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

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# *Topics of discussion*

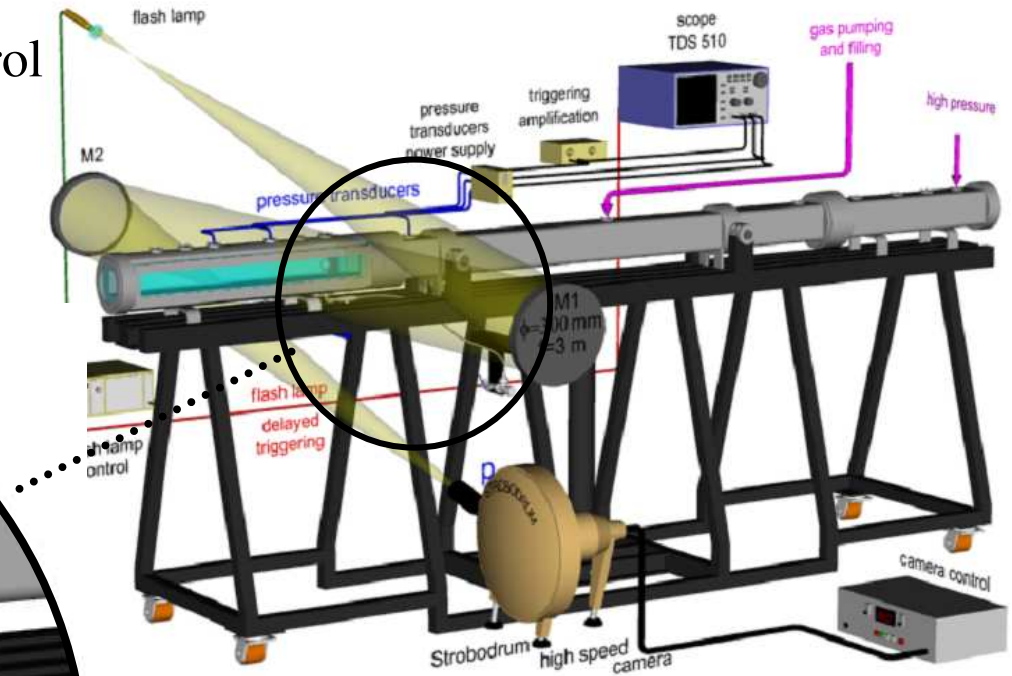
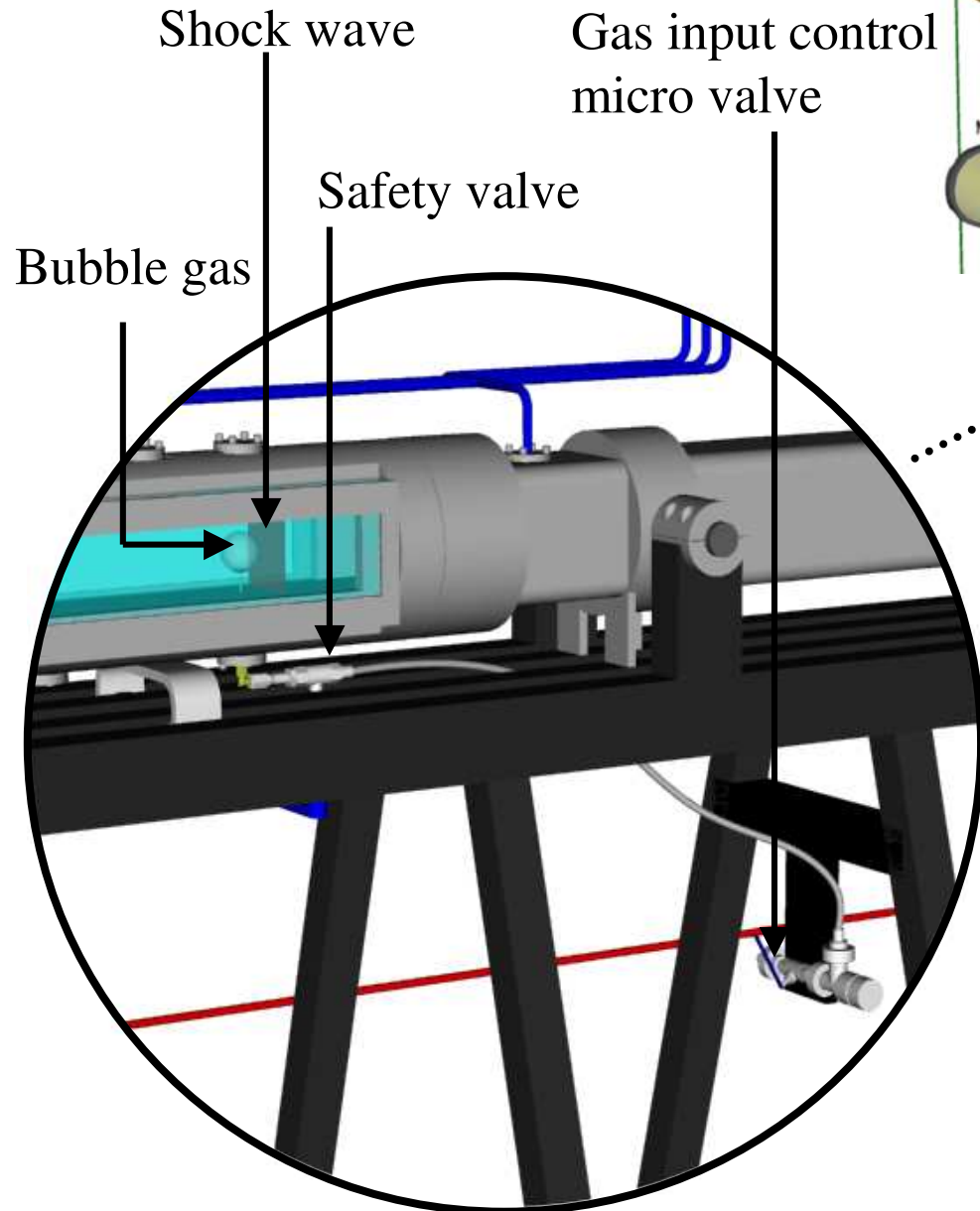
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- *Experimental set-up*
- *Results*
- *Summary*
- *Next step...*

# *Experimental* *Set-up*

# Experimental set-up: Bubble injector



Bubble diameter  
 $4 \pm 0.5$  cm

Bubble gas:

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

# Results: Experimental conditions

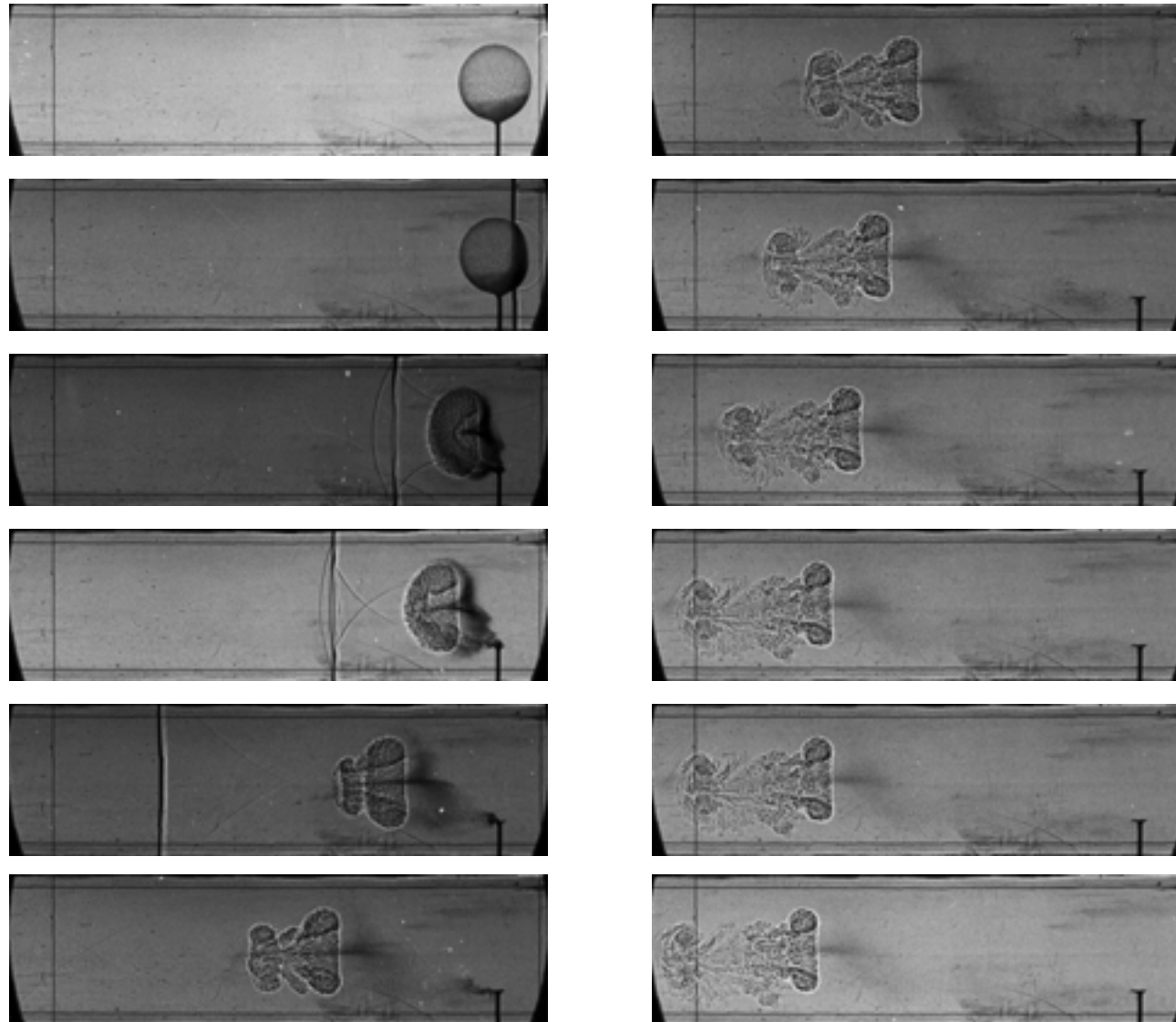
Surrounding gas	air at atmospheric pressure and temperature
Bubble gas	helium $At = - 0.8$ nitrogen $At = - 0.1$ krypton $At = + 0.5$
Bubble diameter	$4 \text{ cm} \pm 0.5\text{cm}$
Mach number and corresponding flow velocity $M / U_{\text{flow}}$	$M = 1.05 / U_{\text{flow}} = 28 \text{ m/s}$ $M = 1.2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

# *Results*

# Results: Helium bubble in air $M = 1.24$

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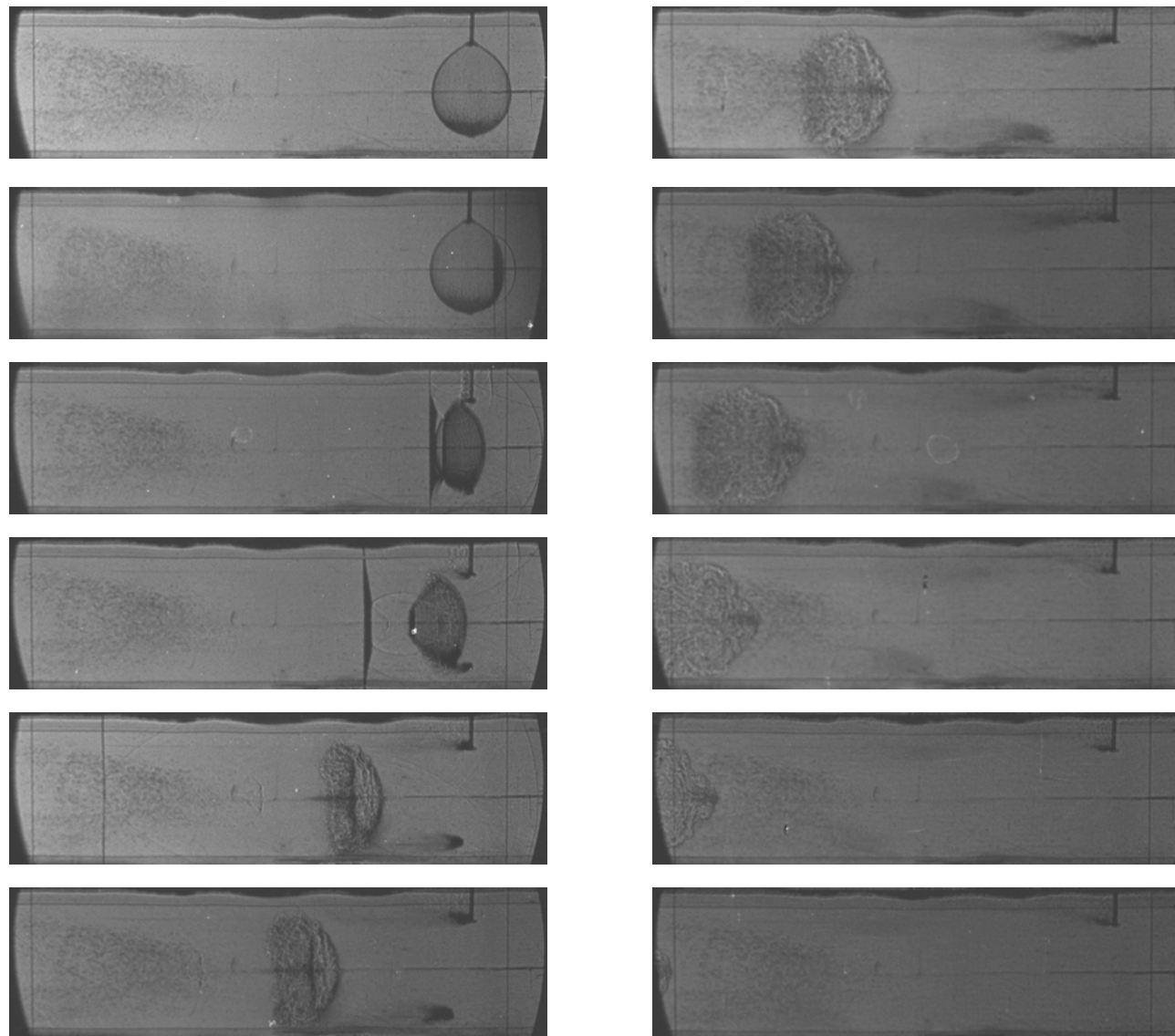
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# *Results: Krypton bubble in air* $M = 1.45$

