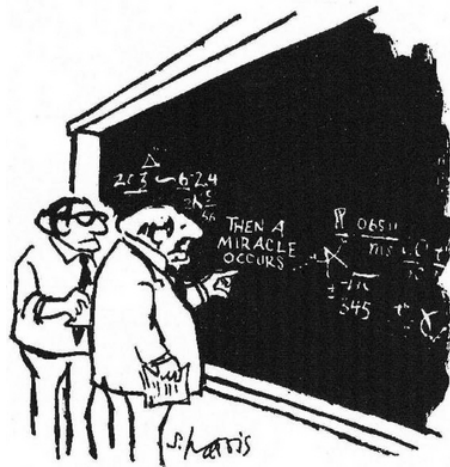


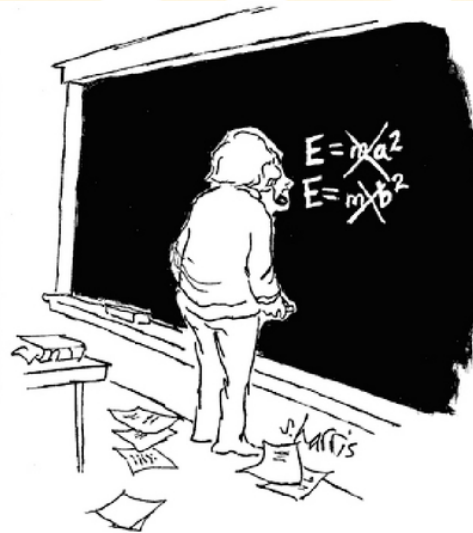
Welcome to Physics 101

Prof. Sean McWilliams

Theoretical Astrophysics (especially General Relativity)
West Virginia University



"I think you should be more explicit here in step two."



Today's lecture

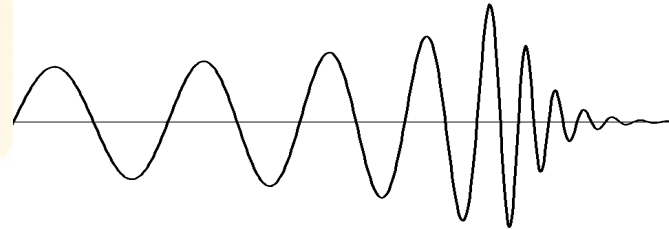
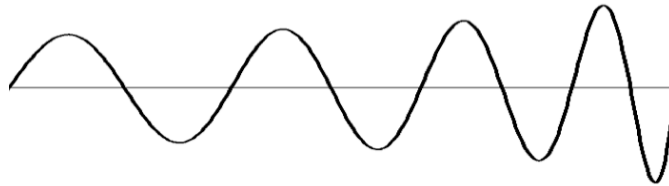
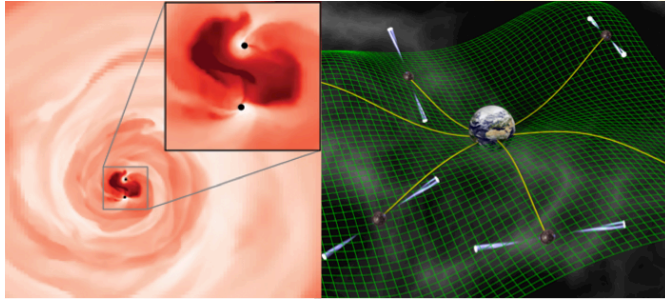
- Who am I?
- What is physics?
- Why should you be interested in physics?
- What will this course be about?
- What are you expected to do?



Who am I?



