

# Modern Physics (Phys. IV): 2704

Professor Jasper Halekas  
Van Allen 70  
MWF 12:30-1:20 Lecture

# Classical Physics



## Assumptions:

- Invariance of Time
- Invariance of Space
- Equipartition
- Determinism
  
- No maximum speed
- No minimum size

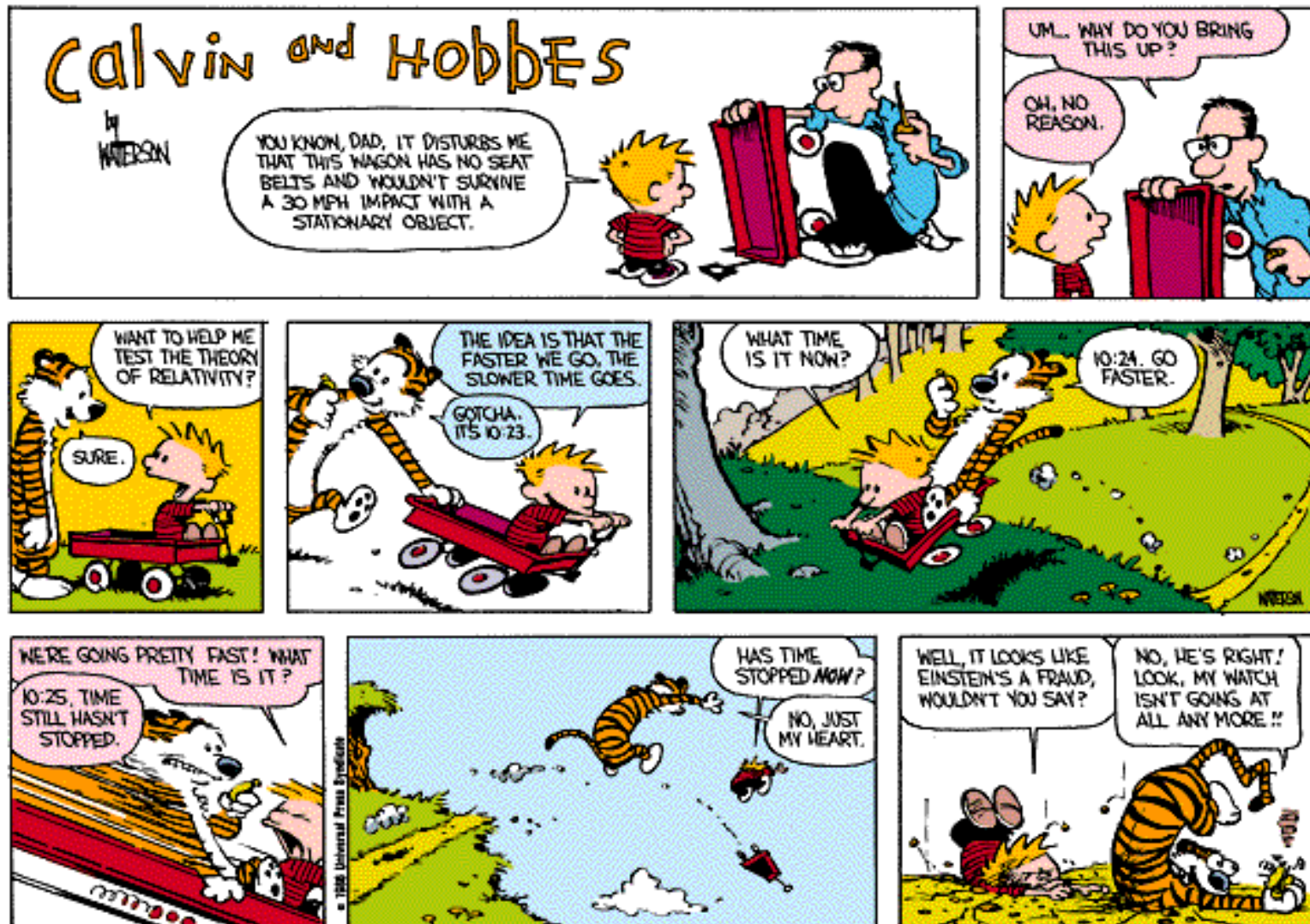
# Modern Physics



# Special Relativity

1. The laws of physics are the same in all inertial reference frames
  2. The speed of light is a constant in all inertial reference frames
- Measured time and spatial intervals depend on our reference frame
  - Energy and momentum have to be redefined

# Time Dilation



# Wave-Particle Duality

- Light (and other things) sometimes behave like they are made of particles
- Light (and other things) sometimes behaves like they are made of waves
- This will never stop being weird...

