6. Inviscid Instability of High Speed Two-phase Flow

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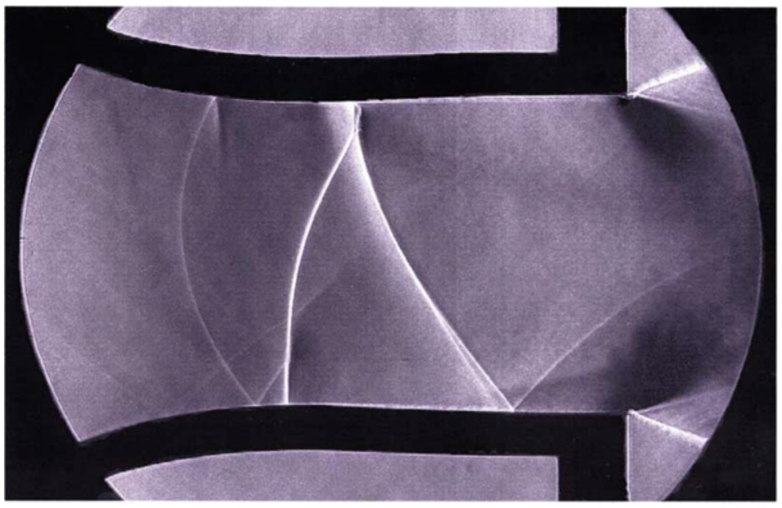

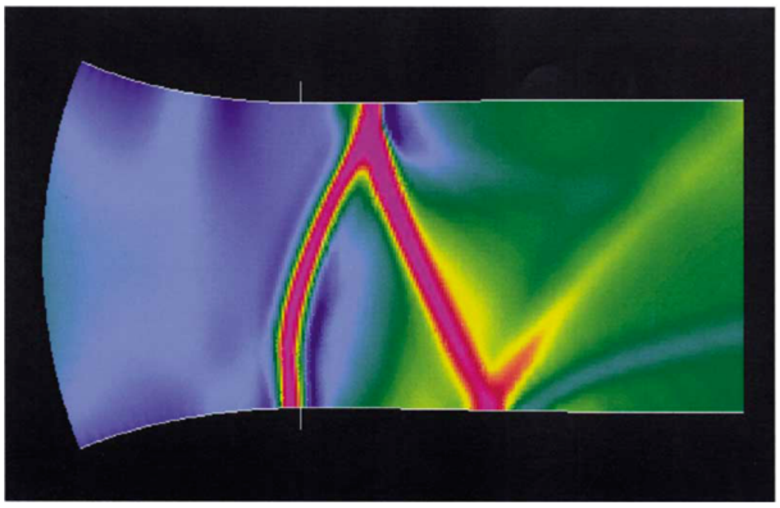

The schlieren picture shows the unsteady transonic flow of a water vapor/carrier gas mixture through a laval nozzle from left to right. Due to the rapid cooling during the expansion the water vapor becomes highly supersaturated and it condenses suddenly near the throat. This leads to thermal choking with unsteady moving oblique shocks in the symmetric nozzle, the frequency is 832Hz. The perfect agreement of experiment and calculation confirms that this bifurcation phenomenon is a new instability caused by strong interactions of compressibility waves and heat addition in transonic flow, and is definitely not controlled by viscosity effects like boundary layer separation etc.

Experiment	
Fluid	Atmospheric humid air
Reservoir temperature	T_{01}=290.3K
Reservoir pressure of the mixture	P_{01}=1.0bar
Water vapor content	10.0g $_{\text{water vapor/kg dry air}}$
Flow visualization	Spark light source Strobokin
	Exposure time 1µs

Calculation	
Model	Inviscid-Euler equations
Color scale	Static pressure disturbance