Introduction to Quantum Mechanics
For Harvard Fall HSSP 2010

Instructor: Lester Kim
E-mail: lkim@fas.harvard.edu

In this course, we will explore the mysterious workings of nature on the atomic scale. Quantum theory (along with Einstein's theory of relativity) is currently the most accurate, scientific framework in describing our universe. Unfortunately, like most subjects in physics, quantum physics requires a lot of mathematics to package and to explain it properly. My goal is to make this as painless as possible but I cannot guarantee that the material will come easily to you.

Schedule (tentative):
Week 1- **Introduction**: History, experiments, classical mechanics (force, momentum, energy, rotations, oscillations)

Week 2- **Calculus**: limits, continuity, differentiation, integration, Taylor series

Week 3- **Linear algebra**: vector spaces, linear transformations, matrices, determinants, eigenvalues, eigenvectors, inner product

Week 4- **Probability and Wave Function**: average value, Gaussian distributions, normalization, wave functions; stationary states, separation of variables

Week 5- **Time-independent Schrodinger equation**: infinite square well, Dirac-delta well, finite square well, step well, free particle, the simple harmonic oscillator

Week 6- **Formalism**: Hilbert Space, Dirac notation, Hermitian operators, Heisenberg's uncertainty principle

Week 7- **Quantum mechanics in 3D**: particle in a box, spherical harmonics, angular momentum, spin

References:
1. ***Introduction to Quantum Mechanics*** by David Griffiths (I will be following this book very closely.)
2. ***Principles of Quantum Mechanics*** by Ramamurti Shankar (An advanced, yet self-contained book that gives a thorough treatment of linear algebra from the very start.)
3. ***The Feynman Lectures Vol. 3*** by Richard Feynman (An unorthodox, advanced, and miraculously illuminating presentation of quantum mechanics from a Nobel laureate who helped develop quantum electrodynamics.)
4. ***The Elegant Universe*** by Brian Greene (This is a book on string theory; however, its most redeeming feature is its clear, qualitative explanation of relativity and quantum mechanics.)

5. ***Introduction to Classical Mechanics*** by David J. Morin (This book gives an advanced presentation of classical mechanics; I will refer to this book whenever it would be helpful for us to go back to classical concepts.)