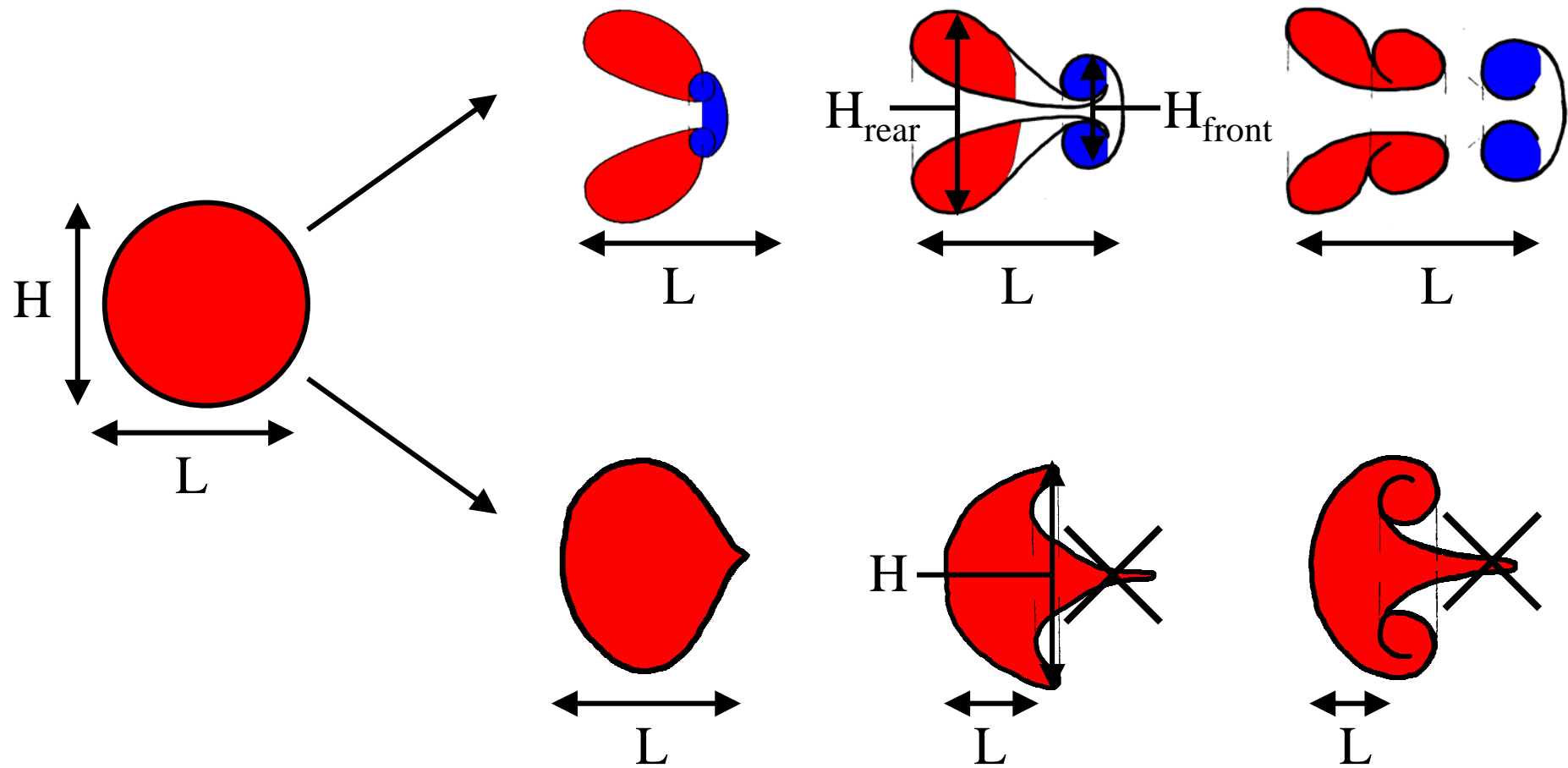
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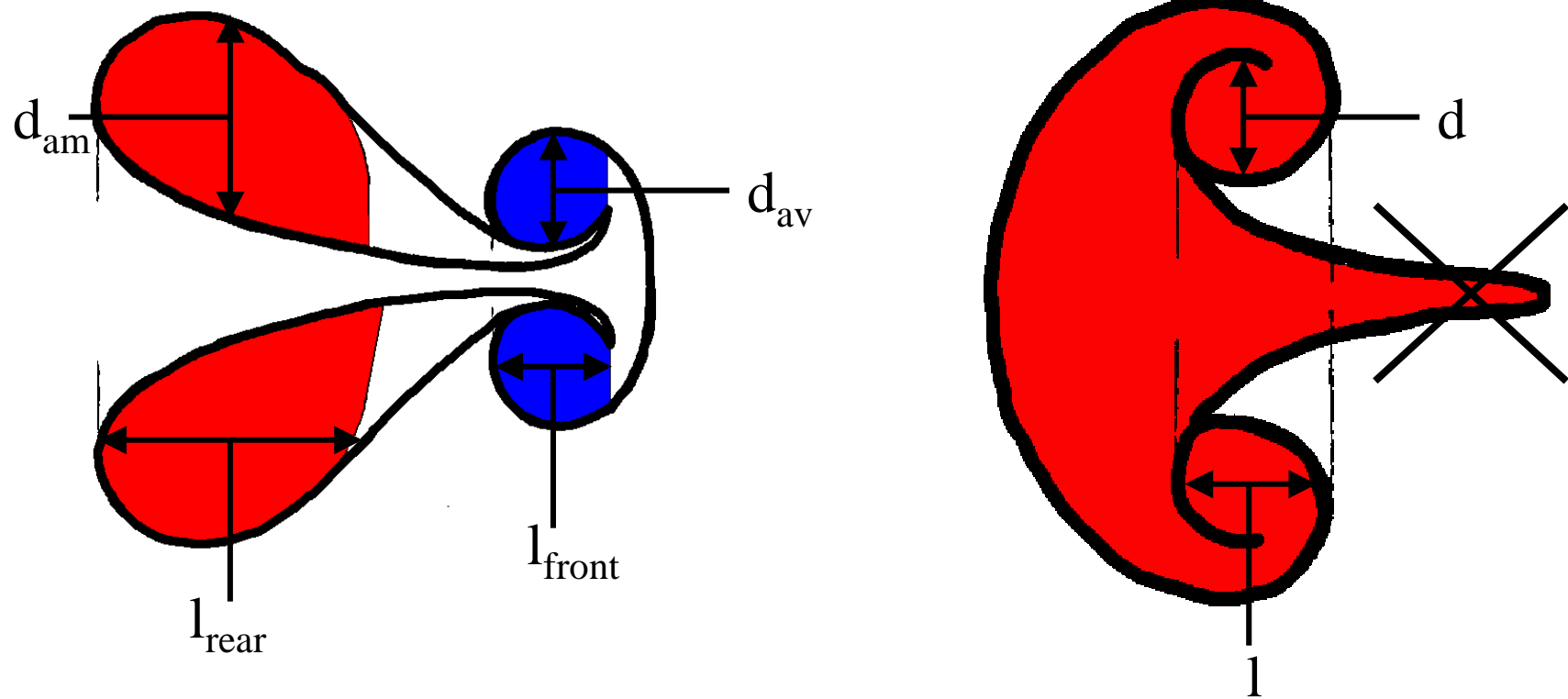




