

The Quantum Enigma syllabus

Lecture Topic

Quantum Enigma reading

(Text material for classical physics, including relativity, was assigned separately.)

Introduction

An overview of the territory we will explore.

Ch. 1 and 2

Part One Classical Physics: Our Intuitive Worldview

Setting the Scene for Science*

Ch. 3

The ancient Greek science of Aristotle, which became the science of the Renaissance. It's what Galileo's method for science had to overturn to spark the industrial and cultural revolution.

A Method for Science*

Ch. 3

Galileo's new approach to science. It is a foundation of our modern science, technology--and our culture.

Motion

Ch. 3

We start science (as Aristotle taught us to) with the simplest aspect of Nature: how objects move.

The Newtonian Synthesis

Newton's $F = Ma$, the "universal equation of motion," and Newton's law of universal gravitation. The synthesis puts the heavens and the earth together.

Our Newtonian Legacy*

The philosophical (and the psychological and social) impact of Newton's physics. It ignited the intellectual movement called "The Enlightenment."

Energy & the Electric Force

Ch. 4

What energy is, and the forms it can take.
The force with which we see, hear, taste,
and-- perhaps--the force with which we think.

Waves

Waves of water, sound, and electric field;
and--we'll later see--waves of matter.

Part Two Relativity: Practice Believing the "Impossible"

M&M, AE's postulate, $v < c$, $E = Mc^2$

Einstein's postulate, the universal speed limit, $E = Mc^2$.

Slowing of time, contraction of length

The slowing of time in moving systems. (How you can become older than your mother.)

Part Three Quantum Mechanics: Confronting the Enigma

Quantum Jumps and Einstein's Photons Ch. 5

A first (gentle) contact with the enigma.

The *Reality* of Atoms

A double entendre: what atoms are really like, *and* a demonstration that they are physically real things.

Bohr's Quantum Atom

Bohr's early quantum description of the atom. Mystery of spectra "explained"! But a strange problem arises.

Waves of Matter Ch. 6 and 7

Aren't atoms little hunks of *stuff*? Apparently not. A second (a bit less gentle) contact with the enigma.

Schrödinger's Equation

The *new* universal law of motion.

Note Ch 9 BEFORE C 8

One-Third of Our Economy Ch. 9

A look at some practical applications of quantum mechanics. It gives us lasers, superconductors, and transistors. It makes big money. (Silicon Valley is based on it.)

Our Skeleton in the Closet Ch. 8

The enigma: where's the physically real world? Quantum mechanics forces a strange worldview upon us.

Wonderful, Wonderful Copenhagen Ch. 10

The standard defense of the absurdity. It's our "official dogma." A new philosophical stance for science.

- Schrödinger's Controversial Cat** Ch. 11
The story Schrödinger told to show that the quantum mechanics he invented is actually absurd.
- Seeking a Real World*** Ch. 12
The Einstein-Bohr debate, Einstein's concession.
- The EPR "Paradox"***
Einstein's "bolt from the blue," a demand for physical reality and a reasonable worldview.
- Spooky Interactions: Bell's Theorem** Ch. 13
What must be true in *any* "reasonable" world.
- Ch. 14
- Bell's Theorem, Tests, and Implications**
The proof that our world is surely "*un*reasonable." The universal connectedness we now know exists--whether or not quantum mechanics is correct.
- Interpreting The Quantum Enigma** Ch. 15
The alternatives to Copenhagen are even more bizarre than the Copenhagen Interpretation itself.
- The Mystery of Consciousness** Ch. 16
Free will, the "hard problem", and robots. Can a computer think?
- The Mystery Meets the Enigma** Ch. 17
"When there are two mysteries, it is tempting to suppose that they have a common source."
- Consciousness and the Quantum Cosmos** Ch. 18
Did consciousness create the universe?