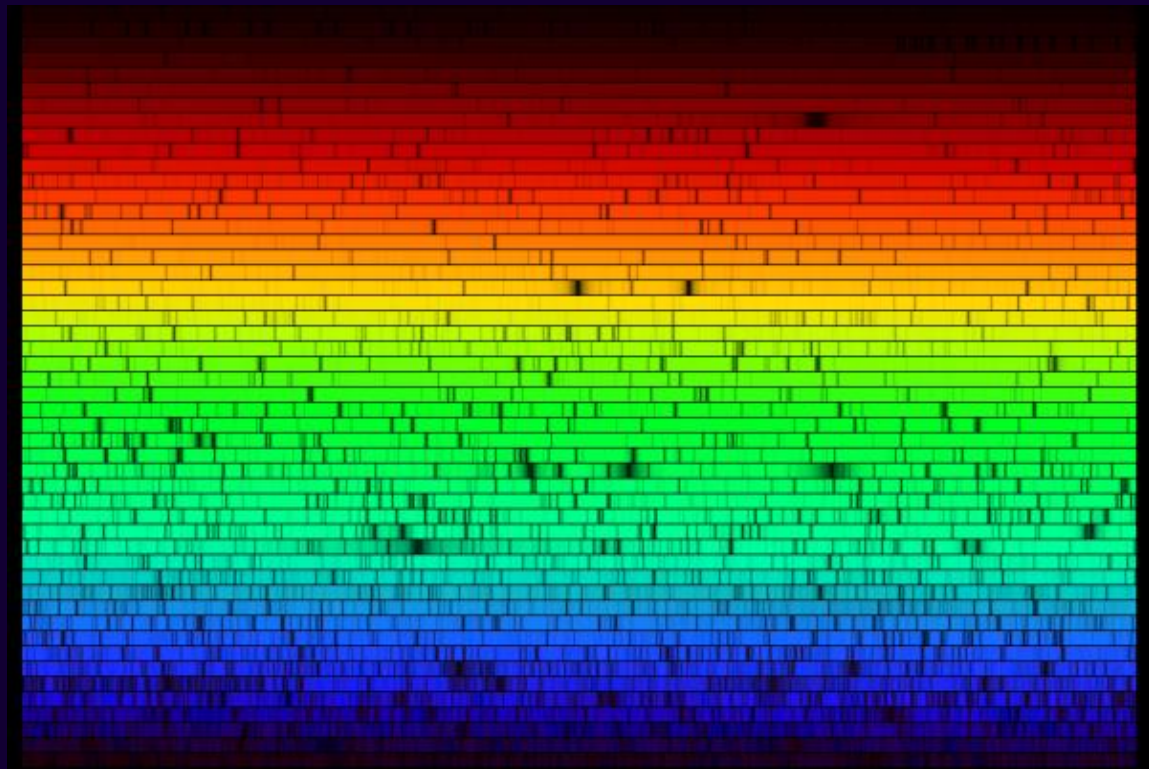


Thermal radiation and spectroscopy

Astronomy 101
Syracuse University, Fall 2017
Walter Freeman

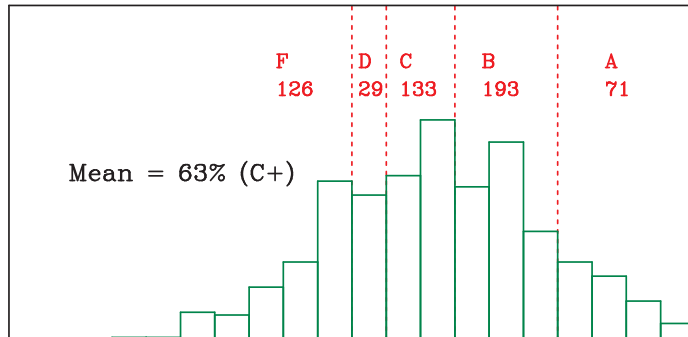
October 26, 2017



Announcements

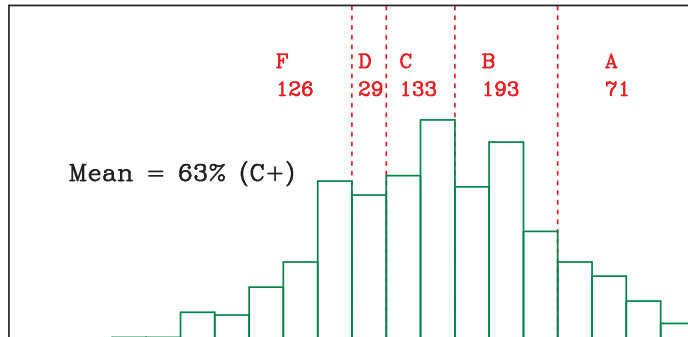
- Paper 2 topic posted; deadline revised from first posting (10 Nov)
- Paper 3 will still be due 20 Nov
- Everyone's wanted to talk to me in person the last few days, so I have some unanswered mail (no time!)
- Will catch up on email tonight/tomorrow

Exam 2 grades



The average here was significantly higher than on Exam 1.

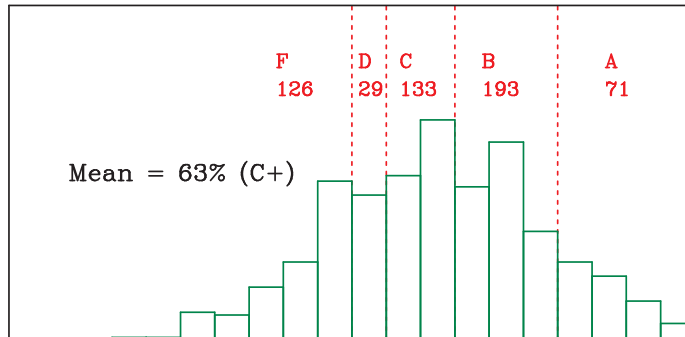
Exam 2 grades



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To people who did well: congratulations!

Exam 2 grades



The average here was significantly higher than on Exam 1.

To people who did well: congratulations!

To people who didn't do as well as they hoped: remember that

- You get to drop your lowest exam grade
- Grades on labs and papers tend to run quite a bit higher than on exams in AST101, so your overall course grade will likely be a letter grade or more higher than your exam grades.

Paper 2

Topic 1: historical astronomy

