

# STARS, SOUND AND ME

Dr. Emily Hatt



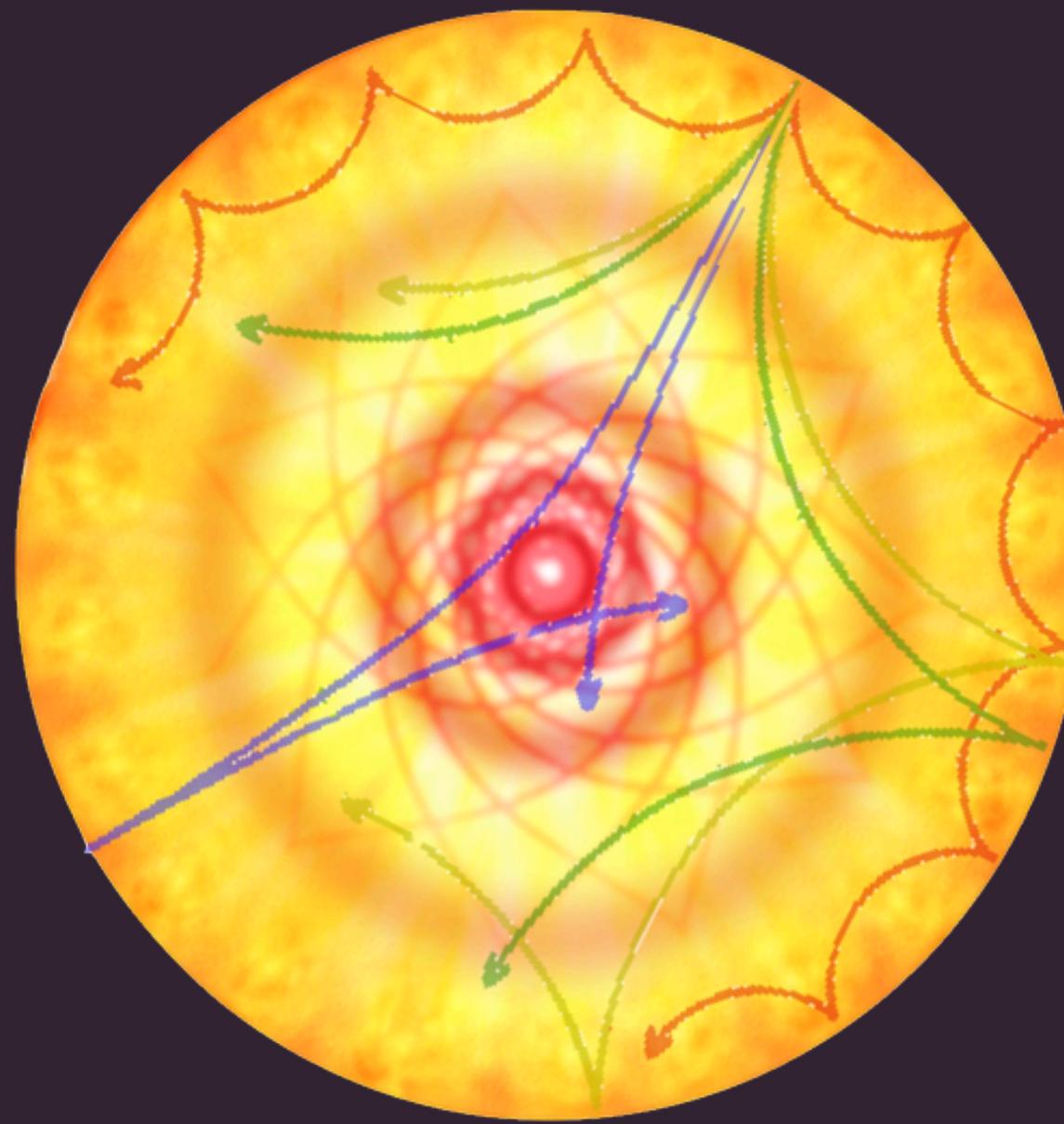
# WHO AM I



# WHAT DO I DO?

Asteroseismology

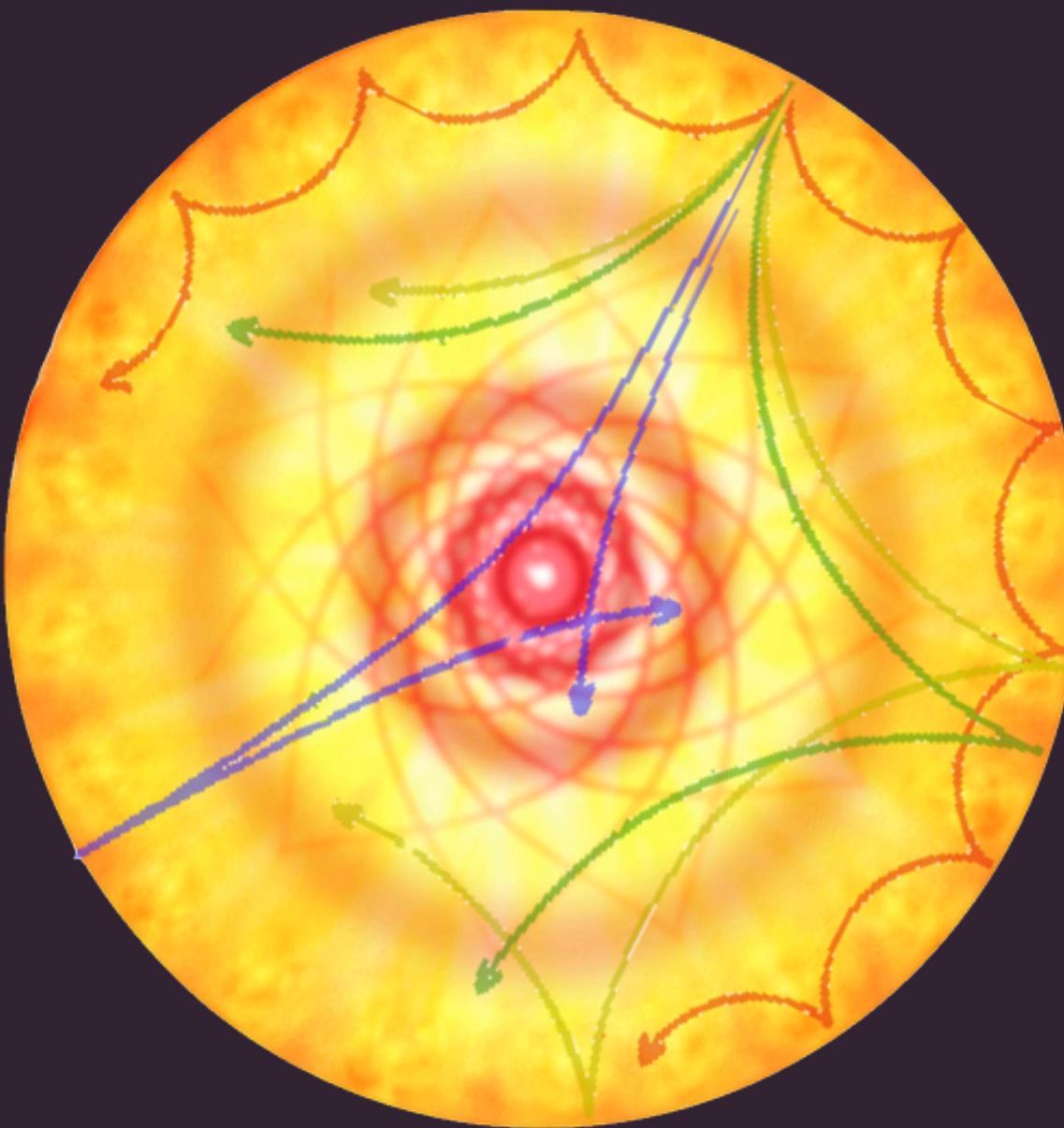
The study of ways stars pulsate



# WHY DO PEOPLE CARE?

Stars are cool

Asteroseismology lets you  
learn more about them





# HOW DO WE OBSERVE A STAR?

# LUMINOSITY



# LUMINOSITY

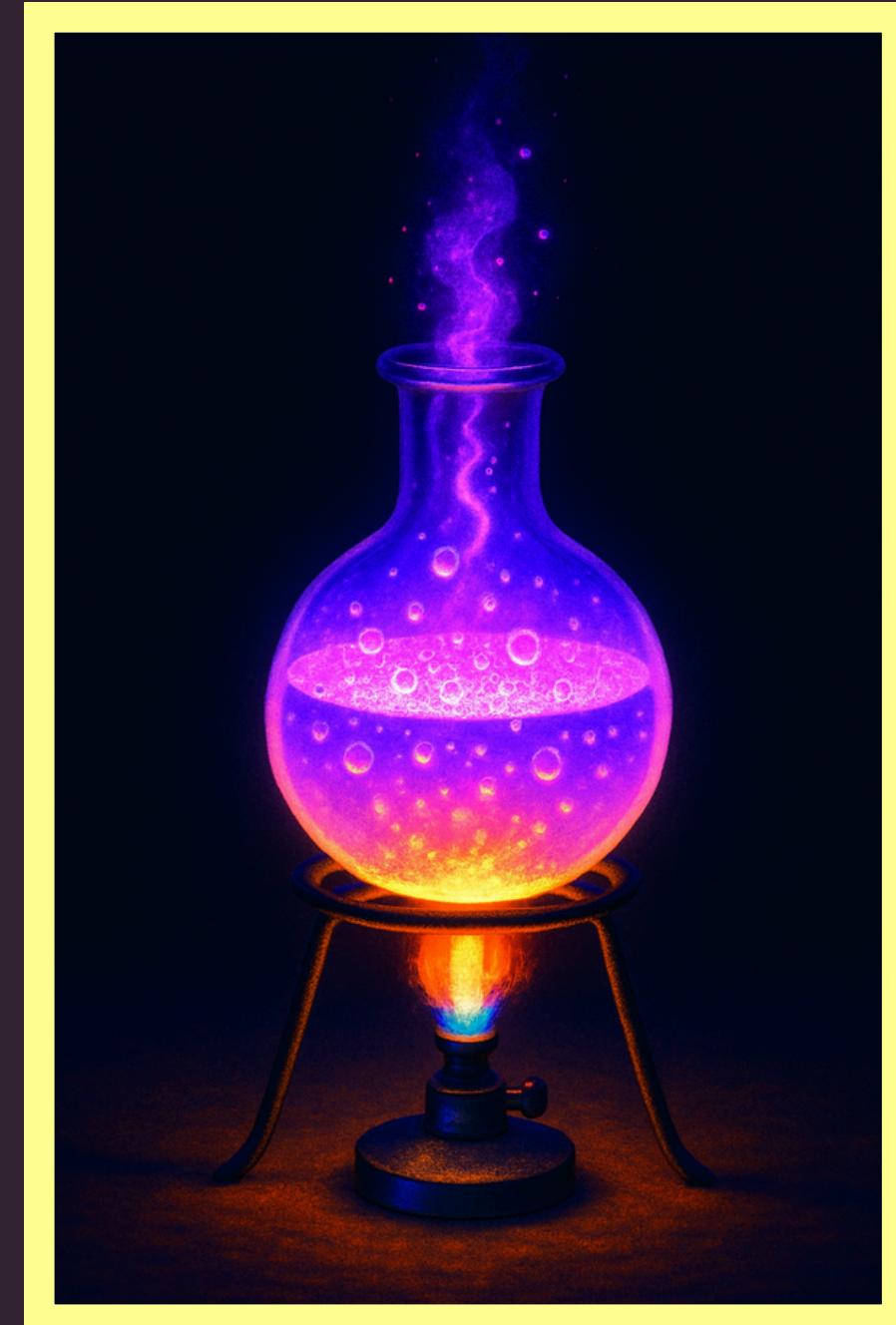


# LUMINOSITY

$$L \propto R^2 T^4$$

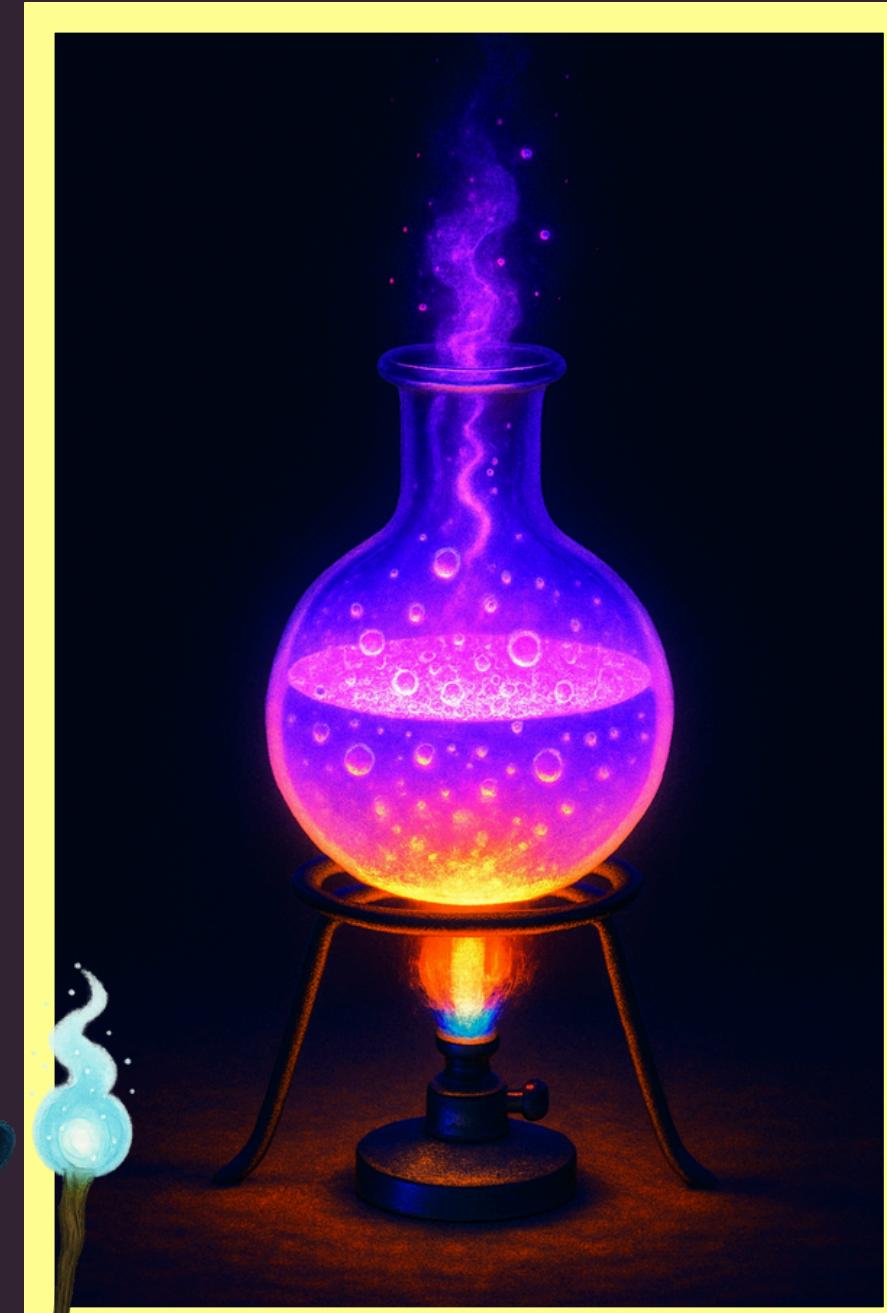


