PHYS 107: Light, Perception, Photography & Visual Phenomena Laboratory

Spring 2021

Dr. Anwar Bhatti

3123 Physical Science Complex Phone: 301-405-6064;
bhatti@umd.edu

Teaching Assistant:

Shikha Chaudhry Redhal
sredhal@umd.edu

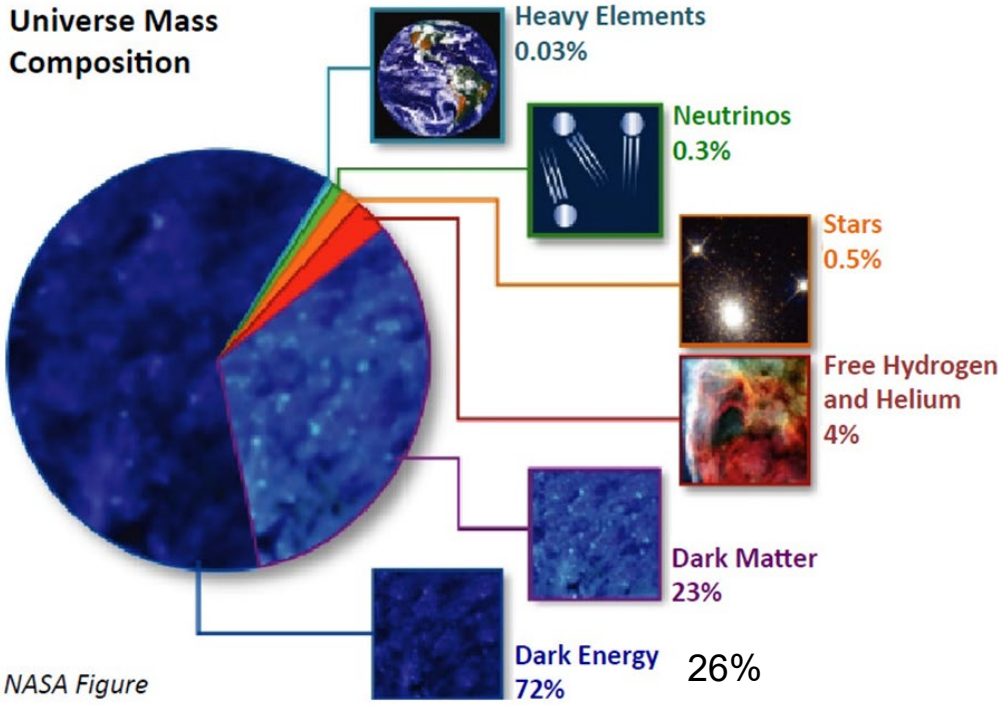
PHYSICS 107

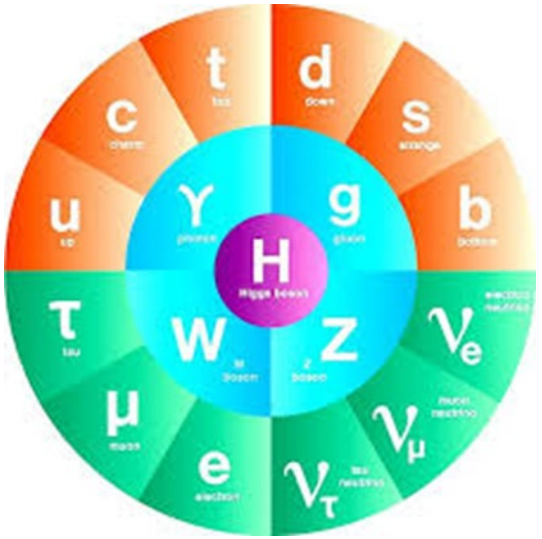
- This is an optional laboratory that accompanies the PHYS 106 lecture course. Experiments include geometrical optics (lenses, cameras, eye), photography, perception, color phenomena, and wave phenomena.
- The main purpose of this lab course is to allow you to study experimentally some of the physical laws, concepts and phenomena covered in your lecture course on light (PHYS 106).
- The laboratory is designed for students who are not majoring in the sciences. There is no prerequisite for the course, but since all of the experiments involve optical phenomena, we strongly recommend concurrent or prior enrollment in PHYS 106.

A little more about me – Anwar Bhatti

- I am a Research Professor of Physics.
- I am teaching only one class this semester:
- I do research in Experimental Particle Physics.
- My research goal is to understand nature of the matter and the forces at the most fundamental level.
- Currently, I work on LZ experiment, searching for the dark matter particles.
- I was a Program Manager at Office of High Energy Physics, Department of Energy (2013-2017).
- Previously, I was Professor of Physics at the Rockefeller University, New York, NY and worked on CMS experiment at Large Hadron Collider, CERN, Geneva Switzerland.

