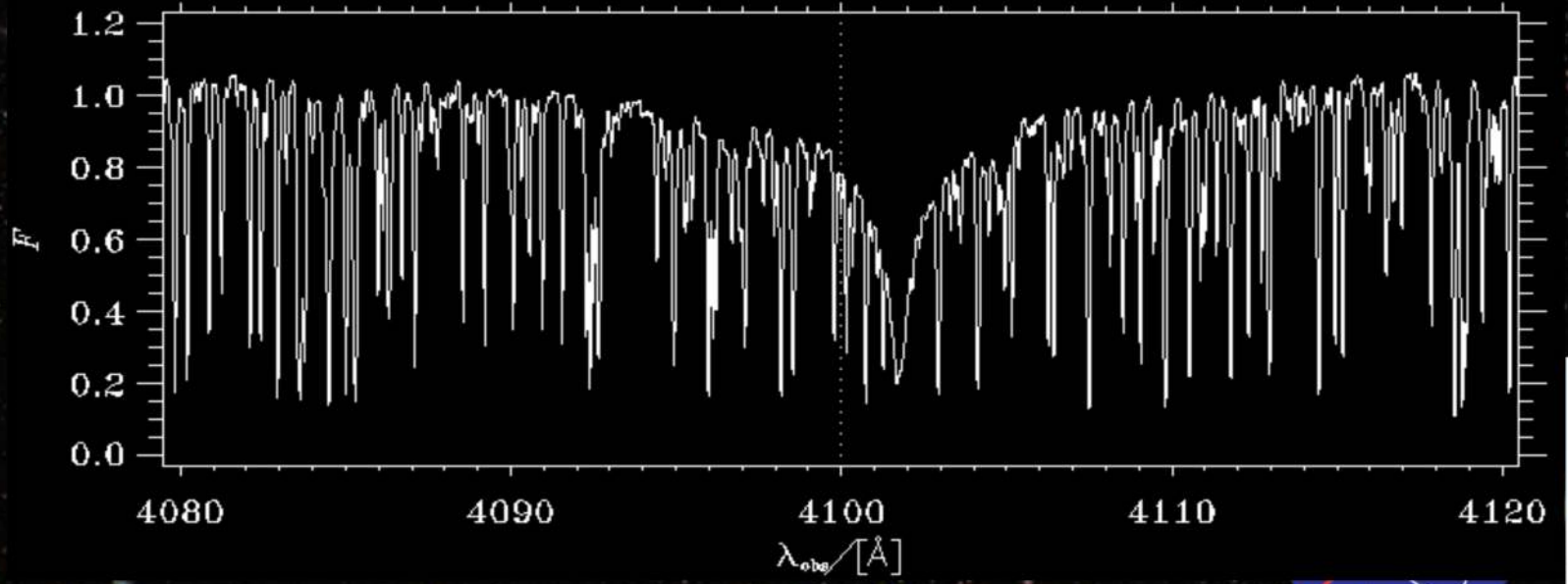
No Spectral Lines ⇔ No Spectra!

NB: Also needed for radiative acceleration

Not the Sun:



The Sun:



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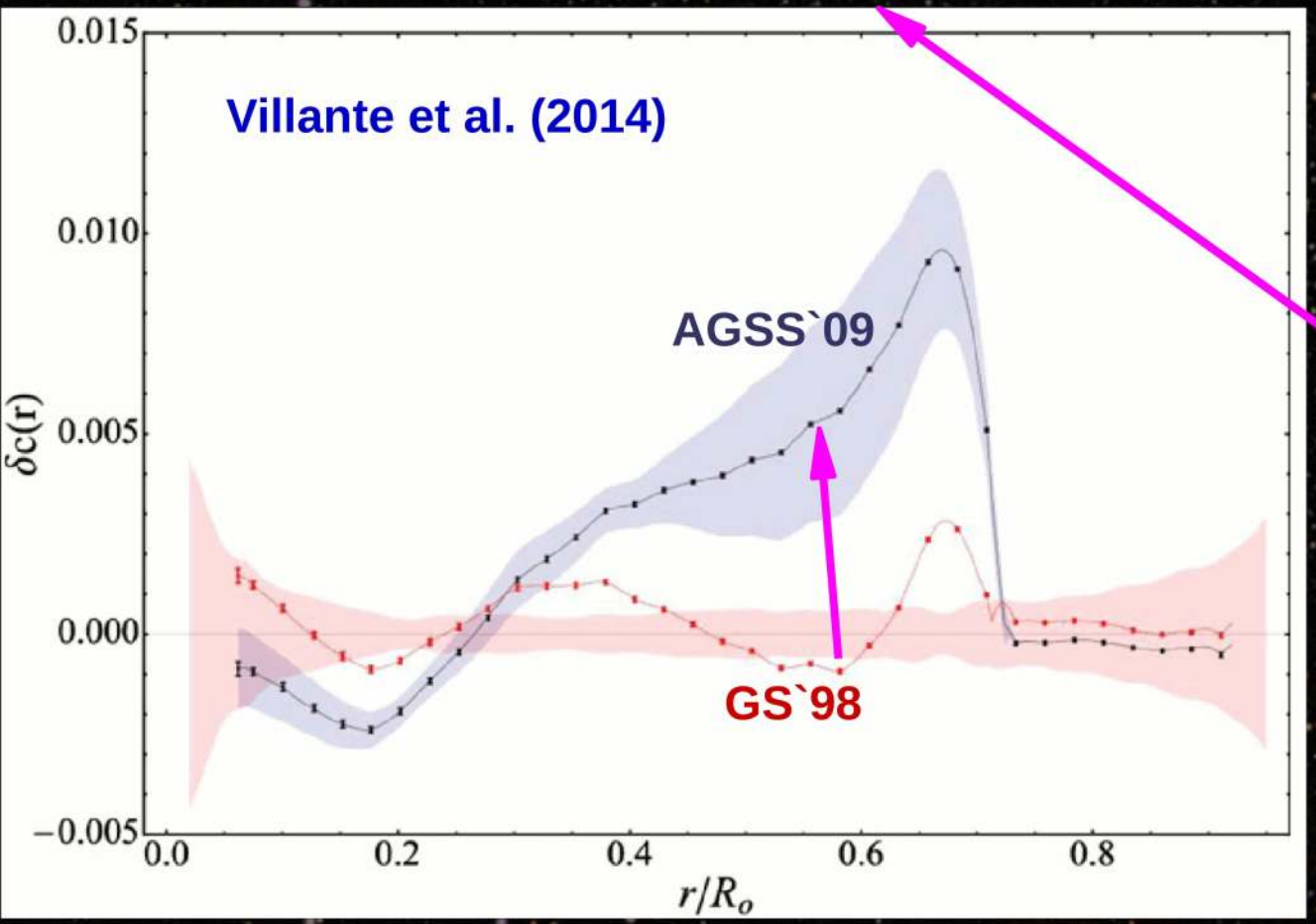
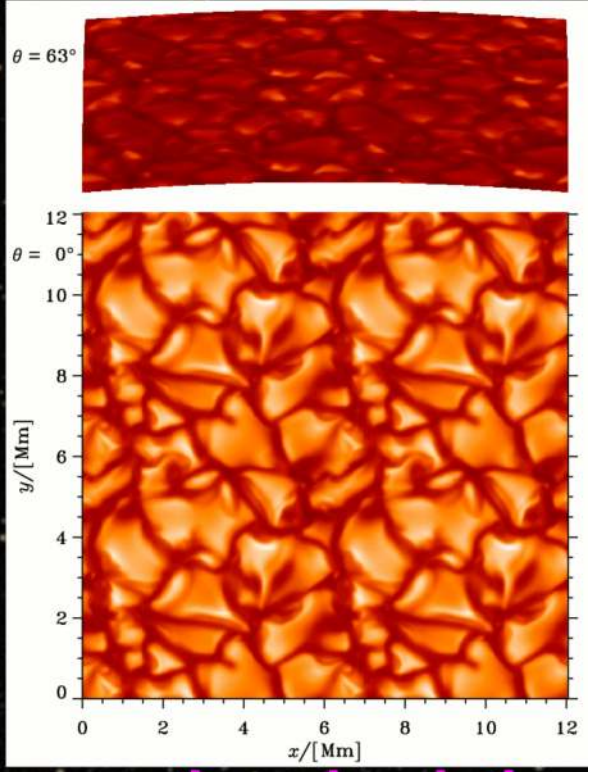
Heard about the "Solar Abundance Problem"?

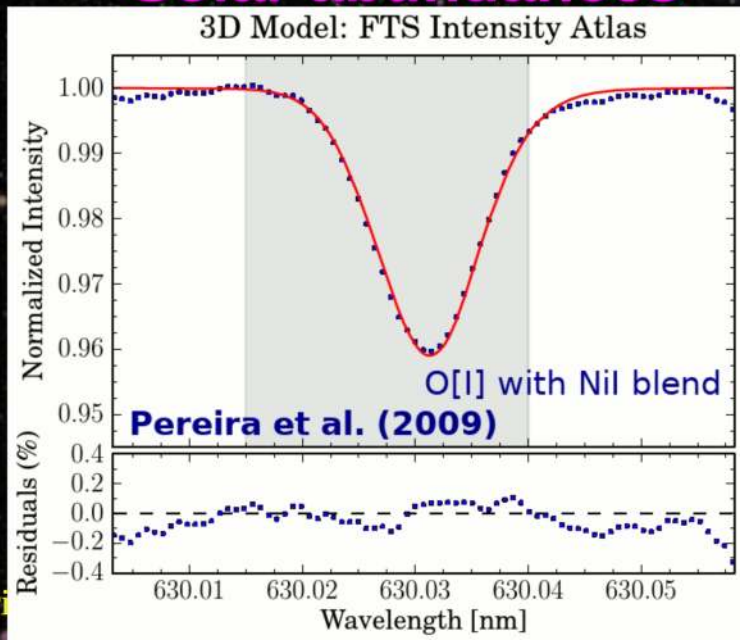
Helioseismic trouble!

