Experimental investigation on the behaviour of a shock accelerated spherical gas inhomogeneity

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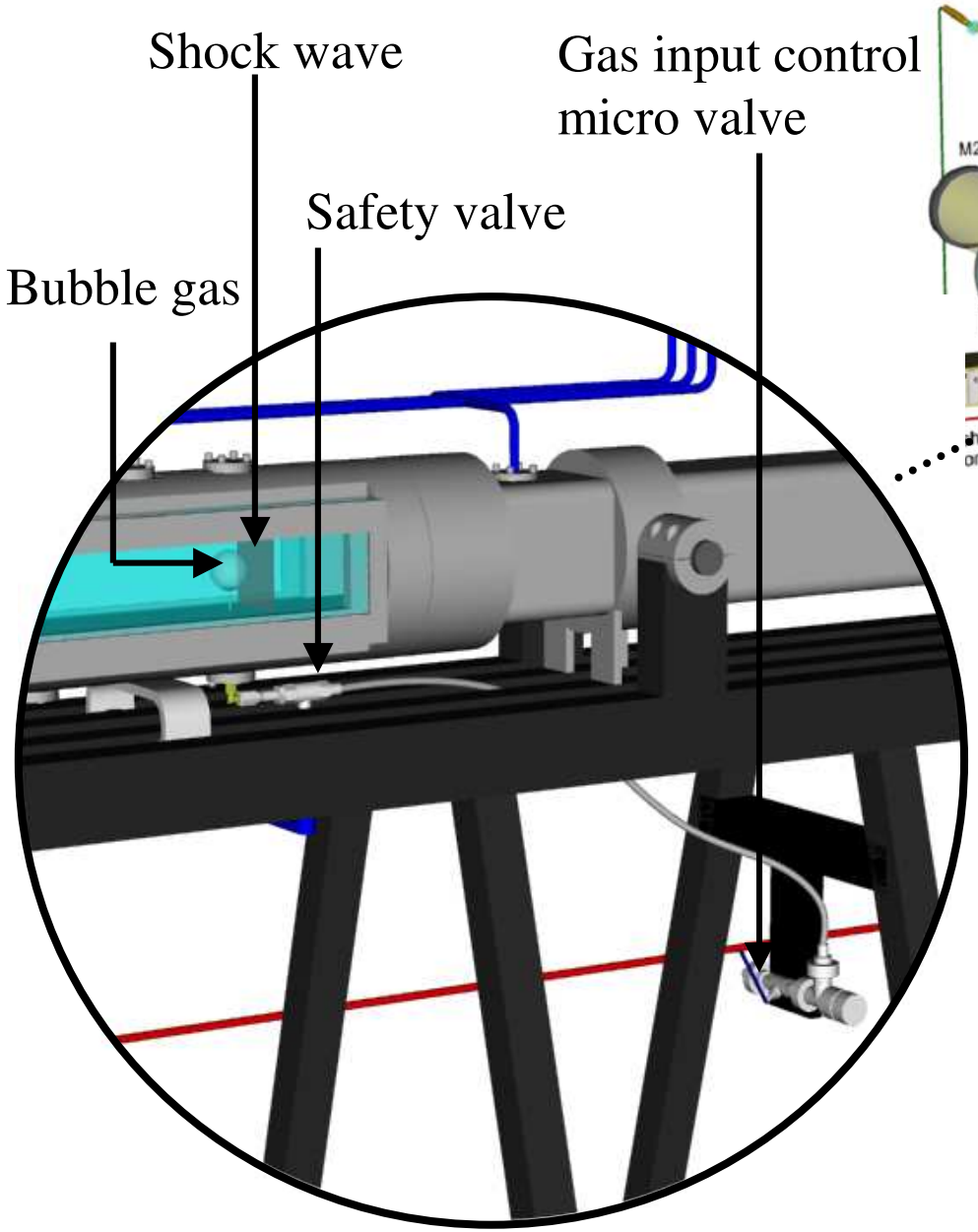
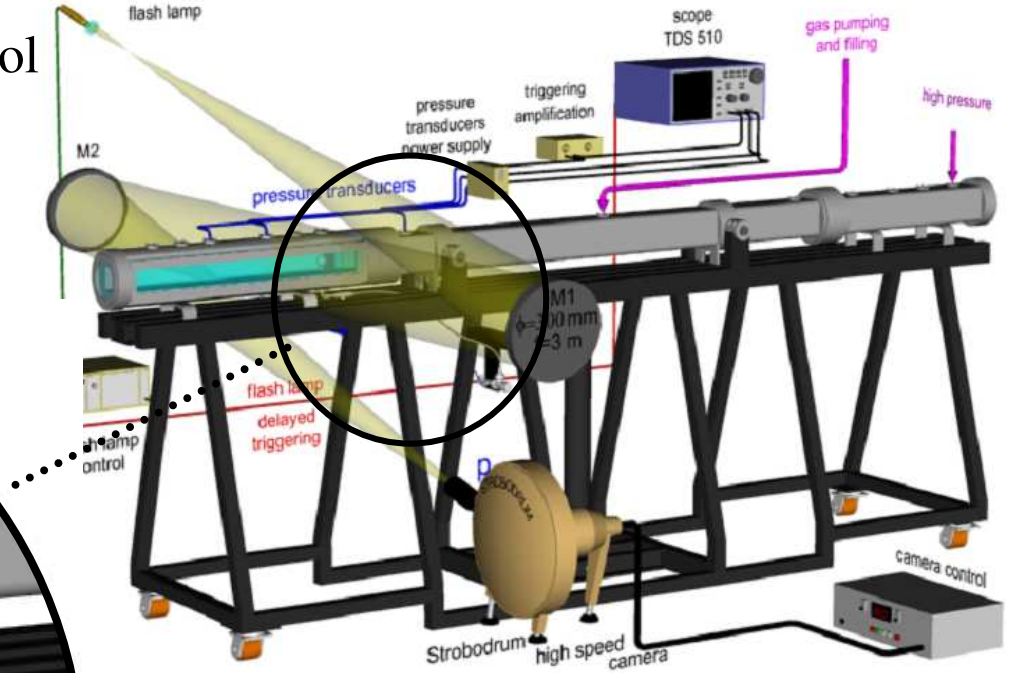
Topics of discussion

- *Experimental set-up*
- *Results*
- *Summary*
- *Next step...*

Experimental Set-up

Experimental set-up:Bubble injector





Bubble diameter

4 ±0.5 cm

Bubble gas:

