Chesapeake Section of the
American Association of Physics Teachers
Spring 2021 Virtual Meeting

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Bringing the physics back into the junior-senior undergraduate quantum mechanics course

Saturday, April 17, 2021 9:50 AM (20 minutes)

Quantum mechanics instruction has remained relatively unchanged for at least 75 years, following a coordinate-space-based formalism that requires significant class time for instruction on the mathematical background for the Frobenius method, delta functions, Fourier transforms, and the like. This mathematics instruction greatly limits the amount of physics that can be included. In this talk, I will tell you how to reverse this trend. In Fall 2020, I taught a one-semester junior-level quantum mechanics course at Georgetown University that worked within a representation independent formalism (emphasizing operators, not wavefunctions). It is mathematically much simpler and frees up significant time for discussing conceptual ideas and physical ideas. I was able to discuss important experiments in detail such as Stern-Gerlach, delayed choice, EPR, Bell inequality tests, Hong-Ou-Mandel, Pickering-Fowler lines, discovery of deuterium, proton radius, electron momentum spectroscopy, time of flight, hyperfine interactions and radio astronomy, cyclotron resonance and MRI, single-photon detection, homodyne detection, and how squeezing is employed to improve LIGO. Come to the presentation and see how you can adopt such a framework for your class as well.
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