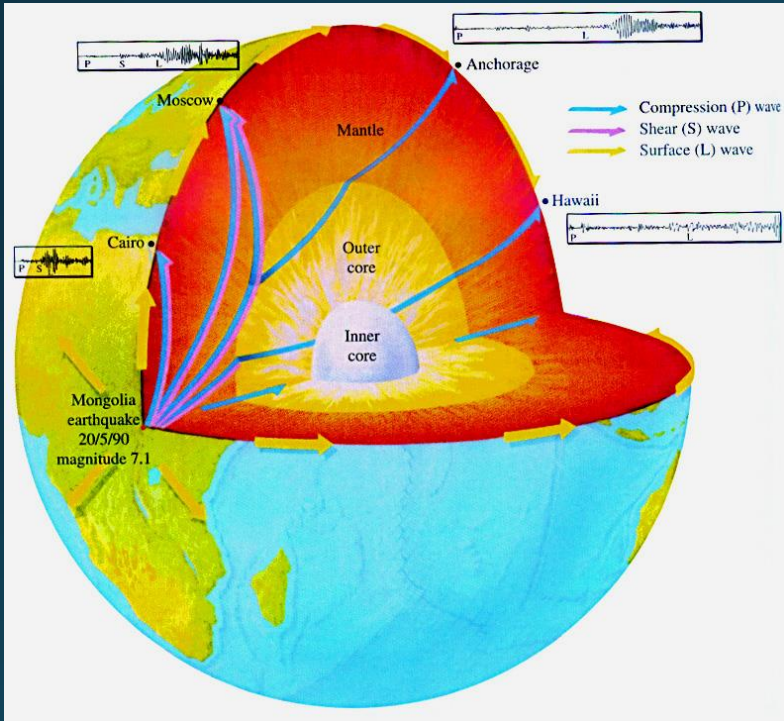


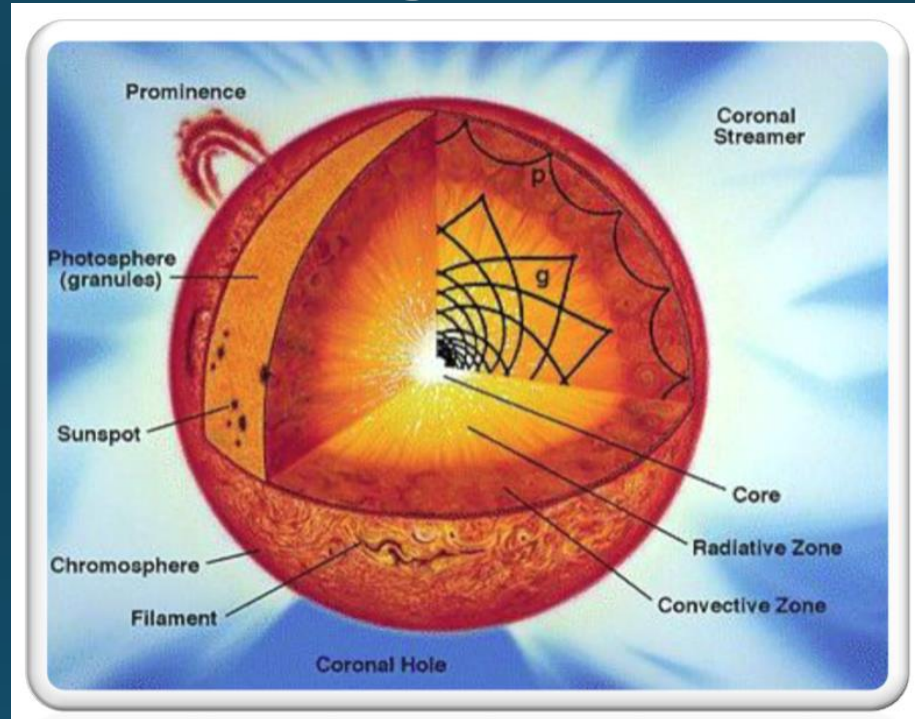
Ethan Dederick

A Possible Mechanism for Driving