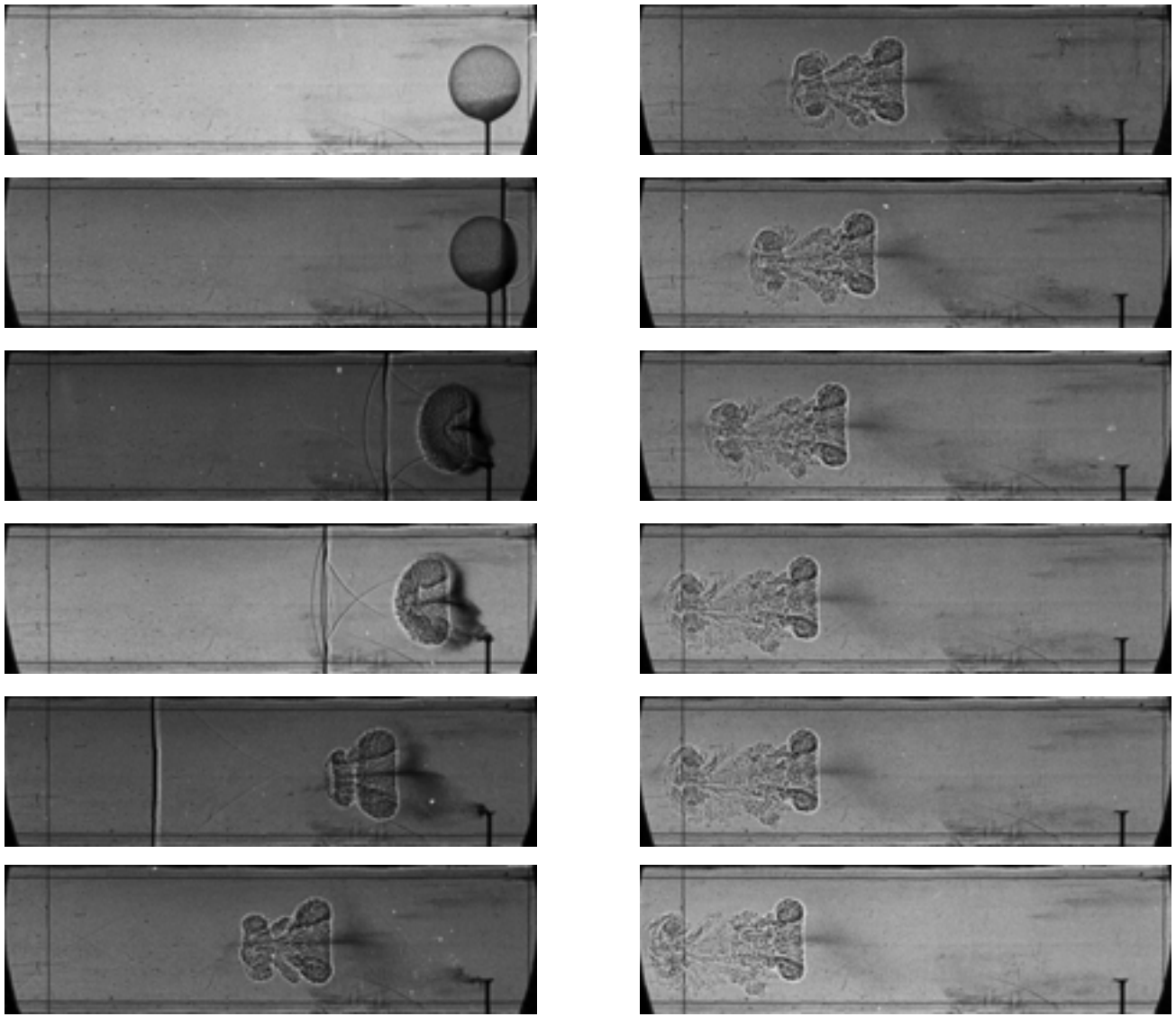
Helium	At = - 0.8
Nitrogen	At = - 0.1
Krypton	At = + 0.5

Results: Experimental conditions

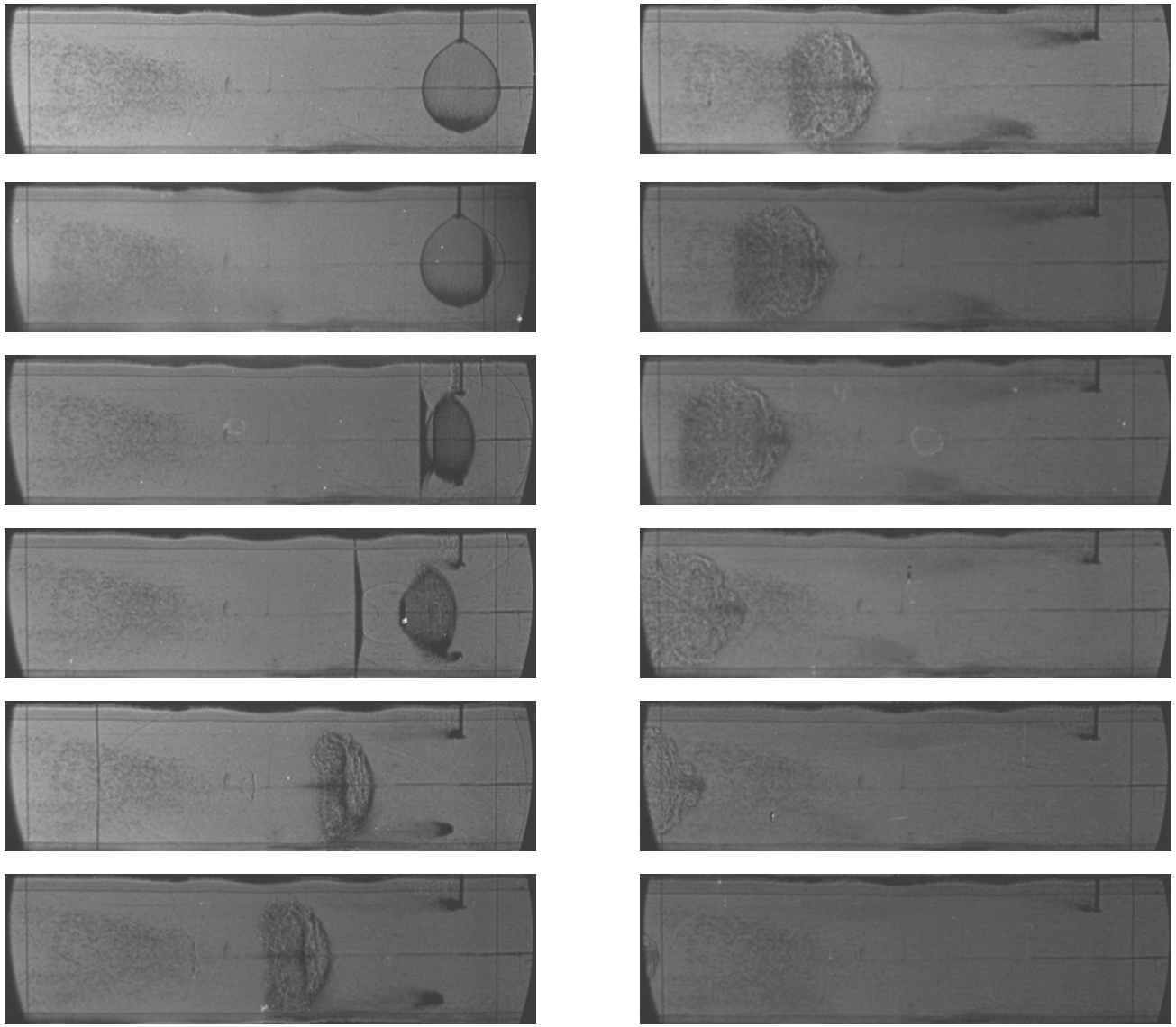
Surrounding gas	air at atmospheric pressure and temperature
Bubble gas	helium At = - 0.8 nitrogen At = - 0.1 krypton At = + 0.5
Bubble diameter	4 cm ±0.5cm
Mach number and corresponding flow velocity M / U_{flow}	M= 1.05 / U_{flow}= 28 m/s M= 1.2 / U_{flow}= 105 m/s M= 1.5 / U_{flow}= 240 m/s M= 1.7 / U_{flow}= 320 m/s

