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The acoustic excitation mechanism of bubbles released from a nozzle

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At the moment of their formation, bubbles emit a short pulse of sound. Bubble noise is associated with sound from a variety of natural processes, including whitecaps, waterfalls, breaking surf and rain. A number of acoustic excitation mechanisms for bubble noise have been proposed, including the increase in internal pressure of the bubble associated with the Laplace pressure, hydrostatic pressure effects, shape mode to volume mode coupling, and a fluid jet associated with the collapse of the neck of air formed during bubble creation. Using bubbles released from a nozzle as a model system, we have determined that sound production is excited by a sudden decrease in bubble volume driven by the collapse of the neck of gas joining the bubble to its parent. A simple analytical model of neck collapse driven by surface tension energy is in agreement with high speed photographic measurements, and sufficient to explain the details of acoustic excitation. [Work supported by ONR and NSF]