Oscillations in Hot Giant Planets

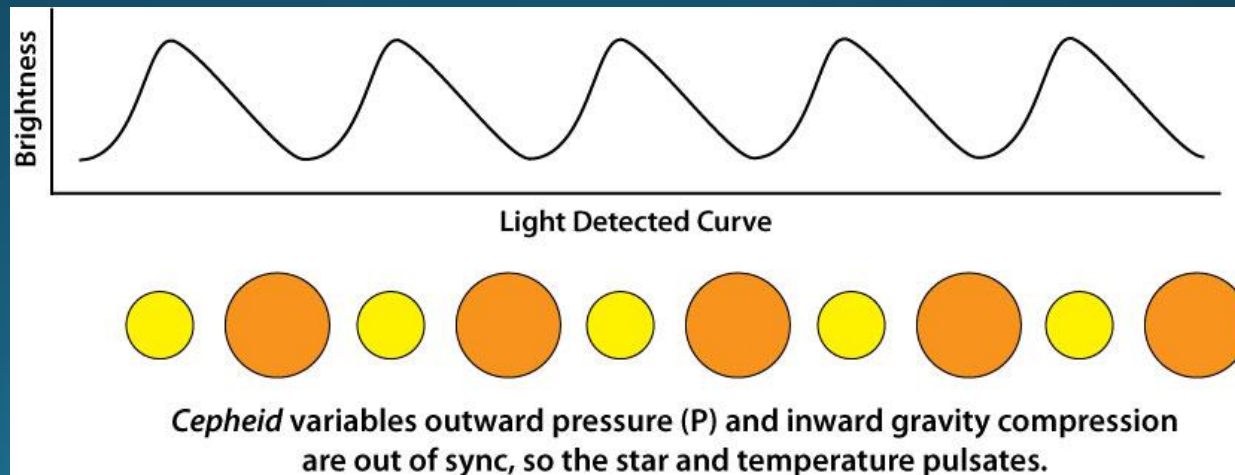
Seems like everything is oscillating these days...