Results

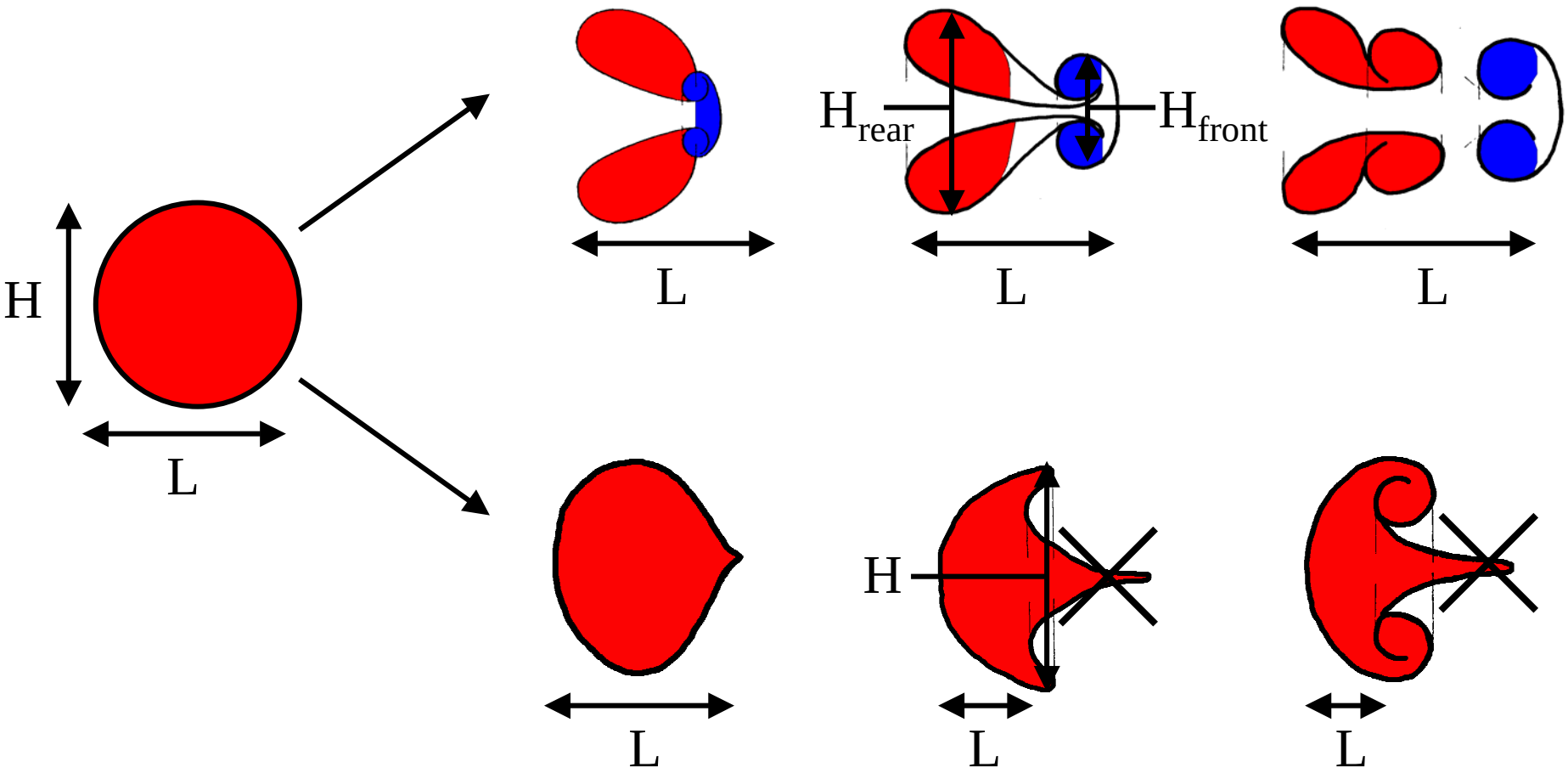
Results: Helium bubble in air M = 1.24



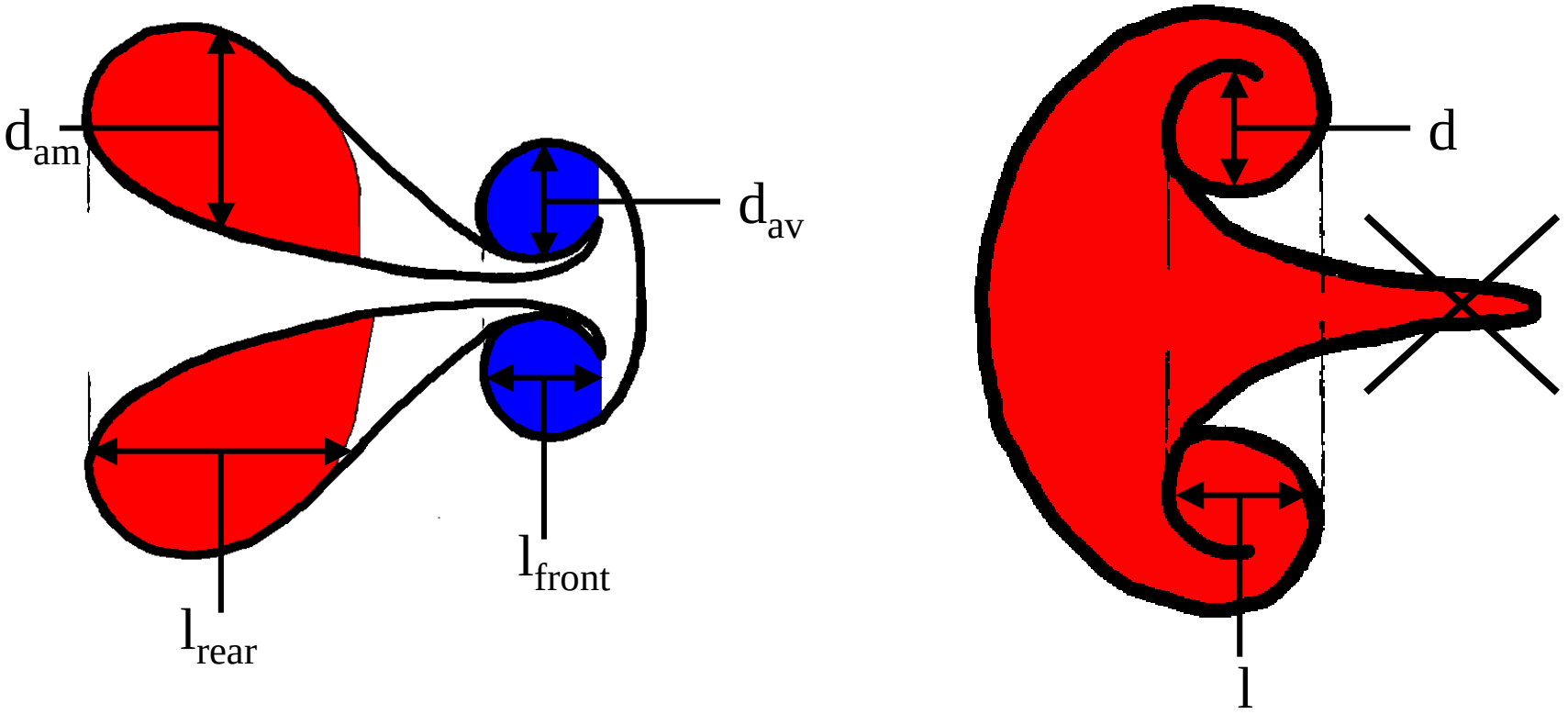
Results: Krypton bubble in air M = 1.45



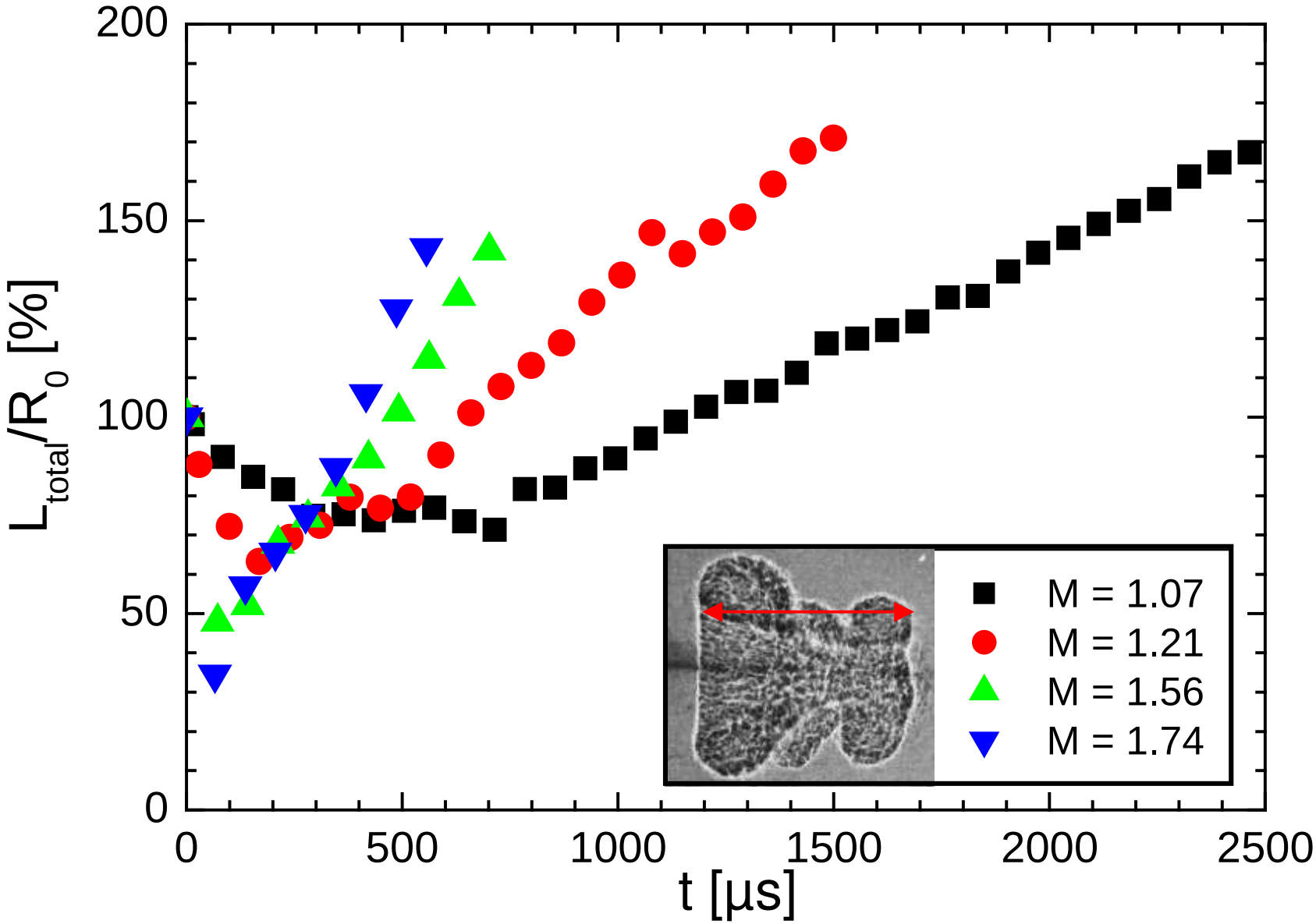