Composition of the universe



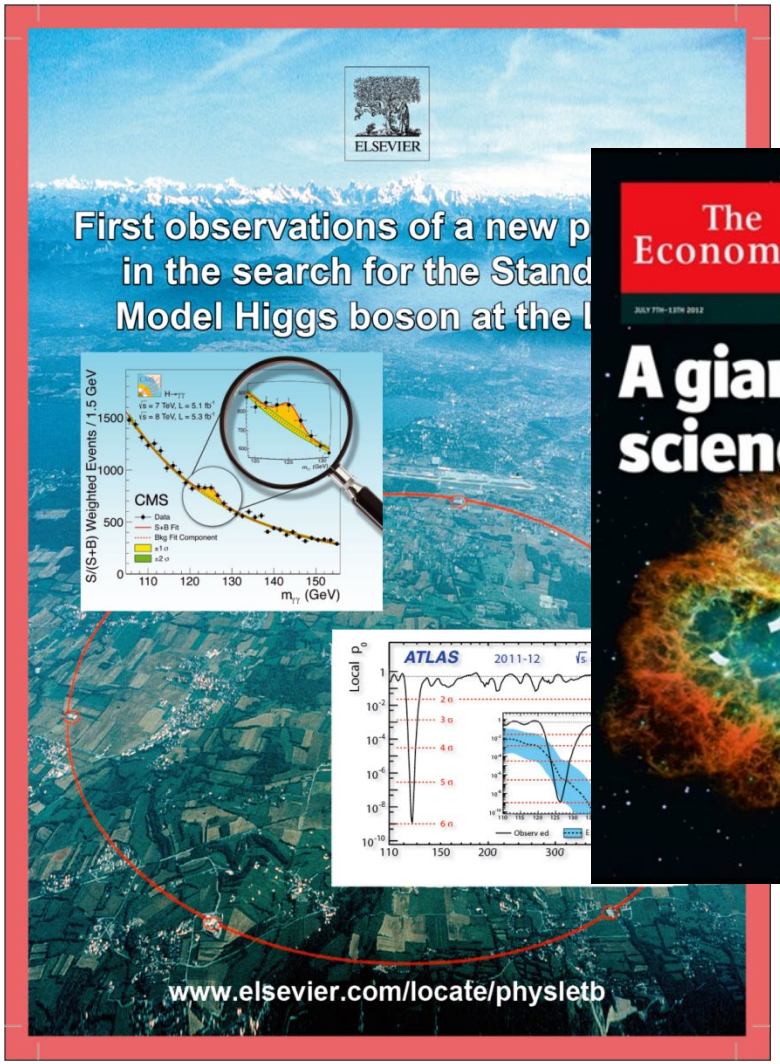


Only ~5% of the universe

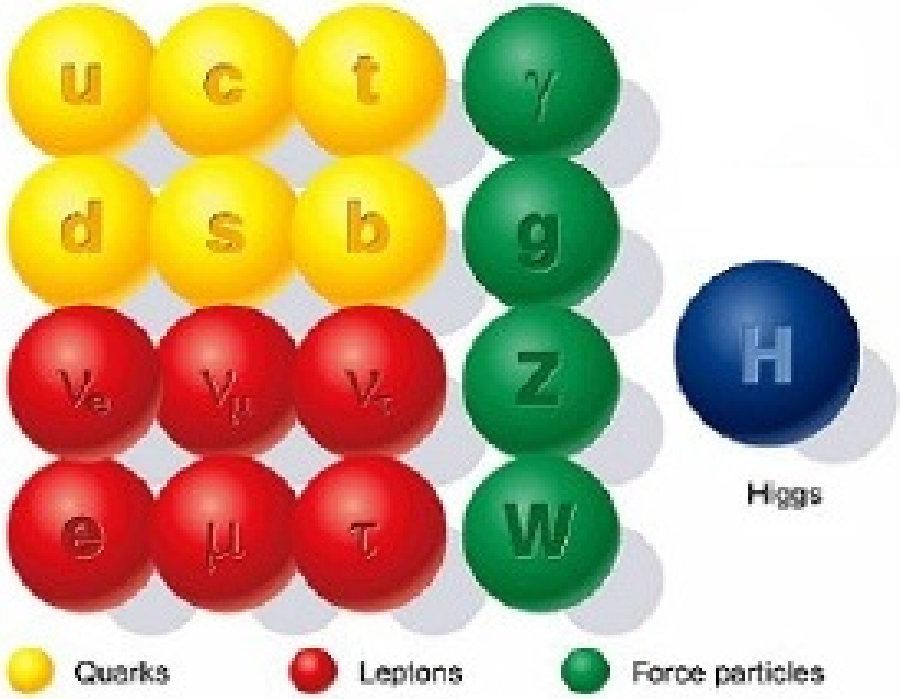
Dark Energy 69% Dark Matter 26% Matter 5%

