LINEAR AND NON-LINEAR STAGES OF THE RICHTMYER-MESHKOV INSTABILITY
DEVELOPMENT IN A LARGE CROSS SECTION SHOCK-TUBE

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I- INTRODUCTION

Present research topic: Fundamental research
- Characterization of the transition phases to turbulence from the development of hydrodynamic instabilities within a shock accelerated interface

II- THE NEW LARGE CROSS SECTION SHOCK TUBE OF IUSTI

Characteristics and usual performances
- Square cross section: 20x20 cm2
- Length: 7.04 meters
- Mach number: from 1.1 to 3
- Initial pressure: from 0.5 atm to 1 atm

III- DIAGNOSTIC SYSTEM - Laser sheet high speed visualization

- Source: from 2 to 50 kHz pulsed copper vapour Oxford laser
- Camera: 321 Cordin streak camera
- External shutter: Electro-optical shutter
  Response time: ~ 1 µs
- Acquisition device: 720 Tektronix scope (4 channels)
- Trigger: signal from PCB pressure gauge

IV- INITIAL CONDITIONS

Gas test
He or Kr

\[ \text{Mach number in seeded air} \approx 1.3 \text{ in air} \]
\[ \text{W_e} \approx 460 \text{ m/s} \]

Heavy/light case (air/He)
\[ A_p \approx 5 \text{ to } 7 \]
\[ W_e \approx 111 \text{ m/s} \]
\[ U_{bg} \approx 225 \text{ m/s} \]
\[ U_{cm} \approx 93 \text{ m/s} \]

Light/heavy case (air/Kr)
\[ A_p \approx 7 \text{ to } 8 \]
\[ W_e \approx 222 \text{ m/s} \]
\[ U_{bg} \approx 115 \text{ m/s} \]
\[ U_{cm} \approx 51 \text{ m/s} \]

Pictures taken just before the run. Air at right is seeded by smoke cigarette and mosquito incense. Pure helium or krypton are used in the left part to study both the heavy/light and light/heavy configurations for the same initial shock wave. The initial interface is materialized by two layers of a thin membrane of nitrocellulose (0.8 µm thick) resting over fine metallic horizontal lines which create 2D perturbations of different wavelengths (2 cm and 4 cm).

VI- CONCLUSIONS AND PERSPECTIVES

- First results in a new shock tube coupled with a high frequency laser sheet technique have been obtained for the study of the transition phases to turbulence initiated by the Richtmyer-Meshkov instability.
- The 20 cm large square cross shock tube prevents from wall boundary layer effects and the special device realized for the control of the initial conditions is successfully available.
- The growing up of the initial perturbations at the interface and the Richtmyer-Meshkov mixing process are clearly visible.
- Runs with a higher observation frequency have to be realized (up to 50 kHz).
- The quality of the picture and in particular the homogeneity of the seeding have to be improved.