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Numerical Solutions and Structures of Double Quantum Jet Solving by an Upwind Scheme SAN-YIH LIN, HUEI-HUANG CHIU, CHIN-TIEN LIN, National Cheng Kung University — The solutions of a double quantum jet are analyzed by solving the quantum fluid dynamical formulation (QFD) of the Schrödinger equation. The QFD equations are obtained by expressing the Schrödinger wave function as $\varphi = \rho^{1/2}\exp(iS/\hbar)$and $\vec{u} = (u, v)$. In QFD, $Q = -\rho^{-1/2}\Delta\rho^{1/2}$ is called as quantum potential. An upwind method is developed to solve the QFD equations. The method use a third-order upwind method to discrete convection terms and the central finite difference method to discrete the quantum potential. A fourth-order Runge-Kutta method is used for time marching. Two cases, one-dimensional free particle with external potential and two-dimensional free particle with external potential, are presented to illustrate the accuracy of the QFD solver. The computational results are compared well with the results obtained by solving the Schrödinger equation. Finally, the QFD solver is applied to solve the solutions of a double quantum jet and to investigate its structures. First, a mathematical formulation is derived to describe the double quantum jet. The jet has the probability density equals 2 and the velocity equals 2 at the inlet of the jet. Then, the solutions are computed by the QFD solver. The structures of the solutions are affected by the strength of the quantum potential. The interesting phenomena of quantum clustering are found.

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