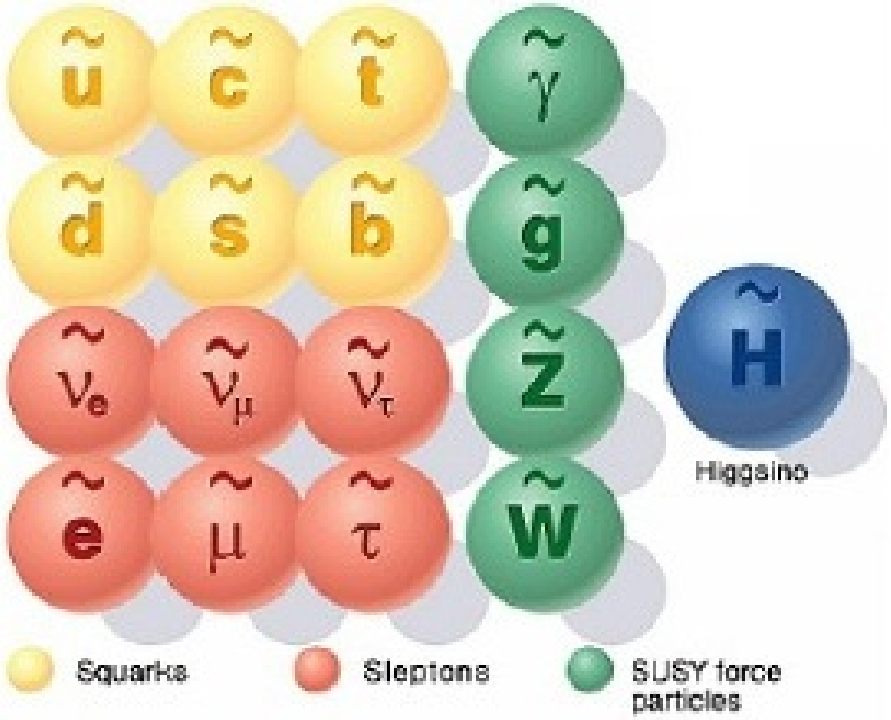
CMS Collaboration June 27, 2012

Higgs boson discovery



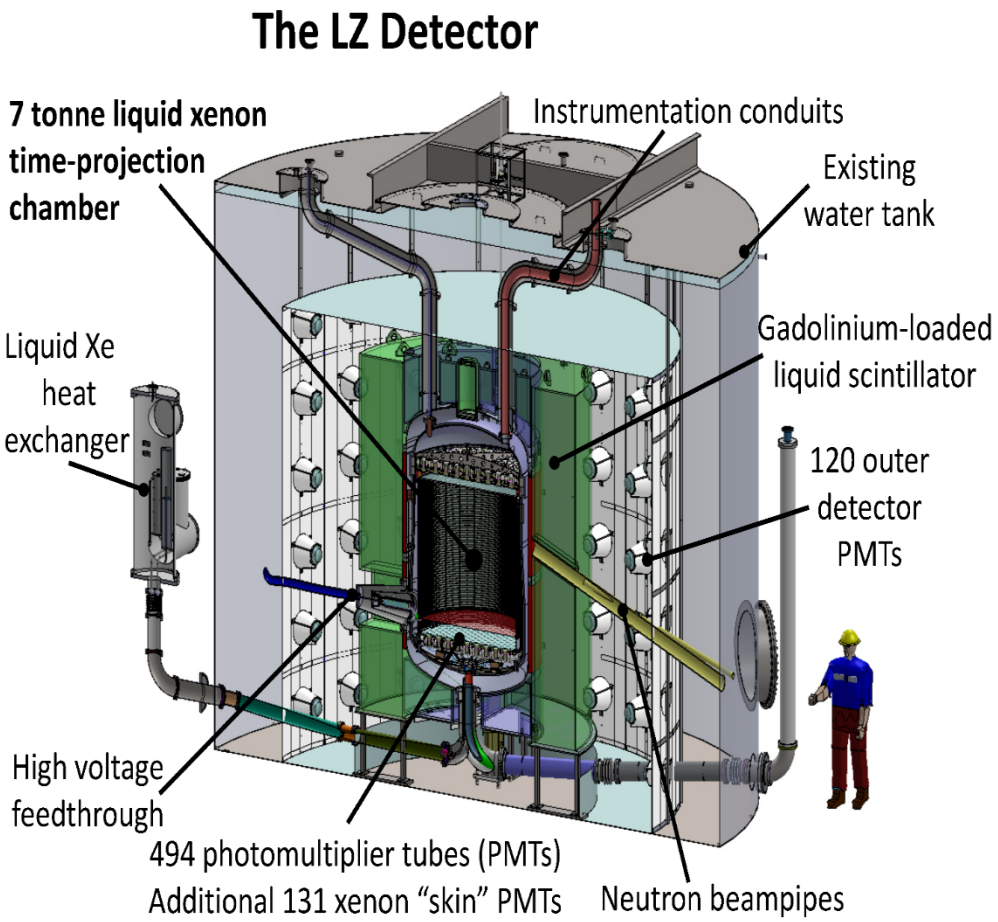
SUPERSYMMETRY

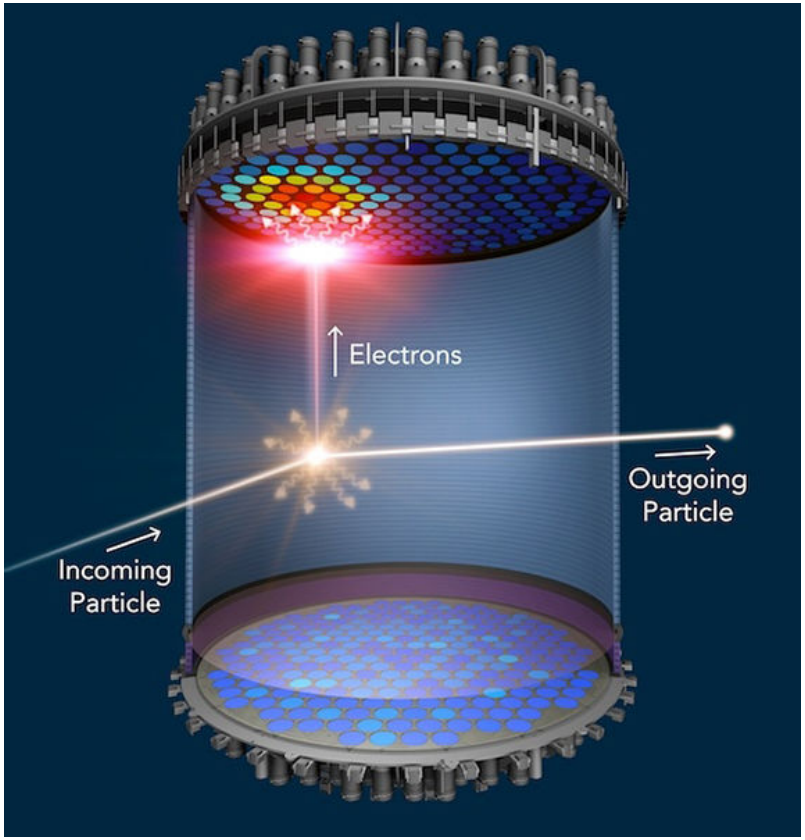




Standard particles **SUSY particles**

LZ experiment





Liquid Xenon Detector

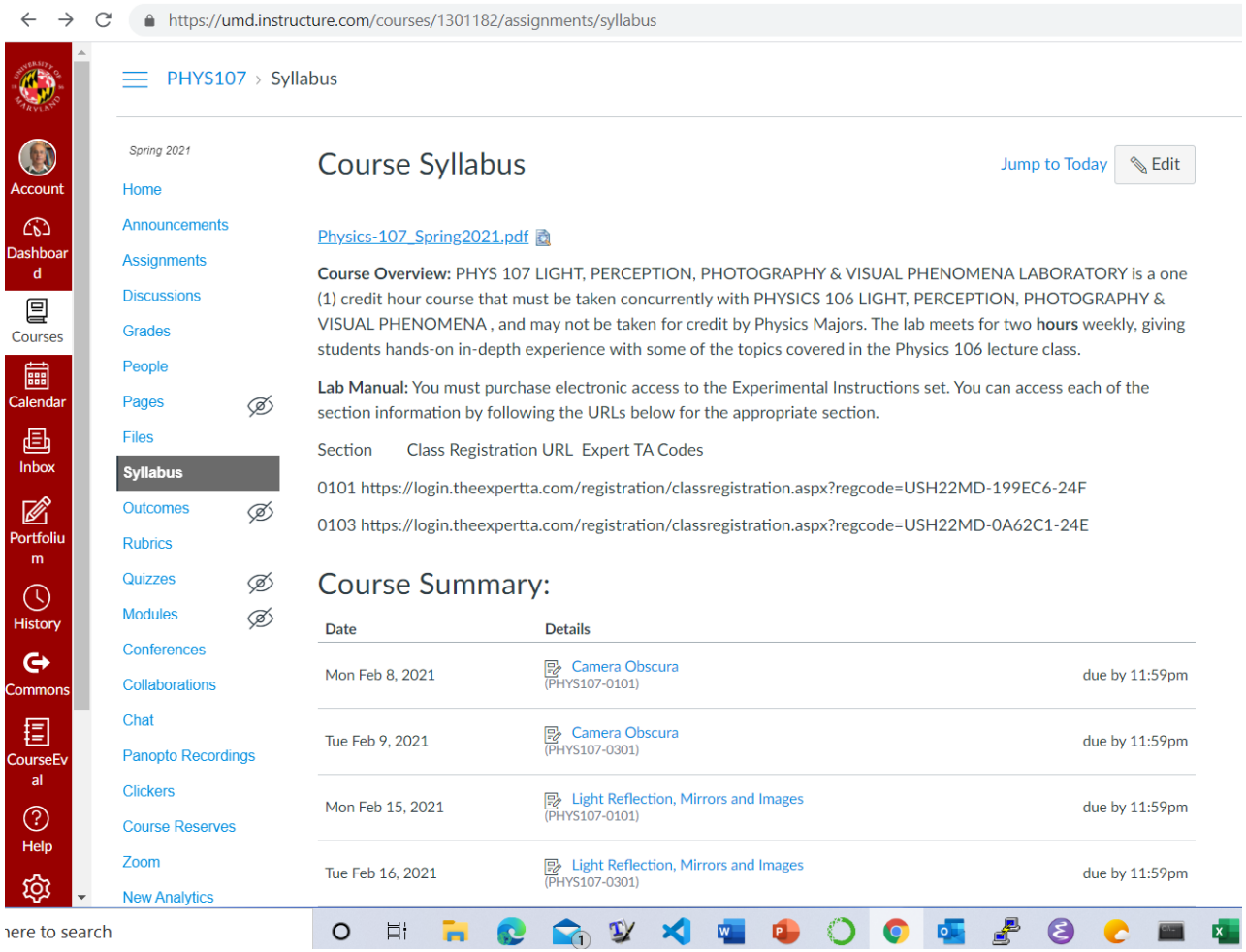
Located at in 4850 ft underground in gold mine in South Dakota

Under construction, data taking Summer 2021.

Teaching Assistant

- Shikha Redhal sredhal@umd.edu
- Aerospace Engineering PhD student
- Background:
  - High Speed Propulsion
  - Working on studying Injector Dynamics in Rotating Detonation Engine
- TA:
  - Engineering Sciences, Mechanical and Aerospace Engineering Dept. (2020)
  - PHYS-107, PHYS-121 (Spring 2021)
- Best way to reach:
  - Email
  - Zoom meeting link: https://umd.zoom.us/j/2805041475
  - 3202 JM Patterson Building

Course web page:elms.umd.edu



The syllabus and schedule can be also found at:
https://umdphysics.umd.edu/images/syllabi/2020/S20/S20_107_Bhattiv2.pdf

Lab Manual

You must purchase electronic **access to the Experimental Instructions set.** You can get access by following links below for the appropriate section.

101	http://goeta.link/USH22MD-199EC6-24F
301	http://goeta.link/USH22MD-0A62C1-24E

Expert TA

Assignments are due on Expert TA before your section meets.

Laboratory work

- Each week, **before you leave the lab**, you must submit your lab report to the TA.
- Each student must complete all experiments. Students who do not complete all experiments will have their grades reduced by one letter grade for each missing experiment.
- Written verification of an illness (or religious holiday or official university event) is needed to obtain permission for a late submission; otherwise, you will get no credit. However, you should not wait till the last two days to do the report, and an illness or event on only those last two days will not count as a valid excuse for tardiness).

- **When are Pre-Lab Questions Due on Expert TA?**
- The pre-lab questions are due on Expert TA at the start of your lab session.
- **When in the Lab Write-up Due?**
- The lab write-up is due at the end of the class before you leave the lab. Your TA does not have the authority to make any exception to this rule. The final judgment of rare cases where exceptions need to be made must be done by the professor in charge of the course.
- You will be able to pick up your graded lab write-ups, pre-lab question answers and quiz answer during the following lab session.

Lab Reports

Every student must turn in their own lab report at the end of each lab class.

Your lab reports should be brief and include:

1. Your name, the experiment number, and the name of the experiment
2. The date
3. The data you collected
4. Any analysis, plots or sketches
5. Answers to all the questions.
6. A brief summary of the important optics results that you obtained in your experiment.

Use proper grammar and spelling, complete sentences, and self-contained answers that make clear what question you are answering.