# COLOUR



# COLOUR

$$\lambda \propto \frac{1}{T}$$



# BASIC OBSERVABLES

Wavelength



Temperature



Luminosity +  
temperature

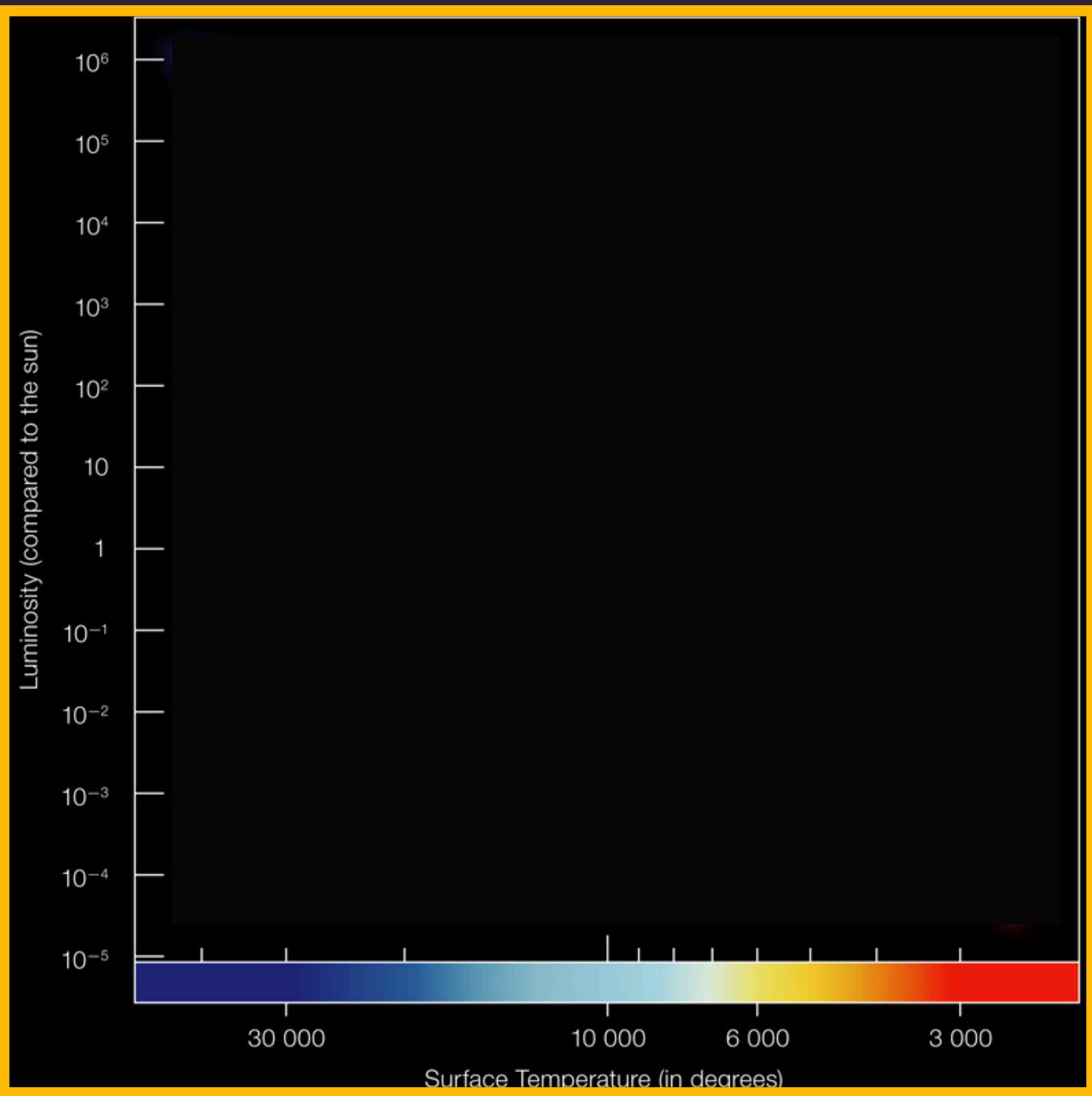


Size





Luminosity



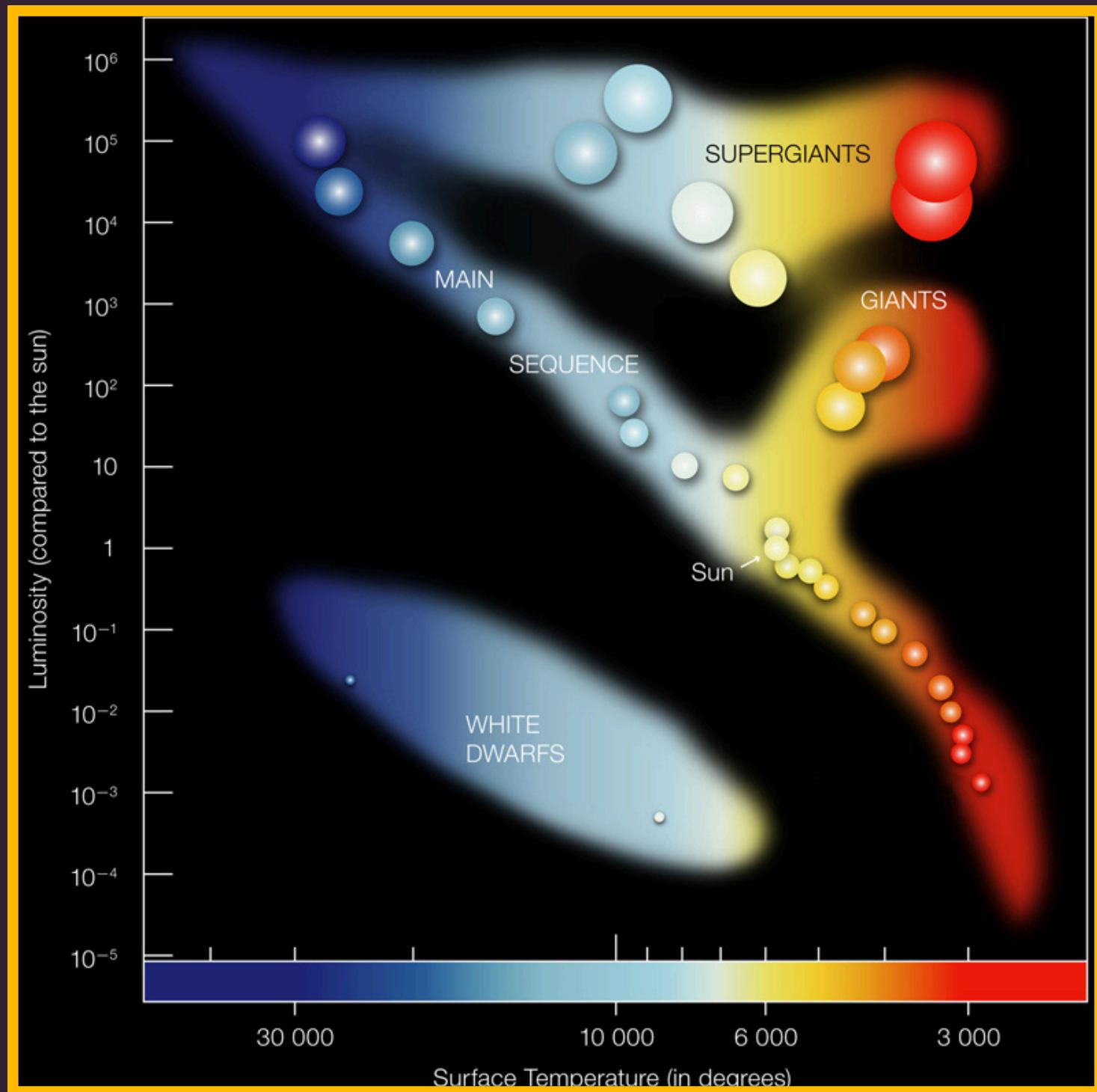
Temperature



$$L \propto R^2 T^4$$



Luminosity ↑



← Temperature

Temperature



# HOW DO WE STUDY STARS?

Observations:

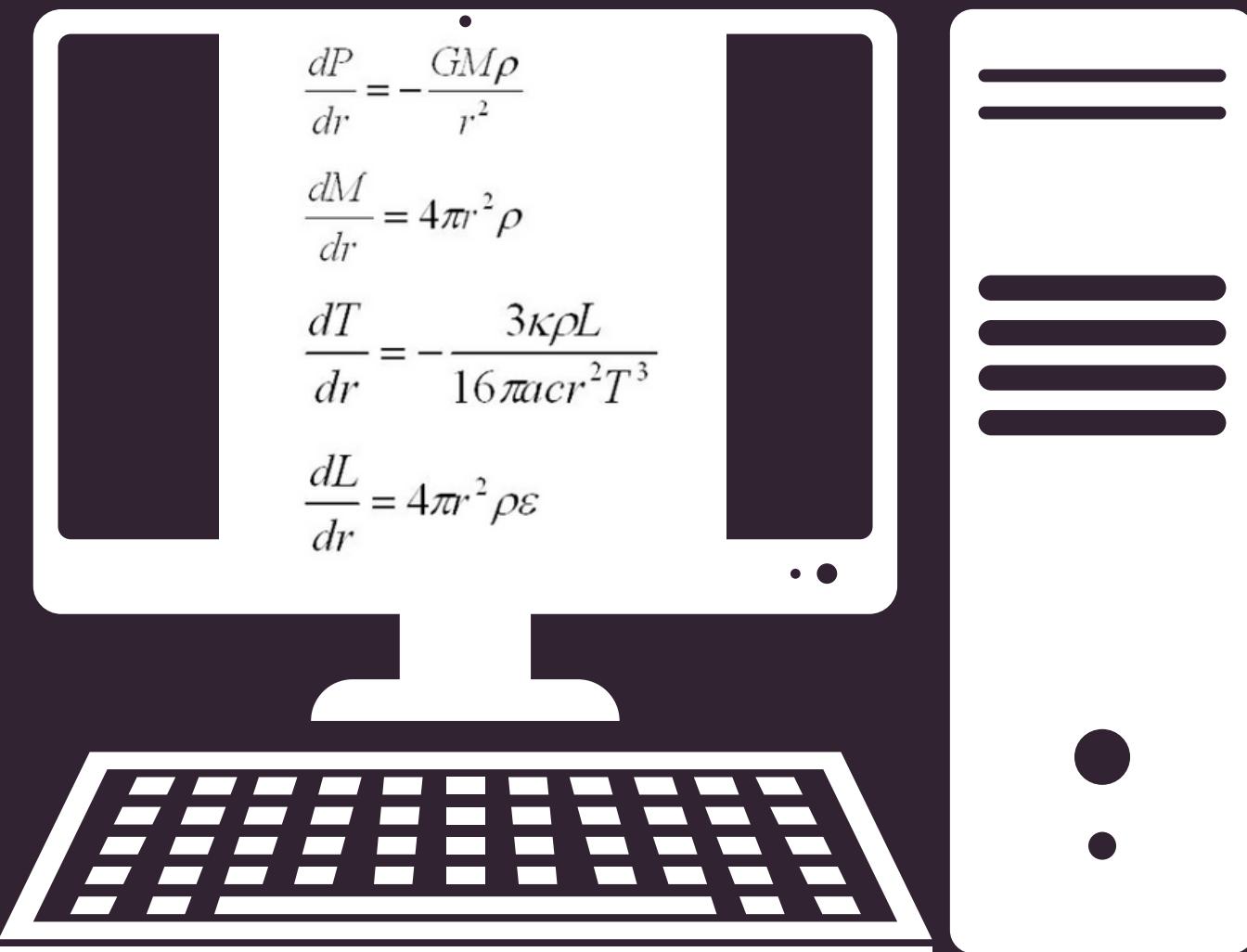
Properties of the  
light they give  
off



Models:

How we think the light  
should change according  
to the physical  
properties

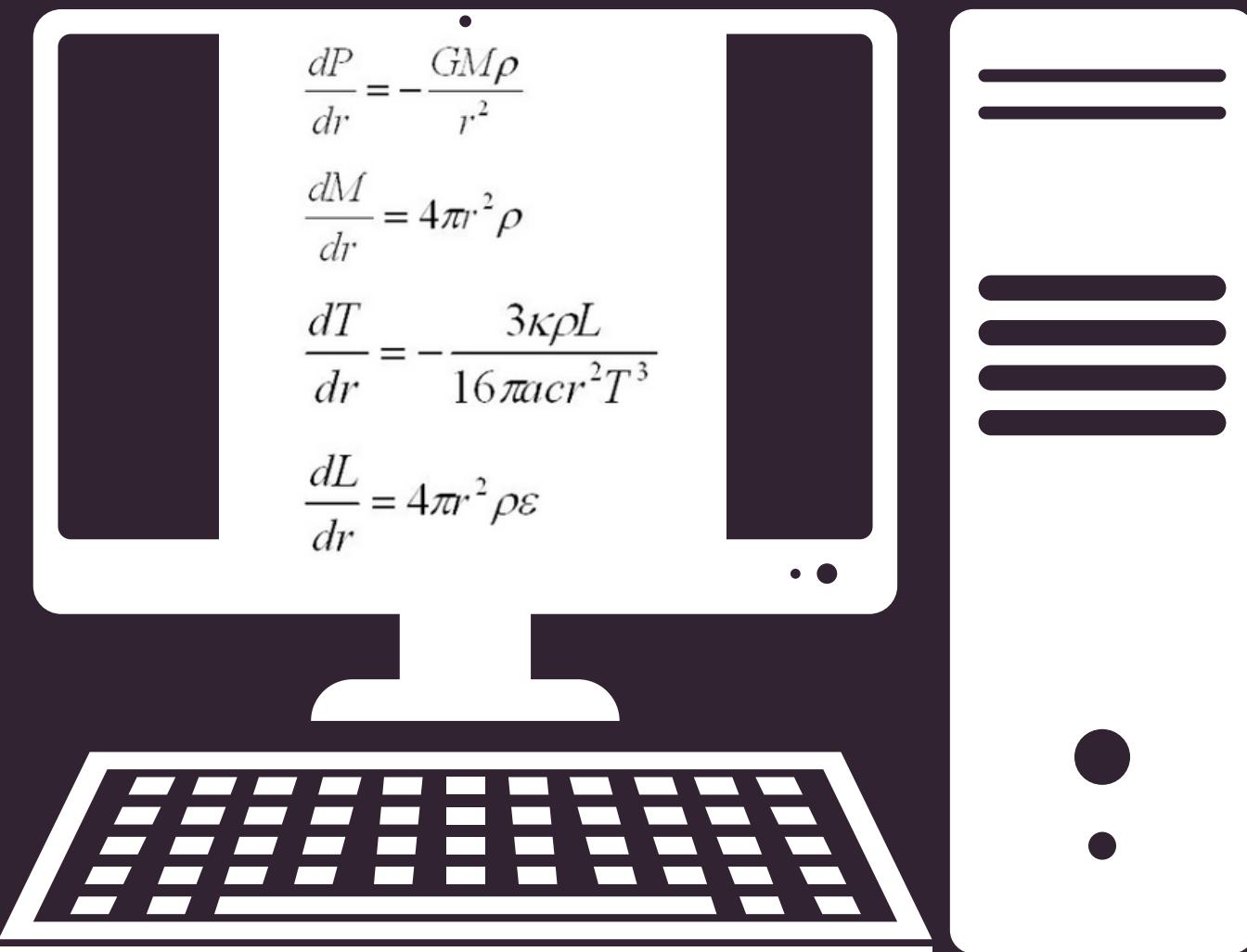
# STELLAR MODELS



Mass of gas cloud  
What it's made of

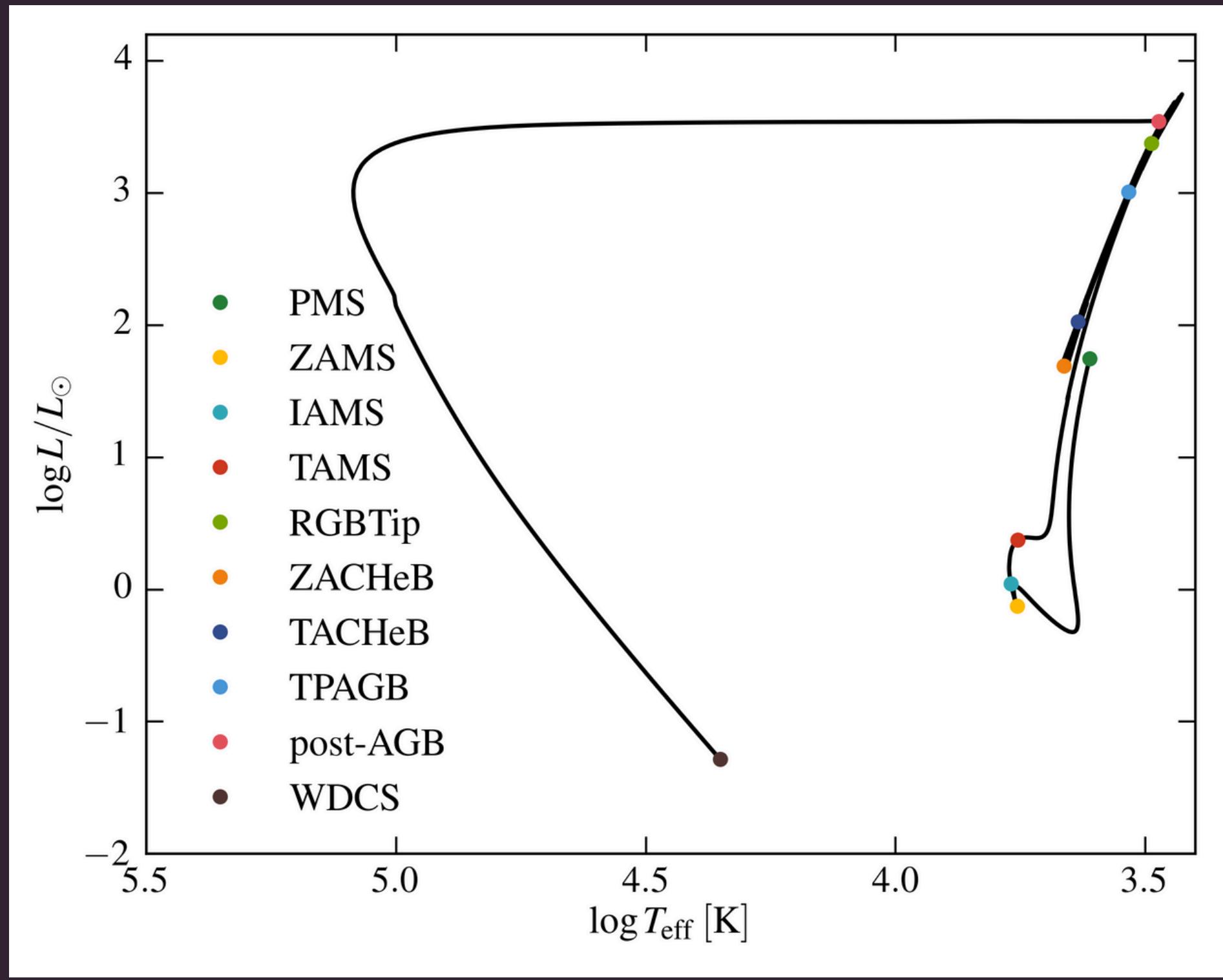


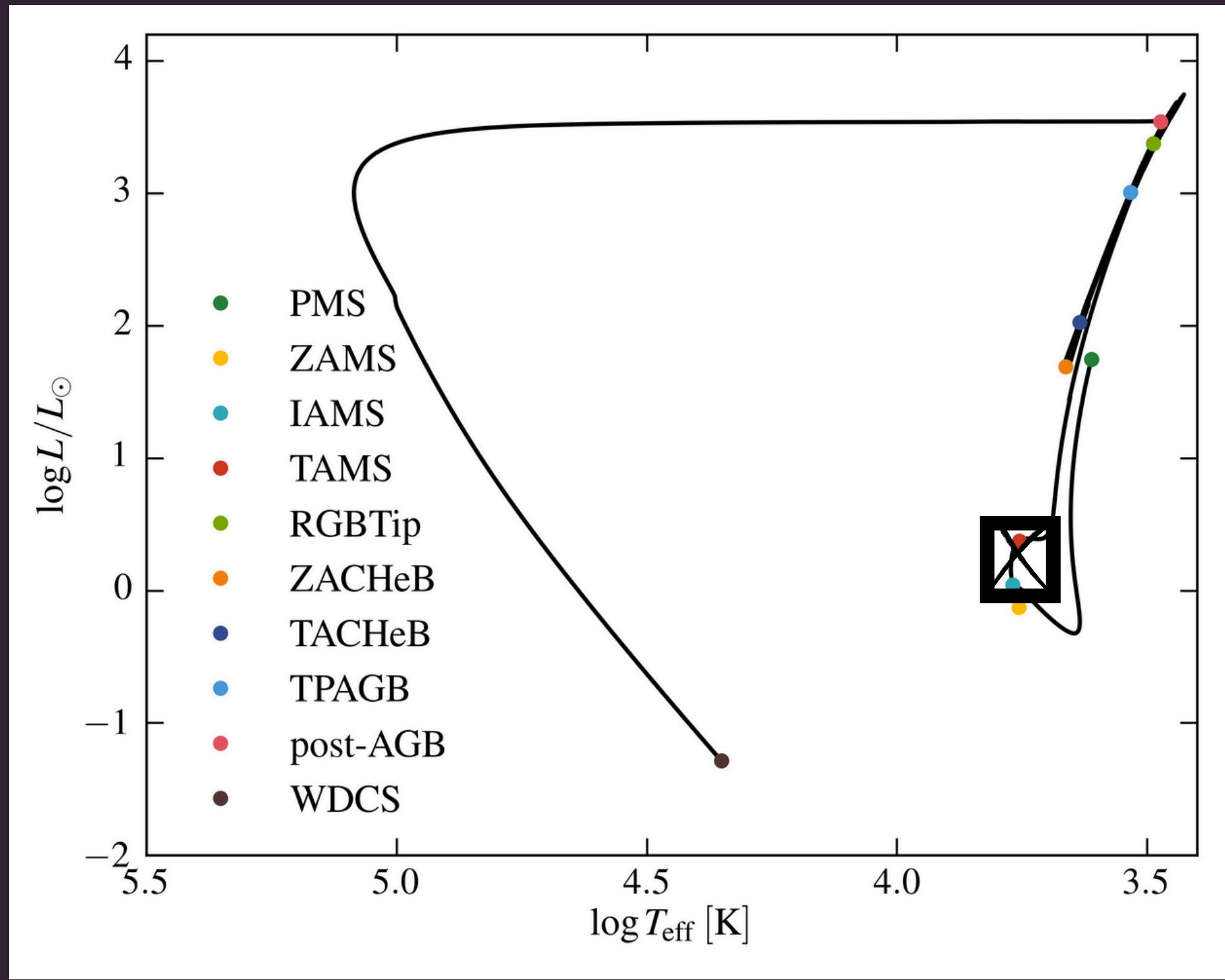
# STELLAR MODELS

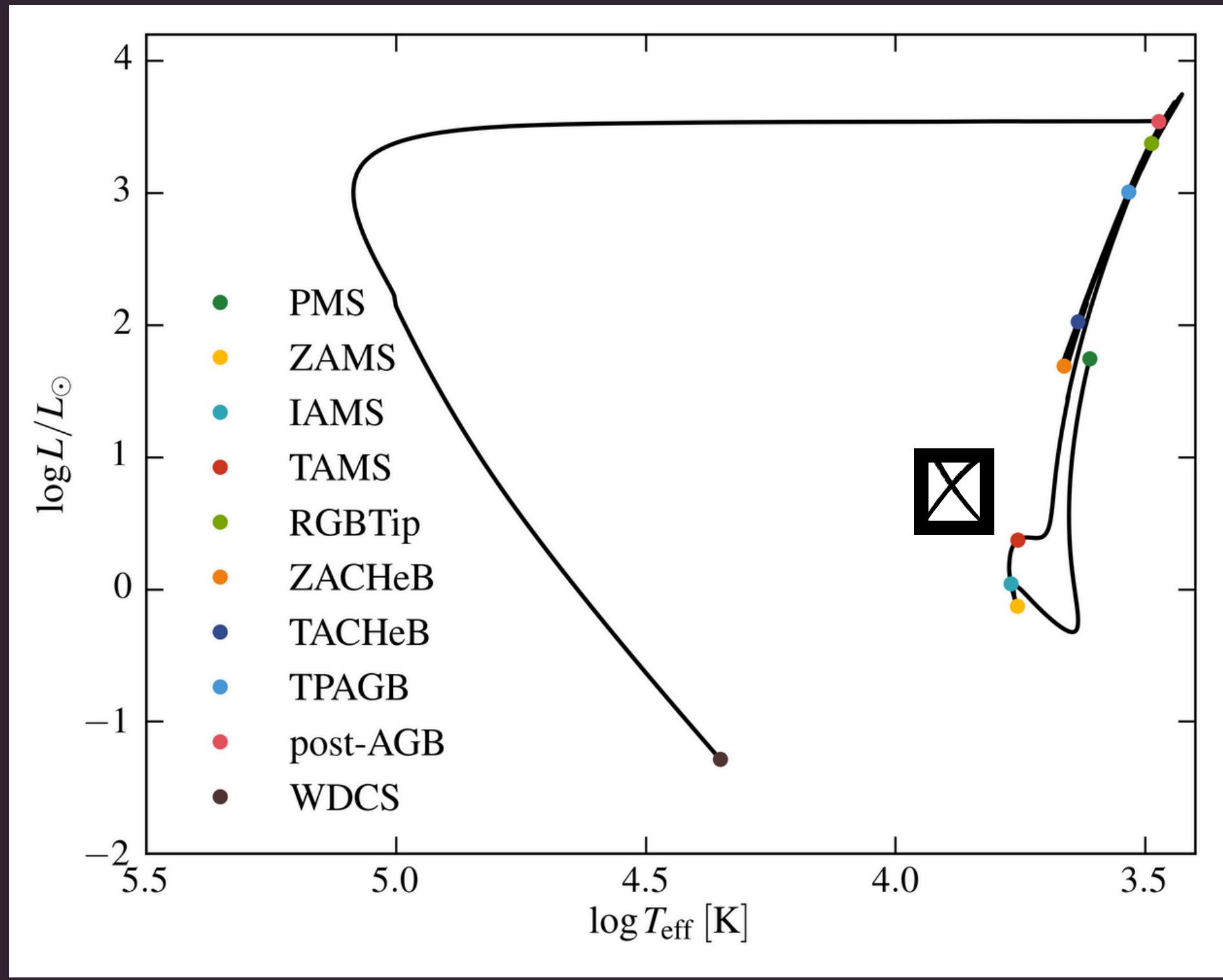


Mass of gas cloud  
What it's made of

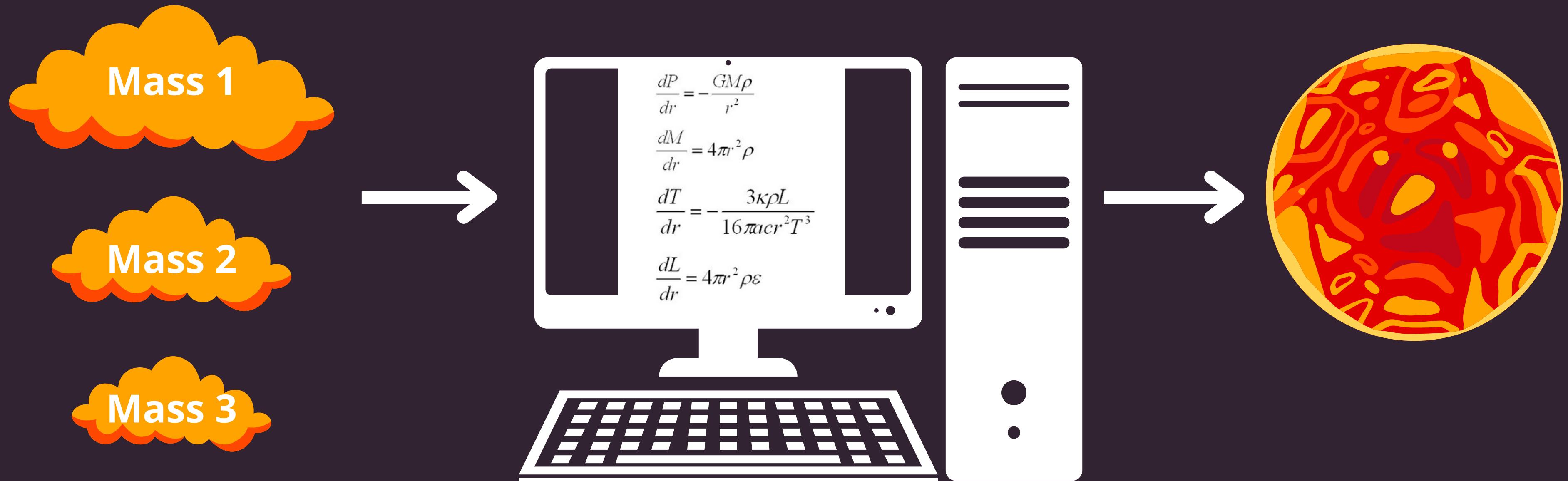






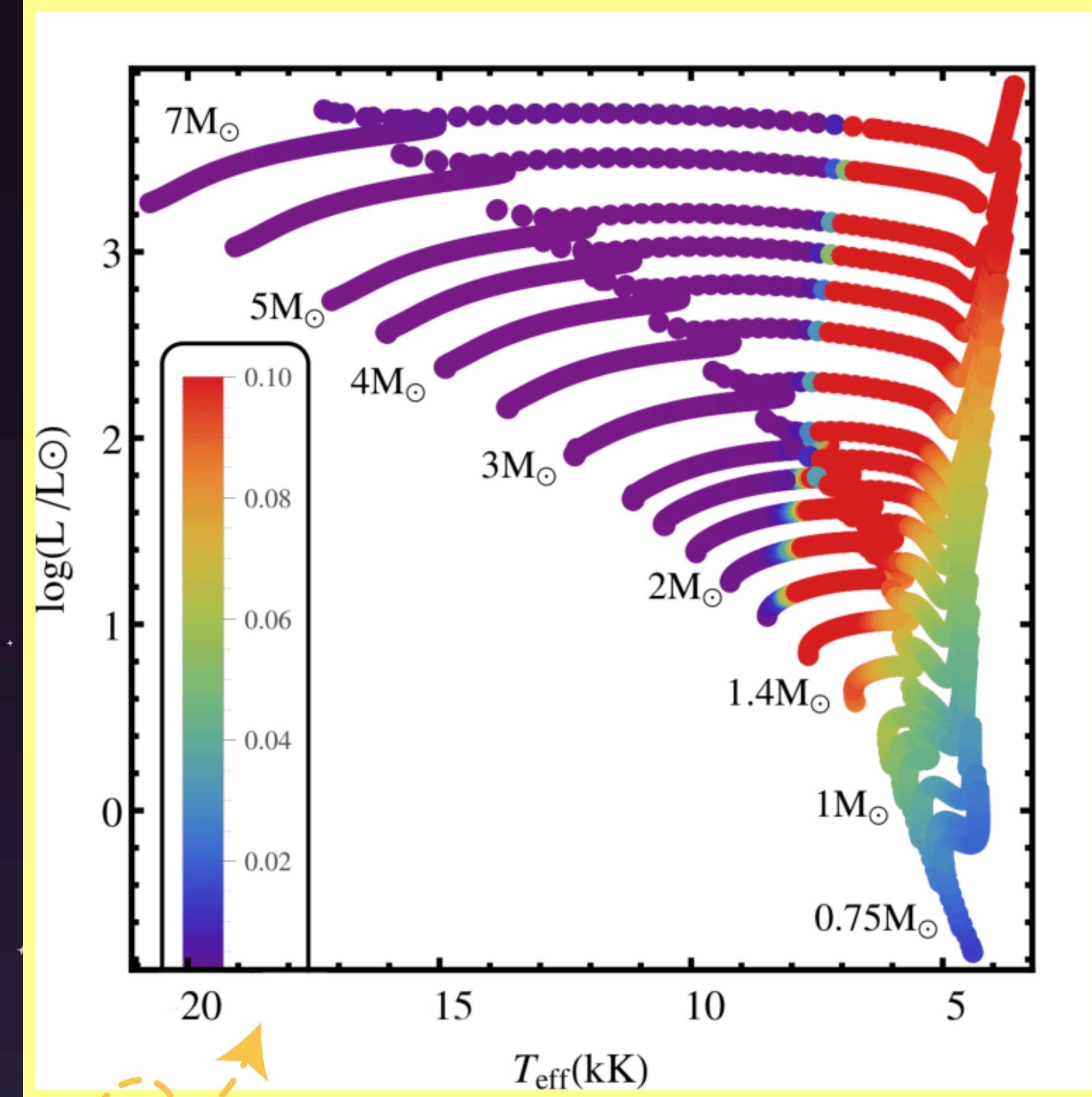


