Physics 2D Lecture Slides
Lecture 1: Jan 5 2004

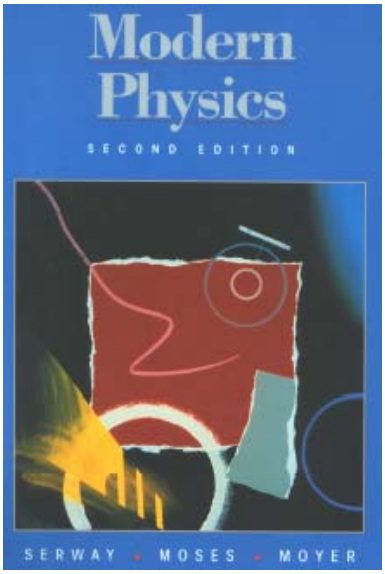
Vivek Sharma

UCSD Physics

Modern Physics (PHYS 2D)

- Exploration of physical ideas and phenomena related to
  - High velocities and acceleration (Einstein's Theory of Relativity)
  - Sub Atomic structure and Dynamics (Quantum Physics)
  - The very small (quarks) and the Very large (cosmos)
- A glimpse of the cutting edge of thought in Physics and technology that it is generating
- A different kind of course :
  - Exciting (Gee Whiz stuff) BUT intense
  - About 40 Nobel Prize winning ideas/experiment in course (~4 / week!)
  - Non-intuitive (how do you figure how electrons act inside an atom)
    - Will require abstract thought
    - Fountainhead of Chemistry, Biology, Electronics, Computing
  - Foundation for tomorrow's technology, chemistry and medicine

Introduction to Modern Physics (2D)



- Course Text: Modern Physics, Serway, Moses, Moyer
  - 2nd Ed, published by Saunders/BrooksCole
- Instructor : Prof. Vivek Sharma
  - Email : modphys@hepmail.ucsd.edu
  - **3314 Mayer Hall, Phone : (858) 534 1943**
  - Office Hours :
    - **Mon 2:00 –3:00 PM & Tue 2:30-3:30 PM**
    - Weekends or other times by (email) appointment
- TA : Brian Wecht
  - Email : bwecht@physics.ucsd.edu
  - **4234 Mayer Hall, Phone: (858) 534-5910**
  - Office Hours : Wed (2:00-3:00 pm) & Thursday (1:00 –2:00 pm)
- Course Web Page **http://modphys.ucsd.edu/2dw04**
  - **Walk thru the web site now**
  - **Please make sure you can access it and check all site links**
  - **Send mail to modphys@hepmail.ucsd.edu if have problems**

General Class Schedule

Lecture	Monday	11:00-11:50 am	WLH 2005	Prof. Sharma
Prof. Office Hour	Monday	2:00 - 3:00 pm	Mayer 3314	Prof. Sharma
Lecture	Tuesday	8:00-8:50 pm	WLH 2005	Prof. Sharma
Prof. Office Hour	Tuesday	2:30-3:30 pm	Mayer 3314	Prof. Sharma
Lecture	Wednesday	11:00-11:50 am	WLH 2005	Prof. Sharma
Discussion	Wednesday	3:00-3:50PM	WLH2005	B.Wecht/ V.Sharma
TA Office Hour	Wednesday	2:00-3:00 pm	Mayer 4234	Brian Wecht
TA Office Hour	Thursday	1:00-2:00 pm	Mayer 4234	Brian Wecht
Problem Solving	Thursday	TBA pm	TBA	Brian Wecht
Quiz	Friday	11:00-11:50 am	WLH 2005	Weekly (starts Jan 16)
Prof. Office Hour	Weekend	By Appointment	Mayer 3314	Prof. Sharma

Check Class Web Page for Problem Session time/location

Quizzes, Final and Grades

- Course score = 60% Quiz + 40% Final Exam
  - 8 quizzes (every Friday starting Jan 16th), best 6 scores count
    - Two problems in each quiz, 40 minutes to do it
      - One problem HW like, other more interesting
    - Closed book exam, some formulae will be provided
      - No "CHEAT SHEETS" please
    - Blue Book required, Code numbers will be given at the 1st quiz. Bring calculator, check battery !
    - No makeup quizzes / See handout for **Quiz regrade protocol**
- Final Exam : Mar 15th , 11:30am - 2:30pm
  - Inform me of possible conflict within 2 weeks of course
  - Don't plan travel/vacation before finals schedule is confirmed !
    - No makeup finals for any reason