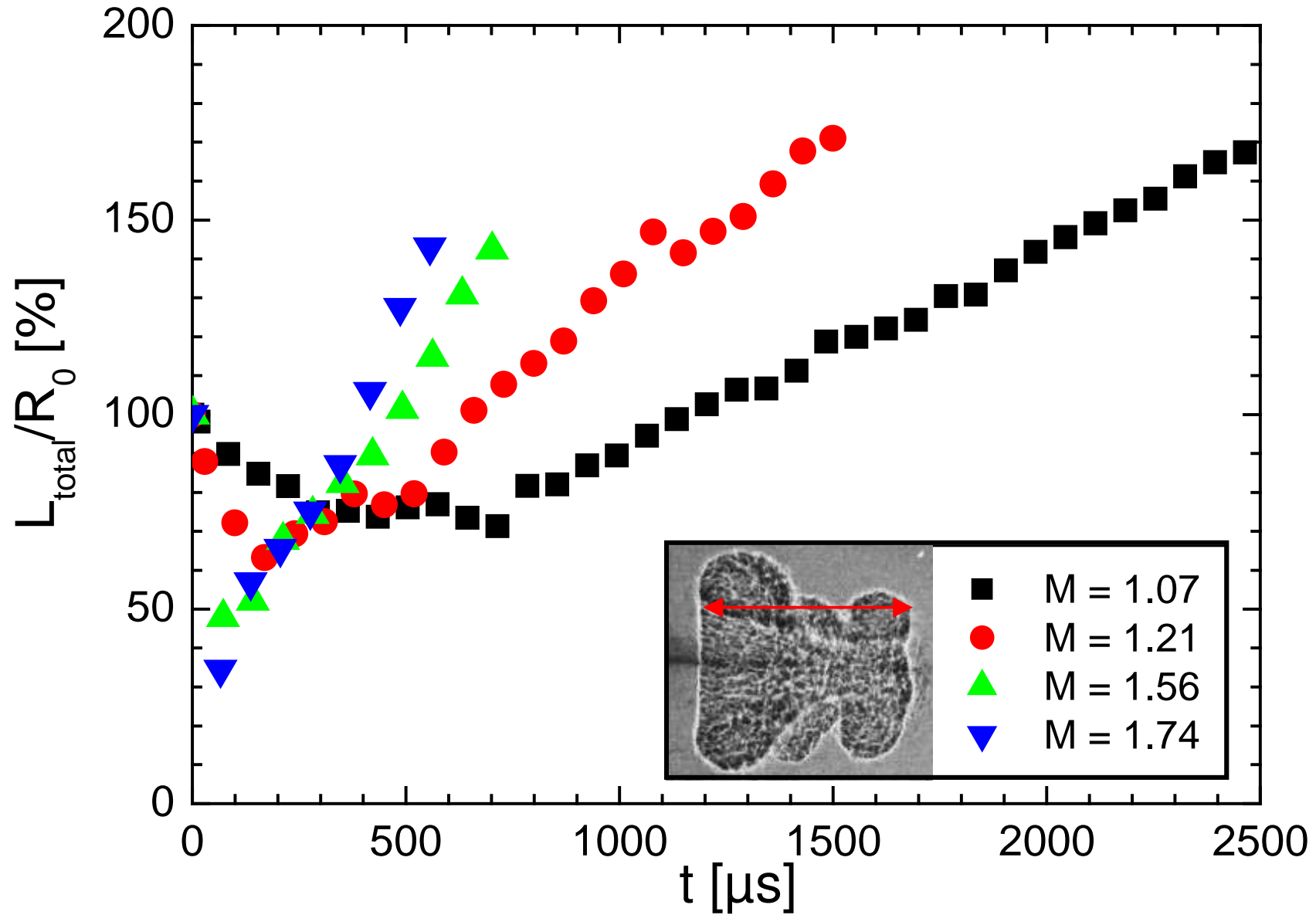
# Results: inhomogeneity sizes



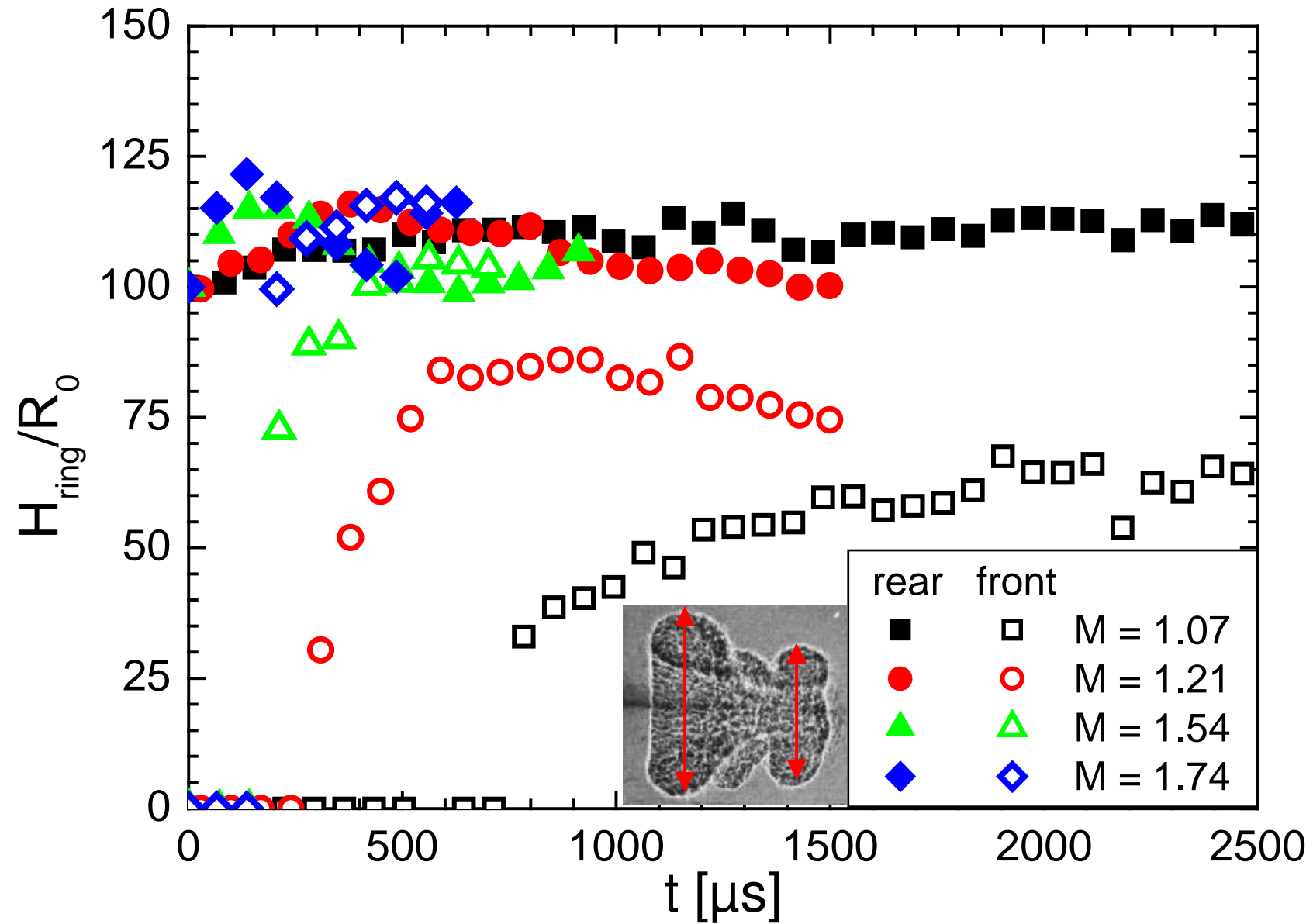
# Results: vortex sizes



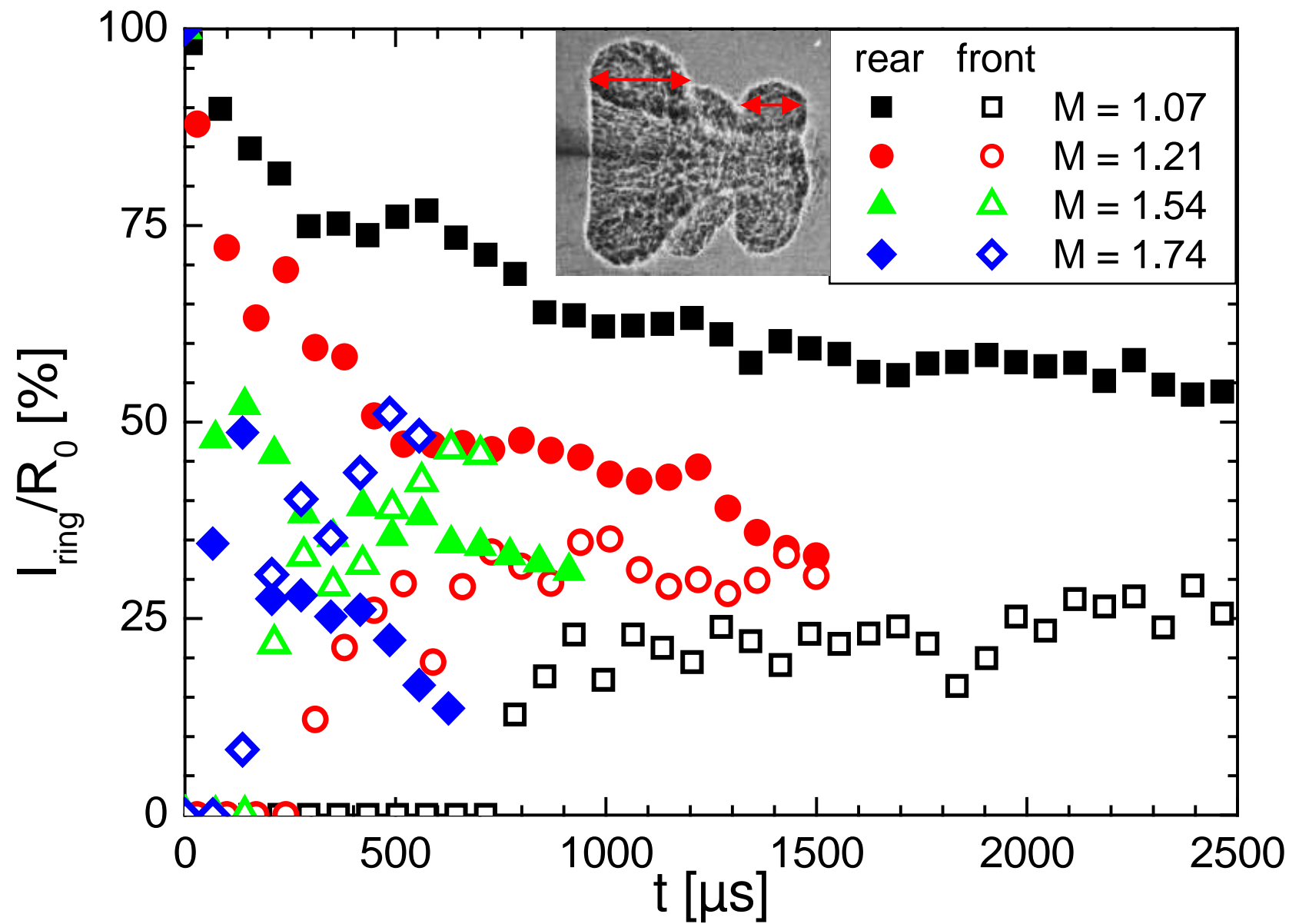
