

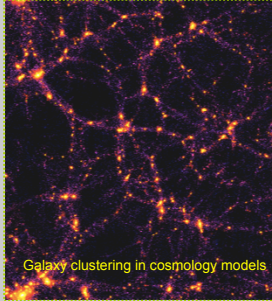
ASTR 1040: Accel Intro Astron 2 Stars & Galaxies

Two merging galaxies
HST: NGC2207 / IC2163

Prof. Juri Toomre TAs: Piyush Agrawal, Connor Bice
Tues/Thur 9:30am, Duane G-125
Lecture 1 17 Jan 2017
Detailed course syllabus passed out
zeus.colorado.edu/astr1040-toomre

Who SHOULD take this course?

- Astronomy/Astrophysics, Physics & Engineering majors
- with prereq **ASTR 1030**
- Moderate amounts of **quantitative work (algebra)**
- with prereq/coreq **MATH 1300** or **APPM 1350**



Galaxy clustering in cosmology models

Beginning of Today's Class

- Course goals
- Course overview
- Course information
- Introduction: Sizes and Scales



The Pleiades cluster: "Seven-Sisters"

Course Goals

Develop a **broad view** of what we think we know about the universe

Understand the forces that shape the universe and its history


Appreciate the beauty and richness of what goes on



Quintuplet galaxy cluster

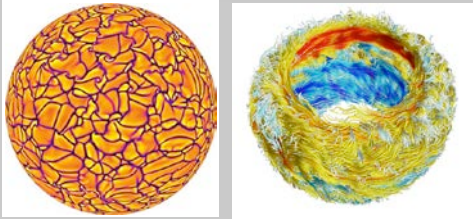

Course Goals (more general)

- Learn critical thinking skills
 - how to think, reason, and argue scientifically, using logic, observation, and evidence
- Understand how we know what we know about the universe
 - and what we *don't* yet know!
- Gain knowledge and appreciation of the scope, scale, and phenomena of the physical universe



Galaxy cluster

Who am I ...

Theoretical astrophysics:
Stellar convection
and magnetism

Who are you...

- **Introduce yourself to 2 neighbors:**
 - Trade names, hometowns, interests, etc.
 - Why are you taking this course?
 - What topics do you most want to learn about in this class?
- **We'll try to get to know you throughout the semester but you can help by...**
 - Asking questions
 - Answering questions
 - Coming to see us in office hours
 - Volunteering for demos

Course Information

COURSE PRIMARY WEB PAGE:
zeus.colorado.edu/astr1040-toomre

Can find info on all assignments (passed out in class), course calendar, lecture notes, reading schedule

Grading is shown on course D2L site – many active links



"Planetary" nebula

Required Text or eText

The Cosmic Perspective
 by Bennett et al. 2017 8th ed

Includes:

Access code for website

www.masteringastronomy.com

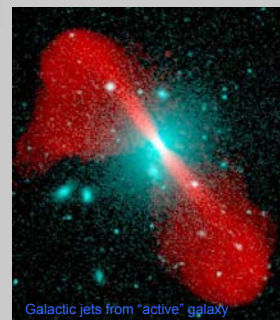
Go there to set up your own MA account! Most homeworks need it

You will need to link to our course there: **ASTR1040TOOMRE2017** (see syllabus, complete by Thursday)



How to succeed in this course

- **GOT TO PUT IN THE TIME:**
 4 credits at CU →
 6 to 10 hours outside of classroom (no kidding)
- Read sections **BEFORE** discussion in class (secrets of memory)
- Come see us during office hours!



Galactic jets from "active" galaxy

Important classroom policies

- Working together on homework is encouraged, BUT:
 - Your answers must be in your own words -- copies will be awarded split credit
 - Cite sources on all write-ups
 - Web submissions must be done independently
 - Using another person's clicker is cheating
- Students are expected to follow the CU Honor Code

Read all course information in your syllabus handout (after class)!

Three in-class mid-term exams (m/c, short essay, qualitative analysis): 45%

Homeworks: 20%


Final exam: 25%

Clickers + discussion contributions + observing: 10%

There are no make-up exams or late turn-ins


i-clickers (radio frequency)

- **Required** -- bring to each class!
- **Register clicker to your CU login name** by Thurs class (by logging into MyCUInfo site, go to student tab, or our D2L course site)
- Used for reading quizzes, in-class discussion questions, feedback



Observatory Nights

- Starting Thur **26 Jan** at 7:30pm, then about every ten days (7 in all) – **go to at least one session by signup**
- **Sommers-Bausch Observatory** (next to Fiske): two new 20" + 24" telescopes



Got Questions?

- Textbook?
- Clickers?
- Office Hours?
- Exam Policy?
- MasteringAstronomy?
- Observing Nights?



Syllabus or course main website
zeus.colorado.edu/astr1040-toomre

Recitations

Two merging galaxies
HST: NGC2207 / IC2163



- We have five *weekly recitations* in D-318:
- **Piyush Agrawal:** Tues 1pm, Wed 3pm
- **Connor Bice:** Tues 2pm, Wed 11am & 2pm
- These are a crucial part of the course

Electronic Device Policy

- Turn off your phones.
- If you wish to take notes on a laptop or tablet, please sit on the left-hand side of the room.