Schedule

Wk	Week of	Expt #	Experiment Title
1	Jan 25	- -	No Labs this Week
2	Feb 1	- -	No Labs this Week
3	Feb 8	1	Camera Obscura
4	Feb 15	3	Light Reflection, Mirrors and Images
5	Feb 22	4	Light Refraction
6	Mar 1	5	Images, Shaped Surfaces, Simple Lenses
7	Mar 8	6	More Simple Lenses
8	Mar 15	- -	Spring Break- No Labs
9	Mar 22	- -	No Labs this Week
10	Mar 29		No Labs this Week
11	Apr 5	7	The Digital Single Lens Reflex Camera
12	Apr 12	8	Polarized Light and Birefringence
13	Apr 19	9	Light: Interference
14	Apr 26	10	Light: Diffraction
15	May 3	11	Diffraction Gratings, Color and Holography
16	May 10	1,2 - 11	Make-Up Labs
16	May 11	- -	Last Day of Classes
16	May 12	- -	Reading Day

What You Need to Bring to the Lab

- Lab manual (online or paper copy). It is essential that you have the latest version of the *Light & Visual Phenomena Laboratory Manual.*
- A lab notebook for taking notes, making sketches, recording data and doing analysis.
- A pen or pencil.
- Paper for writeup lab (you need to submit lab writeup before you leave the lab.)

Grading

- Will be based on the total point accumulation for the 10 labs, each lab being weighted equally.

- Lab Reports: 80%:
- Expert TA assignments: 20%

To qualify for an A, you must distinguish yourself among your peers. All these grade assignments are nominal and are based on previous experience of student participation in the course. In the unexpected circumstance that all students complete the labs with reasonable grades, failing letter grades will not be given.

•**Arriving late to class:** Classes at University of Maryland begin right on the hour. It is important that you arrive on time so that you can get instructions for the lab and have time to finish. If you arrive more than 10 minutes late, you may not be allowed into the lab and will have to make it up during another section.

• **Making Up Missed Labs:** You should make every effort not to miss your regularly scheduled lab. If you miss your regular lab section, you should make that lab up by going to another section that week. Weeks of March 11 and May 6 are also reserved for make-up labs.

Hints for success:

- Do not miss labs
  – missing a lab can cost one letter grade.
- Do the homework!
- Do the homework early!
- Discuss with others but do not copy from others.
- Work through problems on your own first and then discuss.
- Ask if you have any question.

Other information

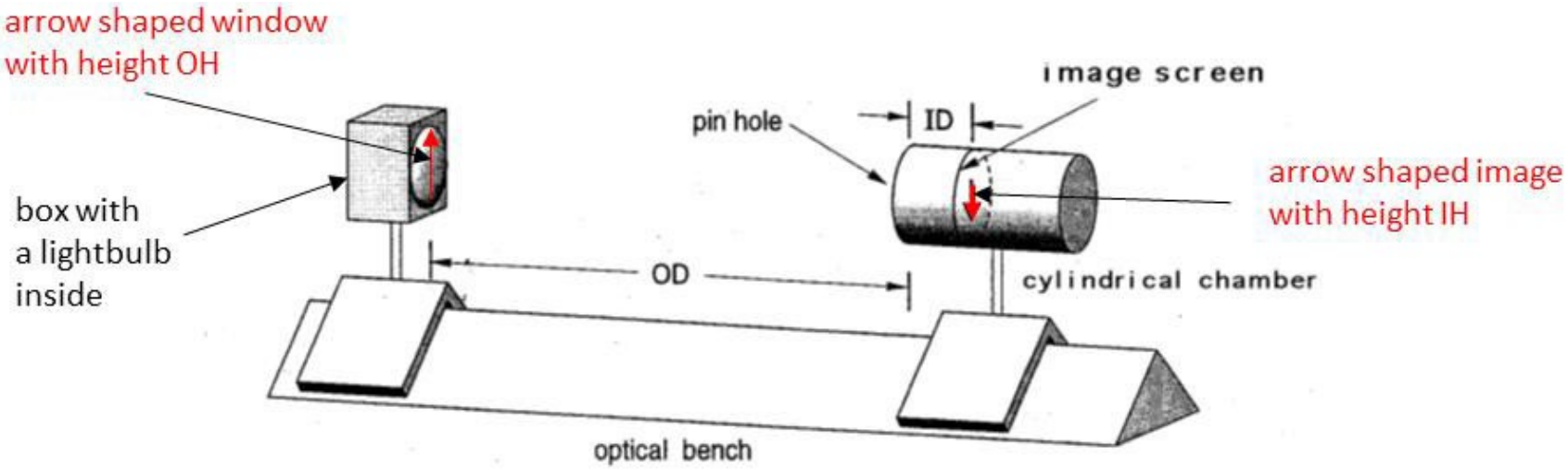
- Course Evaluation
- www.courseevalum.umd.edu

- University Closure
- Students with disabilities

- Academic Integrity
- http://shc.umd.edu/SHC/HonorPledgeInformation.aspx

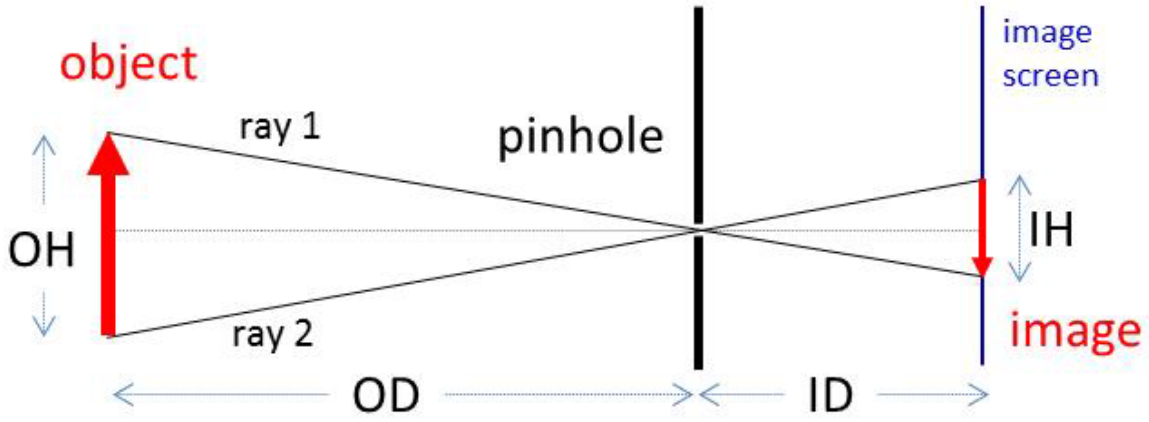
"I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination."