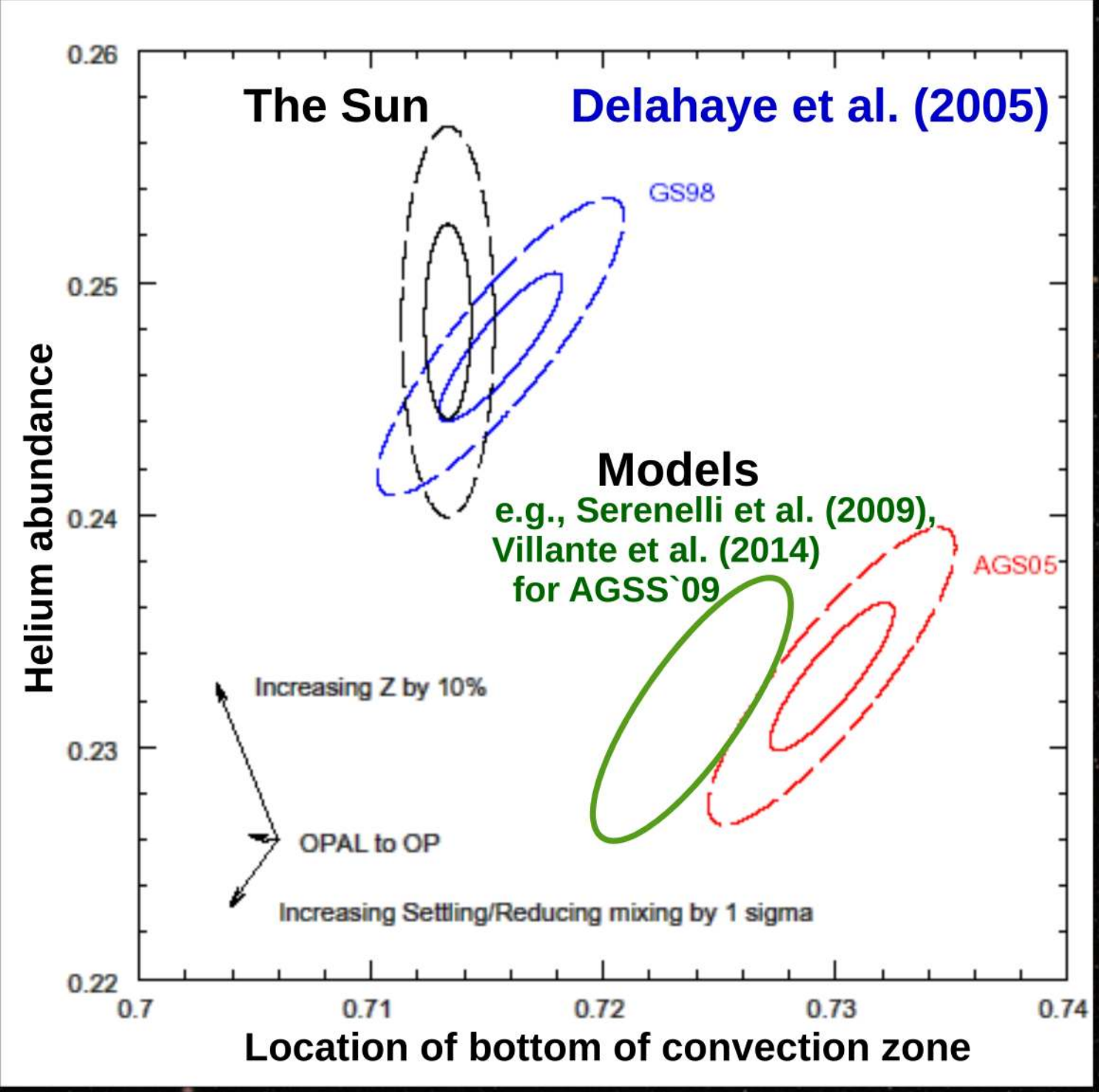




3D convection simulation

Solar abundances





Some fixes?

Points to atomic physics problems!

Prospects for the next few hours

New work on:

- **Spectral Lines:** "*Collisional-radiative modelling for astrophysical applications: X-ray satellite lines and improved ionization equilibrium for Carbon*" by Dr. Giulio Del-Zanna
- **Interior Opacity:** "*Solar Opacities: Updates and Prospects*" by Prof. Anil Pradhan
- **Equation of State:** "*An Equation of State for Whole Stars*" by Dr. Regner Trampedach