What to Expect / Not Expect on the Quiz / Final Handout

Some Useful Numbers, Equations and Identities

Speed of Light, $\mathbf{c} = \mathbf{3.0 \times 10^8 m/s}$

$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}}$$

$$x' = \gamma(x - vt)$$

$$t' = \gamma(t - \frac{xv}{c^2})$$

$$V'_x = \frac{V_x - v}{1 - \frac{V_x v}{c^2}}$$

$$p = \frac{mV_x}{\sqrt{1 - V_x^2/c^2}}$$

$$E = \frac{mc^2}{\sqrt{1 - V_x^2/c^2}} = K + mc^2$$

$$\nu_{obs} = \frac{\sqrt{1 + v/c}}{\sqrt{1 - v/c}} \nu_{source}$$

$$\vec{F} = m\vec{a}$$

$$a = \frac{d^2x}{dt^2}$$

$$\vec{F} = q(\vec{v} \times \vec{B})$$

$$Sin^2\theta + Cos^2\theta = 1$$

All constants will be provided
No need to memorize them

Course Grade

- Our wish is that every body gets an A ! So no curve
- Grading on an absolute scale. Roughly it looks like this :

Total Score	Grade
> 85	A+
> 75	A
> 60	B
> 45	C
< 30	F

- Hint : don't miss the early quizzes, they are easier

Expected Prior Knowledge: Brush up!

- Concepts learnt in Phys 2A, 2B and 2C will be used in 2D
- Familiarity with Vector Calculus & Differential Equation
- Knowledge of PHYSIC 2C material
  - Will need to know concepts in Waves : Interference & Diffraction
    - Chapters 17-18, 33, 36-37 in Fundamentals of Physics by Halliday/Resnick/Walker 6th Ed (On Reserve for this course)
    - Hard to appreciate ideas in Modern Physics without them
  - Notes on 2C concepts needed are posted on class web site
  - TA has video recorded easy to follow lectures (2) which are available for your viewing via Video-on-demand (streaming Video) at the UCSD computer labs (CLICS, Geisel etc)
  - Please start this week with the summary notes at web site
  - Consult TA or me if you need extra help
    - We can help you over weekends but pl. contact us early!!

How To Do Well In This Course

- Don't rely on your intuition ! Always think thru the concept
- Read the assigned text BEFORE lecture to get a feel of the topic
- Attend lecture (ask questions during/before/after lecture) and discussion.
  Review lecture & discussion material using video-on-demand
- Attempt all homework problems yourself
  - Before looking at the problem solutions (available on web every Tuesday afternoon)
  - Before attending Problem Solving session
  - Work in sets of 2-3 to share ideas and problem solving approaches
- Do not try to memorize complicated formulae or Homework problems! Do not just accept a concept without understanding the logic
- Quarter goes fast, don't leave every thing for the week before exam !!
- All-nighters don't work in this course: Get decent sleep before Quiz or Finals
- Don't hesitate to show up at Prof. or TA office hour (they don't bite!)

Lecture 1: Relativity

- Describing a Physical Phenomenon
  - Event (s)
  - Observer (s)
  - Frame(s) of reference (the point of View !)

  } Describe on Black board

    - Inertial Frame of Reference
    - Accelerated Frame of Reference
- Newtonian Relativity and Inertial Frames
  - Laws of Mechanics and Frames of Reference
  - Galilean Transformation of coordinates
    - Addition law for velocities
- Maxwell's Equations & Light
  - Light as Electromagnetic wave
  - Speed of Light is not infinite !
  - Light needs no medium to propagate

Event, Observer, Frame of Reference

- Event : Something happened => (x,y,z,t)
  - Same event can be described by different observers
- Observer(s) : Measures event with a meter stick & a clock
- Frame of Reference :observer is standing on it
  - Inertial Frame of reference ← constant velocity, no force
- An event is not OWNED by an observer or frame of reference
- An event is something that happens, any observer in any reference frame can assign some (x,y,z,t) to it
- Different observers assign different space & time coordinates to same event
  - S describes it with : (x,y,z,t)
  - S' describes same thing with (x',y',x',t')

