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Sound Bullets in Water

San Diego, Calif., Nov. 19 – Sound waves are commonly used in applications ranging from ultrasound imaging to hyperthermia therapy, in which high temperatures are induced, for example, in tumors to destroy them. In 2010, researchers at Caltech led by Chiara Daraio, a professor of aeronautics and applied physics, developed a nonlinear acoustic lens that can focus high-amplitude pressure pulses into compact "sound bullets." In that initial work, the scientists demonstrated how sound bullets form in solids. Now, they have done themselves one better, creating a device that can form and control those bullets in water.

The nonlinear acoustic lens is constructed from chains strung with stainless-steel spheres that are oriented parallel to one another -- and squeezed together -- to form an array. The gadget was inspired by Newton's cradle, a popular toy that consists of a line of identical balls suspended by wires from a frame. When an end ball is pulled back and released, it slams into the next ball, causing the *last* ball in the line to fly outward. Similarly, in the acoustic lens, striking one end of the array generates compact nonlinear pulses of sound – solitary waves that propagate through the lens and can be tightly focused on a target area; when they coalesce at this focal point, they produce a significantly amplified version: the sound bullet. These intense pressure waves may be used to obliterate tumors or kidney stones – leaving surrounding tissues unharmed – or probe objects like ship hulls or bridges for unseen defects.

In the new work, the lens has been made more accurate, and a waterproof interface, which efficiently transmitted the pulses, was inserted between the chains and water. "We use water as a target medium with the idea that the acoustic lens could be used for underwater imaging and/or biomedical applications," says postdoc Carly Donahue, who helped refine the device.

"Currently, our work is fundamental in nature. We are focused on demonstrating proof of principle and establishing the technical strengths and weaknesses, which will inform the future design of engineering devices for specific applications," she adds. "For example, using these systems in biomedical applications requires reducing their dimensions and learning about the related scaling effects. Creating commercially viable devices will require the involvement of industrial partners."

Donahue discusses the technology and its potential applications in a talk at the American Physical Society's (APS) Division of Fluid Dynamics (DFD) meeting, held Nov. 18 – 20 in San Diego, Calif.

Presentation: "An Experimental Study of a Nonlinear Acoustic Lens Interfaced with Water," is at 4:45 p.m. on Sunday, Nov. 18, in Room 30E.
Abstract: http://meeting.aps.org/Meeting/DFD12/Event/177560

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MORE MEETING INFORMATION

The 65th Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics will take place from November 18-20, 2012, in San Diego, Calif. It will bring together researchers from across the globe to address some of the most important questions in modern astronomy, engineering, alternative energy, biology, and medicine. All meeting information, including directions to the Convention Center, is at: http://apsdfd2012.ucsd.edu/

USEFUL LINKS
Main Meeting Web Site: http://apsdfd2012.ucsd.edu/
Searchable Abstracts: http://meeting.aps.org/Meeting/DFD12/APS_epitome
Directions and Maps: http://apsdfd2012.ucsd.edu/?page=Venue_and_Maps

PRESS REGISTRATION
Credentialed full-time journalists and professional freelance journalists working on assignment for major publications or media outlets are invited to attend the conference free of charge. If you are a reporter and would like to attend, please contact Charles Blue (dfdmedia@aps.org, 301-209-3091).

SUPPORT DESK FOR REPORTERS
A media-support desk will be available. Press announcements and other news will be available in the Virtual Press Room (see below).

VIRTUAL PRESS ROOM
The APS Division of Fluid Dynamics Virtual Press Room will be launched in mid-November and will feature news releases, graphics, videos, and other information to aid in covering the meeting on site and remotely. See: http://www.aps.org/units/dfd/pressroom/index.cfm

GALLERY OF FLUID MOTION
Every year, the APS Division of Fluid Dynamics hosts posters and videos that show evocative images and graphics from either computational or experimental studies of flow phenomena. The outstanding entries are selected for their artistic content, originality, and ability to convey information. They will be honored during the meeting, placed on display at the 2013 APS March Meeting, and appear in the annual Gallery of Fluid Motion article in the American Institute of Physics' journal, Physics of Fluids.

Selected entries from the Gallery of Fluid Motion will be hosted as part of the Fluid Dynamics Virtual Press Room. In mid-November, when the Virtual Press Room is launched, another announcement will be sent out.

This release was prepared by the American Institute of Physics (AIP) on behalf of the American Physical Society's (APS) Division of Fluid Dynamics (DFD).

ABOUT THE APS DIVISION OF FLUID DYNAMICS
The Division of Fluid Dynamics of the American Physical Society (APS) exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure. See: http://www.aps.org/units/dfd/