- Remember, we are not after a laundry list of facts; we want you to weave information together to make a coherent narrative
- You don't need to address *every* point on the list; those are just suggestions to get you on the right track

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- <http://astro.if.ufrgs.br/fis2008/TheHistoryofNon-WesternScience.pdf> – source of lots of info, but you can of course use other sources too (maybe you want to investigate a culture not on the list?)

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Topic 2: scientific integrity, ethics, and science vs. pseudoscience

- You don't have to choose something related to astronomy; anything is fine
- Some of you may be addressing topics that are hot-button topics politically. Some guidelines:
 - It's okay to call it like you see it. You don't need to “address both sides” if you feel they don't have merit.
 - Focus on the use/abuse of scientific claims

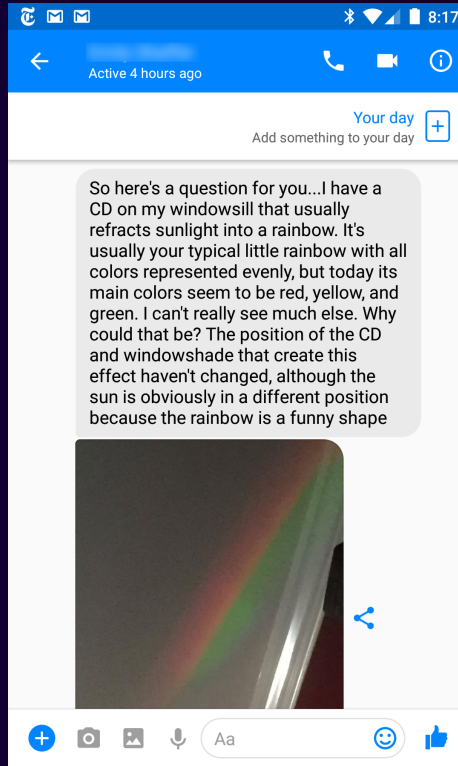
White light isn't really white; it's a mix of many colors (wavelengths).

Our eyes are very limited; we can only distinguish between three colors.

We can learn a lot about an object by the colors of light it emits, but we have to be able to see them first!