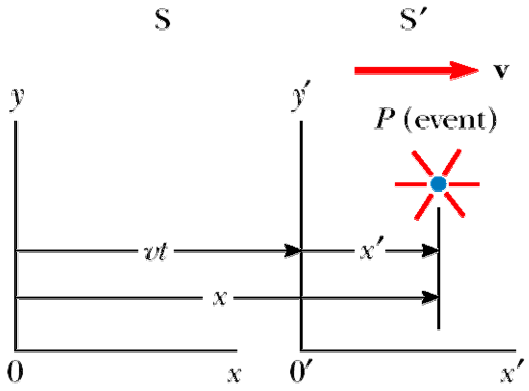
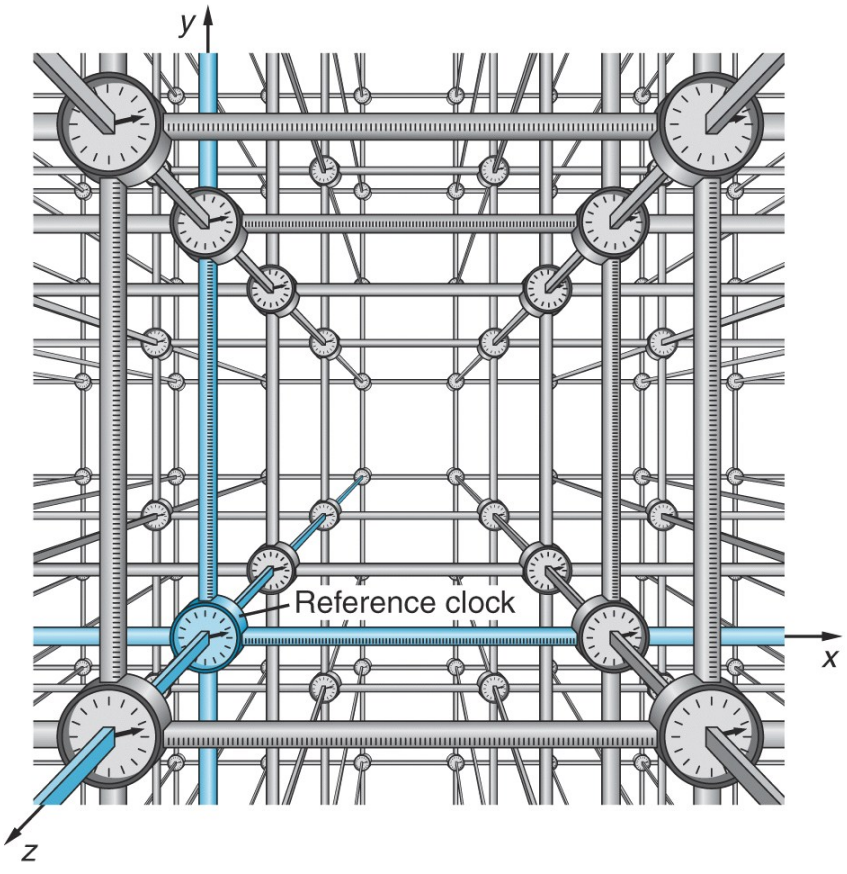
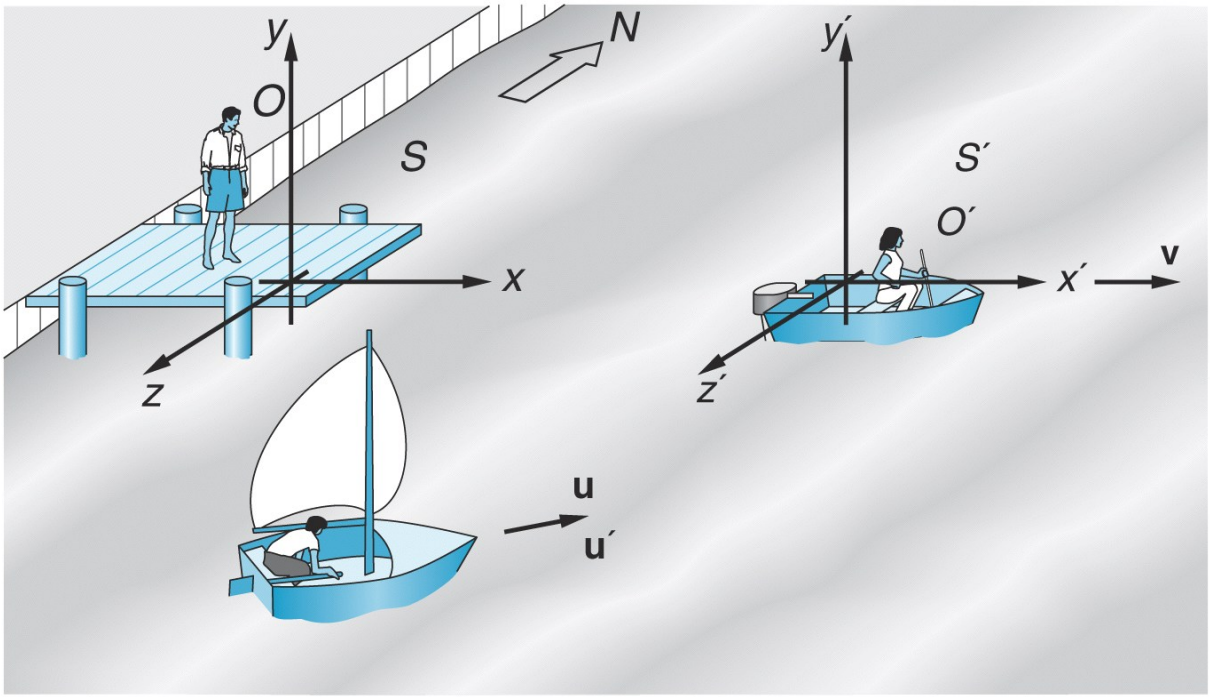