Results: inhomogeneity sizes



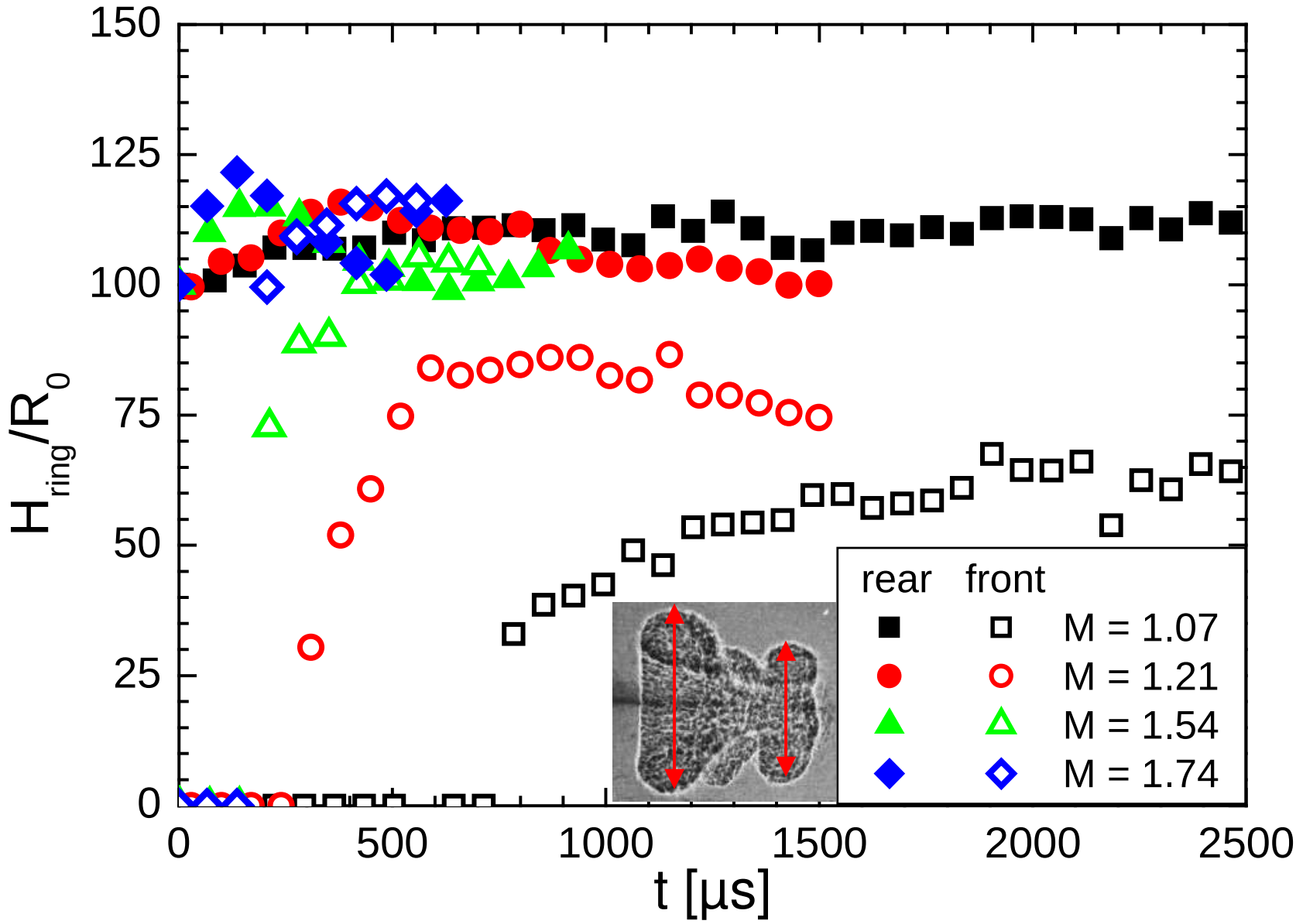
Results: vortex sizes



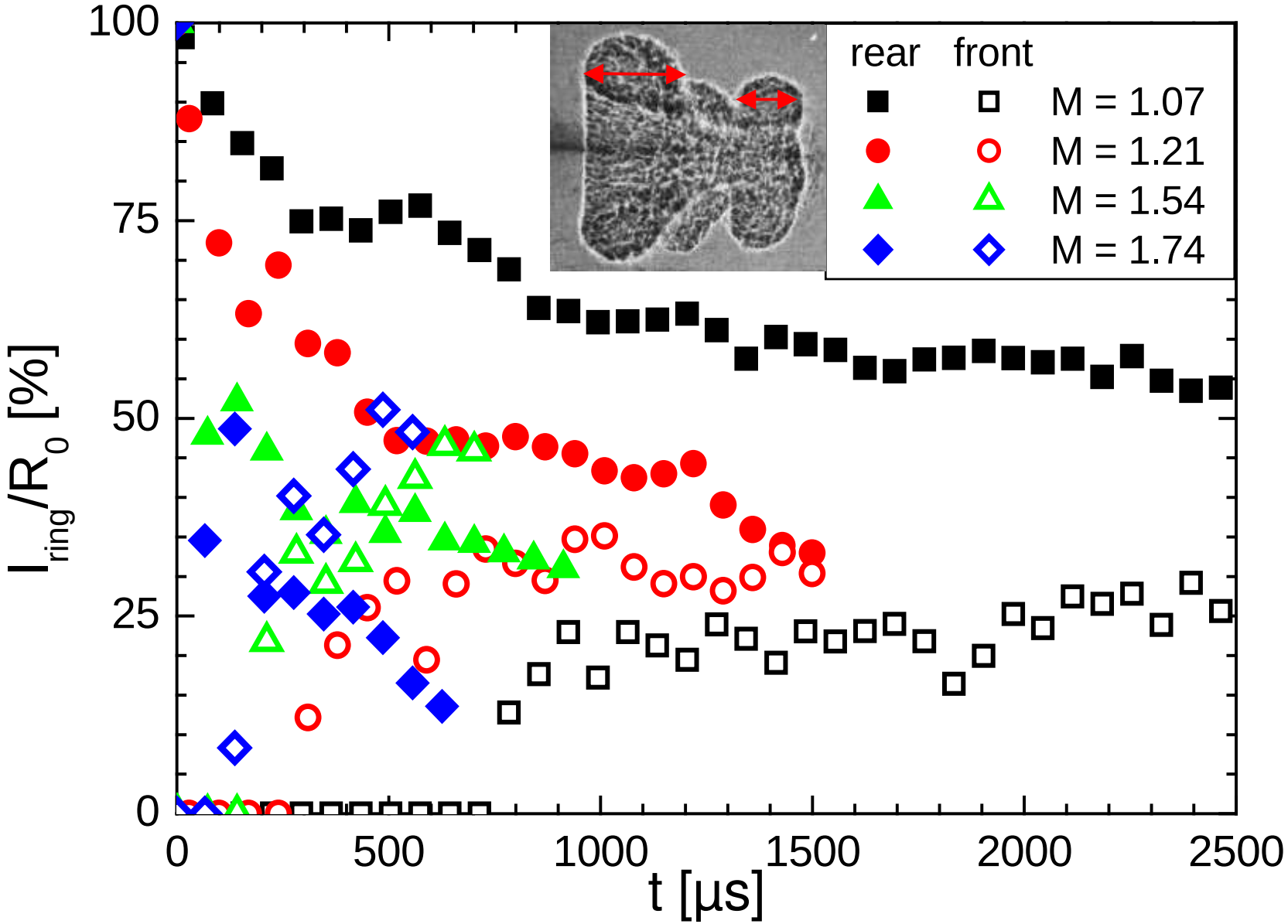
Results: helium bubble in air



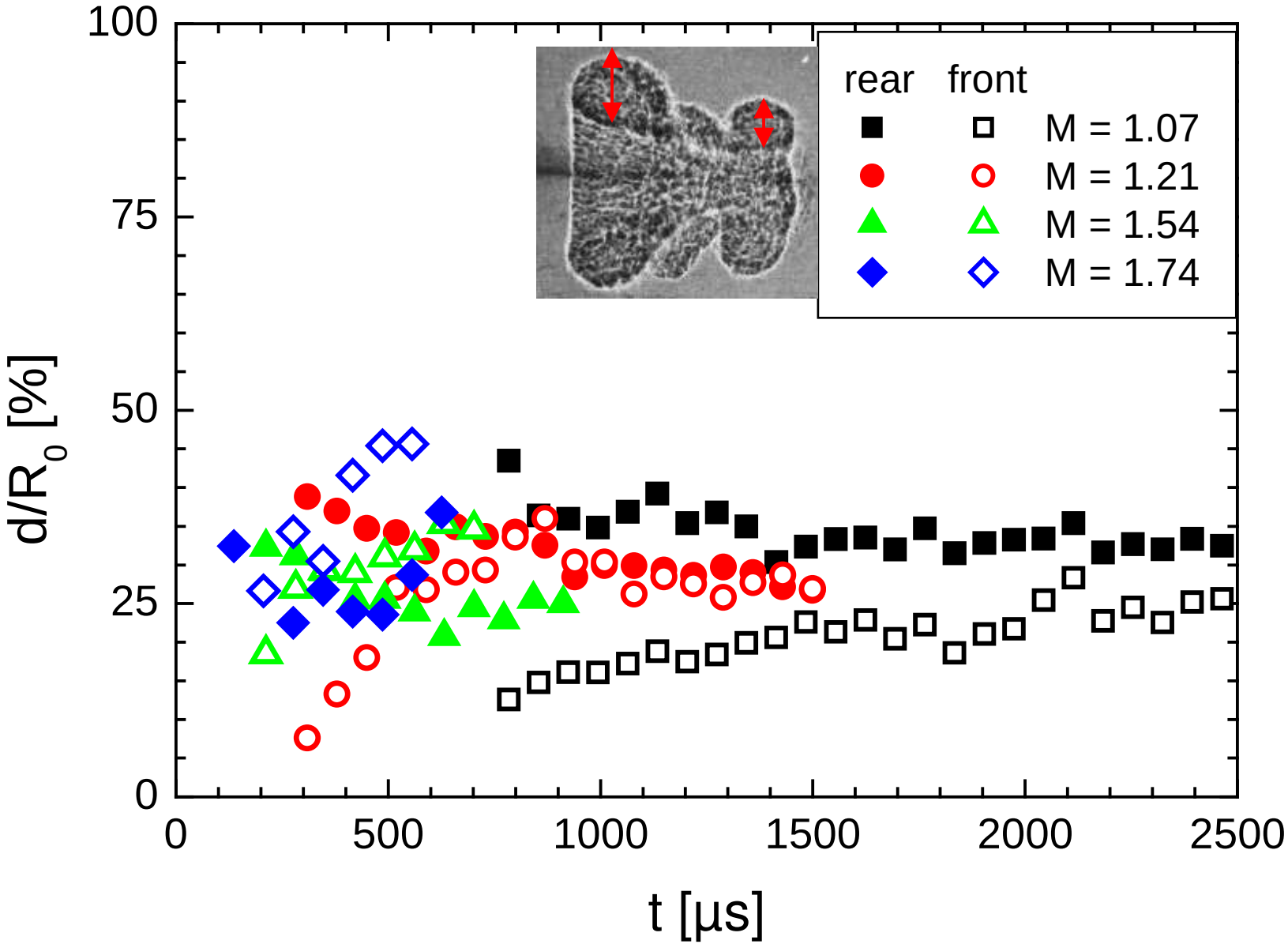
Results: helium bubble in air