# Wave-Particle Duality



*"Once and for all I want to know what I'm paying for. When the electric company tells me whether light is a wave or a particle I'll write my check."*

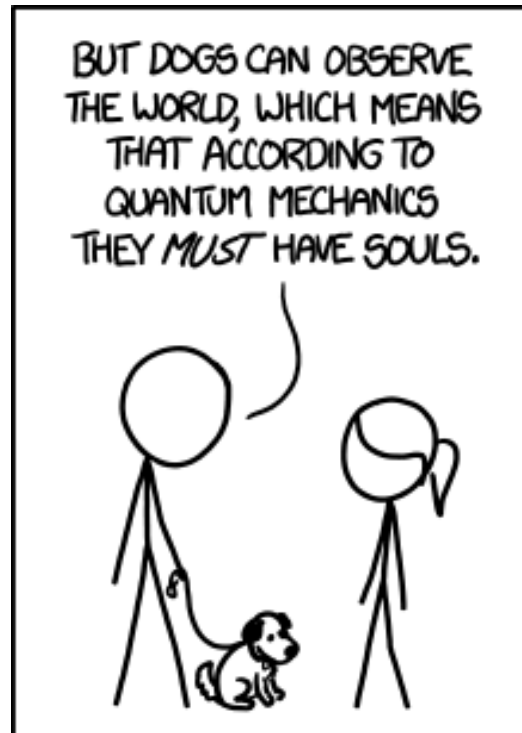
# Quantum Mechanics

$$\left[ \frac{-\hbar^2}{2m} \nabla^2 + V \right] \Psi = i \hbar \frac{\partial}{\partial t} \Psi$$

- The basic equation of motion is not Newton's laws, but Schrödinger's equation.
- At the lowest level, physics is inherently not deterministic



# The Most Misunderstood Science



PROTIP: YOU CAN SAFELY IGNORE ANY SENTENCE THAT INCLUDES THE PHRASE "ACCORDING TO QUANTUM MECHANICS"

# Contacts/Office Hours

- **Instructor:** Jasper S Halekas
- **Office:** 414 Van Allen Hall
- **Phone:** (319) 335-1929
- **E-mail:** [jasper-halekas@uiowa.edu](mailto:jasper-halekas@uiowa.edu)
- **Office Hours:**
  - Monday 10:30-11:30 am,
  - Wednesday 2:00-3:00 pm,
  - Thursday 3:00-4:00 pm
  - *Or by Appointment*

# Resources: People

- Please come to me if you have questions!
- Your TA can answer questions about labs and homework grading
- Help is also available in the 3<sup>rd</sup> floor Tile Room, which is staffed regularly with physics TAs who can help you