Figure 39.2 An event occurs at a point *P*. The event is seen by two observers in inertial frames S and S′, where S′ moves with a velocity **v** relative to S.

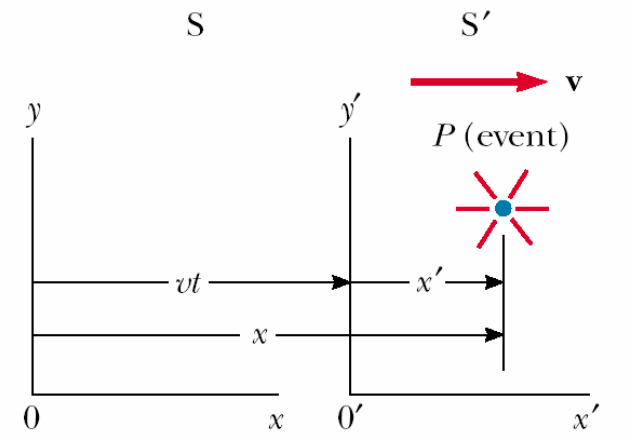
The Universe as a Clockwork of Reference Frames



“Imagining” Ref Frames And Observers



Galilean Transformation of Coordinates



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Galilean Rules of Transformation

$$x' = x - vt$$

$$y' = y$$

$$z' = z$$

$$t' = t$$

Quote from Issac Newton Regarding Time

Absolute, true and mathematical time, of itself, and from nature, flows equably without relation to anything external

$$t = t'$$

There is a universal clock

Or

All clocks are universal

Newtonian/Galilean Relativity

Inertial Frame of Reference is a system in which a free body is not accelerating

Laws of Mechanics must be the same in all Inertial Frames of References
⇒Newton's laws are valid in all Inertial frames of references
⇒No Experiment involving laws of mechanics can differentiate between any two inertial frames of reference
⇒Only the relative motion of one frame of ref. w.r.t other can be detected
⇒ Notion of ABSOLTUTE motion thru scape is meaningless
⇒There is no such thing as a preferred frame of reference

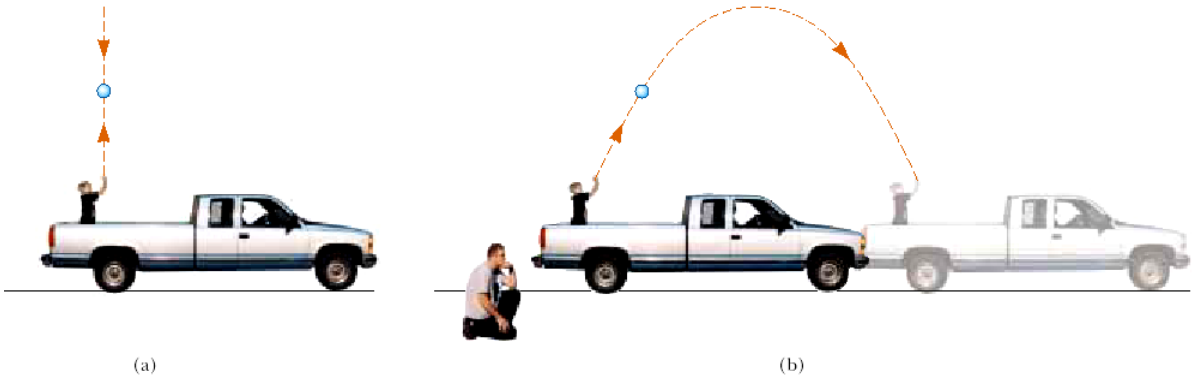

Figure 39.1 (a) The observer in the truck sees the ball move in a vertical path when thrown upward. (b) The Earth observer sees the path of the ball as a parabola.