Experiment I: Camera Obscura



- Understand how light travels and how image is formed.
- Understand which factors determines size of the image.
- What is magnification and how can you change it?

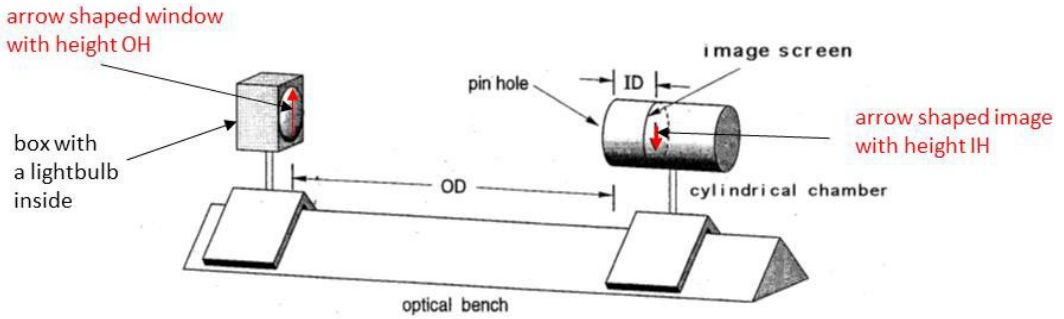
Camera Obscura



- Poke a pinhole in the black paper with a pin.
- Be careful to center the pin on the cylinder.
- Remember all distances are relative to the location of pinhole.
- Read center of mounting rod of light source and center of the mounting rod cylinder with pinhole. From this, calculate the distance between the object and pinhole.
- Read distance of image from pinhole from the yellow tape .

Topic 1: Cross section

- Imagine a vertical cut of the instrument, draw a 2D diagram of the instrument, showing all important components of experiments. It is not a ray diagram and it is not a Fig. 1



A typical refractor

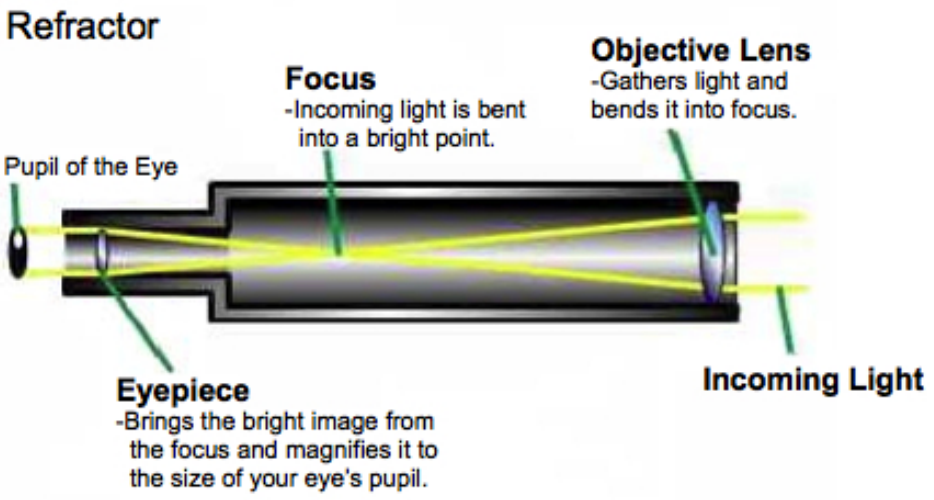
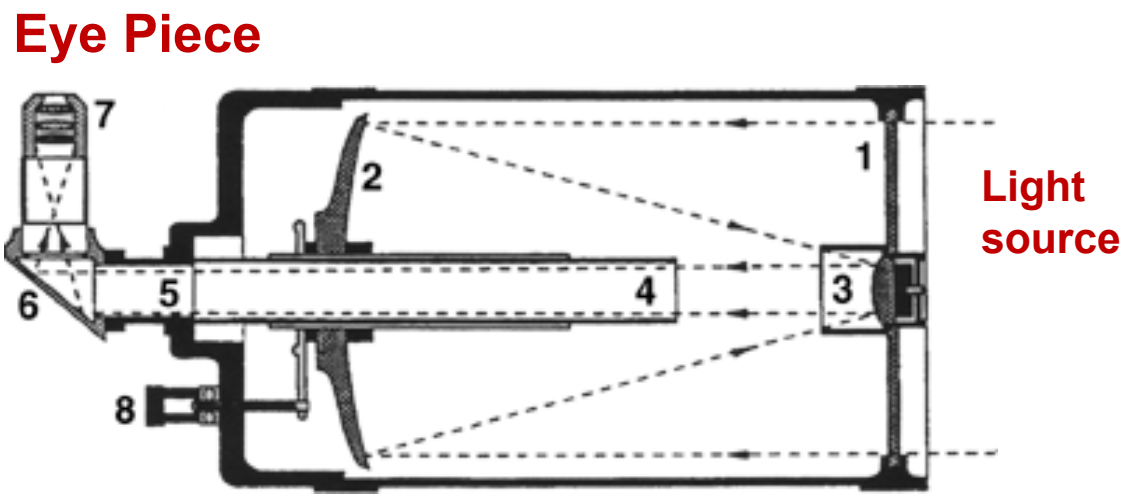


