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An Analytic Study of Energy Eigenstates of Piecewise-constant Potentials Using the Wigner Quasi-probability Distribution MARIO BELLONI, Physics Department, Davidson College, LAURA GILBERT, Davidson College, MICHAEL DONCHESKI, RICHARD ROBINETT, Pennsylvania State University — In the study of classical oscillating systems, a phase-space description is often useful in determining the long-term properties of a systems motion. Wigner, over 70 years ago, was one of the first to introduce a phase-space description of quantum mechanics with a quasi-probability density joint in x and p. The Wigner function is considered a "quasi"- probability density because it can be negative for states which lack a classical analog and because of obvious problems raised by the Heisenberg uncertainty principle which restrict the ability to make simultaneous measurements of both x and p. While many standard potentials have been analyzed using the Wigner function, including that of the free and accelerating particle and the harmonic oscillator, other familiar bound-state problems have not. We calculate the Wigner quasi-probability distribution for the energy eigenstates of several standard piecewise-constant one-dimensional potentials—attractive Dirac delta function, infinite well, finite well, asymmetric infinite well—as well as visualize the results.

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