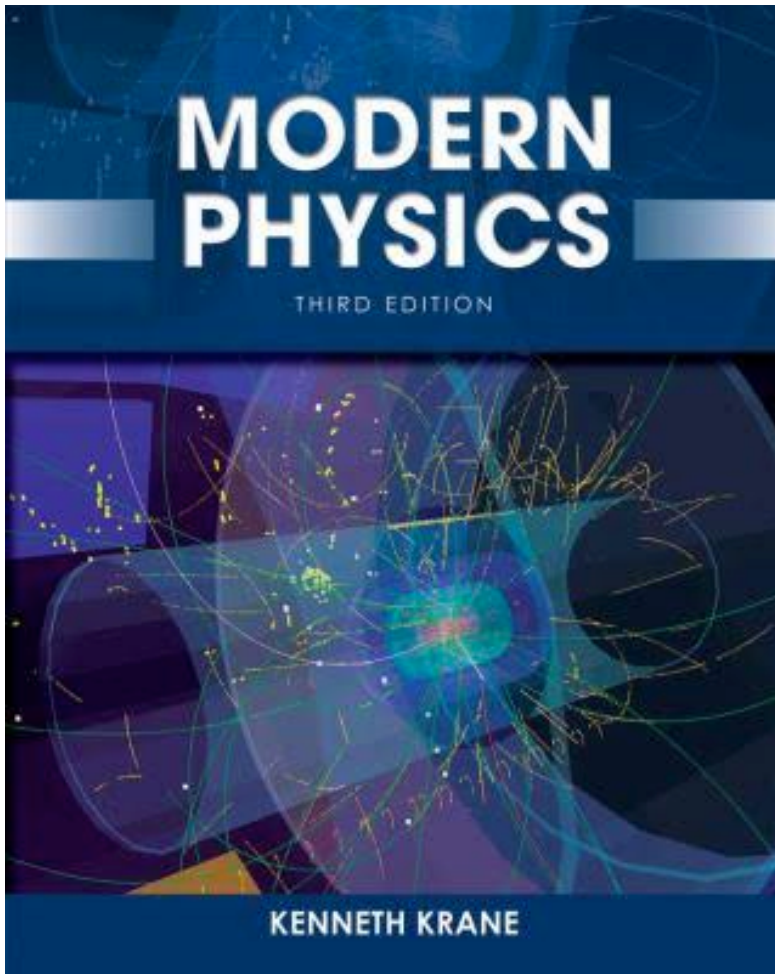
# Resources: Web Pages

- Web Pages:
  - Main Web Page
    - [http://www.physics.uiowa.edu/~jhalekas/teaching/physIV\\_2018/index.html](http://www.physics.uiowa.edu/~jhalekas/teaching/physIV_2018/index.html)
      - Hosts syllabus, schedule, class notes, assignments, etc.
  - ICON:
    - <https://uiowa.instructure.com/courses/73540>
      - Links to main site, Turning Point resources, and lab materials
      - All grades will be posted here

# Resources: Class Notes

- Notes from each class (both slides and blackboard material) will be merged and placed online in PDF form within one day after the class
  - Can be found on the main class web page, on the “Notes” tab

# Resources: Textbook



The textbook can be purchased anywhere  
Make sure you get the Third Edition.

**Lab Manual:**

Provided in electronic form on ICON

# Reading

- Reading should be completed before lecture.
- There are no reading quizzes, but reading ahead is highly recommended, and will make lecture and discussions more productive.
- Tests may include material not explicitly covered in class.

# Homework

- Weekly homework assignments will be hand-written and hand-graded. Assignments are due in class on Fridays (or before). If you do your homework in electronic form please print it out.
- You are allowed to work with other students on the homework, but each student must write out a full set of solutions.
- Solutions **must** clearly show all work. Full credit will not be given for incomplete work. Partial credit may be assigned for correct logic on intermediate steps even if you don't get the final answer.
- The lowest scoring of the 11 homework assignments will be dropped – i.e. you get a “freebie”



# Labs

- The laboratory assignments are a key part of the course, to be held under the supervision of a TA, who will also grade the reports.
  - Remember to complete pre-lab questions before lab!
- Only 9 of 10 labs will be counted toward grading, however, there will be *absolutely no* make-up labs.
- **No labs this week** – labs will start next week

# Computer-Based Labs

- Three labs during the semester (first in week 7) will be computer-based, using Mathematica to obtain numerical solutions and make plots
  - Materials for these will be provided on ICON (but are not yet there)
  - These labs will take place in the computer lab in Van 201 instead of your usual lab room
    - Van 201 will be reserved for the first two hours of your normal lab time and your TA will be there to answer questions
    - The room is usually open at other times in the event you need more time

# Student Response Systems

- Student response systems are not required
- Student response systems are an opportunity to earn extra credit
- Make sure to register your Turning Point account through ICON if you want to get credit!
- The University of Iowa has transitioned to personal device-based response systems. You must register online in ICON by selecting Student Response, then Turning Account Registration from the course modules. If you have a physical clicker, you can exchange it for a license from TurningPoint. Students should go to the IMU Bookstore only for these exchanges. Detailed information and FAQs are available at <http://its.uiowa.edu/srs/>.

# Why are we using SRS?

- To give you a chance to practice tricky concepts and check your understanding in real time – physics (especially modern physics) is tricky!
- To give me feedback on what you get and what you don't – I'm not perfect!
- Because SRS questions can (should) be fun!
- Because peer-reviewed research shows that students in the worst classes that use clickers and other interactive learning techniques learn more than those in the best classes that don't

# SRS Questions Are:

- Anonymous to the rest of the class
  - [Only I know who you are]
- Not graded (any answer counts the same)
- Do not count against you
  - Participating in the clicker questions gives you a chance to gain extra credit
    - 100% participation is not required
    - 90% = 100% for the purposes of extra credit
    - This allows for a few unavoidable absences, dead batteries, technological issues, etc.

# Participation

- Participation will be tracked by your response to questions through student response systems during lecture. These questions are un-graded, so any response counts as participation.
  - We will start using student response systems next Monday
  - Extra credit points will be assigned as follows:

>60% participation	0.5% of overall points
>80% participation	1.0% of overall points
>90% participation	2.0% of overall points

# Exams

- Midterm exams will be held during regular class hours. The final exam will be two hours, scheduled during finals week at a time to be announced.
- Exams will be closed book, long-form, hand-graded
  - You are allowed an equation sheet, which you are responsible for preparing
  - Most questions should not require calculators, but you are allowed to have them
- No make-up exams other than in legitimate extenuating circumstances with **prior** approval!
  - If you do not contact me in advance you **will not** earn full credit for the exam

# Tests/Grading

- **Exam Schedule:**
  - Wednesday, Feb. 21
  - Wednesday, April 4
  - Final Exam, TBD Date
- **Two Midterm Exams:**
  - Ch. 1-4
  - Ch. 5-7
  - Ch. 1-10
- **Grading:**
  - Homework 25%
  - Labs 20%
  - Two Midterms 15% Each
  - Final Exam 25%
  - Participation Extra Credit (up to 2%)



# Grading: How it Works

- Student A has the following scores:

Category	Score	Percentage	Weight	Class Points
Homework	90/100	.900	25	22.5
Labs	870/900	.966	20	19.32
Midterm 1	65/100	.65	15	9.75
Midterm 2	72/100	.72	15	10.8
Final	68/100	.68	25	17
Participation	36/42	.857	up to +2	+1.0
Total				80.37/100

Student A has 80.37 class points. These will determine his/her class rank, which will be used to determine his/her grade.

