American Physical Society
One Physics Ellipse
College Park, MD 20740-3844
www.aps.org

The Complex Sneeze, Caught on Tape

High-speed video captured at MIT shows how phlegm breaks up into droplets and spreads in a sneeze -- work that may lead to better approaches for infection control

----
EMBARGOED for release until 8:00 a.m. ET on Monday, November 23, 2015

For More Information:
Jason Socrates Bardi
jbardi@aip.org
240-535-4954
@jasonbardi

WASHINGTON, D.C., November 23, 2015 -- From the daintiest sleeve-stifled 'shoo to the mightiest head-whipping howl, a sneeze is as unique to an individual as a laugh -- we all do it, but everyone seems to do it differently.

However commonplace it may be in human life, the sneeze remains somewhat of an enigma to science, and we are still a long way from understanding the simple sneeze in all its phlegm-flam glory.

We know that sneezes can spread infectious diseases like measles, influenza or SARS, suspending viruses in droplets that may be inhaled or deposited onto surfaces and later picked up on the hands of some unsuspecting passerby. But we don't understand exactly how far a sneeze can spread or if and why some people spread sickness through sneezing more effectively than others.

"This is a major blind spot when designing public health control and prevention policies, particularly when urgent measures are needed during epidemics or pandemics, said Lydia Bourouiba, the Esther and Harold E. Edgerton Assistant Professor and head of the Fluid Dynamics of Disease Transmission Laboratory at the Massachusetts Institute of Technology (MIT) in Cambridge.

"Our long term goal is to change that," she added.

Last year Bourouiba and her collaborators described in a paper how sneezes are complex, turbulent, highly variable, multiphase flows that can suspend and spread potential pathogen-carrying droplets much further than ever suspected -- with the smaller droplets spanning the size of a room and reaching ventilation ducts at ceiling heights within a few minutes. (See reference at the end of this release).

This month during the American Physical Society's 68th Annual Meeting of the Division of Fluid Dynamics, held Nov. 22-24, 2015, in Boston, Mass., these researchers will present new work that shows how droplets are formed within a high-propulsion sneeze cloud -- a critical piece of the puzzle that has so far been missing.

“Droplets are not all already formed and neatly distributed in size at the exit of the mouth, as previously assumed in the literature," she said. Instead, they undergo a complex cascading breakup that continues after they leave the lungs, pass over the lips and churn through the air.

How the Work was Done

The team's experiments involved capturing high-speed videos of two healthy subjects sneezing about 50 times over the course of several days at different times of the day. They coupled sophisticated data extraction algorithms with new, state-of-the-art 3D visualization techniques developed by Bourouiba's collaborators Professor Alexandra Techet and Dr. Barry Scharfman at MIT to tease out the features of the sneezes from the videos.

The visualizations show how in a sneeze the mucosalivary fluid fragments from sheets to ligaments to droplets outside of the respiratory tract -- something that has never been reported before in respiratory flows. This will be reported in a paper titled, "Visualization of sneeze ejecta: steps of fluid fragmentation leading to respiratory droplets," by Scharfman B. E, Techet A. H., Bush J. W. M. and Bourouiba L. (2015), which is currently in press in the journal, *Experiments in Fluids*.

Bourouiba said the goal of this work in particular, and of her Fluid Dynamics of Disease Transmission Laboratory at MIT in general, is to ground infectious disease prevention firmly in physical understanding to help guide national and international public health policies and develop effective mitigation technologies.

Toward that end, their future work will study phlegm breakup in sick people sneezing and explore how different pathogens spread in a sneeze.

Presentation #G25.1, "3D Spray Droplet Distributions in Sneezes" is authored by Alexandra Techet, Barry Scharfman and Lydia Bourouiba. It will be at 8:00 a.m. ET on Monday, November 23, 2015 in Room 304 of the Hynes Convention Center in Boston, MA. ABSTRACT: http://meetings.aps.org/Meeting/DFD15/Session/G25.1

The previous study referred to in this release is: Bourouiba L., Dehandschoewercker, E., and Bush, J. W. M. (2014) Violent respiratory events: on coughing and sneezing. Journal of Fluid Mechanics. **745**: 537-563.

####

MEETING INFORMATION
The 68th Annual Division of Fluid Dynamics Meeting will be held at Hynes Convention Center in Boston, MA from Nov. 22-24, 2014. More meeting information: https://apsdfd2015.mit.edu/

REGISTERING AS PRESS
Any journalist, full-time or freelance, may attend the conference free of charge. Please email: <jbardi@aip.org> and <dfdmedia@aps.org> and include "DFD Press Registration" in the subject line.

ONSIGHT AND ONLINE PRESS ROOMS
Workspace will be provided on-site during the meeting. The week before the meeting, news, videos and graphics will be made available on the Virtual Press Room: http://www.aps.org/units/dfd/pressroom

LIVE MEDIA EVENT
A press briefing featuring a selection of newsworthy research talks will be streamed live from the conference at 1:00 p.m. ET on Monday, November 23. For more information, email jbardi@aip.org

ABOUT THE APS DIVISION OF FLUID DYNAMICS
The Division of Fluid Dynamics (DFD) 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. DFD Website:
http://www.aps.org/units/dfd/index.cfm

####