# Results: helium bubble in air



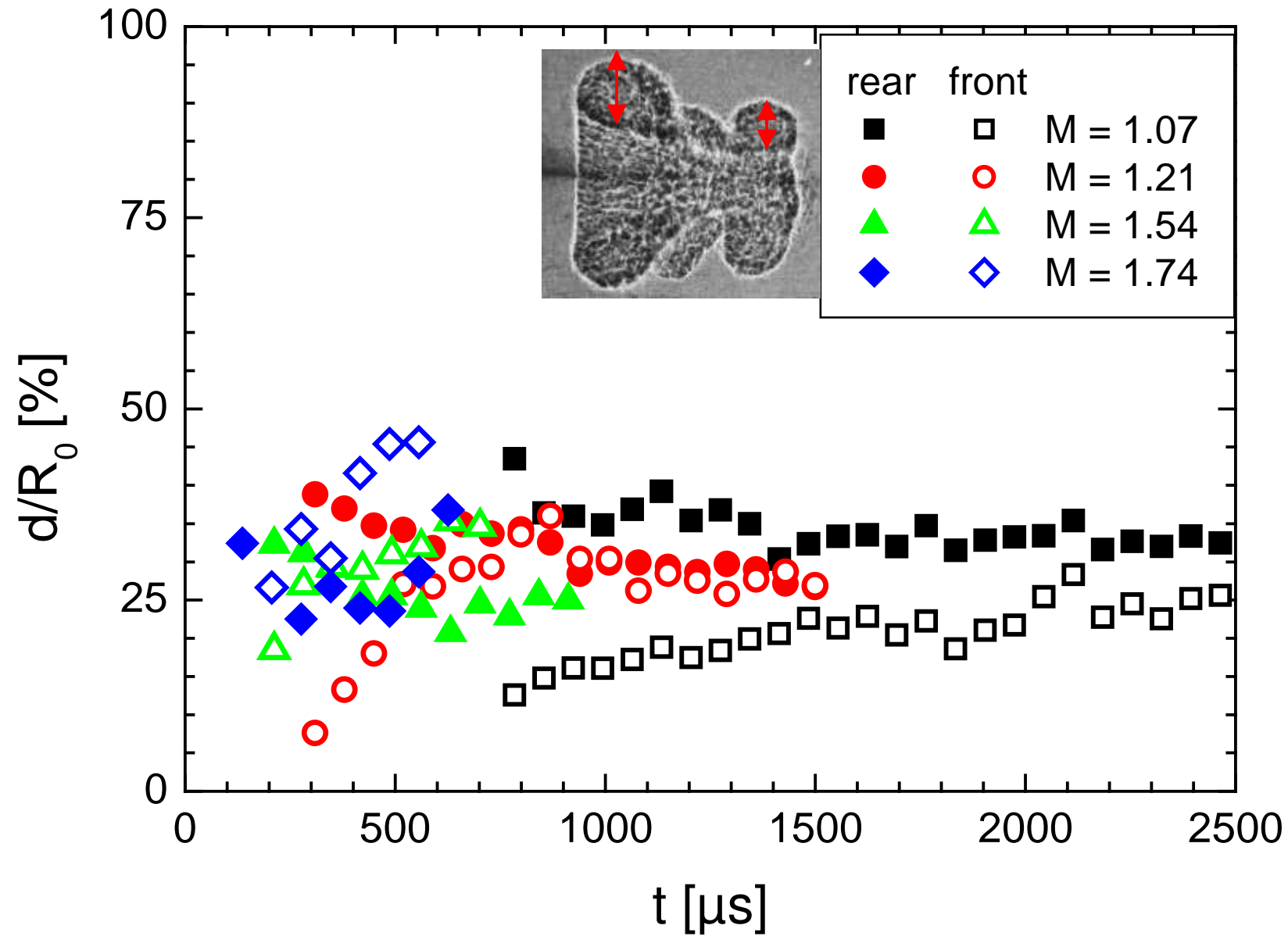
# Results: helium bubble in air



# Results: helium bubble in air



# Results: helium bubble in air



# *Helium results summary*

