Observation of star-shaped surface gravity waves.

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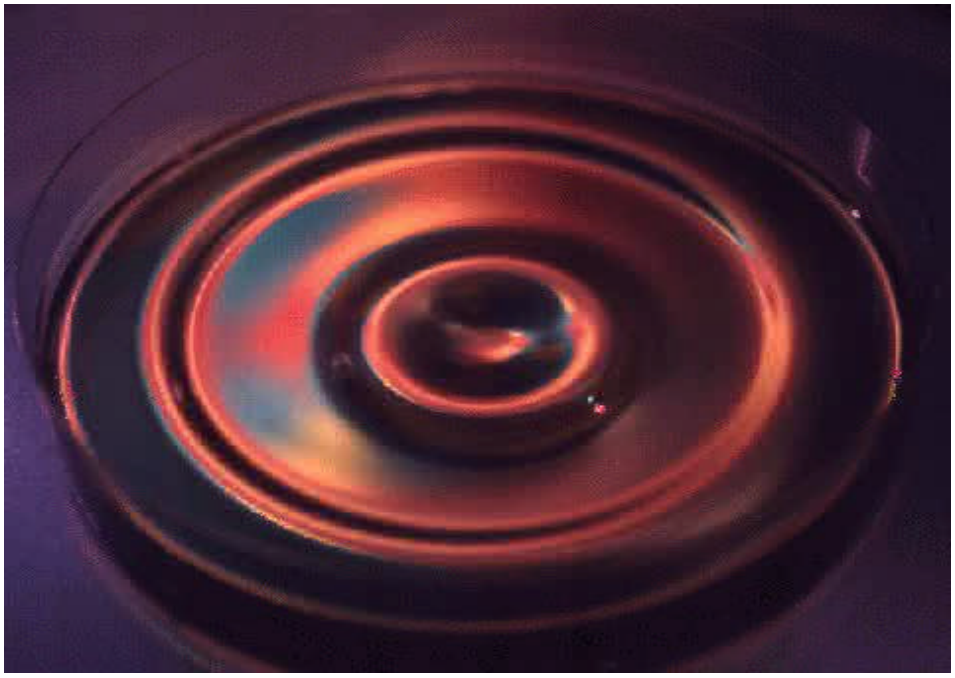

Fig. 1. Axisymmetric surface waves in a cylindrical container (diameter 9 cm, filling level 7 mm, liquid viscosity : 10 times that of water). These waves are parametrically excited by a vertical sinusoidal motion of the container (vibration amplitude = 1,70 mm) and oscillate subharmonically with the driving frequency (here $\Omega /2 \pi = 8$ Hz).The inner and outer crests move contrapropagatively, and experience a phase shift when crossing.