Course Overview

What we will study



Sizes and Scales

- Vast range of **SIZES and SCALES**, finding our way through the universe



Light (Electromagnetic Radiation)

- What is light?
- How do we use it to find out what and where things are?
- Waves vs particles



Telescopes (Tools of the Trade)



Our Nearest Star : The Sun



Star in middle of its life on MS

STELLAR Birth and Life




STARS of very many sizes and colors

Evolution path and color / brightness Depends on MASS



STAR DEATH: white dwarfs, supernovae, neutron stars, black holes



Crab Nebula

This image shows the Crab Nebula, a complex of glowing filaments in shades of blue, green, and orange, representing the remains of a star that died in a supernova explosion.

OUR GALAXY : The Milky Way



200+ billion stars in MW

This image shows a view of the Milky Way galaxy, a spiral galaxy with a bright central core and numerous stars scattered throughout its structure.


Exploring a Universe of GALAXIES




100 Billion+ galaxies!

This image shows a vast field of galaxies, illustrating the immense scale and diversity of galaxies in the universe.

GALACTIC evolution



"Antennae" galaxies

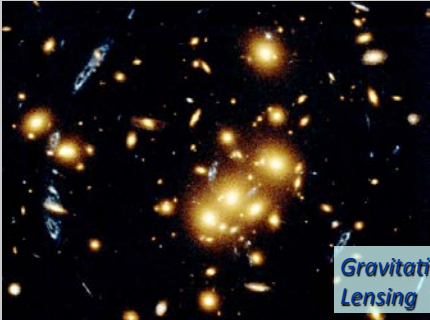


Arp 273 + UGC 1810

Galaxy collisions, quasars

This block contains two images illustrating galactic evolution. The left image shows the "Antennae" galaxies, which are two galaxies in the process of colliding, with long, curved tails of stars and gas extending from their cores. The right image shows Arp 273 + UGC 1810, a pair of interacting galaxies.

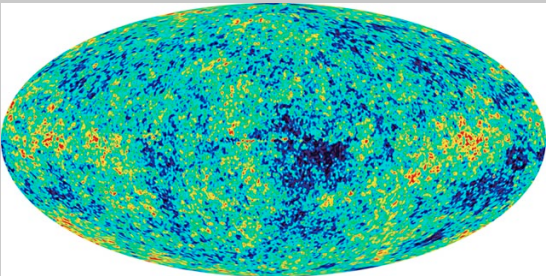
Dark matter and lensing of background galaxies



Gravitational Lensing

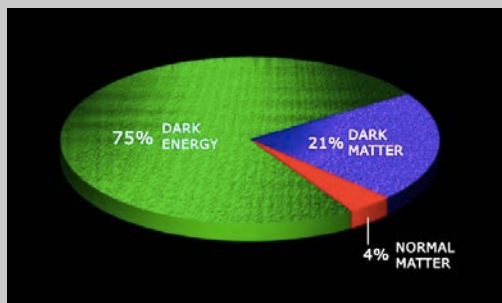
This image illustrates gravitational lensing, where the gravity of a massive foreground object (like a galaxy cluster) bends the light from background galaxies, making them appear distorted or magnified.

BIG BANG beginning



This image shows a map of the Cosmic Microwave Background (CMB), representing the afterglow of the Big Bang. It displays a mottled pattern of colors (blue, green, yellow, red) representing temperature fluctuations across the sky.

Dark Matter, Dark Energy and the Fate of Universe



What this course is NOT?



Astronomy is not Astrology!!!

What this course is NOT?



Memorizing Constellations

Topics for Today and Thursday

- Nature of astronomy as a science
- Scientific method: we observe, hypothesize, test its predictions, maybe fix it and try again
- Mystery of planetary orbits: gravity makes you move on ellipses (...Kepler, Newton)
- Light as waves (and as particles)
- Special colors of light associated with each element

For Thurs class meeting, read/review:

- *How to Succeed in this course*, p. xxiv+
- Chapter 1, all (*Our Place in Universe*)
- Review *Basic Astronomical terms*, p. 6
- Chap 3, sec 3.3, 3.4 (*Kepler, Nature of Science*)
- Chap 4, read all (*Making Sense of Universe*)
- Begin reading Chap 5, carefully (*Light and Matter*)
- You can get a copy of these slides after class from course website (can be helpful)

Mastering Astronomy (MA) + homeworks

- Online MA Assignment (HW # 0) available **NOW**
Walks you through how to submit all the assignments and MA resources available, and some review of concepts (good practice, extra credit)
Complete by Tues Jan 24, 11am
- Homework # 1 on "Light & Spectroscopy" **now** available for pickup, *involves both MA portion and written portion, to be turned in by Thur Jan 26 class*
- Get your MA account set up asap, linking to "ASTR1040T00MRE2017" -- identify yourself by your D2L logon name -- see our syllabus or go to our D2L site if need further instructions or help