On the transition frequencies of acoustically coupled gas bubbles[1]

MASATO IDA, Center for Computational Science and E-systems, Japan Atomic Energy Agency — The transition frequencies of acoustically coupled gas bubbles are reexamined to further clarify their physical properties. In recent papers we have pointed out that a fundamental component in multibubble systems had been overlooked. We have shown theoretically that a bubble interacting with a neighboring bubble in a sound field has up to three "transition frequencies" which invert the pulsation phase of the bubble [Ida, Phys. Lett. A **297**, 210 (2002)]. The number is larger than that of resonance frequencies of the system and at least one of the three is thus not a resonance frequency. In the following papers we have suggested that the height relation between the newly derived characteristic frequency and the driving frequency determines the sign of the secondary Bjerknes force [Ida, Phys. Rev. E **67**, 056617 (2003)] and that the "avoided crossing" and accompanying state exchange taking place between bubbles can be detected by observing the transition frequencies [Ida, Phys. Rev. E **72**, 036306 (2005)]. We here attempt to clarify several similarities and differences among the natural, resonance, and transition frequencies. This effort thoroughly clarifies the roles of the transition frequencies in bubble-bubble interaction [Ida, Phys. Fluids **17**, 097107 (2005)].

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