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One Physics Ellipse
College Park, MD 20740-3844
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**RIVERS, FIRES, STORMS ON JUPITER,**
**OIL, MUCUS, and OTHER FLUID FLOWS**

*Highlights of DFD Meeting in Long Beach, CA, Nov. 21-23, 2010*

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FOR IMMEDIATE RELEASE

For more information, contact
Jason Socrates Bardi,
American Institute of Physics
301-209-3091

WASHINGTON, D.C., November 12, 2010 -- The 63rd Annual Meeting of the American Physical Society's (APS) Division of Fluid Dynamics (DFD) takes place this month from November 21-23, 2010 at the Long Beach Convention Center, located in downtown Long Beach, California. The largest scientific conference of its type, the meeting brings together thousands of researchers from around the globe to present work in engineering, energy, astronomy, medicine, and more -- all related to different forms of fluid flow.

Reporters are invited to attend the conference free of charge. Registration instructions and other information may be found at the end of this news release.

**HIGHLIGHTS OF SCIENTIFIC PROGRAM**

The following is a sampling of the 2,025 scientific presentations at the meeting.

1) WILDFIRES -- Simulating Fire in a Water Tunnel
2) MUCUS -- The Physics of Expulsion
3) OIL -- Separating Water from Oil in the Strategic Petroleum Reserve
4) BUBBLES -- Why They Collapse
5) ELECTRONICS -- "Ion Wind" Technology to Cool Without Fans
6) ENERGY -- Reducing Drag on Ships at Sea
7) PLANETS -- Spinning Orb in France Mimics Jupiter's Atmosphere
8) MEDICINE -- Ultrasound for Stroke Treatment
9) POLLUTION -- Improving Water Quality by Analyzing Streambeds
10) MICROBES -- Food Club for Hungry Protozoa
11) MICROFLUIDICS -- Charged Fluids Get Roughed Up
12) MAGNETISM -- Manipulation of Levitating Drops
13) More Meeting Information

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**1) USING WATER TO STUDY FIRE: SIMULATING WILDFIRES IN WATER TUNNELS**
The behavior of wildfires can be simulated in the lab using water tunnels. Fire, after all, is basically a chemical reaction between oxygen and a fuel, and thus can be modeled using other reactive solutions. In one such experiment, turbulence researcher Bob Breidenthal of the University of Washington in Seattle -- along with undergraduate student Travis Alvarado of the University of Texas and Brian Potter of the Pacific Wildland Fire Sciences Laboratory -- slowly injected salt water and a base into an acidic solution in a water tunnel.

"A visible pH indicator in the plume disappears when it mixes with a certain amount of acidic solution," Breidenthal explains. "The shorter the visible flame length, the faster the simulated burning." Using this set up, he and his colleagues modeled the effect of a crossflow -- essentially, a wind blowing over a wildfire.

At a certain wind speed, the researchers found, there is a transition from a regime that is independent of wind to one that depends on both wind and on fire buoyancy. In this situation, a small change in wind speed has a big effect on the reacting plume, especially near the ground. "We anticipate that this represents a hazard to nearby firefighters," Breidenthal says. Combining the simulation results with information about ambient wind conditions, he says, could help firefighters be deployed more safely.

The presentation, "Wildfire simulation using a chemically-reacting plume in a crossflow" is on Monday, November 22, 2010 at 3:35 p.m. in the Hyatt Regency Long Beach Room: Regency B.
ABSTRACT***:*** *http://meetings.aps.org/Meeting/DFD10/Event/133704*

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**2) THE PHYSICS OF MUCUS EXPULSION**
In humans, mucus is the thick fluid that coats the airways in order to catch pathogens that would otherwise enter the lungs (and thence the bloodstream) when air is breathed in. For mucus to work, though, it must travel to the mouth, where it is spit out or swallowed.