Tectonic Activity



Turbulent Convection



κ -Mechanism

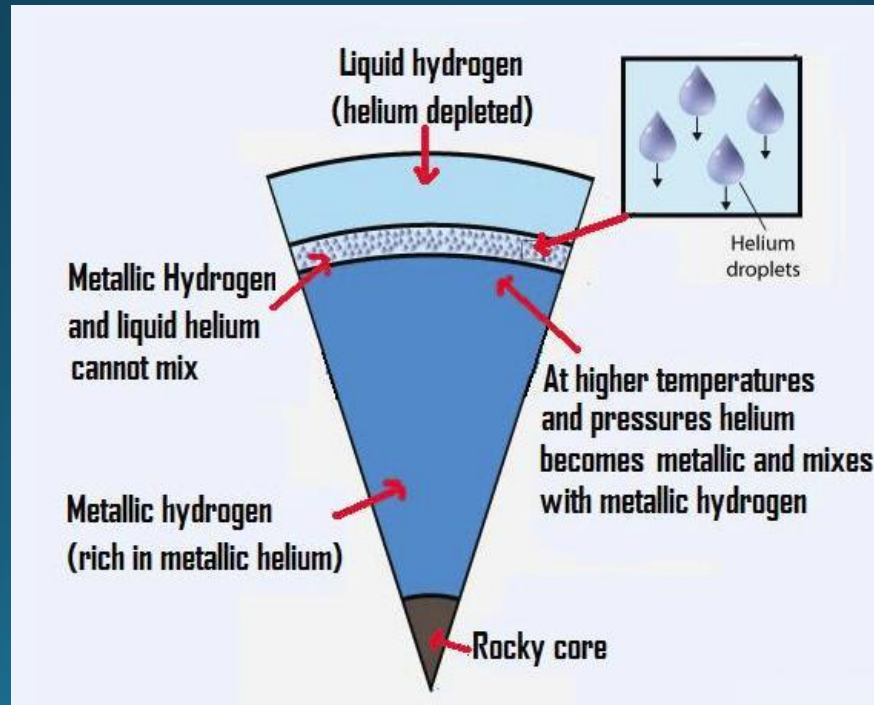
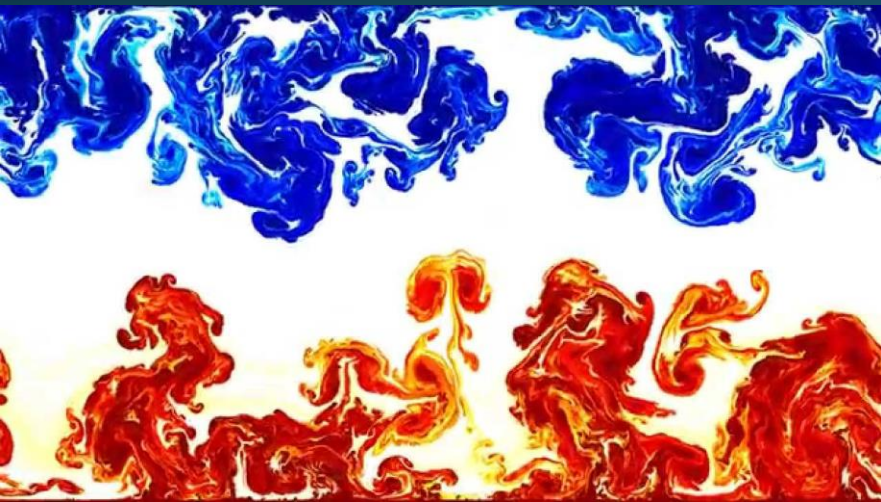
Jupiter & Saturn Oscillate Too!