# CALCULATE MORE MASSES



Observations:  
Properties of the  
light they give  
off

Models:  
How we think the light  
should change according  
to the physical  
properties

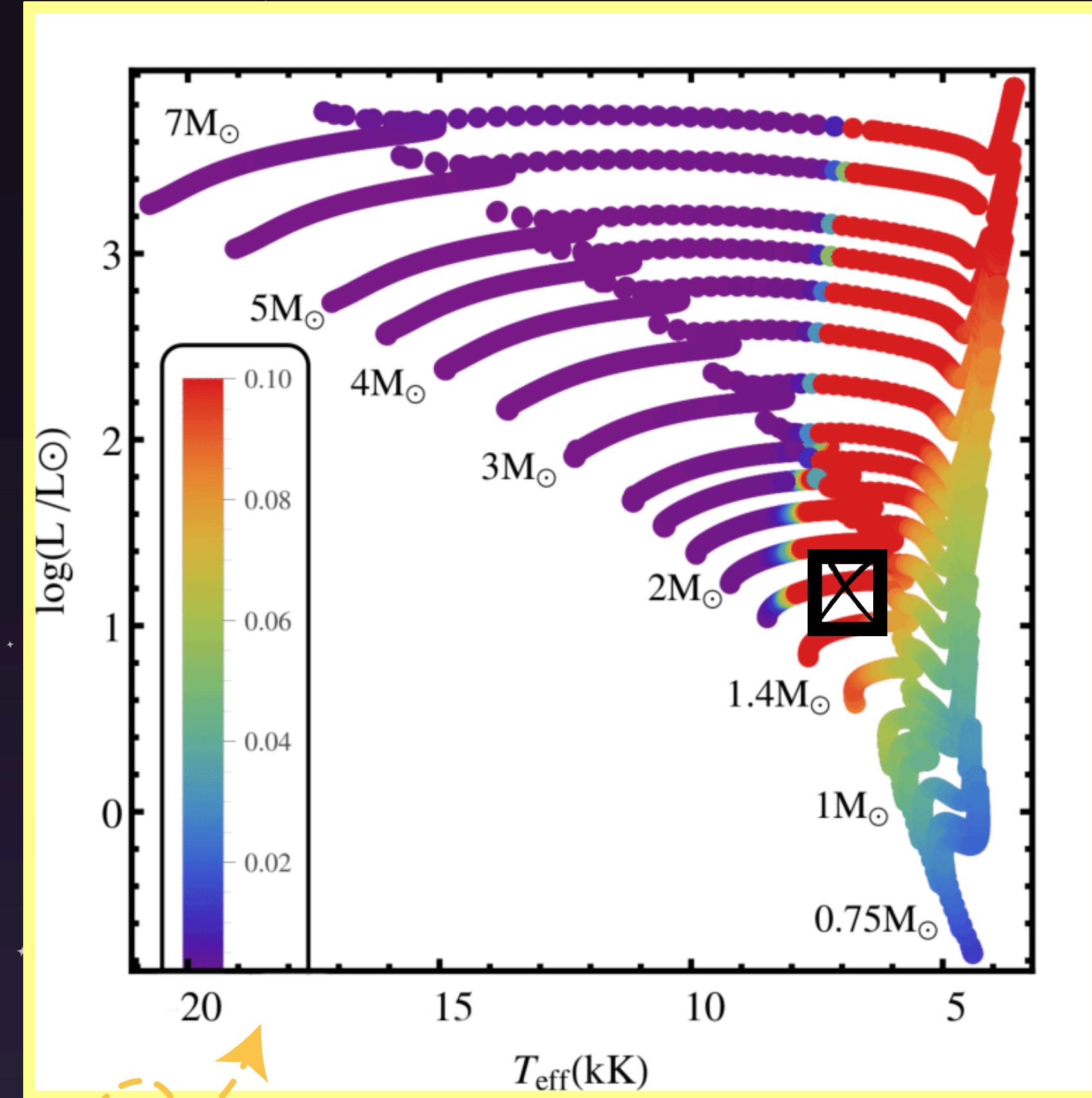


Observations:

Properties of the light they give off

Models:

How we think the light should change according to the physical properties



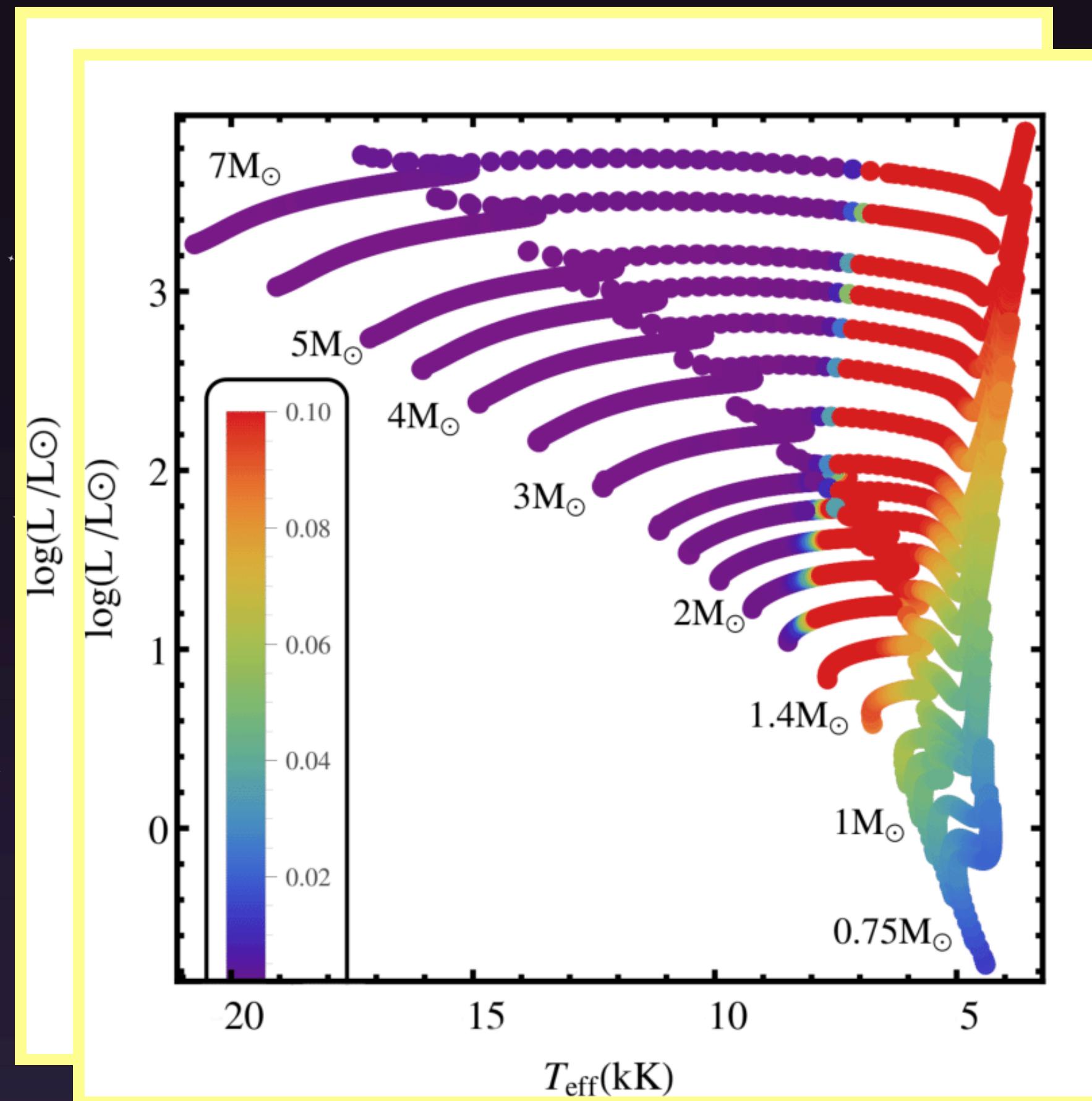
Observations:

Properties of the light they give off

Different gas make-up

Models:

How we think the light should change according to the physical properties



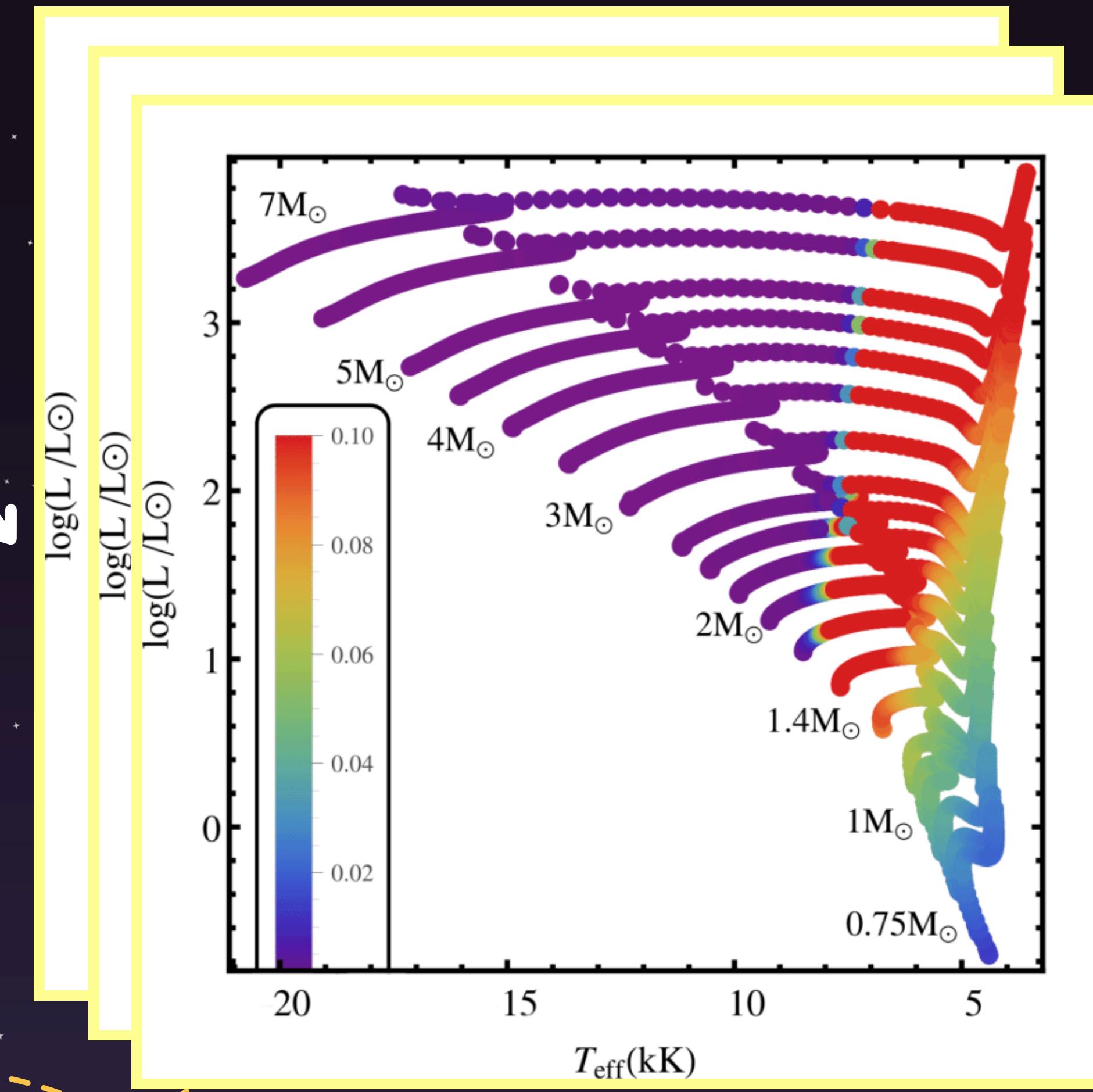
Observations:

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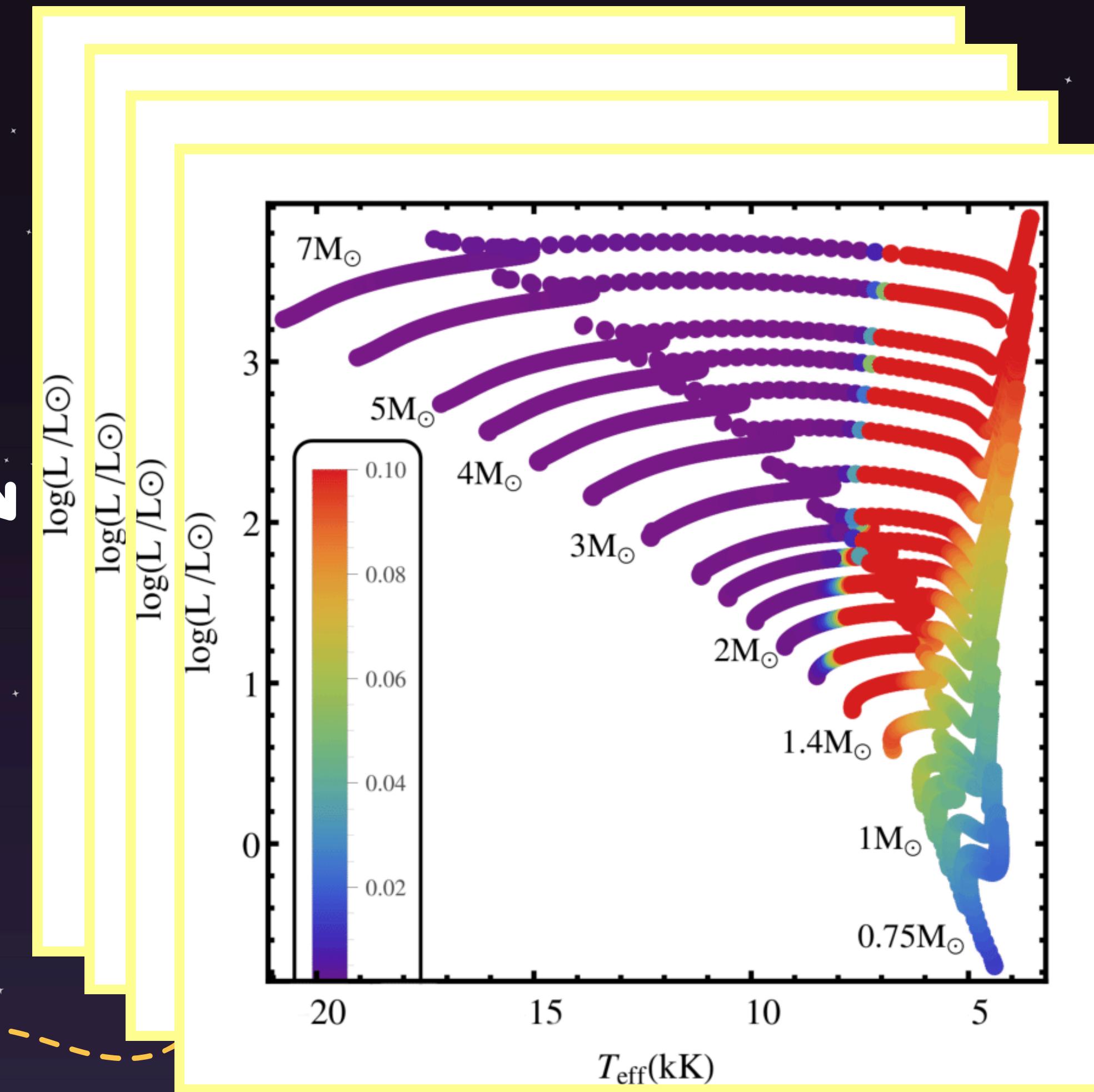
Observations:

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Models:

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**WE NEED MORE DATA!**



# **WE NEED MORE DATA!**

And it needs to come from the inside!