Results: helium bubble in air



Results: helium bubble in air



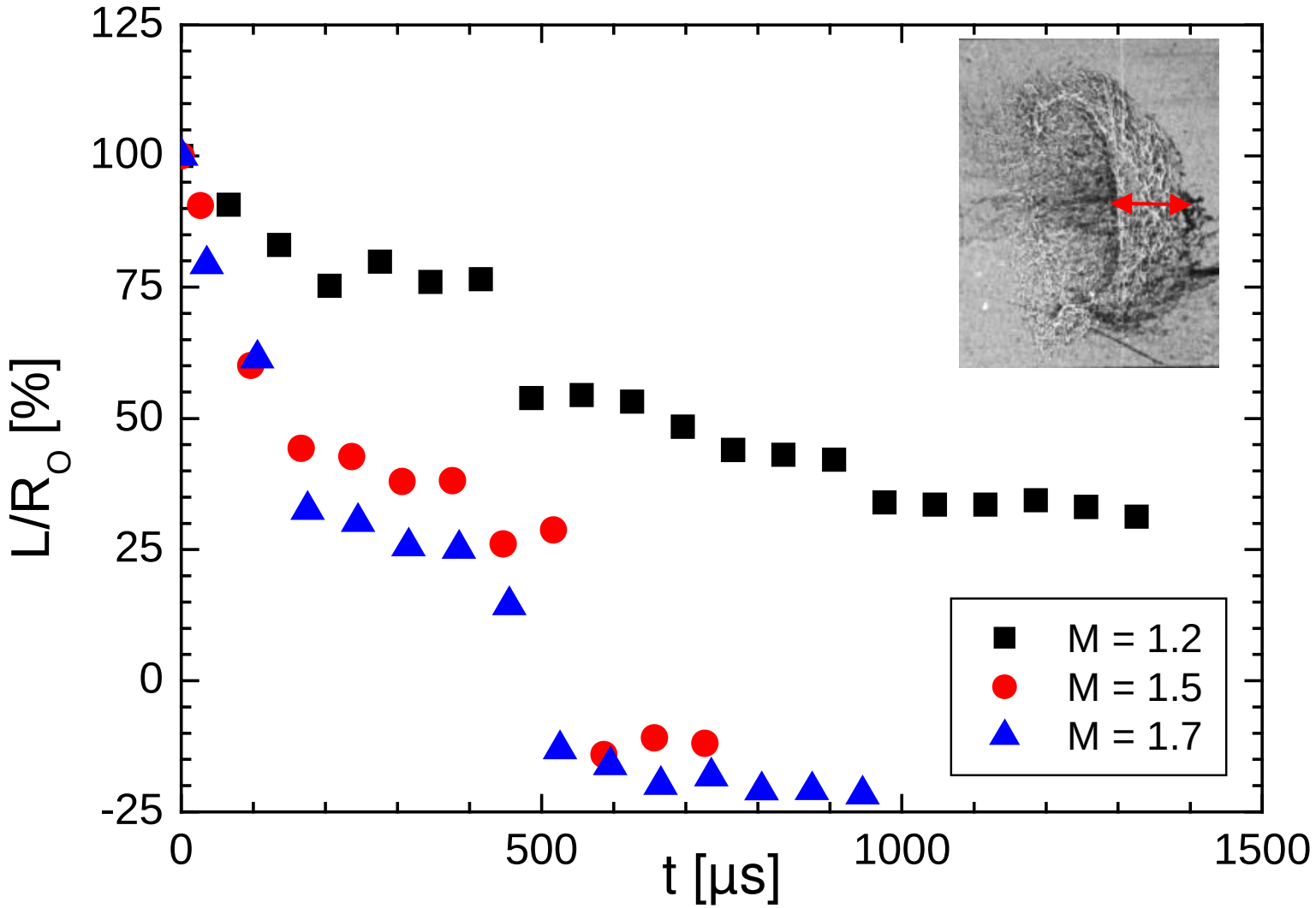
Helium results summary

The stronger the shock wave is,
- the faster the reversal and the separation phases are. This last phase equally illustrates the difference of velocity between front and rear rings.
- the lower the compression length value is.
- the faster the front ring sizes increase whereas the rear ring sizes decrease.