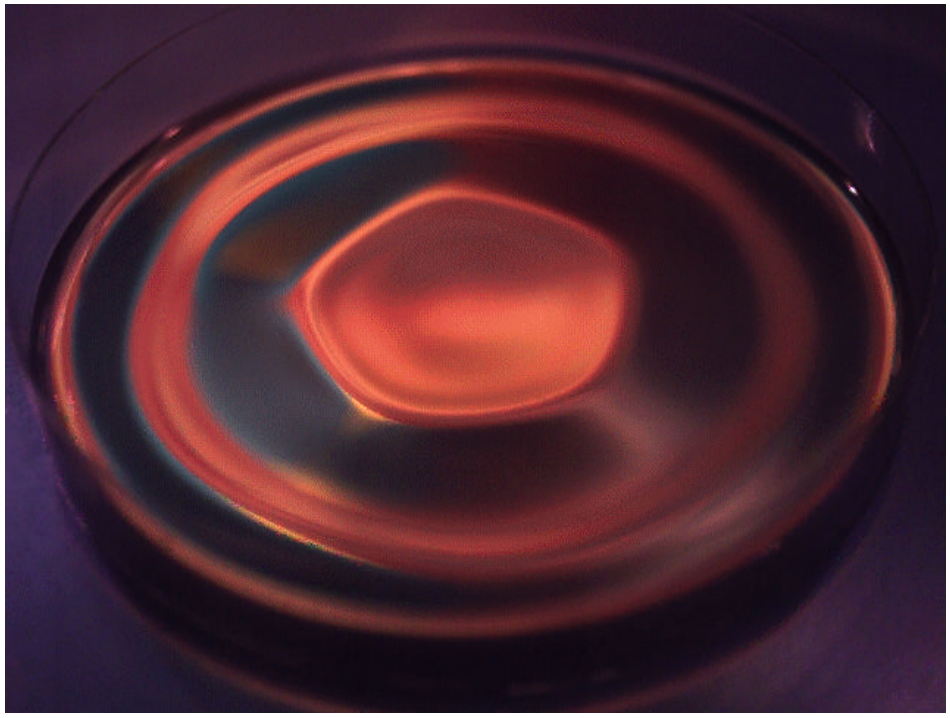

Fig. 2. For a larger vibration amplitude of the cell, we observe a deformation of the axisymmetric crest, with the appearance of five corners. This is the signature of a symmetry breaking (filling level 7 mm, driving frequency $\Omega/2\pi$ = 8 Hz,vibration amplitude 1.85 mm)