Sean McWilliams



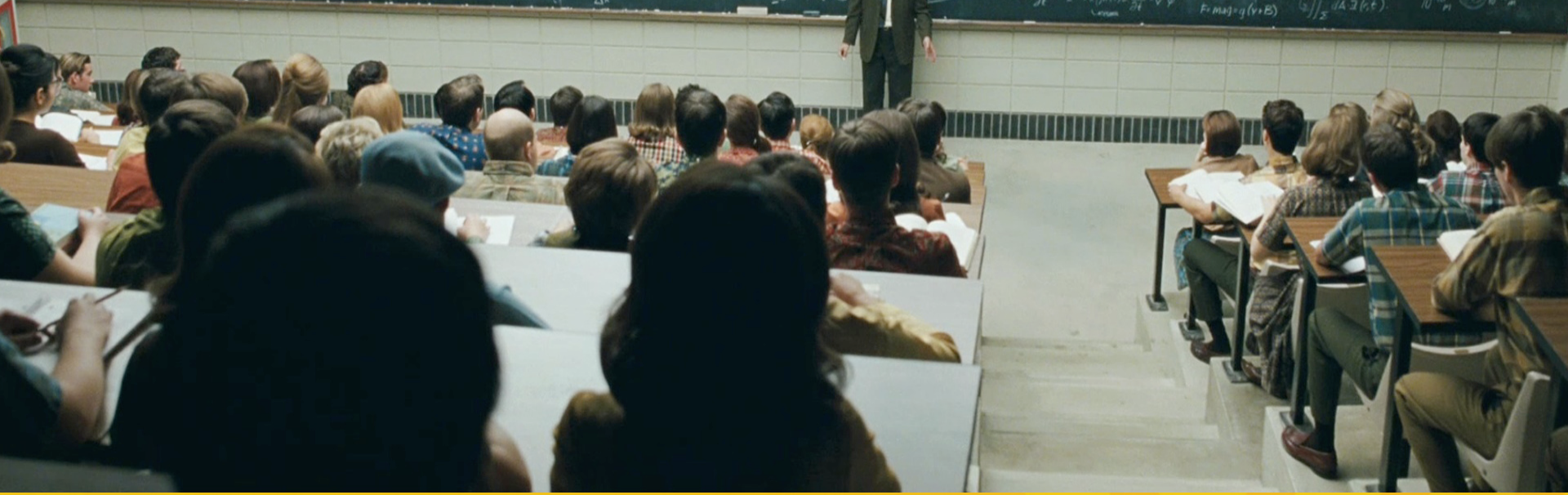
Research topics: Gravitational Waves, Black Holes, Neutron Stars, ...
Office: G58 White Hall Email: sean.mcwilliams@mail.wvu.edu

What is physics?



A large blackboard filled with handwritten physics equations and diagrams. The content includes:

- Mechanics:** Equations for angular momentum ($M = r \times p$), torque ($\tau = r \times F$), and rotational motion. A diagram shows a wheel with forces and a pulley system.
- Electricity and Magnetism:** Calculations for electric fields (E), magnetic fields (B), and magnetic flux ($\Phi = \int \mathbf{B} \cdot d\mathbf{A}$). Includes a diagram of a coil in a magnetic field.
- Optics:** Ray diagrams for lenses and mirrors, and equations for refraction and interference.
- Wave Phenomena:** Equations for wave speed, frequency, and wavelength. Includes a graph of a wave.
- Modern Physics:** Equations for the photoelectric effect ($E = hf$), Compton effect, and relativistic energy ($E = mc^2$).
- Mathematics:** Various calculus-based derivations and integrations.

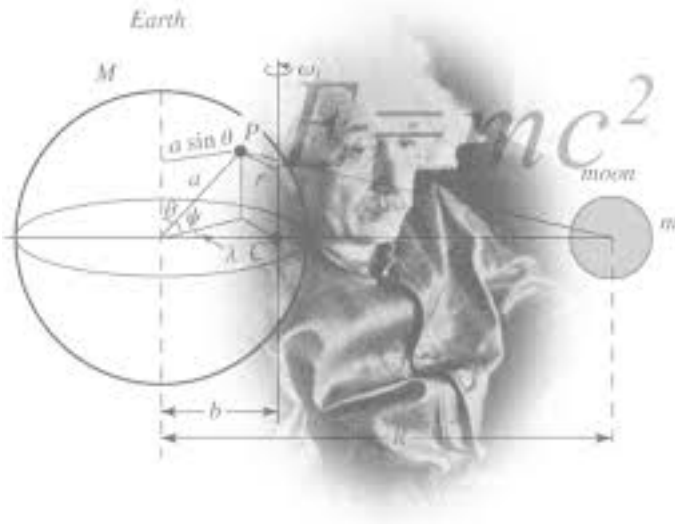




WEST VIRGINIA UNIVERSITY
Physics



What is physics?



*Physics is the general analysis of nature, conducted in order to **understand** and predict how the world and the universe behave. - Wikipedia*

Is this generally possible? - Think about it....



Goedel's incompleteness theorem

Understanding is based on reasoning and logic. Something is *understood*, if it is the logical consequence of something else, that is already understood.

Goedel: “No system can demonstrate its own consistency.”