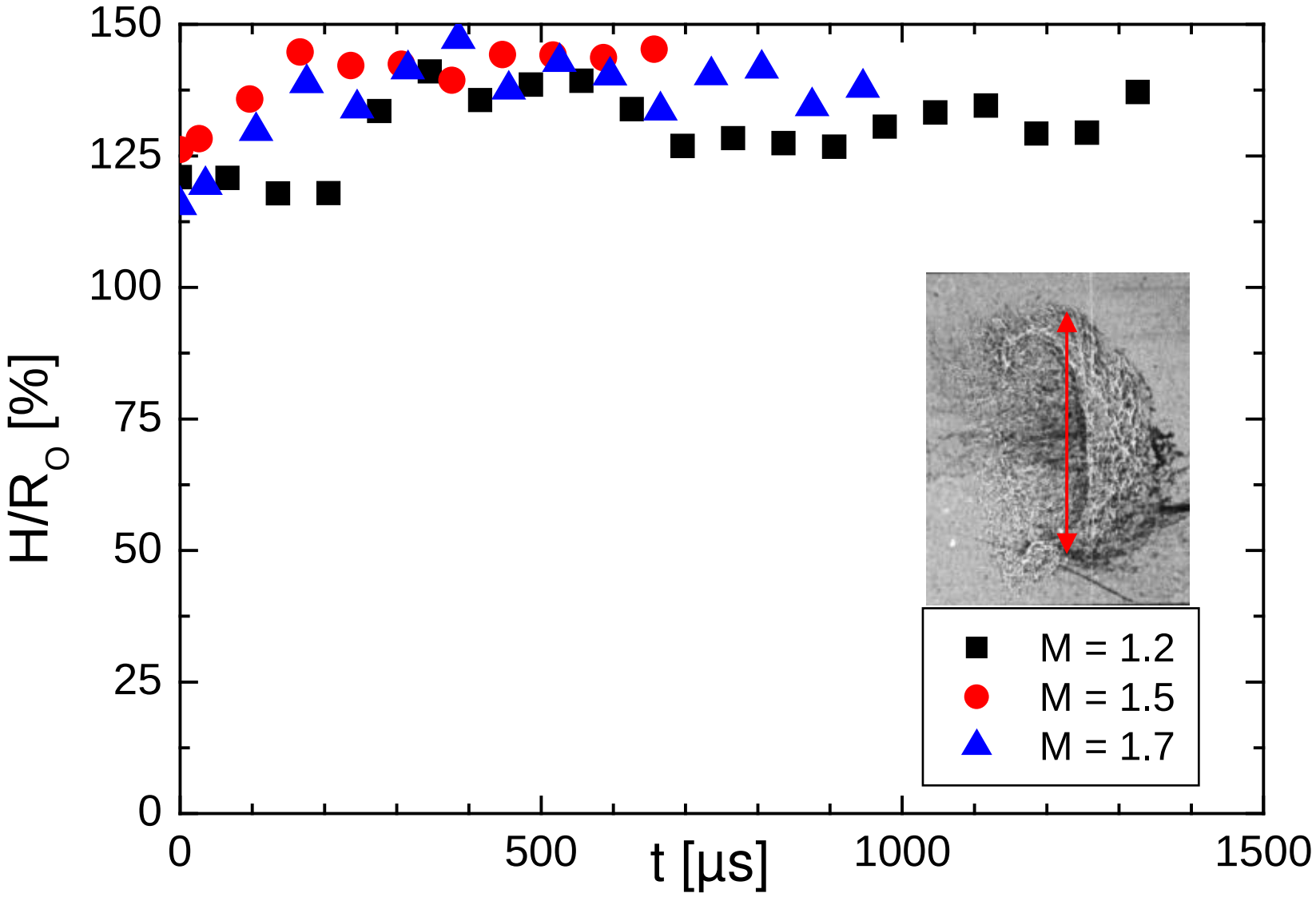
The last point, as well as the experiment films, suggest a mass transfer from the rear ring to the front one.

Sizes seem to tend to reach a stabilization stage.

