Astro 404
Lecture 1
Aug 23, 2021

Announcements:

- **Welcome!**
- download the Syllabus
- please turn on your video

Today's Agenda

1. Introductions
2. Overview and Appetizer:
   Preview! No need to take notes today!
3. Course Mechanics

Introductions and Welcome

Introductions

Getting to know us

`www: ASTR 404 Staff`

Getting to know you

- in-class discussions, after class, office hours

The Facts of Life for Stars

Fact: stars constantly radiates energy

and at a huge rate!

for the Sun: $dE/dt = 4 \times 10^{26}$ Watts!

Fact: stars have a finite ($\neq \infty$) mass

and thus a finite fuel supply (whatever that fuel may be)

Fact: Energy is conserved

no free lunch!

Q: therefore?

Q: some stars are alive today, so...?

Implications

★ stars cannot shine forever
stars have finite lifespans *all stars must die–including the Sun!*

★ stars alive today were not here forever
stars must be born

★ **stars have life cycles** – birth, maturity, death

Note the profound conclusions arising from a little physics
What else can we learn with more physics?

Group Discussion: Stellar Astrophysics–So What?

Q: Why study the Physics, life cycles, and remains of stars?

Q: Importance to Astronomy?

Q: Importance to Physics?

Breakout rooms – also a chance to meet classmates and to talk!

Appoint Scribe to fill in respones on Google Slide

`www: https://docs.google.com/presentation/d/1fMowB8wGQffxKr53rirFuLU`

Note Room number on top of Zoom screen

Stellar Astrophysics–So What?

⋆ *Astronomy and Astrophysics begin with stars*
literally! it's right there in the name!
⋆ *stars populate the naked-eye sky*
and dominate the human experience of the cosmos
⋆ *stars illuminate the Universe*
⋆ *stars create the environments within galaxies*
⋆ *the sky crackles with stellar explosions*
⋆ *most stars host planets*
stellar astro frames planet environments and detection
⋆ *stars power life and provide its raw materials*
... but don't get too close!
⋆ *stars and their remains are sites of extreme physics*
crispy temperatures! huge densities! ultra-strong gravity!

- **stars are central to astrophysics and cosmology**
- **stars probe physics inaccessible in Earthly laboratories**

Taking A406 Here and Now: A Wise Choice

Great *time* to take the course:
Renaissance in study of stars
new results flooding in–some during this semester
by my count: stellar astrophysics contributed to
eleven Nobel Prizes so far

> We are very lucky to live in an age in which we are still making discoveries. It is like the discovery of America–you only discover it once.
>
> – Richard Feynman, *The Character of Physical Law*

Illinois–Home of the Stars

Also great *place* to take this course:
Illinois has major research effort in stellar astrophysics
both theoretical and observational
that builds on 50-year history

including your instructor:
supernova explosions, and stellar element production

so: you are getting the story
from the horse's mouth–so to speak

Getting to Know You: Zoom Poll

Vote your conscience! = Say what you *really* think!

All answers get full credit!

the Sun is middle-aged, having consumed $\sim 1/2$ of its fuel

When the Sun has consumed 3/4 its fuel, it will be

A more luminous (higher Wattage) than today

B less luminous than today

C the same luminosity as today

D none of the above

Appetizer: Course Goals

Stars and the Cosmos

My goal in this course:
get a familiarity with stars and their life cycles
and understand how stellar astrophysics is central to the cosmos

⋆ partly **phenomenology**–*what* we know: "just the facts"

⋆ but also: *how* and *why* things are as we see them
we will apply **physical principles**: "get under the hood"
Stars are one of the few arenas in nature
where *all four fundamental forces* play essential roles
Q: what are these fantastic four forces?
Stars are labs for extreme physics beyond terrestrial experiments

Today: A brief, whirlwind tour: preview of coming attractions

Business

Syllabus

will highlight main points here...

you should read the whole thing carefully

Course Webpage.

You will want to check often.

Public page: Lecture images & notes

Canvas page: homework, exam info posted

Prerequisites:

Credit in Physics 211 and 212–i.e., mechanics, EM

Recommended Astronomy 210, Physics 213 and 214

$\rightarrow$ no prior Astronomy courses required (but helpful)

Prerequisites Continued

So what do I expect you to know?

Astronomy: will review what we need to know
but ASTR 210 will help

Math: vectors, calculus, some ordinary diff eqs
i.e., what you need for Astro/Physics/Engineering majors

Coding: *no programming knowledge required*
but you will be asked to make simple plots
I don't care how you do this

Prerequisites: Physics

Must have:

- classical mechanics (**PHYS 211**)
- electricity & magnetism (**PHYS 212**), especially radiation

Recommended: PHYS 213, 214

We will need and use *thermal physics*

and will (quickly) develop needed thermodynamics and stat. mech.

but easier if you have seen this before

will develop *quantum mechanics* as needed,

and any atomic, nuclear, and particle physics,

relativity needed

if not sure about prereqs, let me know

Course Mode and COVID

We are beginning online.

- medical need for instructor in light of COVID Delta
- not done lightly, I appreciate your patience

Will we shift to in person?

- Frankly, I don't know. I hope so.
- Depends on progress of COVID
- I will keep you updated

COVID Policies - see Syllabus

If we do return to face-to-face:

do not come to class if you have COVID

Participation

Critical to participate, especially when meeting online.

Participation part of grade: 40 points of our 1000

How to get participation points? **See syllabus.** Briefly:

- Polls during lecture (up to 40 points)
- Asking or answering questions during lecture (up to 4 points)
- Speak to instructor
  after class, in office hours, or by appointment