Image from http://www.science.howstuffworks.com/telescope1.thm

Image from http://www.ukc.ac.uk/public/telescope_guide/

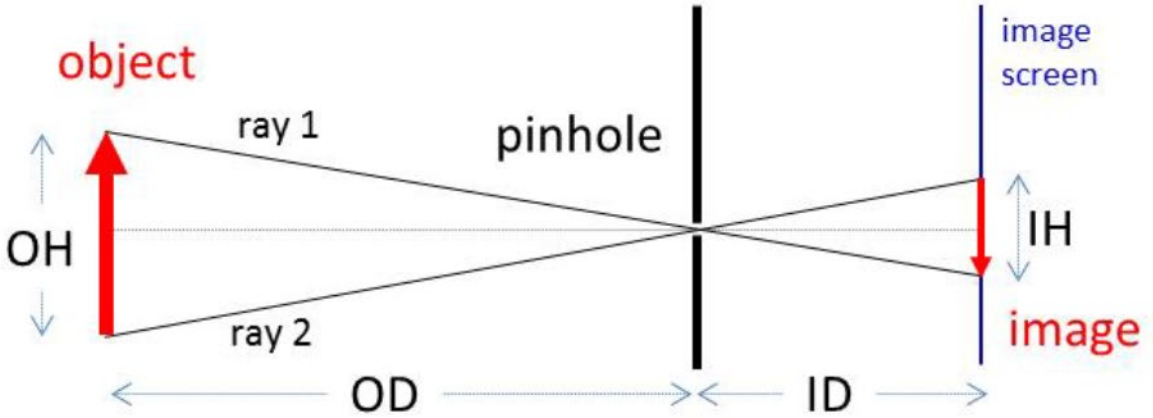
Cross section



Light enters through the **Corrector Lens (1)**, then is reflected from the perforated **Primary Mirror (2)** at the rear of the telescope tube forward to the **Secondary Mirror (3)**. Light is then reflected from the Secondary Mirror back through **Primary Baffle Tube (4)** beyond the **Rear Cell (5)**. Illustration shows the Rear Cell with accessories attached: 90 degree **Zenith Prism (6)** (or Mirror) diagonal, and an **Eyepiece (7)**. The current production C-14's include a 2" Mirror diagonal instead of the shown 1.25" prism; the image will be presented to the observer appearing right side up, but reversed left to right.

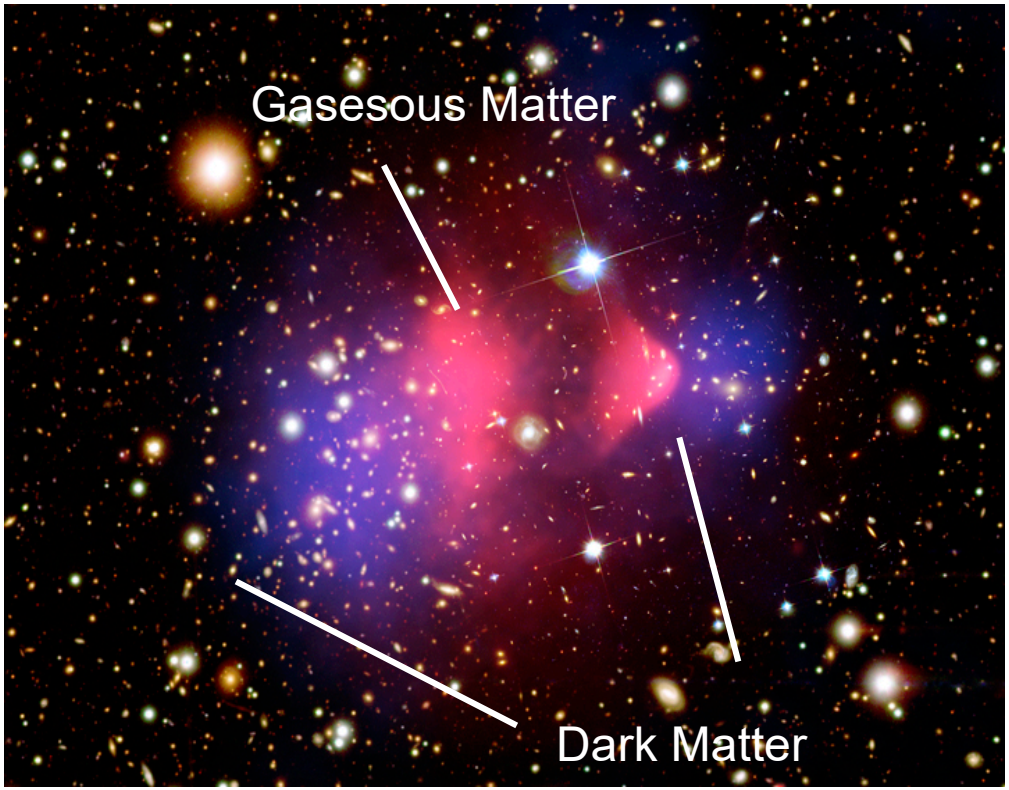
Topic 11

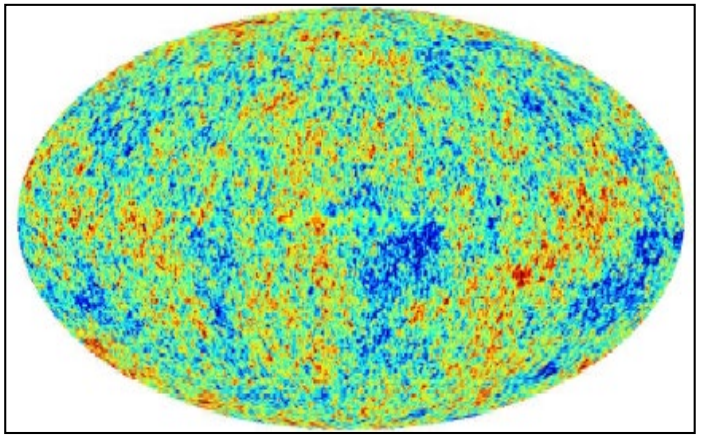
- ***Draw*** a full scale ray diagram with *OD*, *ID* and *HO* the same size as one of your measurement sets in the table.
- Measure *IH* from your diagram.
- ***How*** does it compare to the measured *IH* in your table?