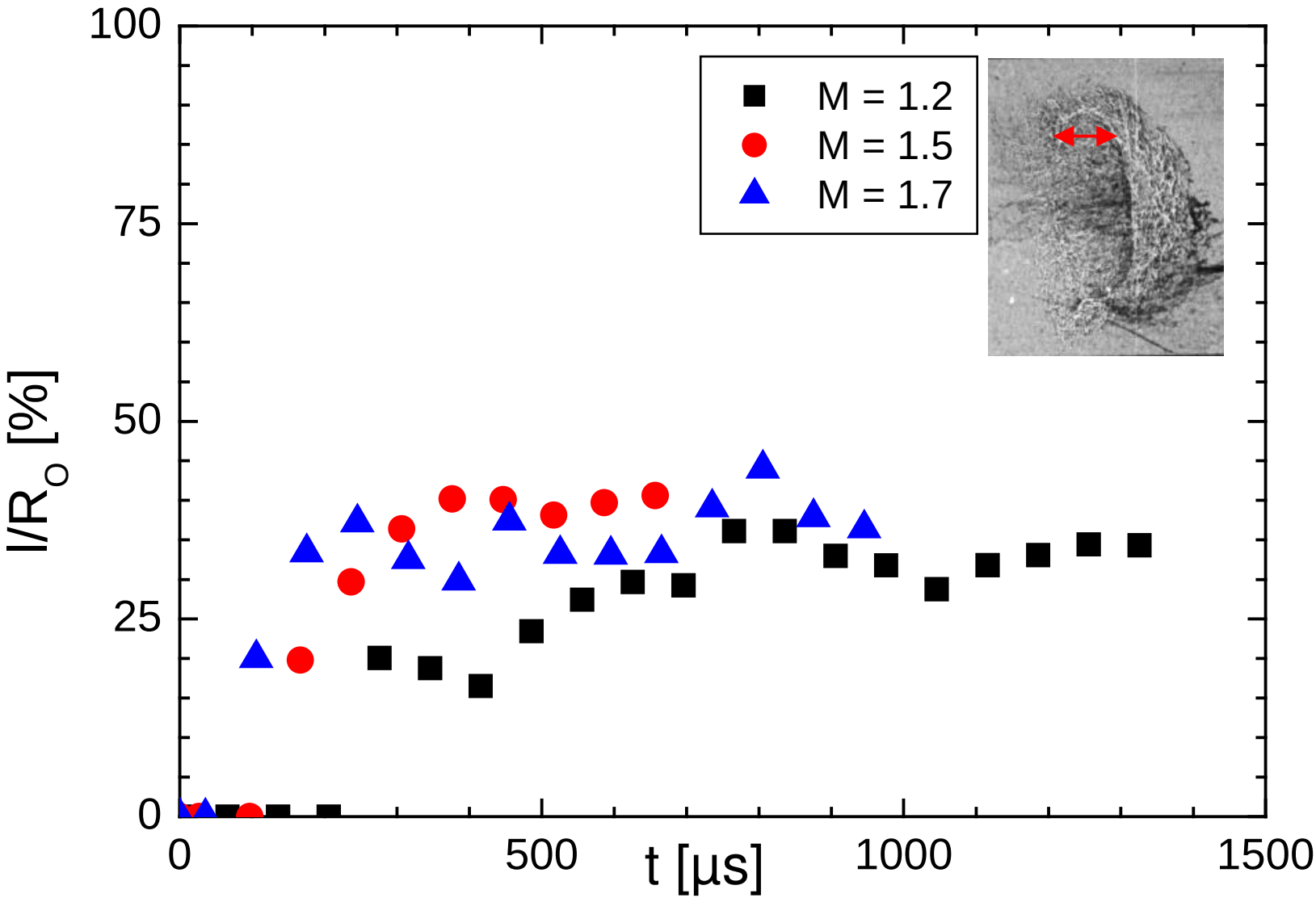
Results: krypton bubble in air



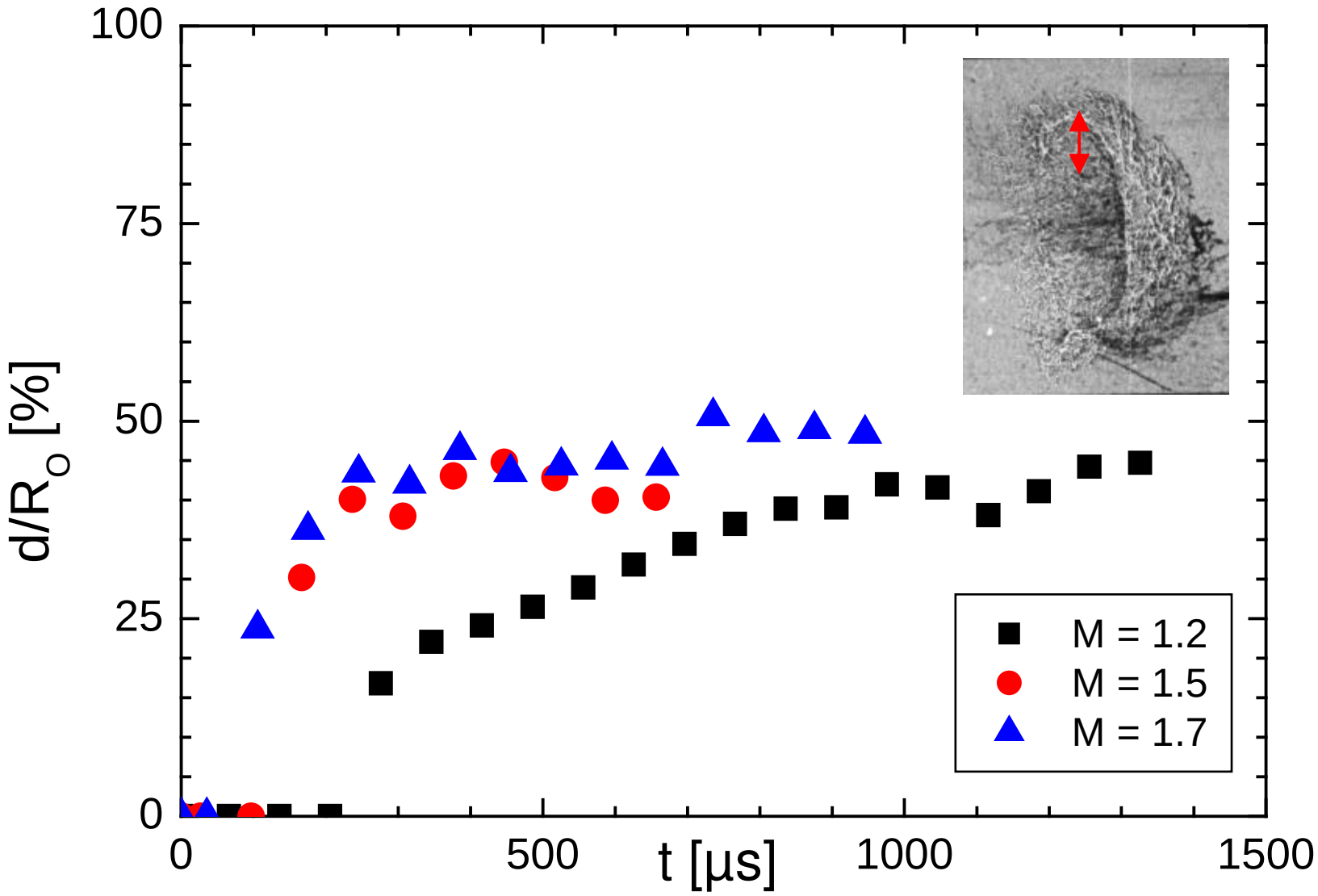
Results: krypton bubble in air



Results: krypton bubble in air



Results: krypton bubble in air



Krypton results summary

The stronger the shock wave is,
- the faster the axial length decreases. It may result in a reversal phase for high Mach number (M >1.5)
- the faster the growth of the vortex is.

These points, as well as the experiment films, suggest a mass transfer from the body of the inhomogeneity to the vortex ring.

Sizes seem to tend to reach a stabilization stage.

Summary

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A final stage tends to be reached whatever the Mach number is, but its characteristics depend on the initial incident shock wave Mach number.

A mass transfer seems to occur in both cases (H/L and L/H) from low vortical area to high ones.

Difficulties have been encountered in measurement of L/H case.

Next step...

Work in progress

- Measurements of other sizes. Mainly the velocity (*24th ISSW, Beijing, July 2004*) and vortex pair spacing.
- Repetition of experiments in similar conditions to check results
- Comparison with numerical simulation (*Giordano et al, 9th IWPCTM, Poster*)
- Comparison with previous work

Next step…

- Shock/multiple bubbles interaction

- Improvement of the diagnostic device to obtain more accurate measurements