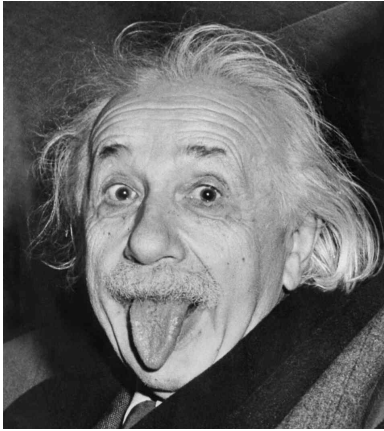
http://en.wikipedia.org/wiki/Gödel's_incompleteness_theorems

There is an inherent contradiction in logic itself. You must accept axioms - a statement that is *believed* to be true.



This insight can make a scientist a very strong believer....

Famous conceptual changes - famous physicists

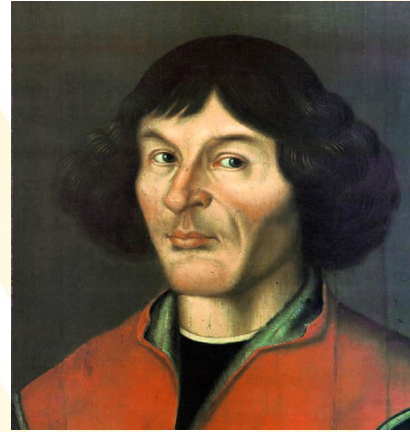


Albert Einstein

Theory of relativity
Photoelectric effect

(Nobel prize 1921)

http://www.nobelprize.org/nobel_prizes/physics/laureates/1921/einstein-bio.html



Nicolaus Copernicus

Heliocentric model
of the solar system

<http://scienceworld.wolfram.com/biography/Copernicus.html>



Erwin Schroedinger

Quantum theory

(Nobel prize 1933)

<http://www.youtube.com/watch?v=IOYyCHGWJq4>



Isaac Newton

Classical Mechanics

<http://www.newton.ac.uk/newtlife.html>

Subdivisions of Physics

Mechanics

cause and effect of forces, motion and energy of objects

Thermodynamics

heat and how heat energy is transformed

Cryogenics

study of matter at extremely low temperatures

Plasma Physics

studies activity of highly ionized, electrically charged gases

Solid State Physics

study of physical properties of solid materials

Geophysics

physics of the Earth (earthquakes, volcanoes, oceanography)

Astrophysics

how interstellar bodies (planets/stars) interact

Acoustics

the study of sound and how sound travels

Optics

the study of light and how it travels

Electromagnetism

the interaction between electric, magnetic fields and charges

Fluid Dynamics

observes the behavior of moving liquids and gases

Biophysics

from the molecular scale to whole organisms and ecosystems

Statistical Physics

models the effects of systems of many particles

High Energy Physics

dedicated to searching for fundamental particles

Atomic Physics

understanding the structure of the individual atom

Molecular Physics

understanding the structure of molecules

Nuclear Physics

structure of atomic nucleus and nuclear reactions

Quantum Physics

study of extremely small systems and quantization of energy

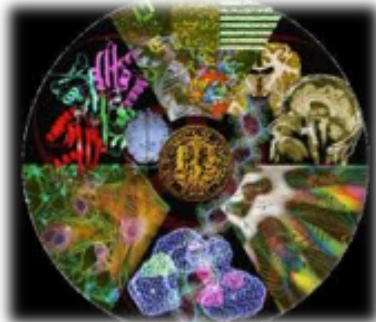


Why should you be interested in physics?



Why study physics?

Physics is **crucial to understanding the world around us**, the world inside us (biology), and the world beyond us (universe). Physics has led to **great discoveries** (e.g. computers, lasers, microscopes). Moreover, it's the basis of many other sciences, including chemistry, oceanography, seismology, and astronomy.



Gain skills in:

Problem Solving, Estimation, and Intuitive Guessing

Extremely Marketable Skills!



Where does physics matter?



Rollercoasters **Basketball**

Seat Belts **Figure Skating**

Pulsars **Fast Computing**

Breaking Bones **Construction**

Martial Arts **Blood Pressure**

Space Missions **Football**



What will this course be about?



Chapter	Topic
1	Introduction
2	Motion in one dimension
3	Vectors + two dimensional motion
4	The Laws of Motion
5	Energy
6	Momentum and Collisions
7	Rotational Motion and Gravity
8	Rotational Equilibrium + Dynamics
9	Solids and Fluids
10	Thermal Physics
11	Energy in Thermal Processes
13	Vibrations and Waves
14	Sound