# SEISMOLOGY

Send soundwaves through a material

Measure their properties

Find out about the material



ASTERO

# SEISMOLOGY

'Send' soundwaves through a material  
star

Measure their properties

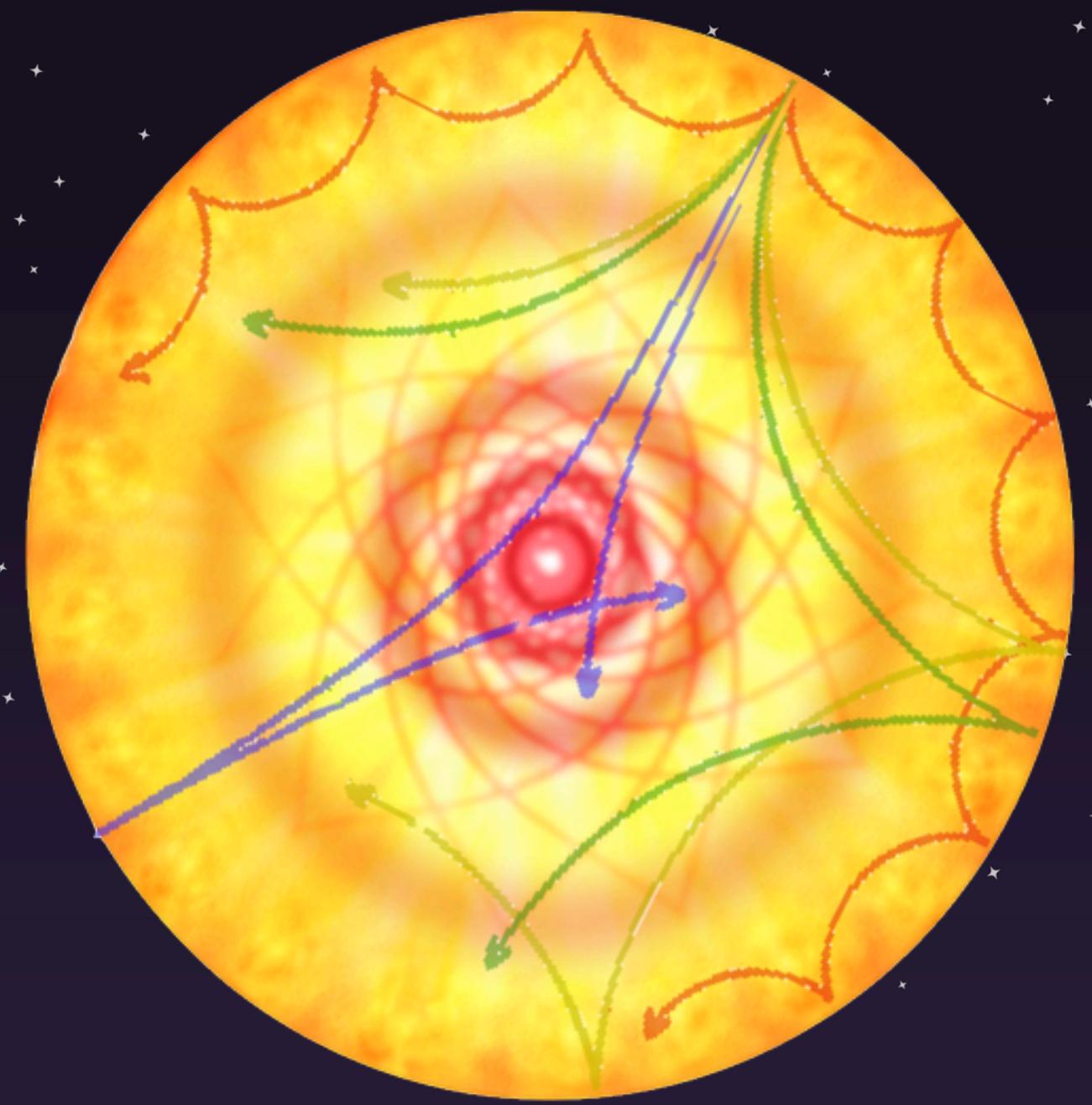
Find out about the material  
star





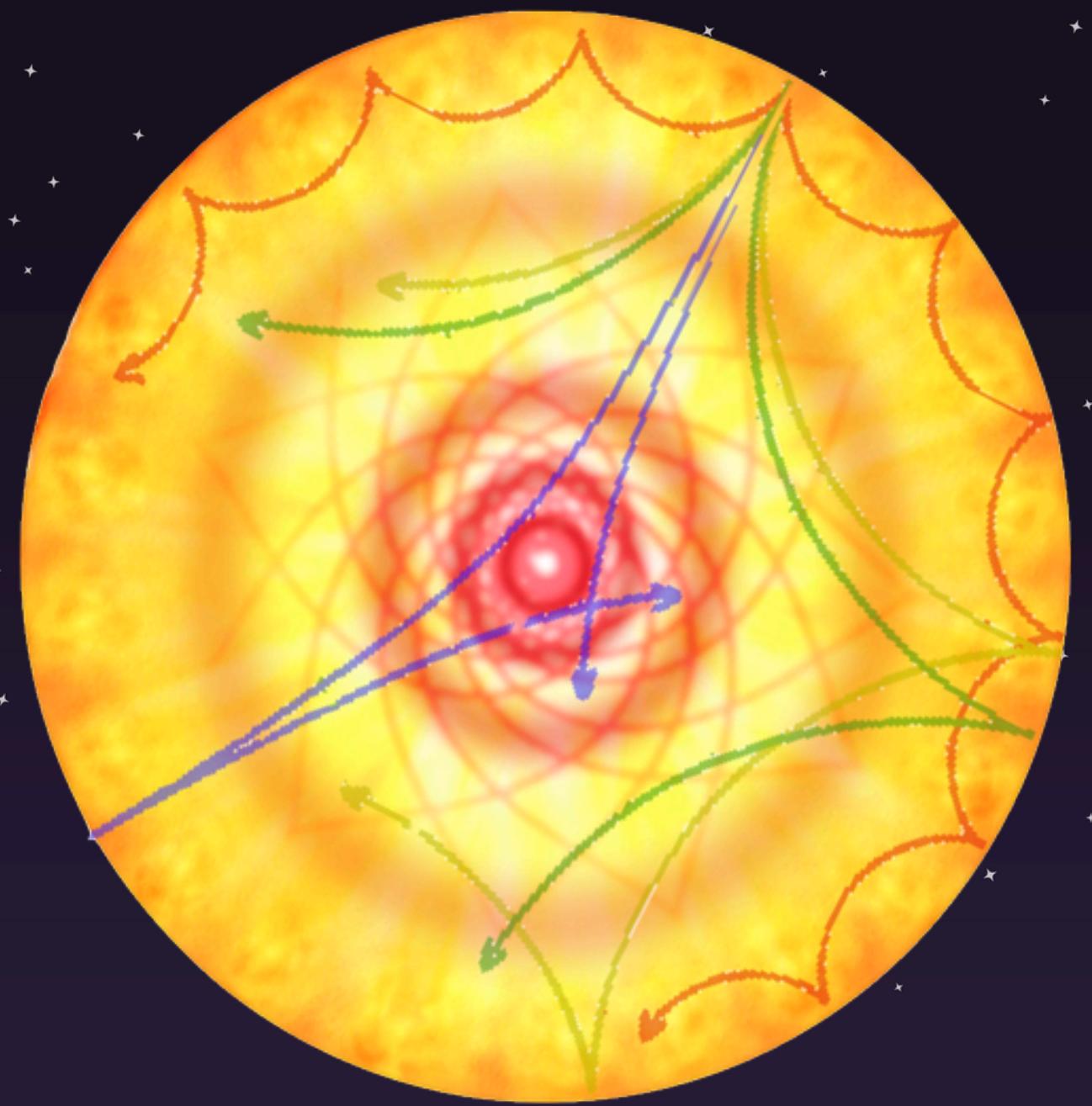
# WAVES?

## Sound



# WAVES?

Sound

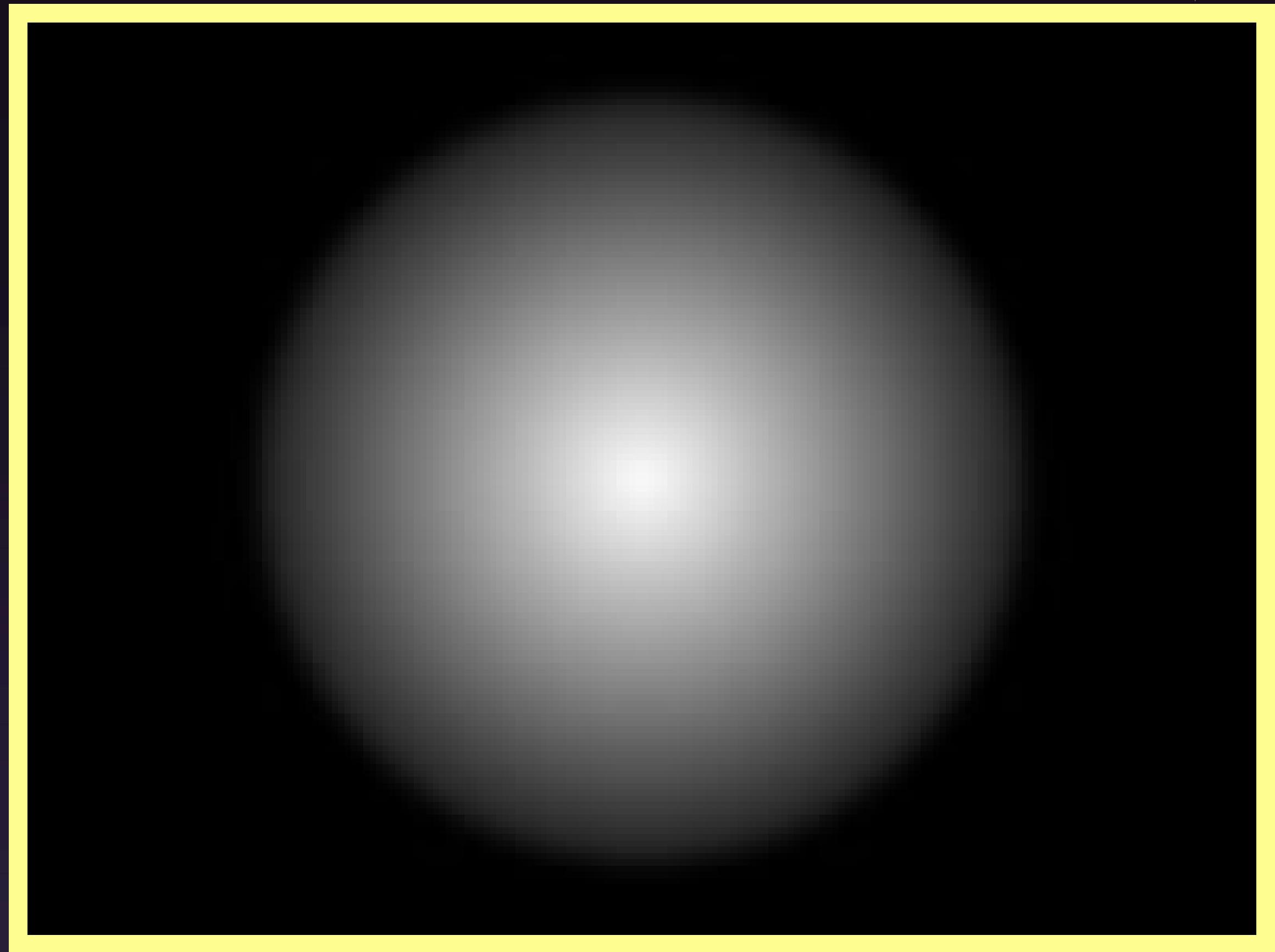


**WAVES**

**↓**

**TRAPPED WAVES**

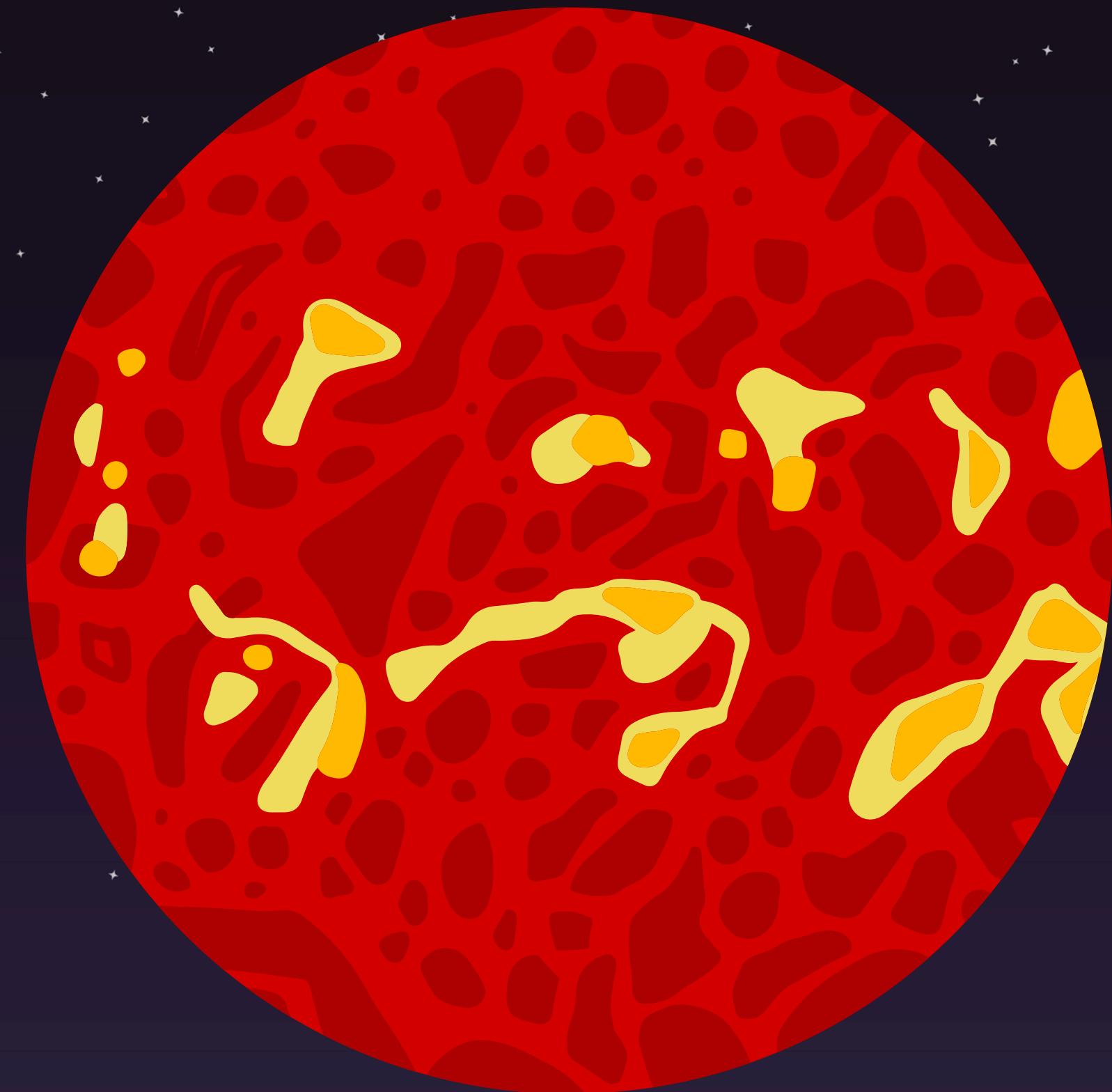
A large, bold, yellow arrow points downwards from the word "WAVES" to the word "TRAPPED WAVES".



# HOW DO WE MEASURE IT?

Contraction = increase in  
brightness

Expansion = decrease in  
brightness



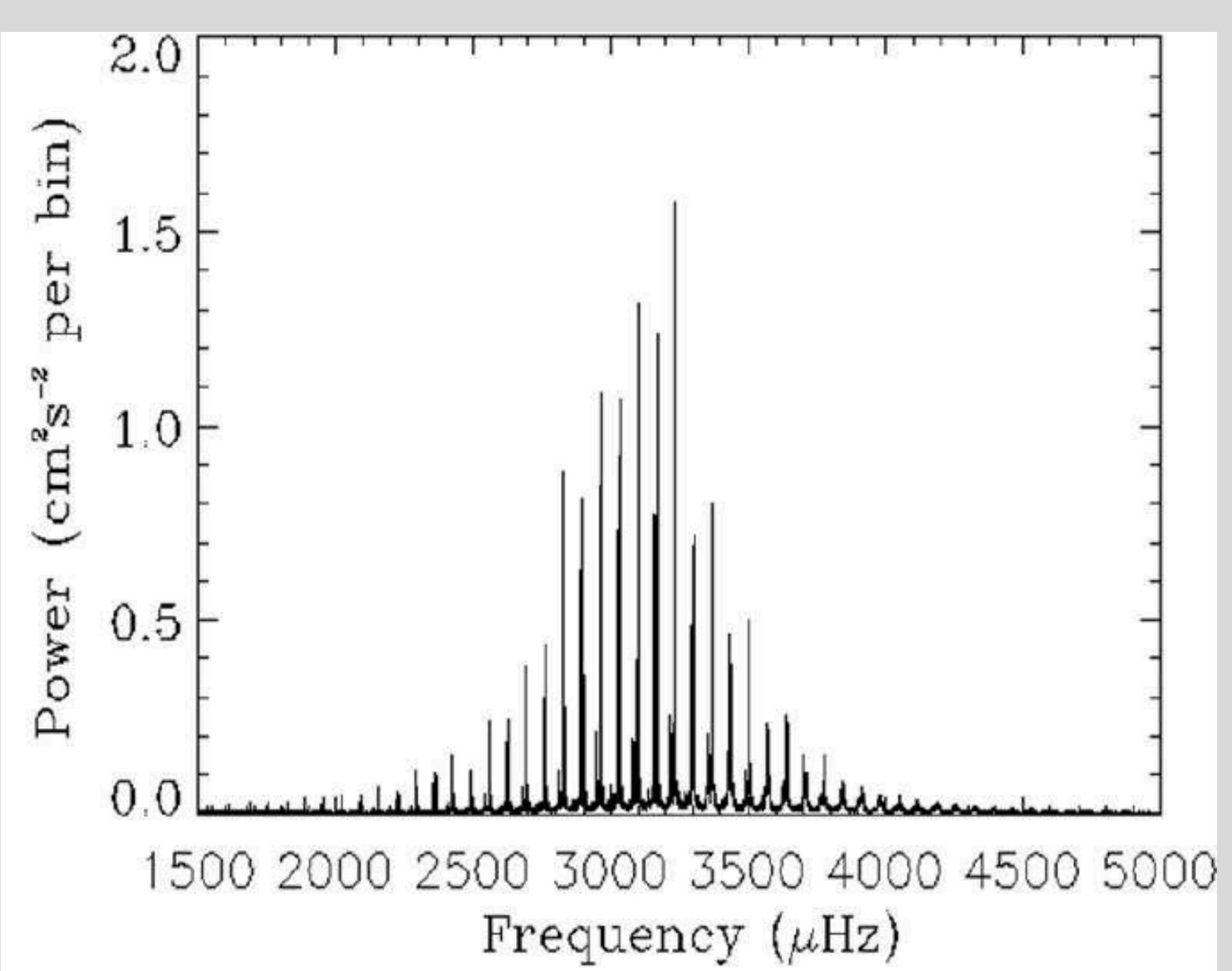
# HOW DO WE MEASURE IT?