Researchers at the University of North Carolina, a group including Roberto Camassa, Michael Jenkinson, Shreyas Tikare, Jeffrey Olander, and Reed Ogrosky, study the way in which the body gets rid of mucus. In healthy lungs, mucus is urged along by tiny cilia that line the airways. But the very act of breathing, and of course coughing and sneezing, also play important roles in clearing mucus. "Understanding the clearing mechanism of mucus is key to providing an effective cure for diseases such as cystic fibrosis," says Camassa. "This is the underlying motivation for our research, which is part of a collaborative effort among several departments at UNC to provide a comprehensive study of how the lung functions."

The research specifically studies how mucus is expelled from the trachea. The North Carolina researchers use a 1-cm-diameter glass tube whose inner surface can be coated with mucus. Pumping air through the tube forces mucus upwards, against gravity. Actually, the mucus (silicone oil was the actual fluid used) moves upwards in waves, a process which the researchers are trying to quantify by mathematical and numerical models. More information can be found on the website for the Virtual Lung Project: http://cismm.cs.unc.edu/research-collaboration/lung-cluster/virtual-lung-project/

The presentation, "Emulation of Mucus Propulsion in the Trachea Driven by Constant Air Flow" is on Tuesday, November 23, 2010 at 2:08 PM in the Hyatt Regency Long Beach Room: Regency E.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/134248*

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**3) SEPARATING WATER FROM OIL IN THE STRATEGIC PETROLEUM RESERVE**
Oil and water may not mix, but that doesn't mean that separating one from the other isn't challenging -- as the Gulf oil spill has made abundantly clear. But it's not always the oil that needs to be removed. In the Strategic Petroleum Reserve -- the Department of Energy's emergency fuel supply, which is kept inside massive artificial caverns carved within salt domes, briny water must be taken out to add in more oil.

The task is complicated, because "if the oil–brine interface is too close to the bottom of the withdrawal pipe, oil may be withdrawn along with the oil, forming an emulsion -- and obvious environmental concerns," says mechanical engineer Tim O'Hern of Sandia National Laboratories.

O'Hern and his colleagues are studying how salty water can be removed without accidentally collecting any oil. Their goal is to determine the threshold brine withdrawal flow rates at which oil is first entrained -- or drawn in -- to develop improved predictive simulations and to provide operational advice to the Strategic Petroleum Reserve. "It is essentially like sticking a straw through the oil layer into the water or brine water and sucking on the straw," O'Hern says. "It really is a pretty simple experiment."

The presentation, "Transition from Selective Withdrawal to Light Layer Entrainment in an Oil-Water System" is at 3:31 PM on Tuesday, November 23, 2010 in the Long Beach Convention Center Room: 202B.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/134350*

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**4) WHY BUBBLES COLLAPSE**
Using a combination of experiments and theory, Massachusetts Institute of Technology (MIT) and Princeton University researchers made a significant discovery while investigating why capillary forces seem to display attributes that are normally exclusively ascribed to gravitational forces.

"For more than a decade, scientists have believed that when highly viscous bubbles popped, they would collapse under their own weight due to gravitational forces," explains James Bird, a National Science Foundation postdoctoral fellow in the Department of Mathematics at MIT. "Yet, we demonstrated that these bubbles burst in the same manner whether they are popped upside down or right-side up—suggesting that gravity alone cannot account for this behavior. Instead, we show that surface tension drives the collapse."

The researchers' numerical models show how the influence of viscosity makes the dynamics appear as if the collapse is caused by gravity. These findings have implications for the way they model a wide variety of viscous bubbles, including those found in boiling lava, molten glass and shaving cream.

Bird and colleagues will provide more details about their research at the American Physical Society's Division of Fluid Dynamics (DFD) annual meeting, Nov. 21-23, 2010, in Long Beach, Calif.

The presentation, "The rupture dynamics of ultra-viscous bubbles" is at 11:35 a.m. on Monday, November 22, 2010 in the Long Beach Convention Center Room: 203B.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/133334*

NOTE: An image is available to accompany this abstract.
CAPTION: High-speed image showing the retraction dynamics of the bubble.