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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.

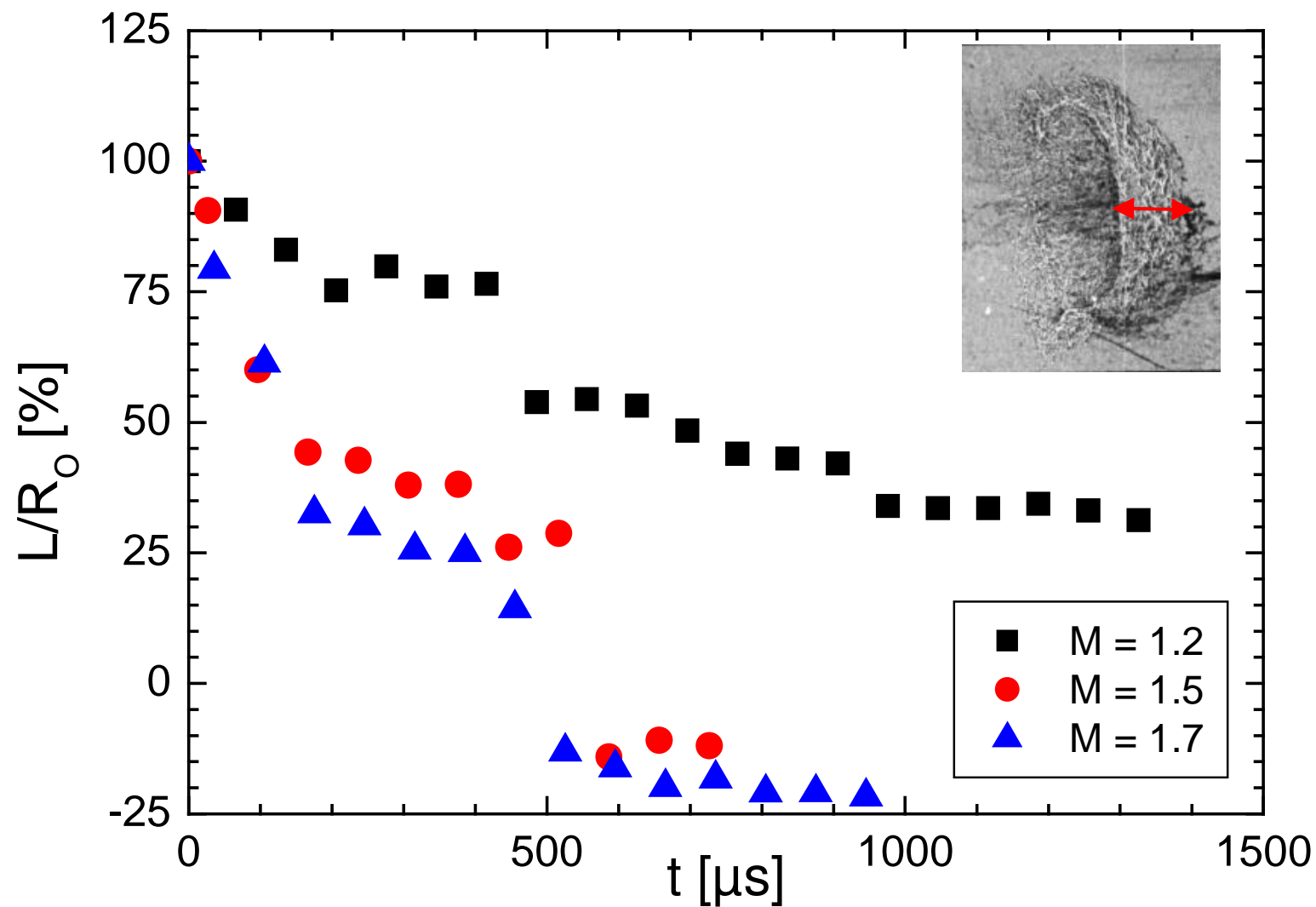
- the lower the compression length value is.