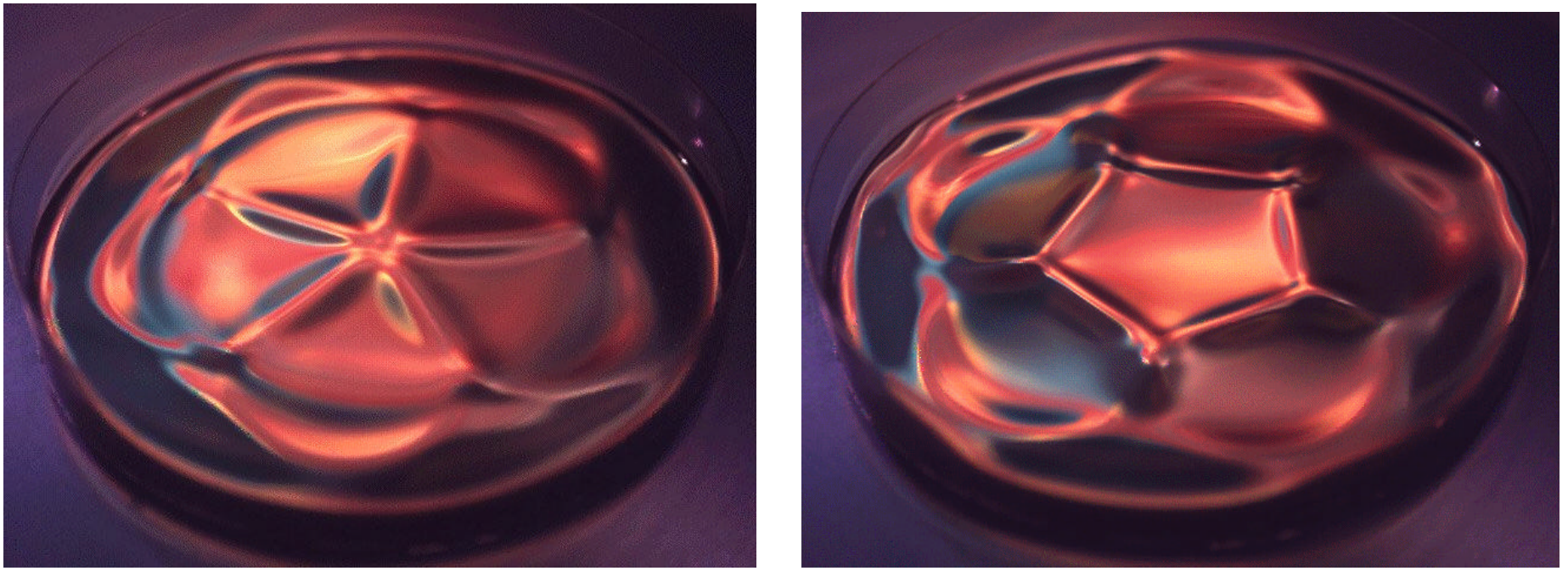

Fig. 3. A new type of standing wave appears for a vibration amplitude of 1.95 mm (filling level 7 mm, driving frequency $\Omega/2\pi$ = 8 Hz),having alternatively the shape of a five-branched star (a) and of a pentagon (b). The occurrence of these shapes is separated by an interval of time which corresponds to the forcing period, i.e. half the pattern period.

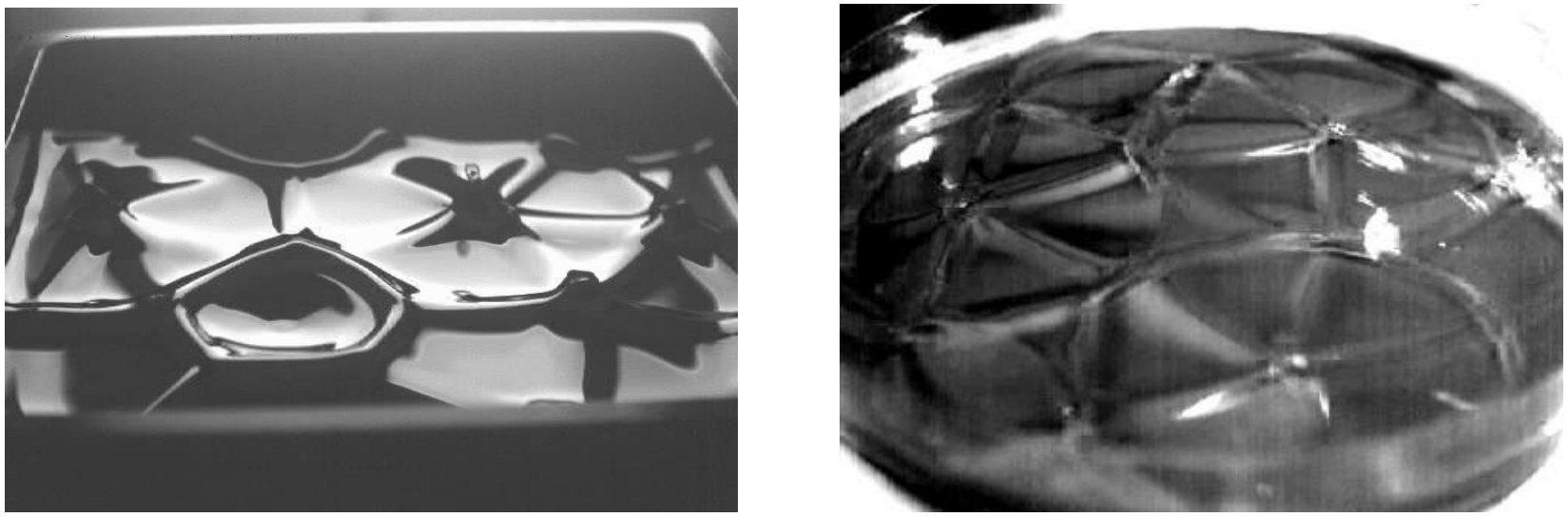

Fig. 4. For identical filling level, vibration parameters and forcing history, the wave pattern is **independent** of the container **shape** and **size**.
(a). In a cylindrical container of radius 17 cm, we observe a tiling of star-shaped waves.
(b). In a square container (17 cm x 17 cm), we observe analogue patterns.

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Movies available at
http://www.unice.fr/rajchenbach/Nonlinear_waves.htm
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