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**5) "ION WIND" TECHNOLOGY TO COOL WITHOUT FANS**

A team of researchers in South Korea is investigating the potential of using ion wind generation for cooling electronic devices. "Can you imagine cooling devices that produce wind without fans?" asks Bumchang Kim, an engineering graduate student at Pohang University of Science and Technology. The phenomenon known as ion wind generation is capable of doing this.

"Ion wind involves air molecules flowing as wind by colliding with ion molecules that have positive or negative charges," Kim explains. "Since the mechanism of generating ion wind doesn't require as much space or as many moving parts as other existing cooling methods, it will enable small, silent cooling devices suitable for portable or compact electronics such as cell phones and laptops."

The team recently investigated the effects of working conditions and the environment on ion wind generation's performance, which they believe will be helpful for using ion wind more efficiently.

The presentation, "Ion wind generation and its application to cooling" is at 1:03 p.m. on Tuesday, November 23, 2010in the Hyatt Regency Long Beach Room: Regency D.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/134232*

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**6) REDUCING DRAG ON SHIPS AT SEA**

Ships at sea consume billions of barrels of oil a year and are a noteworthy source of air pollution. Much of the propulsive power of a ship is used to overcome frictional drag that the water exerts on the hull, and hence any reduction in frictional drag of ocean-going vessels leads to environmental and economic benefits.

Graduate student Simo Makiharju is part of a team at the University of Michigan that conducted experiments to investigate the behavior, suitability, and limitations of a method of drag reduction called "partial cavity drag reduction," based on air lubrication. They created a test model with a backward-facing step downstream from the leading edge of the model and a cavity-terminating sloped surface "beach" further downstream of the step. When a suitable amount of gas (usually air) was injected at the step, the step and beach trapped a ventilated partial cavity over the longitudinal mid-section of the model, and the frictional drag on the surface was reduced by more than 95 percent -- results that suggest that this technique could potentially lead to considerable energy savings.

The presentation, "Perturbed Partial Cavity Drag Reduction at High Reynolds Numbers" is at 10:30 a.m. on Monday, November 22, 2010in the Hyatt Regency Long Beach Room: Regency A.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/133373*

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**7) TIDAL WINDS: FROM THE LAB TO PLANETS**

Jupiter is striped with so-called zonal winds: broad bands running parallel to the planet's equator in which prevailing winds blow at different velocities. Jupiter and other gaseous planets like Saturn and Neptune are essentially spheres of fluid spinning on an axis. Complementing the already known mechanics of convection and stratified turbulence, the repeated tidal bulge caused by an orbiting moon can cause the flow to organize itself in zonal winds. (See A. Tilgner, P.R.L. 99, 194501, 2007).

Cyprien Morize, Michael Le Bars, and Patrice Le Gal at IRPHE Laboratory in France built a model of a rotating celestial fluid body that mimics some aspects of a gaseous planet. It consists of a hollow deformable sphere filled with water. To reproduce a tidally deformed planet like Jupiter and Saturn, they rotated the sphere and simultaneously elliptically deformed it at an independent orbital rate to mimic an orbital tidal deformation. The flow showed strong internal shear layers for certain ratios of the orbital and spin velocities, corresponding to the frequencies of inertial modes of a sphere. In addition, quantitative measurements of velocity fields in the equatorial plane showed that the tidal winds to blow at about 1 percent of the local spinning velocity.

“Perturbations at the surface of the sphere correspond to zonal winds driven by tides,” says Morize. “Such a mechanism could take place almost generically in the atmospheres of gas giants, or in the liquid cores of planets as Earth, where it would constitute an additional source of zonal wind generation in addition to the already known mechanisms.”