- 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.

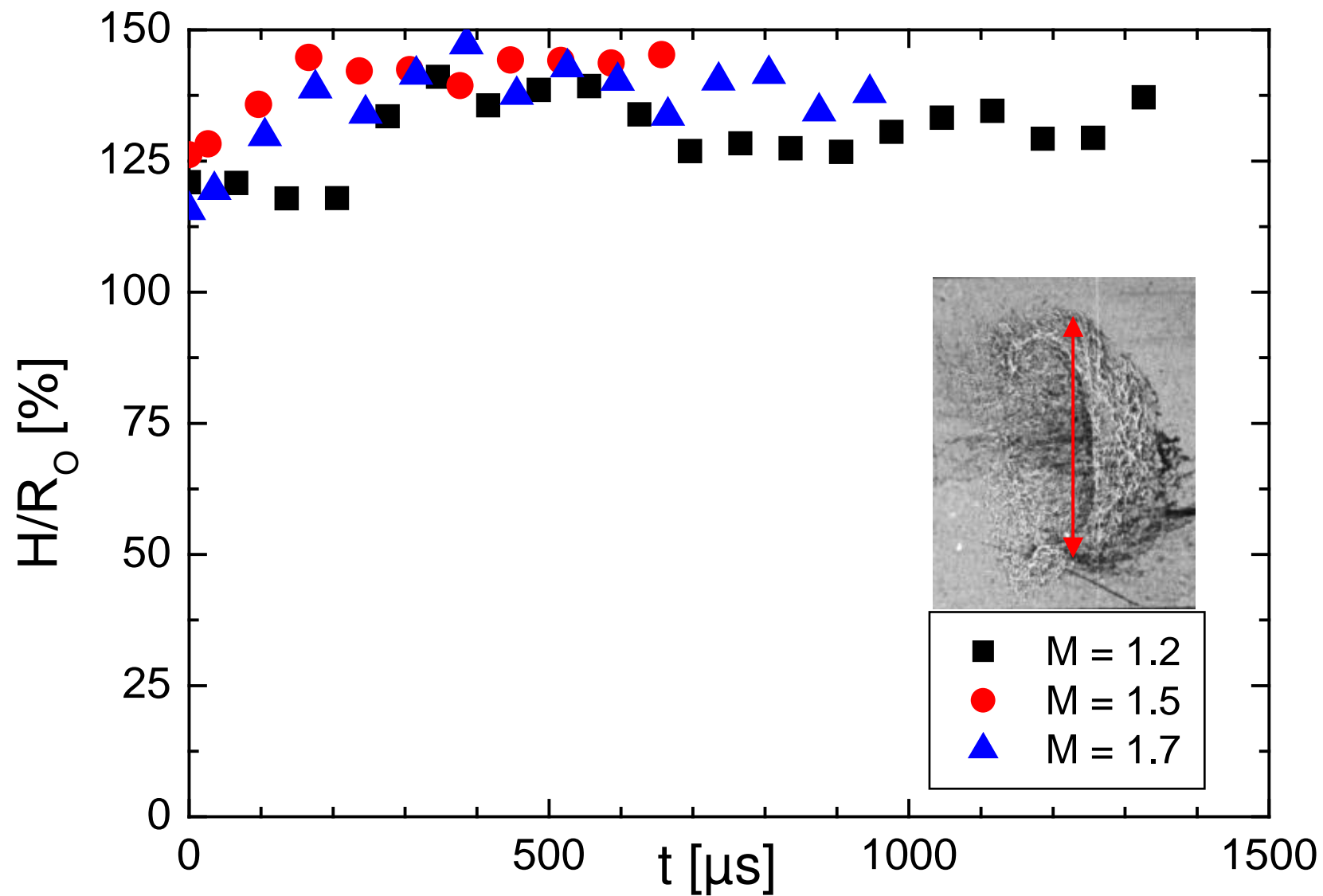
Sizes seem to tend to reach a stabilization stage.

