Big Bang, Black Holes, No Math

ASTR/PHYS 109

Dr. David Toback

Lectures 2 & 3
Prep For Today (is now due) - L3

- Reading (If you haven’t already):
  - Required: BBBHNMM: Chapter 1-4
  - Recommended: (BHOT: Chap. 1-3, SHU: Chap. 1-2, TOE: Chap. 1)

- Pre-Lecture Reading Questions (Partial)
  - 4 questions from Unit 1 (Chapters 1-4 or recommended reading): Due before class
    - Make sure you get a Receipt from TurnItIn
  - If you need an extension let me know

- eCampus Stuff:
  - Warm-up quizzes (including AMS): due before class
    - If you need an extension let me know
    - If you need additional attempts, follow the instructions
Going Big - Chapter 2

- You have to get started somewhere
- Start by looking at the various things in the universe
  - Go from sizes we know to the VERY big
- After that we'll do the very small
  - Chapter 3
The Very Big: Why Start Here?

• If we want to understand the universe and where it comes from (and what’s going to happen to it) we need to know:
  1. What’s in it
  2. What it’s made of

• Said differently, “What are we trying to explain?” or “If the Big Bang is the answer, what is the question”?
  - If we were detectives trying to explain what happened, we’d need to gather evidence:
  - What evidence do we gather by looking at the scene of the crime?
Starting out...

Just starting out...
A size we know: The nose in front of your face (well... someone's face)

10 centimeters, or 0.1 meters, or $10^{-1}$ meters.
About 3 inches
Look from farther away...

Moving out, but still staying at sizes we know and love

1 meter (or about 3 feet)
Bigger still...

The Statue of Liberty in New York

10 meters (or about 30 feet)
Keep going...

100 meters or about a football field, or $10^2$ meters
Starting to get out there...

- Manhattan and the Hudson river
- 1 kilometer or $10^3$ meters

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Introduction
Topic 2: Going Big
Even bigger… use an airplane

- Can see the grid structure of Manhattan
- Important to the story?

→ Yes! Can tell us a LOT about how New York City was constructed!

10 kilometers or $10^4$ meters
Go to Drawings

Manhattan
Statue of Liberty
Atlantic ocean

100 kilometers or $10^5$ meters

Introduction
Topic 2: Going Big

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Yet bigger...

The eastern coast of the U.S.

• If we looked at photos we would see no evidence of human life except for lights at night

1000 km or $10^6$ meters (1 Megameter)
Now we can see most of the Earth, but we can't see the streets.

10^7 meters!
The Earth is a sphere in space

10^8 meters!
Introduction

Topic 2: Going Big

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More Drawings

Orbit of the Moon (27.3 days)

The Earth

10^9 meters, a billion meters (a gigameter), a million miles
The Earth orbiting the Sun

The Earth on its trajectory around the sun

The Moon going around the Earth

$10^{10}$ meters!
Earth around the Sun

Orbit of the Earth
- Yellow circle is the Moon's orbit

Orbit of Venus

10^{11} meters!

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Introduction
Topic 2: Going Big
The Inner Planets

- Mars, Earth, Venus and Mercury orbiting the Sun
- All the planets move in the same direction (counterclockwise in this picture)
- A clue?

10^{12} meters!

~A billion miles!
The Outer Planets

- Jupiter, Saturn, Uranus and Neptune
- Again all move in the same direction!
- Look from the side: All move in the same plane!
- Another clue?

\[ 10^{13} \text{ meters!} \]
Aside on why Pluto isn’t a planet
End-of-Chapter Quizzes

- There are End-of-Chapter quizzes for each chapter
  - Helps ensure you have a good knowledge of some of the important FACTS for each chapter
  - Will be done online, using eCampus
  - Need a 100% on all quizzes to pass course
  - Are assigned AFTER we finish the chapter in lecture, and due before the next lecture
  - If you need more attempts, follow the standard instructions
eCampus Quizzes

• Start with free Warmup quizzes
  - Need a 100% on most of them (don't worry... most are easy if you read this document)
  - In the “Quizzes” folder, then go to “Required Warm-ups”

• When these are done, the End-Of-Chapter Quizzes folder becomes available
  - In the “Quizzes” folder, then go to “End-of-Chapter Quizzes” folder
  - First one is Chapter 2 (no Chapter 1 quiz)
  - EOC quiz due AFTER we finish the chapter in lecture
Perfect Quizzes

Bad news:
• To pass the course you need to get a perfect score on all of them

Good news:
• You can take as many attempts as you want until you get a perfect score
• Feedback for most quiz questions
• I will only count your best score

I REALLY want you to learn and get good grades!

There will be many assignments with this rule, but not all of them (e.g. AMS)
Just for Fun...

• We have created a “just for fun” Facebook account for students (past, present and future) who want to stay in touch with the course

• *Learning about the Big Bang and Black Holes Without the Math*

• It’s not part of the course, but I try to post fun, related things there periodically
  
  - If you send me something fun (and appropriate for public consumption) I’ll post it for everyone
  
  - If you send me something fun, but inappropriate, I’ll say thank you and just enjoy privately

• Also, lots of fun stuff on [http://people.physics.tamu.edu/toback/109/Video/](http://people.physics.tamu.edu/toback/109/Video/)
Prep For Next Time - L3

• Reading (If you haven't already):
  - Required: BBBHNM: Chapter 1-4
  - Recommended: (BHOT: Chap. 1-3, SHU: Chap. 1-2, TOE: Chap. 1)

• Pre-Lecture Reading Questions (Partial)
  - 4 questions from Unit 1 (Chapters 1-4 or recommended reading): Was due already
    • If you need an extension let me know
    • Make sure you get a Receipt from TurnItIn
    • Will start grading soon

• eCampus Stuff:
  - Warm-up quizzes (including AMS): due before class
    • If you need an extension let me know
    • If you need additional attempts, follow the instructions
  - If we finished Chapter 2 then end-of-chapter quiz 2 (else just above)
Useful Links

- Course Website
  http://people.physics.tamu.edu/toback/109
- Course Organization
- Class Schedule
- eCampus Instructions
  http://people.physics.tamu.edu/toback/109/ECampus_Quiz_Instructions_and_Help.pdf
- PLRQ Instructions
- Lecture Notes
  http://people.physics.tamu.edu/toback/109/Lectures/
- Papers and Peerceptiv
  http://people.physics.tamu.edu/toback/109/WritingAssignments/Papers_and_Peerceptiv.pdf
- FAQ Page
Full Set of Readings So Far

• Required: BBBHNM: Chap 1-4
• Recommended:
  - BHOT: Chap. 1-3
  - SHU: Chap. 1-2
  - TOE: Chap. 1