# Grading: How it Works

- CLAS recommends the following grade distribution for advanced courses:
  - A 22%, B 38%, C 36%, D 3%, F 1%.
  - A similar curve will be used in assigning final grades – this curve may be adjusted slightly depending on the overall performance of the class
- For example:
  - If 80.37 translated to a class rank of  $9/32 = 72^{\text{nd}}$  percentile, Student A would get a B by this curve.

# Grading: How it Works

- A note for those taking the class w/o lab
  - Since scores for labs are typically higher than other grade categories, it wouldn't be fair to adjust the relative percentages for the other grade items and grade you on the same curve as those taking the lab
  - In order to establish a fair playing field, your grade will be computed as if you had taken the lab and received lab grades with the same percentile ranking as the total of your exams + homework
  - This ensures that you will be ranked fairly with respect to the other students based only upon your exams + homework scores

# Cheating

- **Don't!**
- Cheating is a major disservice to you and your classmates
- If you are caught, it will affect your grade, and you could face disciplinary action

# Communication

- Please let me know if you have questions, comments, complaints, or are struggling with particular concepts. This class is for you, and I am here to help.
  - Students may communicate with me by phone, e-mail, or in person
  - Students with issues or questions should if possible raise them in person by attending office hours or by scheduling an appointment
  - If you prefer to give me anonymous feedback there is a comments envelope on my door

# Ask Questions!

- The fact that I ask SRS questions in part to get feedback does not mean that you should not also ask other questions in class, discussion, or office hours
- If you have a question, others may also have the same question
- Don't be afraid to speak up!

# Some Interesting Enrollment Trends

## ON SERIES

- I: 45 students
- II: 35 students
- III: 27 students
- IV: 38 students

## PAST YEARS PHYSICS IV

- 2011: 20 students
- 2012: 24 students
- 2013: 24 students
- 2014: 16 students
- 2015: 30 students
- 2016: 27 students
- 2017: 32 students
- 2018: 38 students

# What I Care About (And Don't Care About) as an Instructor

- I care about:
  - Developing a strong conceptual understanding
  - Learning how to approach problems and apply problem-solving tools
- I don't care about:
  - Rote memorization of facts or equations
- As you progress in physics, you will never be able to remember every equation
  - Nor will you need to – that's what reference material is for!
  - However, if you remember concepts and how to approach problems of different types, you will be a good physicist



# Schedule

## Physics 2704

## Physics IV

## 2018 Schedule

Dates	Week	Reading (Due Monday unless noted)	HW Due Friday	Lab	Notes
January 15-19	Week 1	Ch. 1 ( <i>Wed.</i> )	No HW	No Lab	<i>Holiday Mon. 1/15</i>
January 22-26	Week 2	Ch. 2.1-2.6	HW 1	E7	
Jan. 29-Feb. 2	Week 3	Ch. 2.7-3.3	HW 2	S1	
February 5-9	Week 4	Ch. 3.4-4.2	HW 3	Q1	
February 12-16	Week 5	Ch. 4.3-4.7	HW 4	Q4	
February 19-23	Week 6	No Reading	No HW	No Lab	Midterm #1 Wed. 2/21 on Ch. 1-4
Feb. 26-March 2	Week 7	Ch. 5.1-5.3	HW 5	C1	
March 5-9	Week 8	Ch. 5.4-5.6	HW 6	C2	
March 12-16	Spring Break	No Reading	No HW	No Lab	Woo-hoo!
March 19-23	Week 9	Ch. 6	HW 7	Q3	
March 26-30	Week 10	Ch. 7	HW 8	Q9	
April 2-6	Week 11	No Reading	No HW	No Lab	Midterm #2 Wed. 4/4 on Ch. 5-7
April 9-13	Week 12	Ch. 8	HW 9	Q7	
April 16-20	Week 13	Ch. 9	HW 10	No Lab	
April 23-27	Week 14	Ch. 10	HW 11	C3	
April 30-May 4	Week 15	No Reading	No HW	No Lab	
May 7-11	Finals Week	No Reading	No HW	No Lab	Final Exam TBA on Ch. 1-10