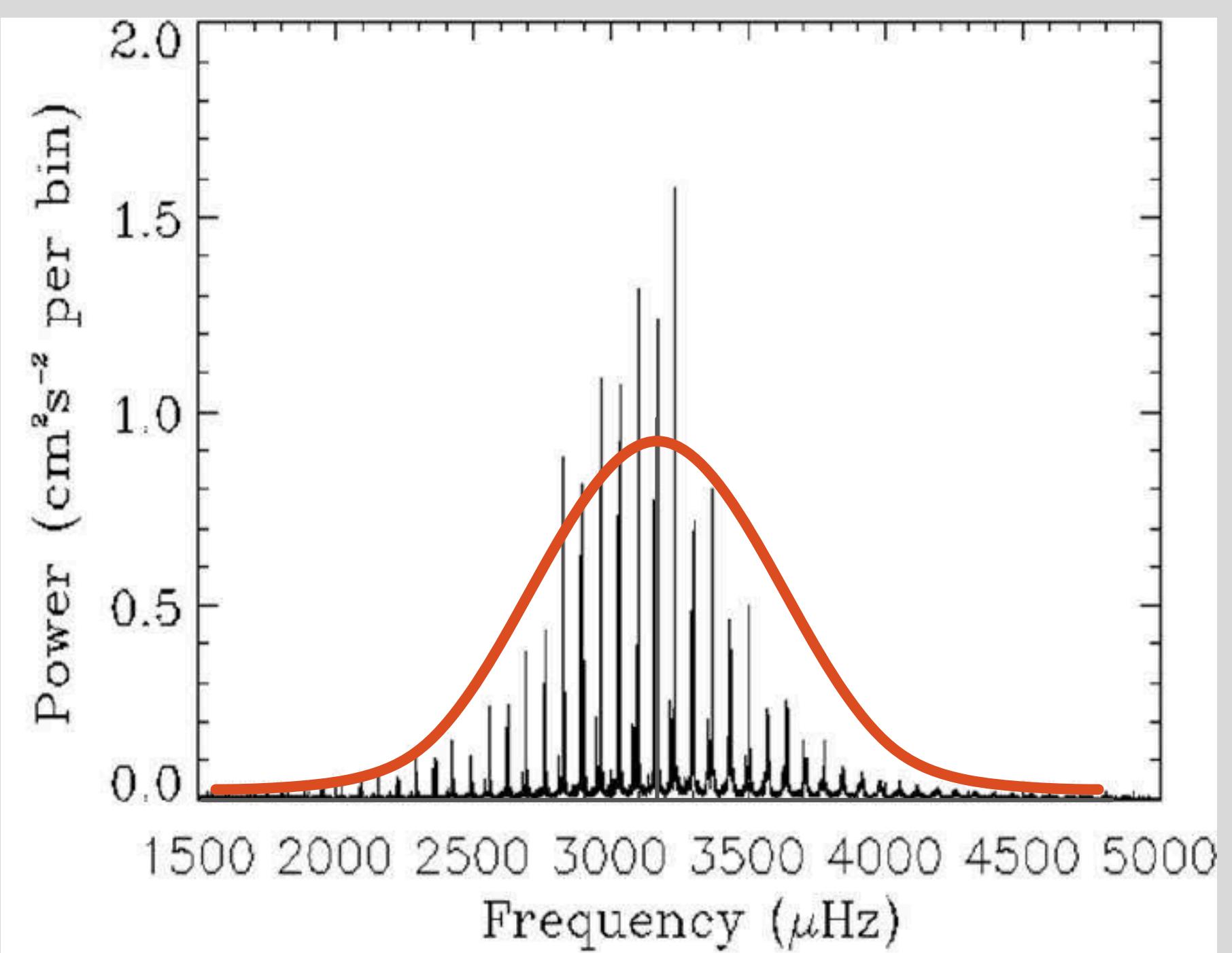
Contraction = increas  
brightn

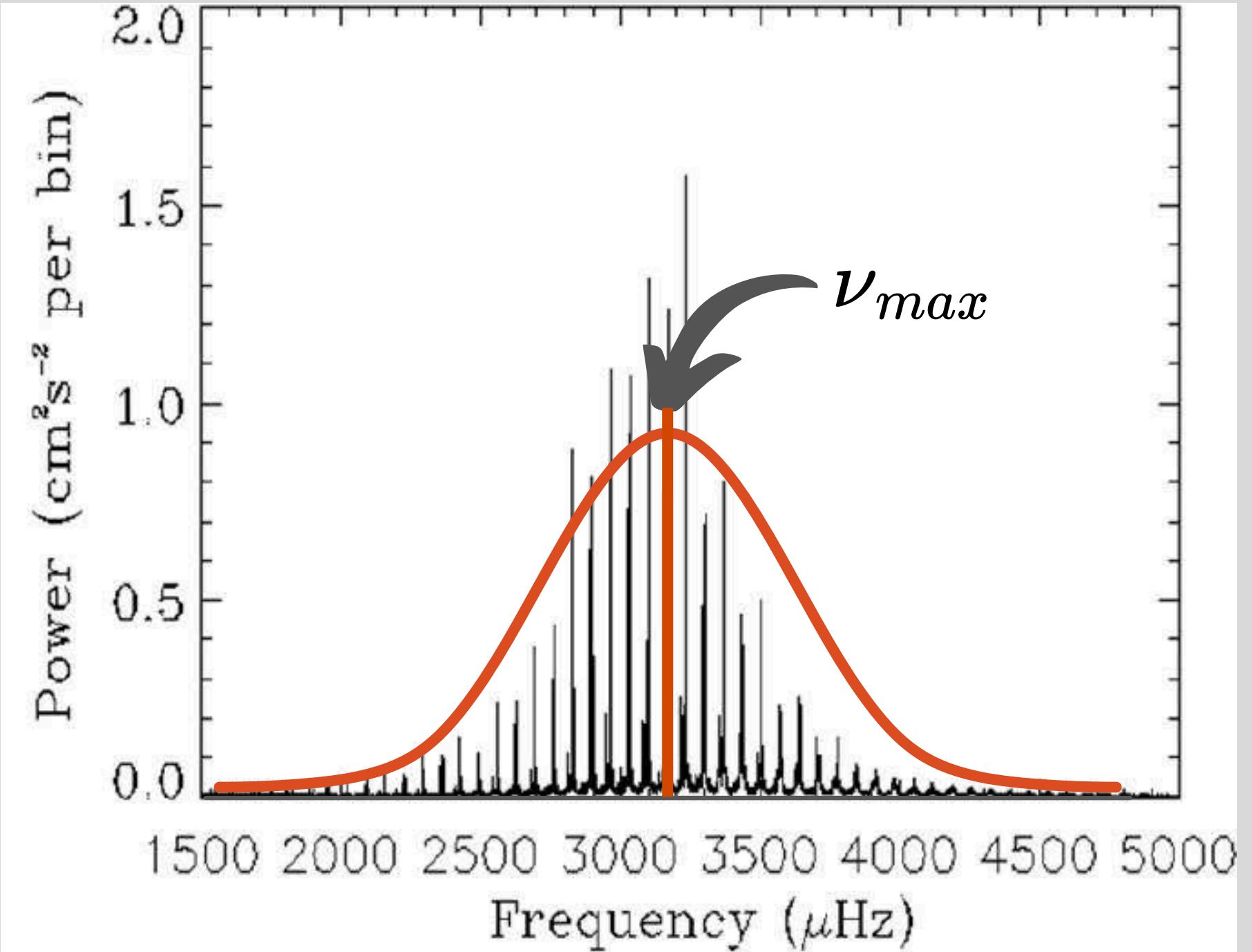
Expansion = decrease in  
brightness

Measure brightness as a function of time



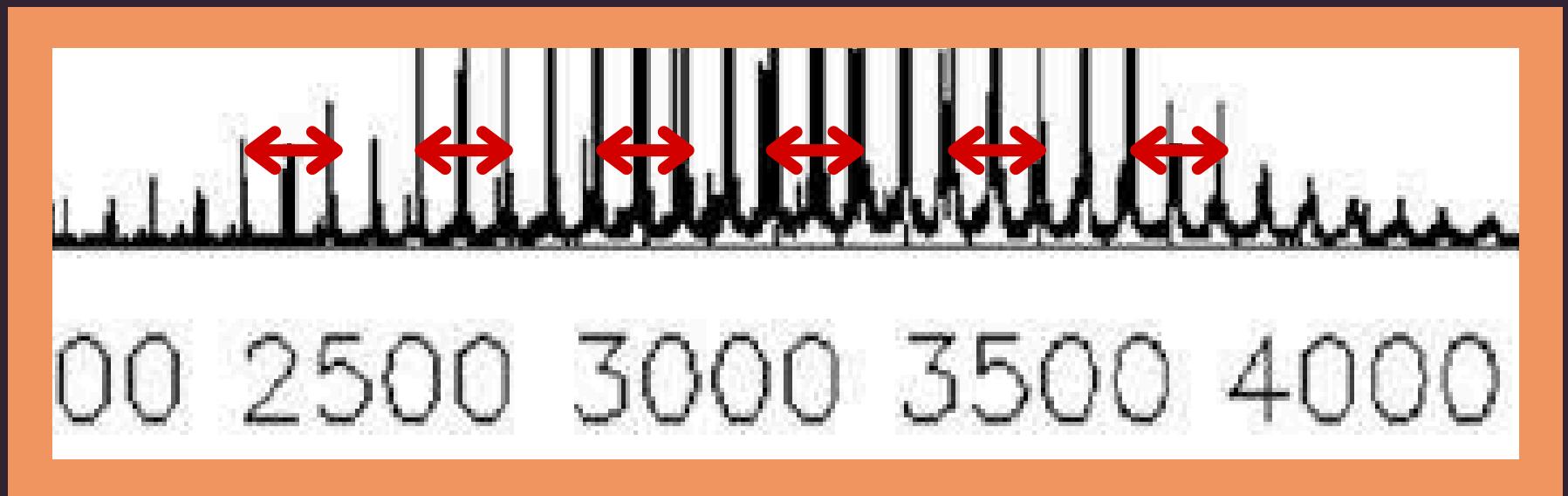
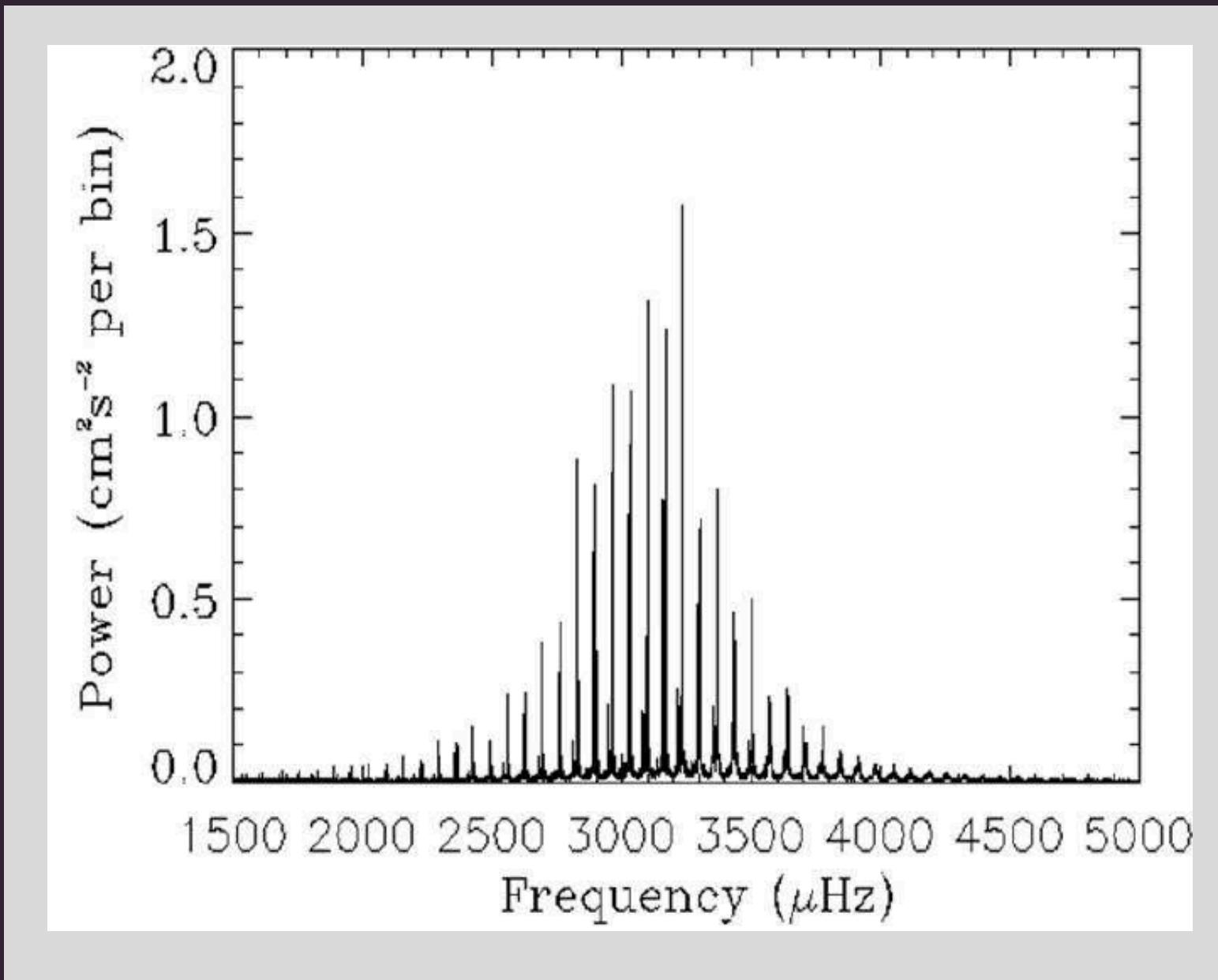