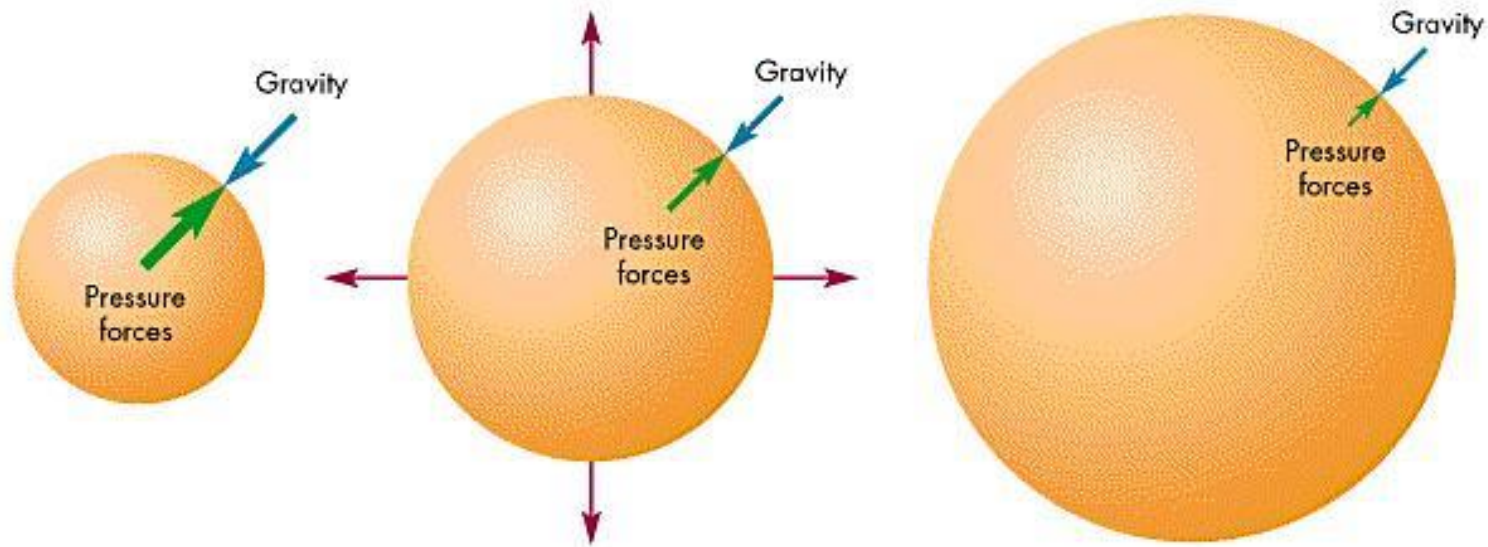
Gaulme et al. 2011 created velocity maps of Jupiter and found excess power in the power spectrum for mHz oscillations

