

Physics 002B **Title: Quantum Theory in Search of Reality**
Fall Semester 2009 **Instructor: Professor John Boccio**
Prerequisite: High school algebra and geometry

This 1st-year seminar will investigate the **existence(or nonexistence) of an intelligible external reality.**

We will examine several tentative images of the world as proposed by quantum physicists.

The search for a picture of "the way the world really is" is, as we will see, an enterprise that **transcends the narrow interests of theoretical physics.** The investigative path that we will follow in the seminar will always stretch your mind and often leave you gasping.

Below is a quote about Albert Einstein from the physicist Abraham Pais:

"We often discussed his notions on objective reality. I recall that during one walk Einstein suddenly stopped, turned to me and asked whether I really believed that the moon exists only when I look at it."

In this seminar we will not only answer Einstein's question, but also the more general question: "What is reality?".

The answer(s) may surprise you; you may not believe them; you can, however, build computers, iPods, and iPhones with them.

Along the way I will introduce you to my **scientific culture and its language, namely, mathematics.**

There is no way to understand this subject without learning the language, so I will teach you the necessary mathematics as needed.

You will find out how contemporary theoretical physics views the world you live in and why we believe this view is correct.

Topics to be Discussed

01. Classical background - What was "true" and how it failed
02. Quantum thoughts - Introduction
03. Experiments - Fundamental ideas
04. Mathematics - Tools of the trade
05. More mathematics - Further tools

06. Postulates - The theory
07. Quantum details - How it all works
08. Formalism: The theoretical/experimental tools
09. Locality, EPR, Bell and Bertlmann - Challenges and truth
10. Cats, friends, boiling pots and erasers - Reality lessons
11. Many worlds, decoherence and regress - The alternatives
12. Final attempts - What have we really done
13. God, free will and all that stuff: Ramblings of the professor and other physicists and philosophers

If you are interested in physics and philosophy, not afraid to learn some new mathematics based on your high school mathematics and willing to do lots of reading, thinking and talking, then this seminar is designed for you.

There are only **12 slots** in the seminar.

Seminar learning is different than any other kind of class. You will do readings, prepare presentations on specialized topics, have discussions with me and other students between seminars. Even after all of that work there will still be new material that you do not fully understand as the seminar begins. The goal of the actual seminar meeting is to clear up all remaining difficulties and end with everyone understanding that week's subject matter. The process works, but when you first take apart in it, you will feel that you are floundering and not making progress, but as you will see the seminar meetings are amazing in their ability to work out problems as long as everyone participates, asks questions and talks openly.

If you are interested, then please email me at

boccio@swarthmore.edu

or stop by and see me in my office - Science Center 127.

Tell me why you are interested in this seminar and register early.

Thanks,

John Boccio