# KELVIN–HELMHOLTZ INSTABILITY ON SHOCK PROPAGATION IN CURVED CHANNEL

J.N. DOWSE[1], I.E. IVANOV[2], I.A., KRYUKOV[2], B.W. SKEWS[1], I.A. ZNAMENSKAYA[2]

[1]Department of Physics, Lomonosov State University, Moscow, 119991, Russia

[2]The University of the Witwatersrand Johannesburg, Wits 2050, South Africa

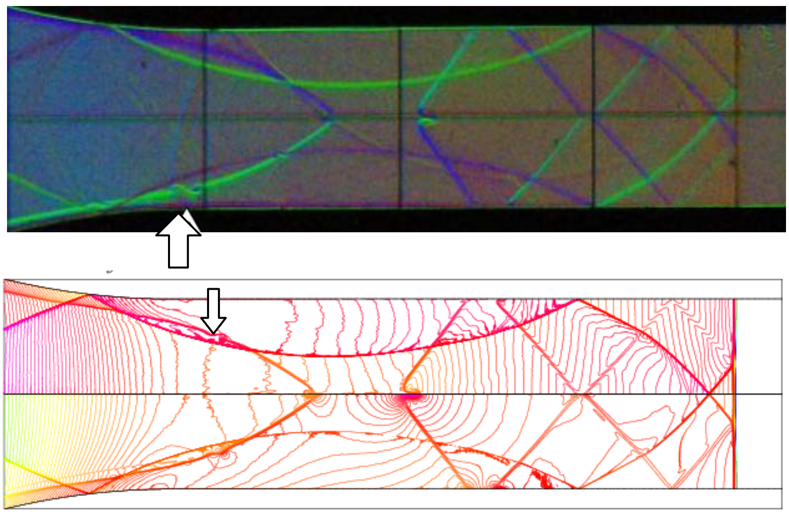
[c]Corresponding author: Tel.: + 7(495)939-44-28; Email: znamen@phys.msu.ru

**KEYWORDS**:

**Main subjects**: Kelvin–Helmholtz Instability
**Fluid:** gas, shock wave
**Visualization method(s):** colour Schlieren, CFD
**Other keywords:** shock tube, high performance computing

***ABSTRACT:*** Kelvin–Helmholtz instability was observed in some gas dynamic flows with shock waves when velocity shear is present within a fluid. Experimental results for shock interaction with curved channel profile had been conducted [1]. Accurate analysis of the problem at 80% reduction in channel area showed that in later time steps shear layers break down and form large KH instabilities. A colour Schlieren visualisation technique was used. In the reduced section the results show earlier produced sets of shear layers breaking down into KHI, later it is quite profound near the boundary. Detailed high performance computing of the 2D problem was conducted for Initial Mach number 1,2-2. The two-dimensional unsteady Euler equations and Navier-Stokes equations were solved with finite-volume Godunov method of high order. MUSCL approach was implemented with the procedure of the spatial reconstruction of the conservative fifth-order accuracy in conjunction with the Runge-Kutta third-order approximation in time. Numerical calculations were performed on a uniform Cartesian computational grid of computational cells 4000x800.

Figure 1a show the flow when the shock (M=1.33) has just propagated through the profile reduction. Instability arises in the one bottom shear layer at a single point. The CFD results (density field up and Mach numbers down) are shown in Fig. 1b. Flow analysis showed the KHI (indicated by white arrows) arises in computational and physical experiments at about the same time, but with a slight shift in space. That can be attributed to the influence of the additional contact surface present in the experiment, perturbations of the channel walls.



a

b

Fig.1

## References

[1] J.N. Dowse, B.W. Skews. Area change effects on shock wave propagation. Proceedings of the 28th International Symposium on Shock Waves (ISSW-28), Manchester, UK, 17-22 July 2011. (CD Rom Proceedings 2840.pdf)