NOTE: an image is available for reporters at: *http://www.fast.u-psud.fr/~morize/morize_im2.tif*

CAPTION: A spinning model of a rotating celestial fluid body that mimics some aspects of a gas giant planet in the lab present a new mechanism of zonal winds generation by tides. Visualizations allow broad bands to be distinguished at the surface of the sphere with a similar shape of those on Jupiter.

The presentation, "Experimental Determination of Zonal Winds Driven by Tides is at 2:08 PM on Tuesday, November 23, 2010in the Hyatt Regency Long Beach Room: Regency F.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/134258*

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**8) ULTRASOUND FOR STROKE TREATMENT**

A team of University of California researchers is studying how high-intensity focused ultrasound (HIFU) can accelerate thrombolysis, the dissolution of blood clots, *in vitro* and *in vivo* for treatment of ischemic stroke.

Stroke is the second leading cause of death worldwide and the third most common cause in the United States, so finding better ways to treat stroke has the potential to have a major impact on human health.

"Currently, most research is focused on using a U.S. Food and Drug Administration approved drug for treatment of stroke, but in clinical use this drug is limited in not only its therapeutic effects but also in the number of stroke victims eligible to receive this treatment," says Andrew Szeri, an engineer at the University of California, Berkeley. The team is scrutinizing damage to blood clots associated with the collapse of tiny bubbles that are generated in a HIFU field.

"Our research is focused on analyzing a method for stroke treatment that is noninvasive, fast acting and safe," Szeri explains. "It may become an effective treatment for the vast majority of stroke cases, without the use of any further drugs."

The presentation, "Cavitation damage in blood clots under HIFU" is at 9:31 a.m. on Monday, November 22, 2010in the Long Beach Convention Center Room: 203B.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/133075*

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**9) IMPROVING WATER QUALITY BY ANALYZING STREAMBEDS**
Most people think of the quest for clean water in terms of the chemicals and toxic wastes that are poured into rivers and streams. But a growing body of scientific evidence on the physics of turbulent flow from the National Center for Earth-Surface Dynamics based at the St. Anthony Falls Laboratory at the University of Minnesota goes beneath the surface to study bottom conditions, stream bed structure and bank properties. By doing so, their work reveals more complex causes -- and potential solutions -- for degraded water quality, unstable stream banks, flooding, and impaired habitat of fish and other aquatic life. In their latest study, the Minnesota scientists analyzed turbulent flow patterns of structurally complex streambeds characterized by meanders and riffles.

Explains Fotis Sotiropoulos, director of the St. Anthony Falls Laboratory: "A staggering 44 percent of the 3.5 million miles of our nation's rivers and streams are degraded due to sedimentation and excess nutrients resulting from unsustainable urban development and land use practices. In our work, we want to help rectify this and improve stream restoration." He says their work is motivated by the societal relevance of clean water -- for human health, habitat health and all the flora and fauna that depend on it, commerce, recreation and natural beauty.

Dr. Sotiropoulos' team takes a novel approach because of its access to the unusual facility on site, the Outdoor StreamLab based on the Mississippi River. StreamLab allows natural conditions to be studied in real time under rigorous experimental controls. Data from the experiments are coupled with analysis from Virtual StreamLab, which is a high-resolution computational fluid dynamics computer code for simulating turbulent flow in natural streams. With this method of combined experimental and computational studies, new levels of evidence-based analysis of the dynamic interactions between flowing water and streambed, bank and sediment properties are now possible.

The presentation, "On the physics of turbulent flows in natural meander bends: Insights gained by LES" is at 5:06 p.m. on Monday, November 22, 2010 in the Long Beach Convention Center Room: 102B.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/133533*

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**10) FOOD CLUB FOR HUNGRY PROTOZOA**
A simple protozoan creature called Salpingoeca rosetta is usually found in an individual, "unicellular" form, but under certain conditions, these microbes can work together to survive. Nicole King, a biologist at the University of California, Berkeley who studies this tiny creature, has found that under these conditions it mimics multicellular organisms by becoming a collective, colonial entity.

