Generalized KdV equation induced from position-dependent effective mass quantum models and mass-deformed soliton solution through inverse scattering transform

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We consider one-dimensional stationary position-dependent effective mass quantum model and derive a generalized KdV equation in (1+1) dimension through Lax pair formulation, one being the effective mass Schroedinger operator and the other being the time-evolution of wave functions. We obtain an infinite number of conserved quantities for the generated nonlinear equation and explicitly show that the new generalized KdV equation is an integrable system. Inverse scattering transform method is applied to obtain general solution of the nonlinear equation, and then N-soliton solution is derived for reflectionless potentials. Finally, a special choice has been made for the variable mass function to get mass-deformed soliton solution. The influence of position and time-dependence of mass and also of the different representations of kinetic energy operator on the nature of such solitons is investigated in detail. The remarkable features of such solitons are demonstrated in several interesting figures and are contrasted with the conventional KdV-soliton associated with constant-mass quantum model.