The structure of Kelvin-Helmholtz vortices with super sonic flow

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We have done two dimensional simulations of the Kelvin-Helmholtz instability with super sonic flow using CIP method. KHI occurs when a velocity shear is set up across a shear layer. The linear analyses show that KHI can't grow vigorously under the situations where the flow velocity is exceeding the sound speed. In this study, however, KHI grows into a vortex even when one of the sides has a super sonic flow (large density jump across the shear layer). The formation of the shock is essential for the KHI vigorous growth and the structure of the vortex is strongly influenced by the formation of the shock geometry. The angle of the shock limits the sub sonic area where the vortex can be rolled up, and the shock intensity influences the centripetal force of the vortex. Thus, we conclude that the structure of the vortex rolled up under the super sonic flow is determined by the balance of the shock angle and the shock intensity. With the same mechanism, KHI can also grow under some situations where both sides have a super sonic flow.