Why do they pulsate?

1. Turbulent Convection
2. Helium Rain
3. Moist Convection
4. Ortho- to Para-hydrogen conversion
5. κ -Mechanism



κ -Mechanism

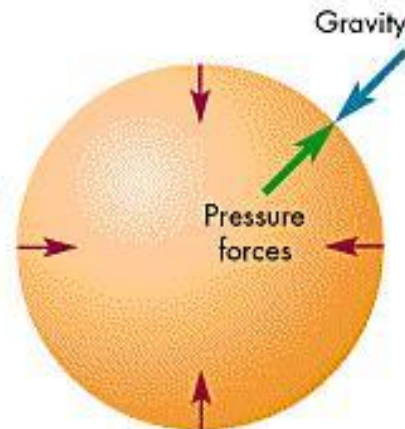


A Pressure forces exceed gravity: Pulsating star begins to expand

B Pressure and gravity balance but inertia makes the pulsating star expand further

C Gravity exceeds pressure: Pulsating star begins to contract

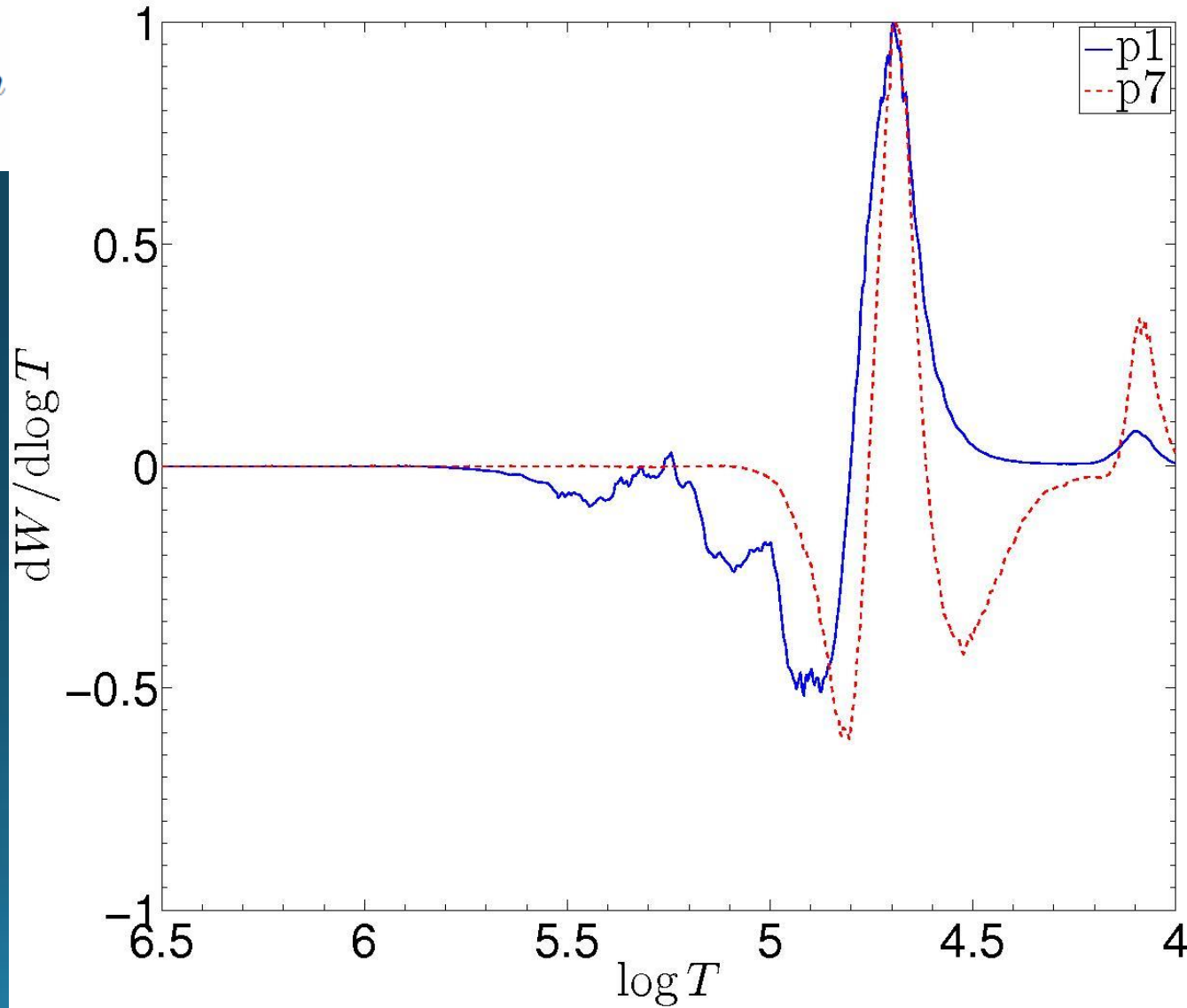
D Pressure and gravity balance but inertia makes the pulsating star contract further



Differential Work Function

$$\left\langle \frac{dW}{dt} \right\rangle = \Re \left[\int_0^M (\Gamma_3 - 1) \left(\frac{\delta \rho}{\rho} \right)^* \left(\delta \epsilon - \frac{d}{dm} \delta L \right) \right] dm$$

