Big Bang, Black Holes, No Math
ASTR/PHYS 109
Dr. David Toback
Lectures 7-10

Physics We Need
Topic 1: Light and Doppler Shifts
Prep For Today (is now due) - L10

No one in back 5 rows and no laptops or cellphones
We have gotten ahead of the tentative schedule, so we will extend due dates
  • iClicker:
    - Make sure to register by clicking on the link in eCampus (will be in the Home area)
  • Reading:
    - (BBBHNM Unit 2/Chapters 5-9)
    - Recommended Reading:
      • See P3 of http://people.physics.tamu.edu/toback/109/Syllabus.pdf
  • Warmup Quizzes:
    - Warm-up Quiz Part 4 (Peerceptiv): Postponed - Will assign soon
  • Pre-Lecture Reading Questions:
    - Unit 2 Text Submission: Was due already
      • Pass/Revise assignment:
        - Most grades posted: 10 = Pass, 5 = Revise
        - If you don’t pass post 4 questions (can re-use excellent ones) to “PLRQ Unit 2 Revision”. If you don’t pass a second time, submit to “PLRQ Unit 2 – Revision 2”
        - Final due dates will be assigned soon. we will set up dates for Revisions after you get Feedback
    - Unit 2 Quiz: Will open up for you in eCampus AFTER they are graded and you get a Pass. Also requires Unit 1 and EOC 3. Final due date not yet assigned
  • End-of-Chapter Quizzes

Holes, No Math - Topic 1: Light and Doppler Shifts
The Topics

• Some stuff we need learn a little about:
  1. Light and Doppler Shifts
  2. Gravity, General Relativity and Dark Matter
  3. Atomic Physics and Quantum Mechanics
  4. Nuclear Physics and Chemistry
  5. Temperature and Thermal Equilibrium

• We won’t spend too long on each, just enough to get back to the big picture...

• Since there is no perfect way to present them (they all tie into each other) we’ll just start somewhere and get going...
The Doppler “Effect” for Cars

Hears a Lower Pitched Sound

Hears a Higher Pitched Sound

A car blaring its horn and going past you will give the famous “Eeeeee-Yowwwwww” sound.
What Does This Have to do with Light?

- Since both sound and light are waves, the Doppler “Effect” applies equally to both
  - Normally can’t see this effect for light since its wavelength is small and its speed is fast
- Can in special cases:
  - Things need to be moving really fast, like stars and galaxies
  - Need really good measuring devices like the ones Astronomers have
Doppler Effect and Light

**Red Shift**
Sees light with a larger wavelength

**Blue Shift**
Sees light with a smaller wavelength

Galaxy moves to the right ➔
Look at Light from Galaxies

- The light from galaxies moving away from us will appear to have longer wavelength light
  - The light is more *Red*, or shifted to the *Red* side of the light spectrum
  - "Red Shifted"
- The light from galaxies moving towards us will appear with shorter wavelength
  - The light is more *Blue*, or shifted to the *Blue* side of the light spectrum
  - "Blue Shifted"
The Doppler Effect in Action

Sound waves from a parked car's horn have the same wavelength in all the directions.

Doppler Effect
Three Observers

What does an object emitting light look like to different observers when it is

1) Not moving
2) Moving

Doppler Shift

Big Bang, Black Holes, No Math Top
Look at some cases

Next lets look at two cases where an “explosion” occurs and things move away from that location

1. I stay at the explosion point, but the other stuff goes off into space (I’m at the “center” of the explosion)

2. I’m just one of the things that got blasted into space. I move along with them

1. How would this look to an outside observer?

2. How it would look to me in my reference frame?
Case 1: Two Objects as they move away from an Explosion (I'm at the explosion site)

What it looks like when I'm stationary (or in my reference frame)

Big Bang, Black Holes, No Math

Physics We Need  

Topic 1: Light and Doppler Shifts
Case 2: Two Objects and Me Moving Away from the Explosion site (seen by someone else)

What it looks like when I'm moving relative to the objects
Case 2: Two Objects and Me Moving Away from the Explosion Site (from my perspective)

Why were these cases important?

Sorry... you'll have to wait until we look at galaxies sending us light.
Doppler Effect and Light: Summary

Compare the light coming from a car that’s parked and one that’s coming towards you.