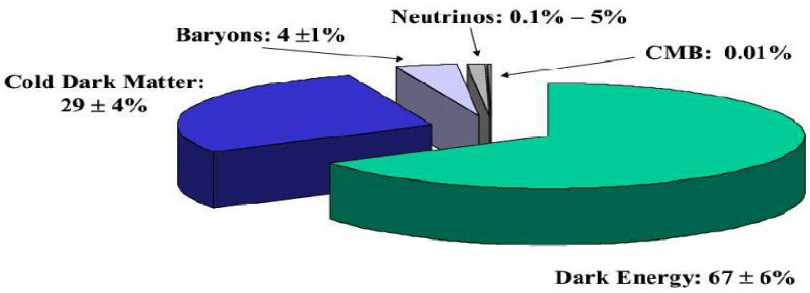


Questions?

The Dark Side of the Universe



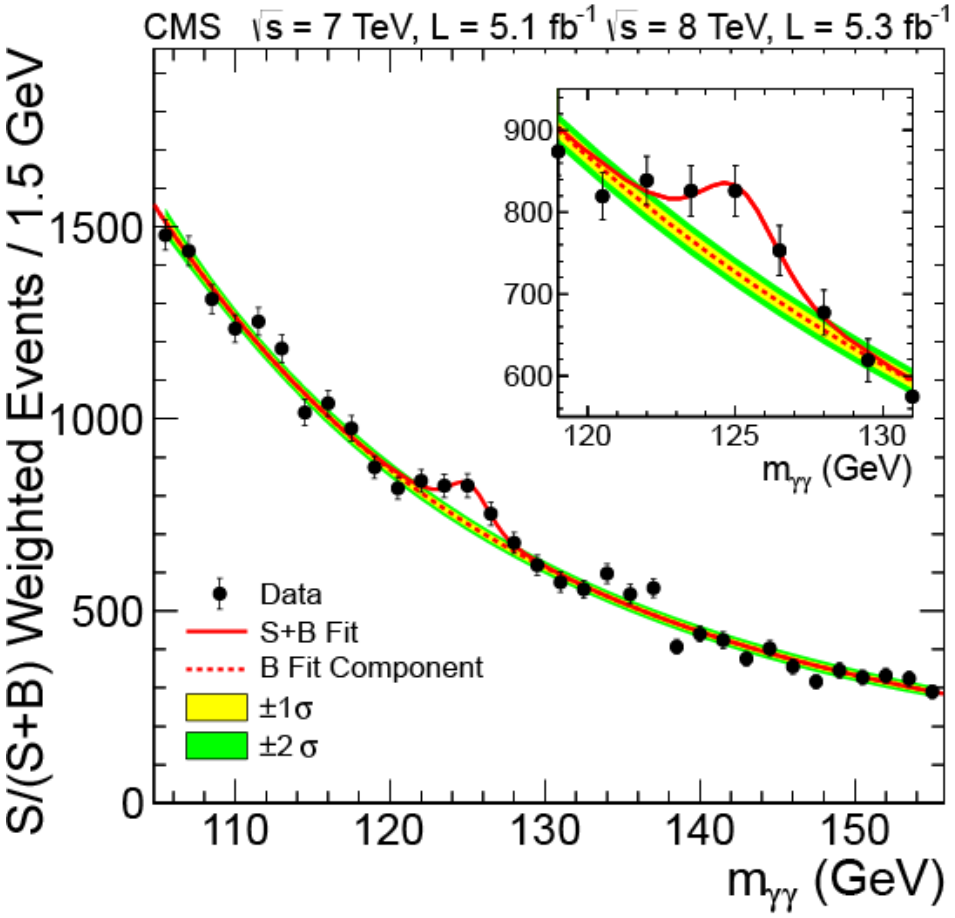


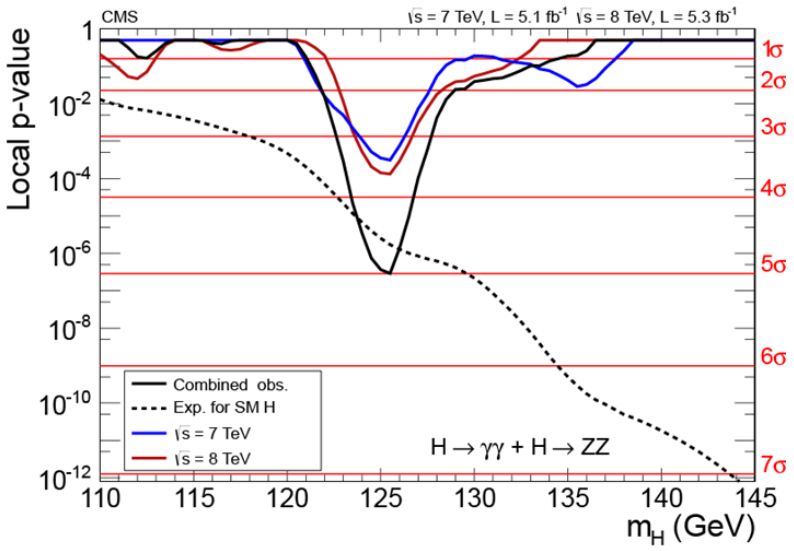


Lightest SUSY particle would be a prime candidate for Dark Matter

Dark Energy?
Remnant of some elementary scalar field analogous to the Higgs field?

Higgs discovery





What is the chance that one would see this peak even if Higgs boson was there?

Instructor

- Prof. Anwar Bhatti
- Department of Physics
- 3123 Physical Sciences Complex
- Phone: 301-405-6064
- Email: bhatti@umd.edu