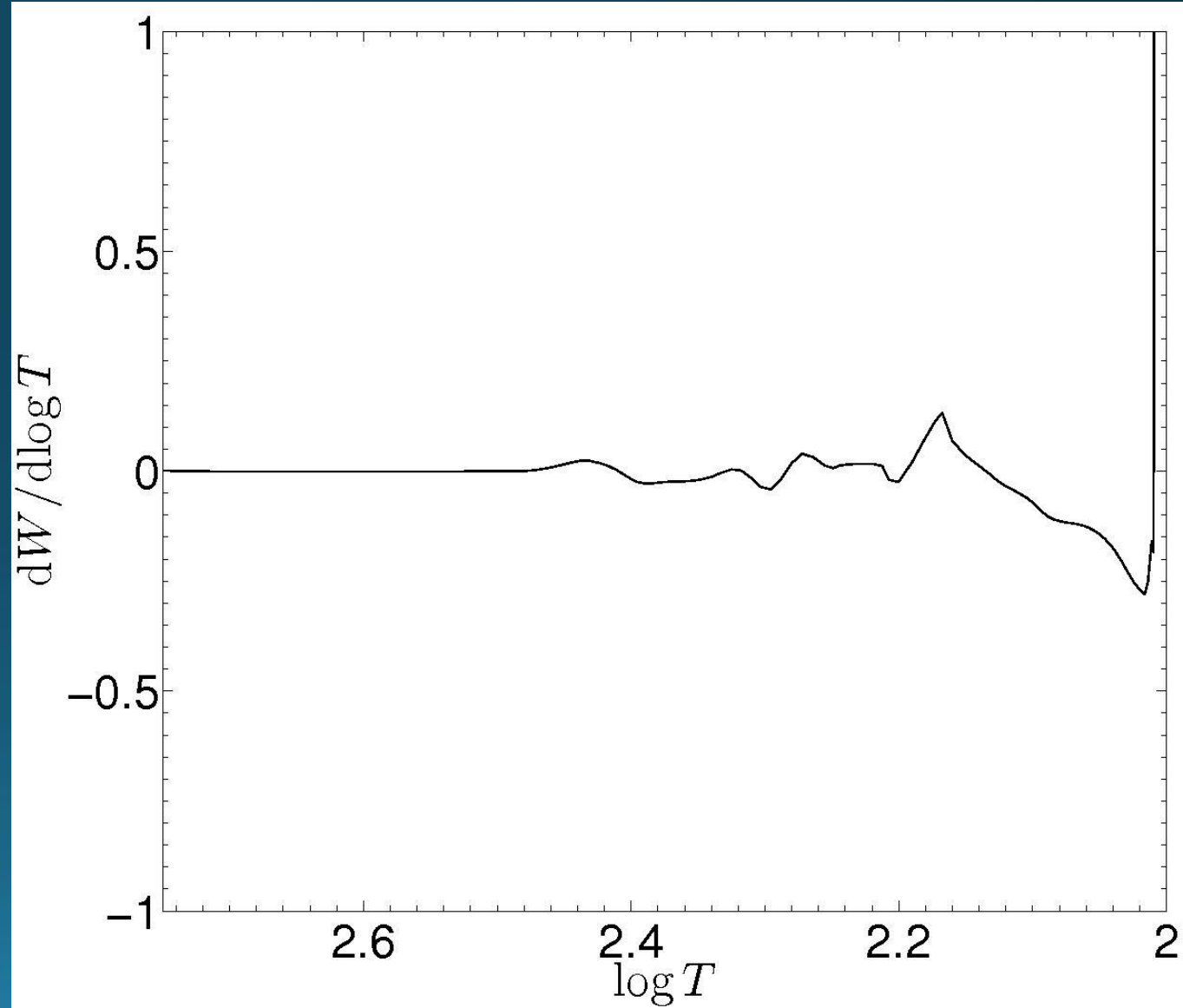
The differential work function for a δ Scuti model and the $l = 1$, p1 and p7 modes. p1 is an unstable mode while p7 is stable.



Jupiter Work Function

- Jupiter does not have nuclear fusion
- However, Jupiter is contracting, and thus releasing energy
- Could the κ -Mechanism be at work at lower wavelengths and molecular opacities?

Nope!



What about for Hot Jupiters?