We do that by spreading them out. Then we can see what colors are there in great detail.

A friend sent me this yesterday:



The two pictures:

Shortly after sunrise:



Later in the day:



The two pictures:

Shortly after sunrise:



Later in the day:



What is different?

What happened here?

A: There's less blue light right after sunrise because the Sun is different then

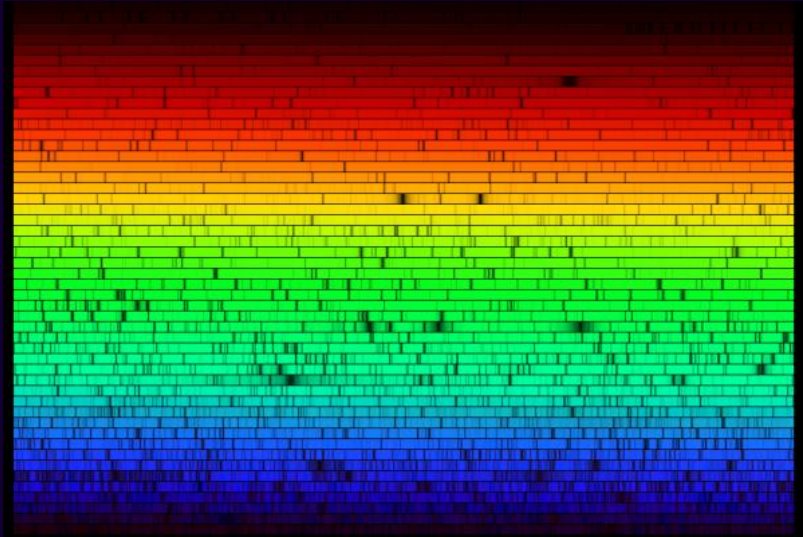
B: The colors are in a different order earlier in the day

C: All the colors are fainter right after sunrise

D: There's less blue light right after sunrise because something happened to the light as it was traveling here

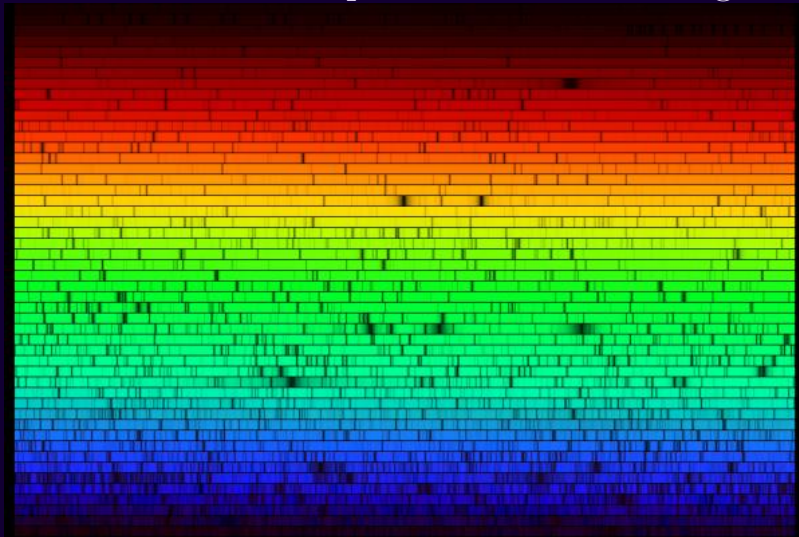
Light and spectra

Let's look at that picture of the Sun again:



Light and spectra

Let's look at that picture of the Sun again:



Need to understand:

- Where did all those colors come from in the first place? (today)
- Why are there dark lines? (next Tuesday)

Why does the sun shine?

A: Chemical reactions make light!

B: Nuclear reactions make light!

C: It's really hot, so it glows

D: That's just what stars do

Why does the sun shine?

A: Chemical reactions make light!

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C: It's really hot, so it glows

D: That's just what stars do

E: Google to the rescue!

Incandescence

“The sun is a mass of incandescent gas” – what does that mean?

Objects glow because they're hot. This is called *thermal radiation*.