If a car is coming toward you with its lights on:

1. The color of the light changes.
2. The speed of the light does not!
Putting It All Together

Since stars can be billions of light-years away, and are moving quickly, we can use the Doppler effect on light to measure the speed and direction of all objects in the night sky – More in Chapter 10

(Can also use it to tell us what Stars are made of, but for that we need to learn about quantum mechanics...)

Big Bang, Black Holes, No Math  Physics We Need  Topic 1: Light and Doppler Shifts
Lecture on Chapter 5 now complete
Outline for Unit 2: Physics We Need

1. Light and Doppler Shifts ←Done
2. Gravity, General Relativity and Dark Matter ←Next
3. Atomic Physics and Quantum Mechanics
4. Nuclear Physics and Chemistry
5. Temperature and Thermal Equilibrium
Papers
Paper Topics and Due Dates

- Papers will be announced before we start the chapter
- Assigned after we finish the chapter
- 4 Papers
  - Paper 1: Evidence for Dark Matter
    - Assigned after Chapter 6, Typically week 5
  - Paper 2: Evidence Stars are made of Atoms
    - Assigned after Chapter 8, Typically week 7
  - Paper 3: Evidence Universe started with a Big Bang
    - Assigned after Chapter 12, Typically week 10
  - Paper 4: Evidence for Black Holes
    - Assigned after Chapter 17, Typically week 14
Style of the Paper

• Explain it to someone who isn’t taking the class (no jargon)
• ~600 words (This is the equivalent of both sides of a sheet of paper, double spaced)
• No citations! Use your own words
• Only use information from the book
• Text should be professional. You are “trusted guide” not a “buddy” or “comedian”
Paper Format

• Must follow expected Format
  - Like the case a trial lawyer will make
• Each paper is usually 5 paragraphs:
  - Introduction paragraph that outlines the evidence
    • Lawyer’s opening statement
  - 1 paragraph per piece of evidence (often, but not always, three)
    • Testimony from the expert witnesses
  - Conclusion paragraph that ties it together
    • Lawyer’s closing arguments

people.physics.tamu.edu/toback/109/WritingAssignments/samplepaper.shtml
Different than usual...

- Each Paper Assignment has 3 Stages, all in Peerceptiv
  1. Text Submission
     - Also submit to TurnItIn
  2. Review (evaluate others text)
     - You are required to do 3 reviews
     - You can do these as soon as you submit
       (assuming others have submitted before you to Review)
  3. Back-evaluate your graders
     - You need to do this for each Review, but it can only happen after your paper has been Reviewed
     - Your grade is based on quality of your text (graded on a curve), but you only get a grade if you pass the Review and Back-evaluation portions. If you don’t pass your Reviews the first time you will have to do more
- Actual dates from the Lecture notes
Help Available for the Writing Stage

- We provide feedback on your paper if you submit a draft on eCampus in “Rough Drafts (Optional)” in TurnItIn
  - We aren't going to correct grammar, or just tell you what are missing to get an A
- We have set things up so you can submit a revision (to the same assignment) but you will need to do a full set of Reviews and back-evaluations
- We also recommend going to the Writing Center
Biggest reasons people don't do well

1. Don’t read all the hand-out instructions on how to use Peerceptiv
   http://people.physics.tamu.edu/toback/109/WritingAssignments/Papers_and_Peerceptiv.pdf

2. Don’t read all the paper-specific instructions given in the assignment
   • Hints given in addition to requirements

3. Don’t do all the Peerceptiv stages and/or Forget to submit to TurnItIn

4. Don’t get help when you need it
   • Go to the Writing Center
   • Submit a draft to the TA
   • Read the hints on the handouts
Peerceptiv for Papers

In eCampus

http://people.physics.tamu.edu/toback/109/WritingAssignments/Papers_and_Peerceptiv.pdf
Why are we using Peerceptiv?

**Skills:**
- People in the real world need to do multiple drafts of documents, often with others, until they are excellent.
- People in the real world need to know how to tell the difference between an excellent document and a mediocre one.
- People in the real world need to know how to give feedback on documents others have written that will help them get turned from being mediocre into something that is excellent.

**How does this impact you?**
- You need to get good at this for after you graduate.
- Learn to better evaluate/improve your own work to ensure it is excellent BEFORE you submit it for a grade.
Prep For Next Time - L10

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- End-of-Chapter Quizzes
  - If we finished Chapter 5 then End-of-Chapter Quizzes 5a & b (else just Chapter 4)