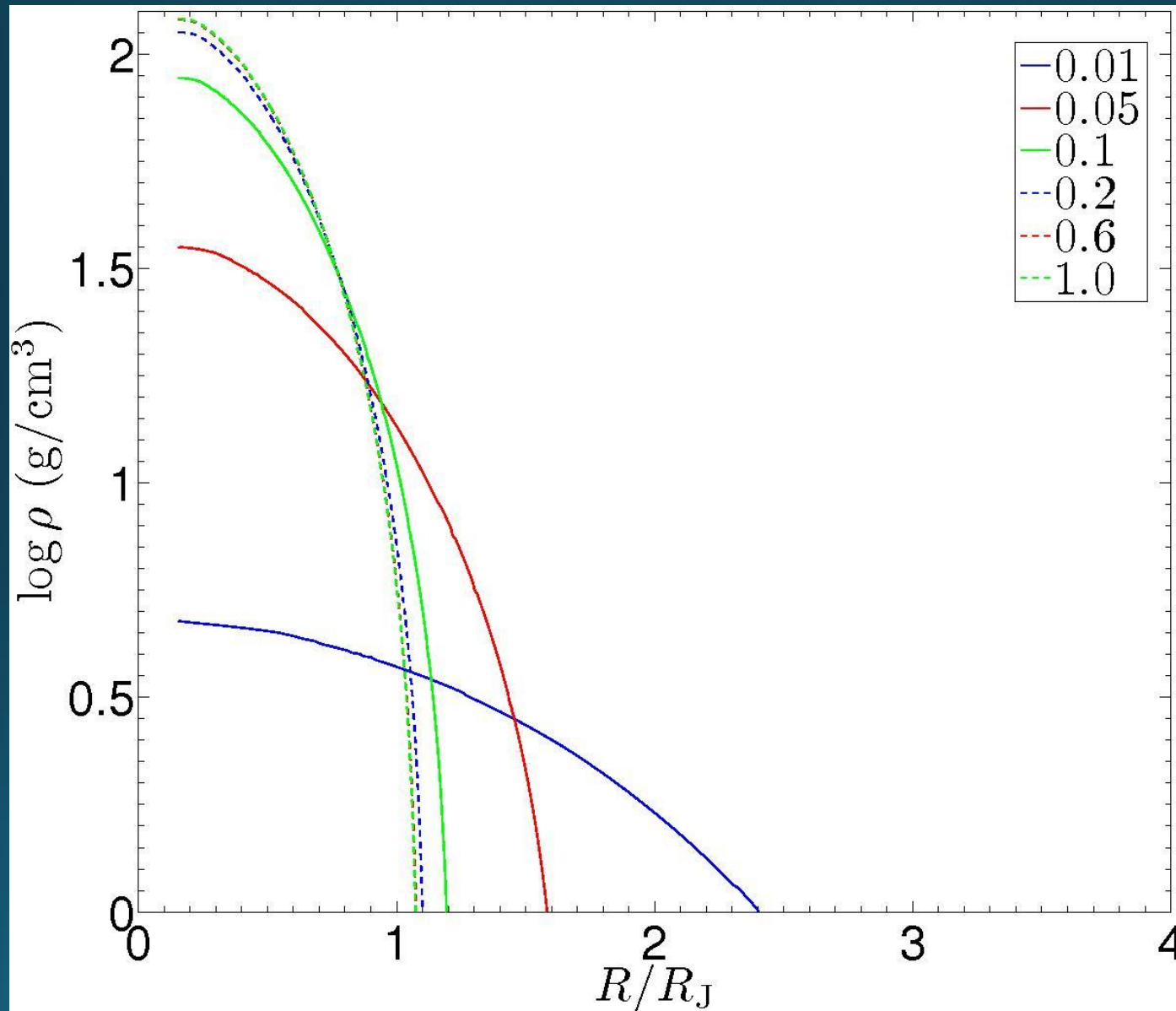
- I made a mistake... 10^9 erg cm⁻² s⁻¹ of irradiation, but we saw excited modes!

Spectral Type	Mass (M_{\odot})	$\log T_{\text{eff}}$ (K)	Luminosity (L_{\odot})	Age (Gyr)
M5	0.28	3.565	0.0126	3
M0	0.49	3.584	0.0383	3
K5	0.58	3.598	0.0645	3
K0	0.76	3.670	0.216	3
G5	0.91	3.731	0.523	2.258
G0	1.05	3.767	1.027	1.264
F5	1.33	3.816	3.144	0.535
F0	1.59	3.871	6.828	0.370
A5	1.98	3.944	16.700	0.203

Planet ranges:

1. $1 - 30 M_J$
2. $0.01 - 0.2$ AU
3. $300 \text{ cm}^2 \text{ g}^{-1}$ column depth
4. $10 M_E$ core
5. Aged to host star age