- Any object with a temperature emits electromagnetic radiation (“light”).
- For objects as warm as we are, this is in the “far infrared”.
- As objects heat up, the peak wavelength decreases (the average photon energy increases)
- As objects heat up, the total intensity emitted goes up *rapidly* (proportional to T^4)
- This is also called “blackbody radiation” (since even a black object glows if it's warmed up)

See the simulation to see how this works...

Takeaways: thermal radiation

- Any object with a temperature glows
- Hotter objects glow “bluer” (shorter wavelengths) and brighter
- This glow is a *broad spread of wavelengths* – there aren’t narrow bright or dark lines in it

What will happen if I turn the power up on the lamp?

A: The height of the graph will go up

B: The graph will shift left

C: The graph will shift right

D: The height of the graph will go down

Complete *Lecture Tutorials* pp. 59-62.

We will learn about those dark lines after this.

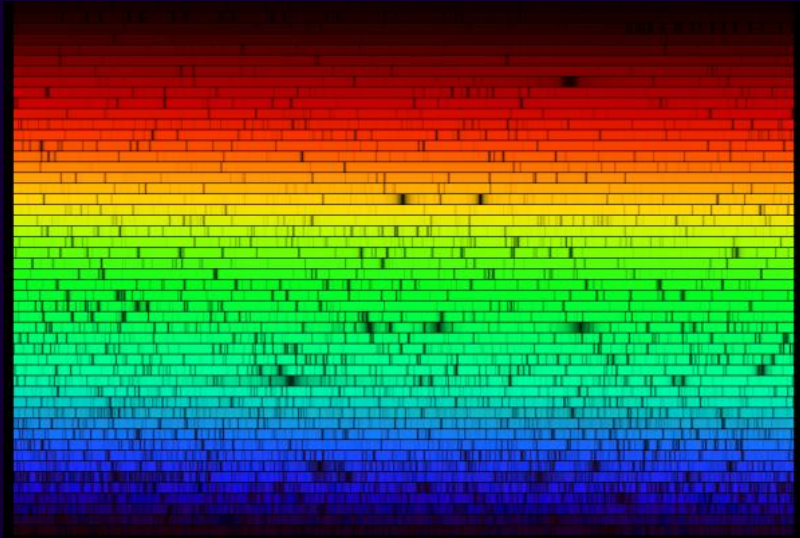
What will happen if I put a colored plate in between?

A: The height of the graph will go down

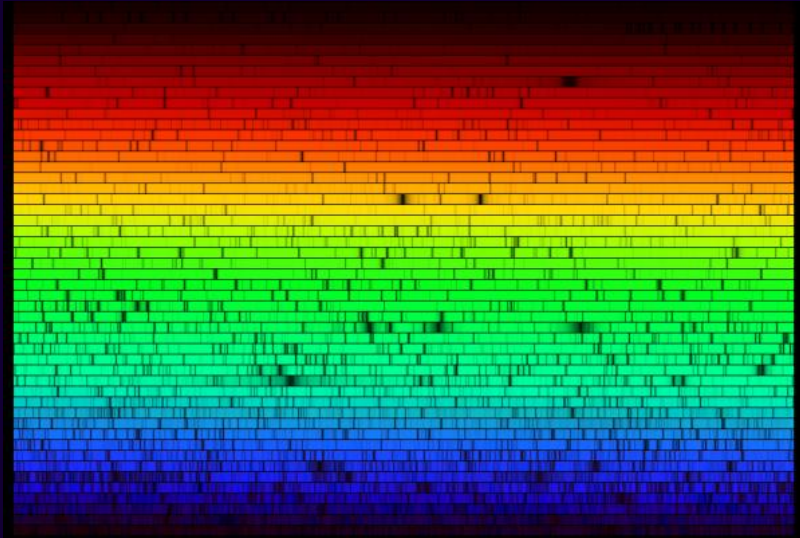
B: A narrow dip will appear in the graph C: A narrow peak will appear in the graph

D: The graph will shift left

E: The graph will shift right



- The hot core of the Sun emits light of all wavelengths



- The hot core of the Sun emits light of all wavelengths
- The gases in the cooler atmosphere absorb very particular colors ... but why, and which ones?

Chemistry 101 in a nutshell

(on the document camera)

Start on *Lecture Tutorials* pp. 65-69.

This is the crux of this unit, so ask lots of questions to us!