# Results: krypton bubble in air

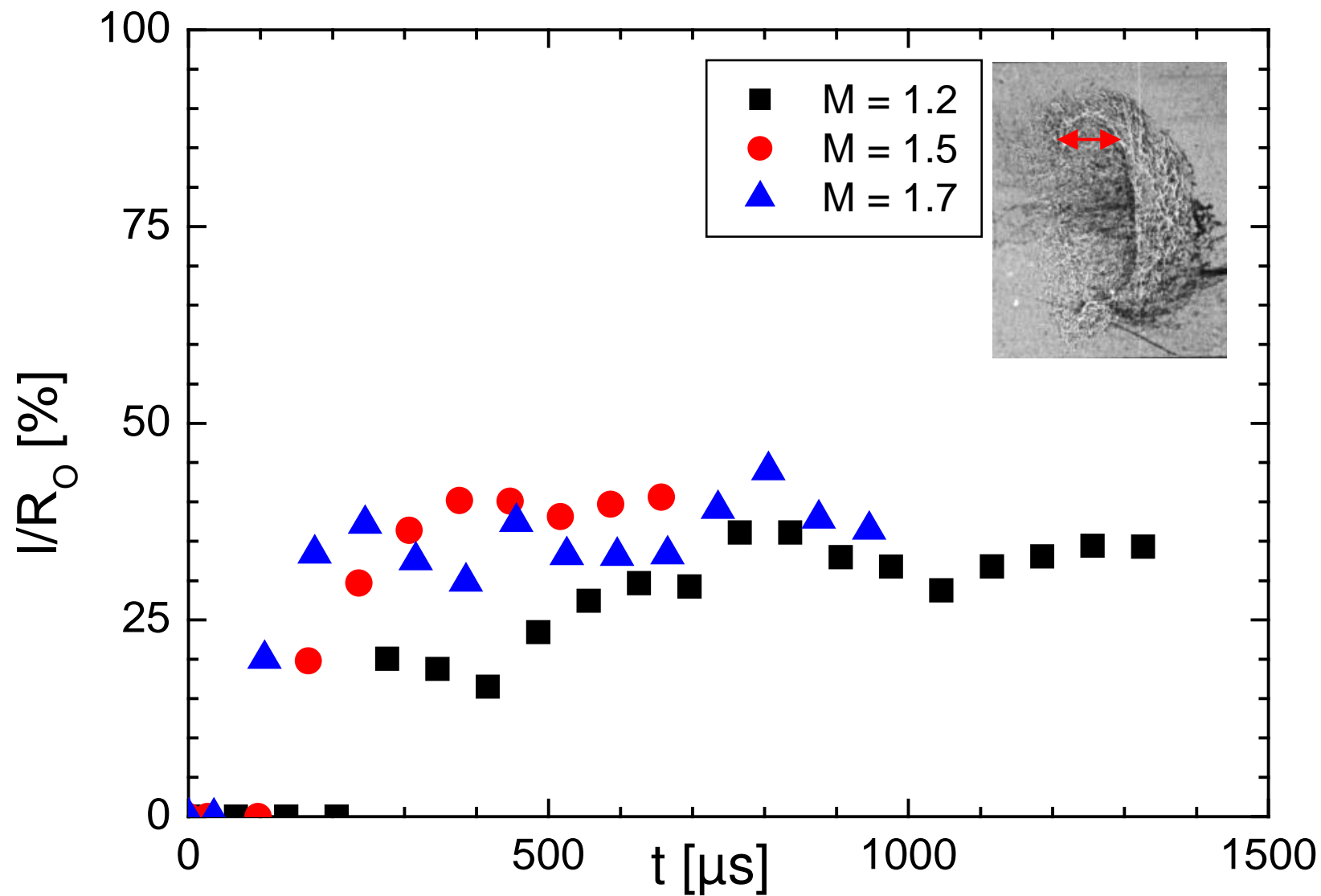




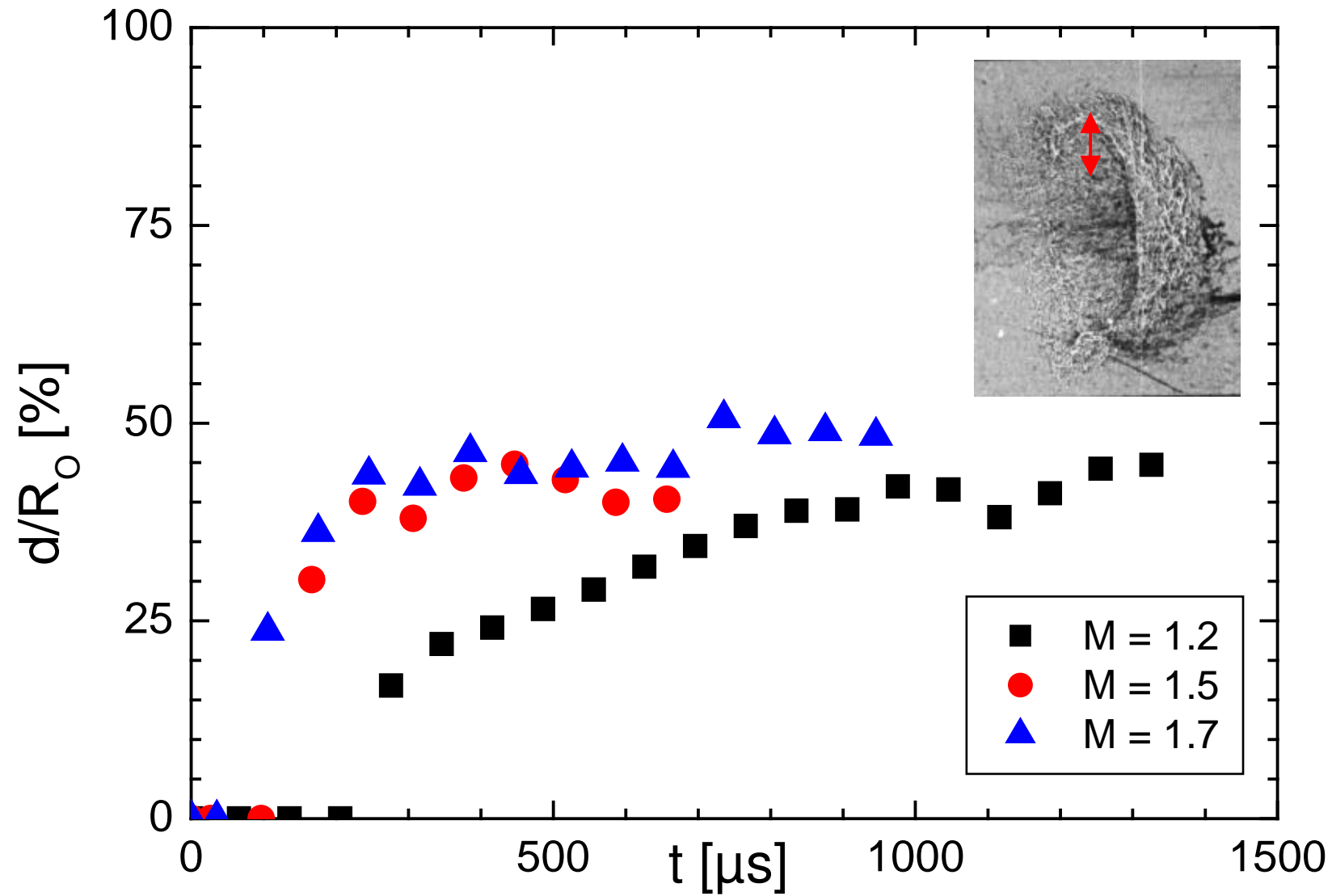
# Results: krypton bubble in air



# Results: krypton bubble in air



# Results: krypton bubble in air



# *Krypton results summary*

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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*

# 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*

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- 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 IWPCMTM, Poster*)
- Comparison with previous work

## *Next step...*

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- Shock/multiple bubbles interaction
- Improvement of the diagnostic device to obtain more accurate measurements