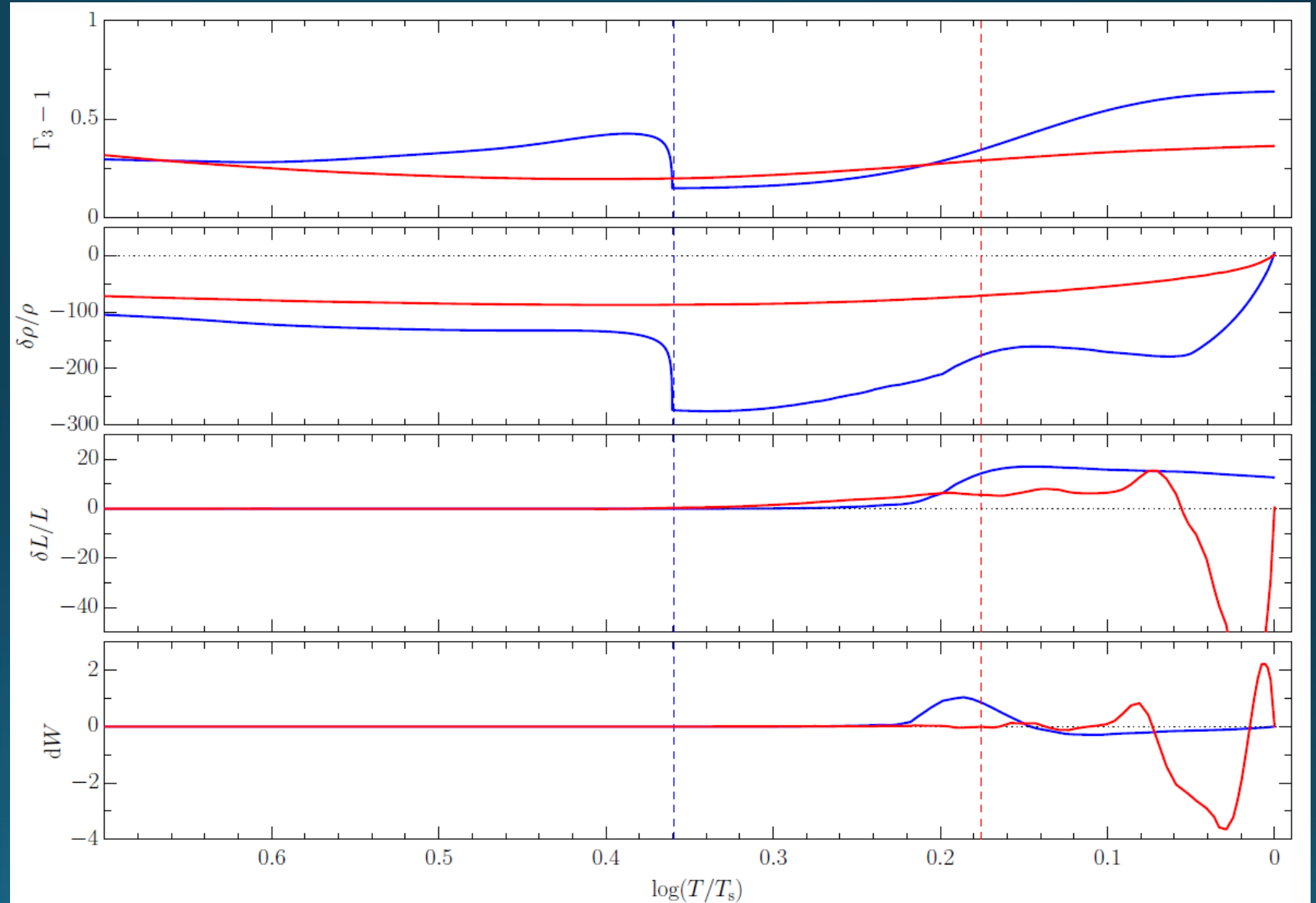
Radiative Suppression Mechanism



Radiative Suppression Mechanism

Red = Damped

Blue = Excited



Questions?