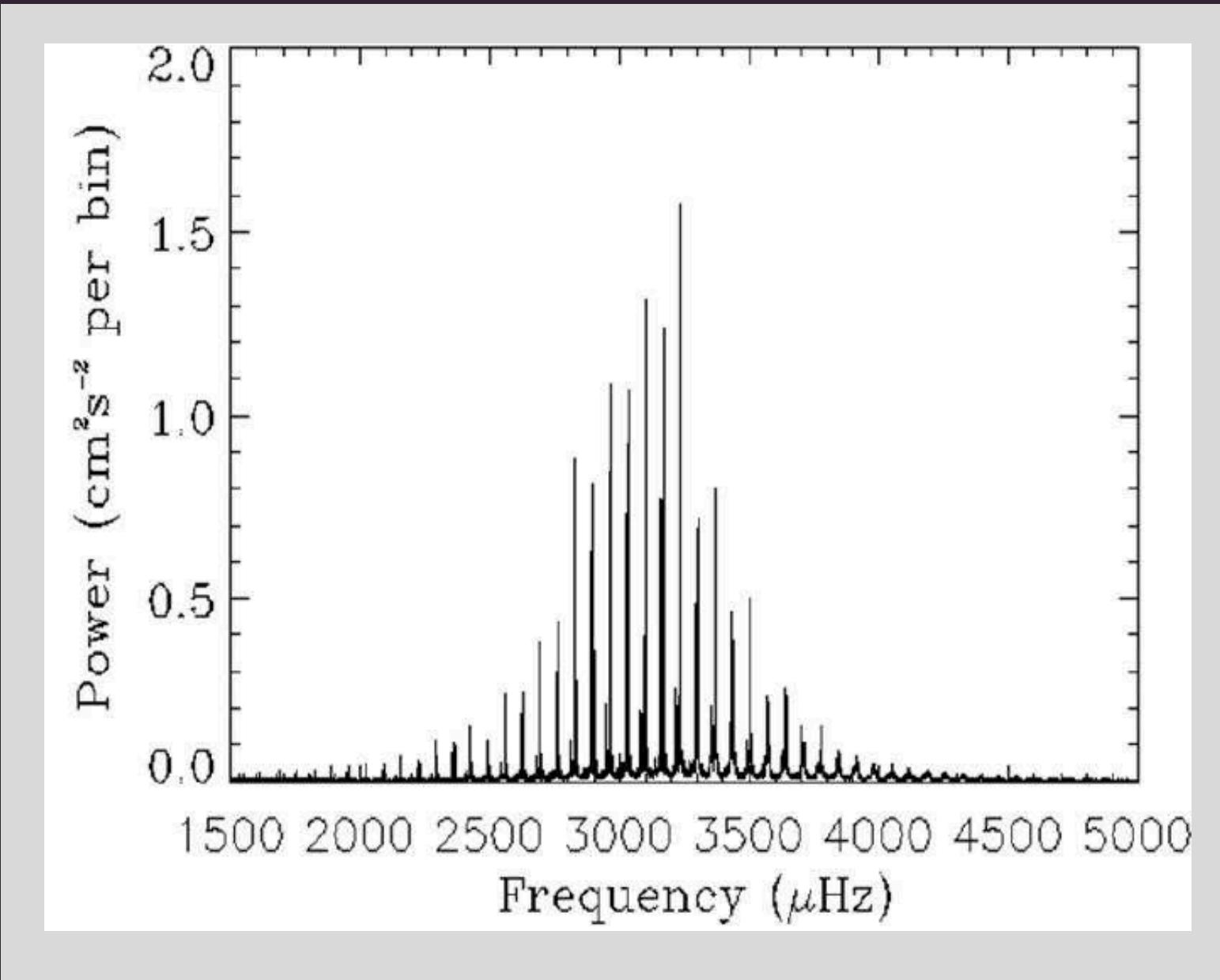




Surface Gravity

Temperature





Δν

Density

# WHAT DID IT DO FOR US?



$\nu_{max} \rightarrow$  Surface gravity, temperature

$\Delta\nu \rightarrow$  Density

# WHAT DID IT DO FOR US?



$\nu_{max} \rightarrow$  Surface gravity, temperature

↑  
mass, radius

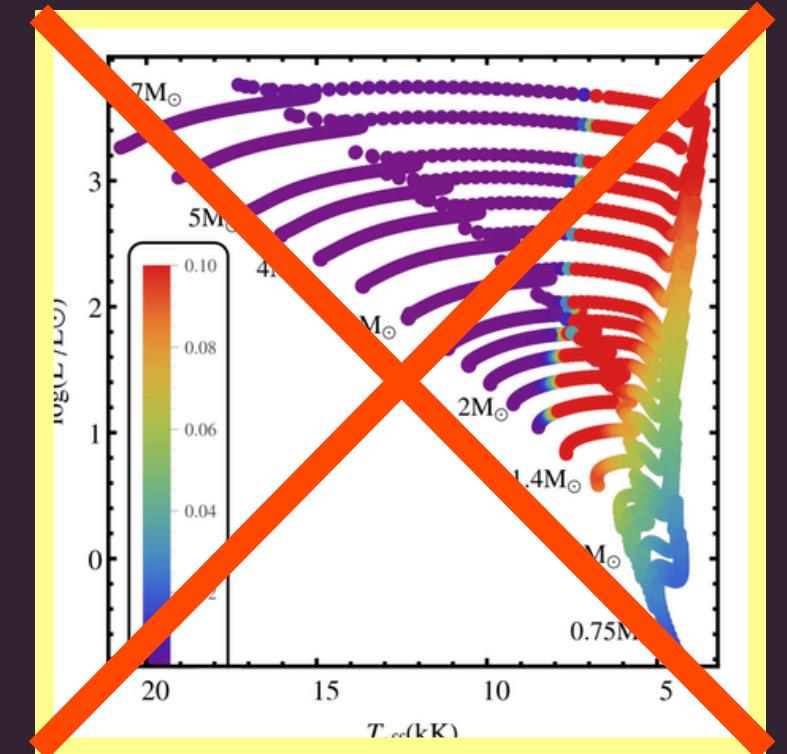
$\Delta\nu \rightarrow$  Density

# WHAT DID IT DO FOR US?



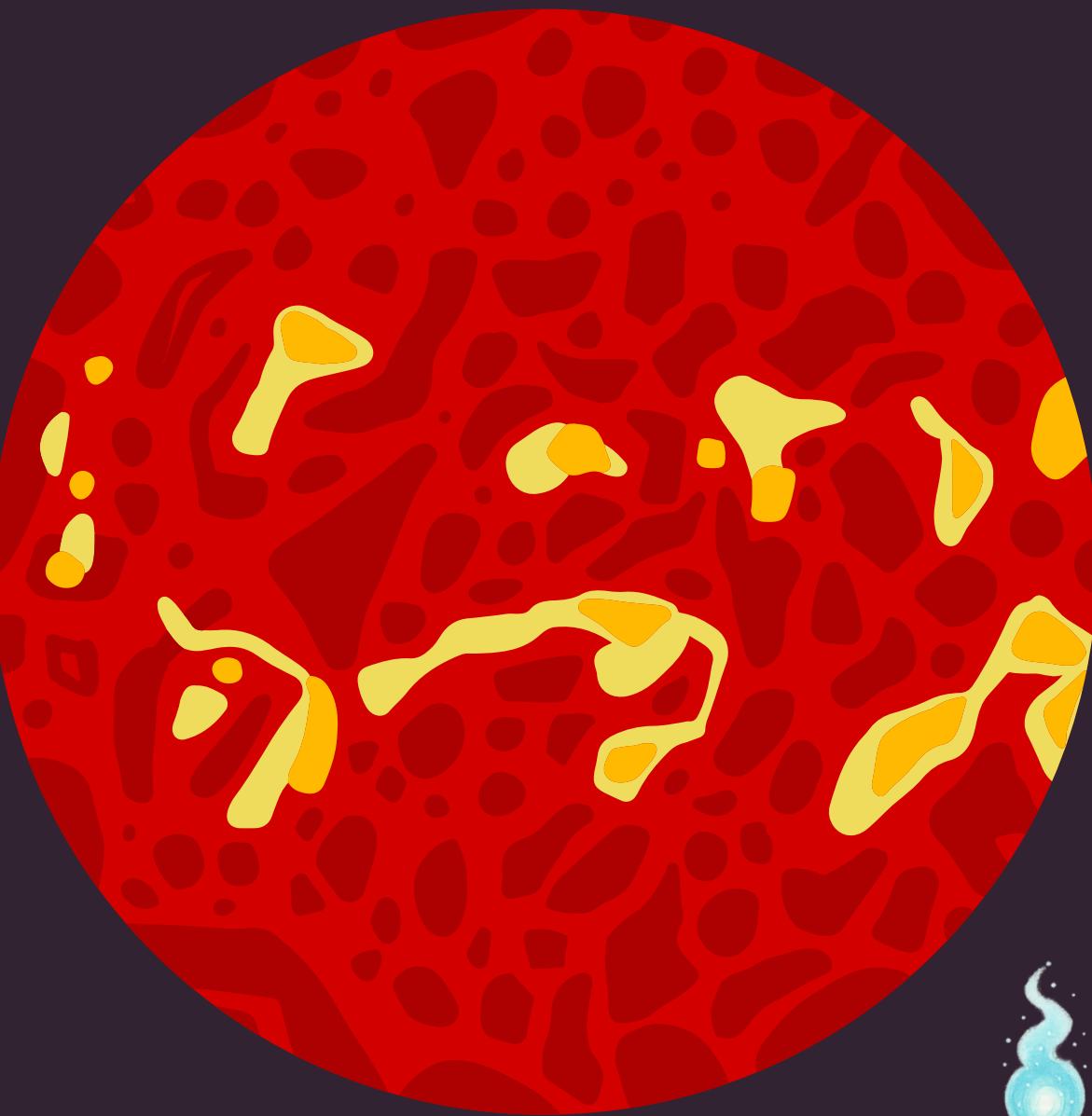
$\nu_{max} \rightarrow$  Surface gravity, temperature  
mass, radius

$\Delta\nu \rightarrow$  Density



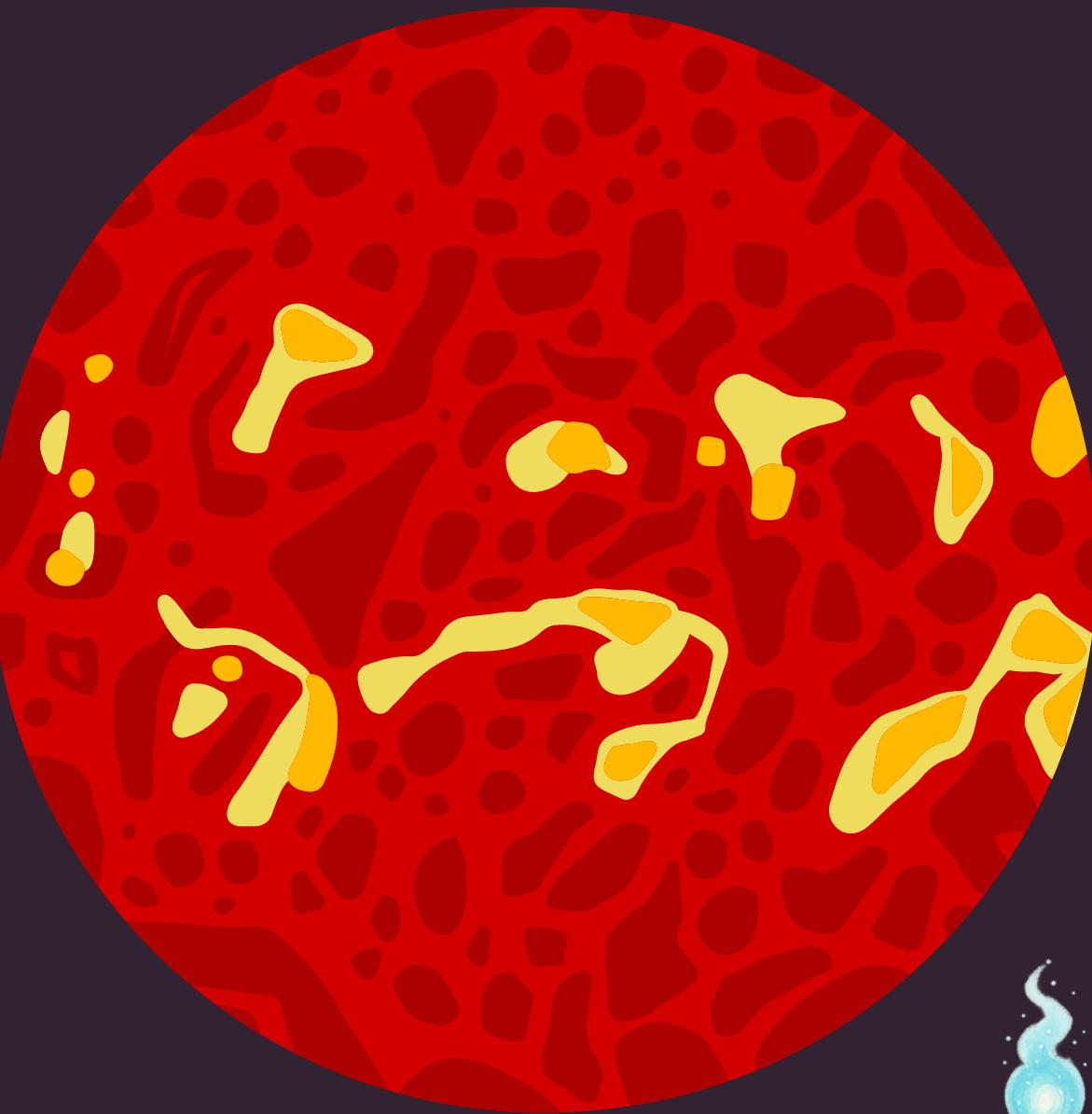
# CONCLUSIONS

- Stars are not just static spheres of gas - they pulsate



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- Measuring the properties of the pulsations tells us about the physical properties of the star



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- Stars are not just static spheres of gas - they pulsate
- Measuring the properties of the pulsations tells us about the physical properties of the star
- We can even learn about the deep internal layers

