Quantum systems with position dependent mass

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Effective mass theory is a continuous model often used in condensed matter physics to describe the transport of charge carriers in periodic structures, such as metals and semiconductors. One of the consequences of the effective mass theory is the possibility of the mass depend on position. This can be seen, for instance, in a non-uniform conductor or in a junction of materials having different effective masses. The Schrödinger equation with a position dependent mass (PDM) has been a topic discussed strongly in the research activities. The main problem is that mass no longer commute with the momentum operator in the kinetic energy. As a consequence, the usual Hamiltonian operator is no longer Hermitian. Then, it is necessary to change it in order to obtain an Hermitian one. In this work we used a model proposed recently to study the electronic transport properties of quantum systems with PDM. Through this new Hamiltonian proposed, we obtained the boundary conditions and the transmission (T) and reflection (R) coefficients for quantum systems with electrostatic potential barriers considering a piecewise constant mass and analyse the transport properties of them. We consider three cases: a step potential and one and two potential barriers, where the last one is the resonant tunneling diode. We verified that the model that we used works perfectly for the case of one and two barriers, but the sum of the T and R coefficients is different of 1 for the step potential. The validity of the model is discussed.