"They form a ball with all of their tails pointed outwards," said Marcus Roper, a mathematician at the University of California, Berkeley, who studies the fluid dynamics produced by these whip-like tails, or flagella, which these microorganisms use both to move and to create currents that draw in food. Roper discovered that the collective action of all of these flagella beating next to each other affects the water in ways that could capture more food than the tiny organisms would be able to find individually in lean times.

"By sticking together they create a stronger flow that can pull in food from farther away," he said. The drawback of sticking together, though, is that their tails point in opposite directions. The organisms push against each other, which makes collective movement difficult.

The presentation, "Do choanoflagellate cells cooperate hydrodynamically to increase feeding fluxes?" is at 1:29 PM on Tuesday, November 23, 2010 in the Long Beach Convention Center Room: 201B.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/134108*

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**11) CHARGED FLUIDS GET ROUGHED UP**

Microfluidics is a lab-on-a-chip science in which tiny blobs of fluids -- as small as nanoliters -- are propelled around networks of narrow channels. The downside of making the channels ever smaller is that fluids have trouble getting through, owing to increased friction. One way around this limitation is to use fluids containing ions (electrolytes such as salt water, blood, etc.), which develop nanoscale screening clouds of ions around charged walls. Then, the application of an electric field forces these nanoscale ion clouds - and also the fluid - through the small channels.

And yet when flow rates for electrolytes in small channels were measured, they have been less than predicted. Rob Messinger and Todd Squires, chemical engineers at UC Santa Barbara, believe they have an explanation. They point to wall roughness, even at the nanometer scale, as being important. "Conservation is the culprit," says Messinger. "Because rough surfaces make for non-uniform ionic currents within the screening cloud, ions must be forced into and out of this nano-scale screening cloud to keep the current going." The ion movement, which ought to be uniform within the ion screening cloud, is reduced and limited by the wall roughness. This results in a reduced fluid flow rate.

This effect, Messinger argues, may well play a role in a number of technologies that depend upon moving fluid by these 'electrokinetic' flows, including microfluidic devices for energy storage, biological and chemical sensors, electrophoretic separation and sequencing of DNA, or the study of proteomics.

The presentation, "Suppression of Electrokinetic Flows by Surface Roughness" is at 8:13 a.m. on Sunday, November 21, 2010in the Long Beach Convention Center Room: 202B
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/132284*

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**12) MAGNETIC MANIPULATION OF LEVITATING DROPS**

When water is placed on a hot iron at 300°C, the liquid levitates on a cushion of its own vapor. This so-called Leidenfrost effect makes the drops move very fast without boiling, because they don't quite touch the substrate. Keyvan Piroird and colleagues Bapstiste Darbois, David Quéré, and Christophe Clanet at Ecole Polytechnique and ESPCI in France studied how liquid oxygen, which boils at -183°C, behaves when placed on any solid at room temperature.

When drops of liquid oxygen are in the Leidenfrost state, they flee rapidly everywhere. The film of vapor supporting them has a typical thickness of 0.1 mm, which can be seen with the naked eye. Water vapor in the air can also be seen as it condenses in clouds around the cold drop of liquid oxygen.

Even more intriguing is the paramagnetism of liquid oxygen: a magnet positioned near the drop causes it to flatten out. Magnets placed strategically below the substrate can be used to trap these ultra-mobile drops. As the liquid crosses the magnet, the drop slows down or even stops, depending on its velocity. Manipulating these "independent" drops can help scientists learn how (and how much) energy is transferred in drops -- a phenomenon that occurs in many situations, including impacts and coalescence.

The presentation, "Paramagnetic Leidenfrost Drops" is at 4:36 PM on Sunday, November 21, 2010 in the Long Beach Convention Center Room: 203C.
ABSTRACT: *http://meetings.aps.org/Meeting/DFD10/Event/132818*

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## MORE MEETING INFORMATION

The 63rd Annual DFD Meeting is hosted this year by the University of Southern California, California State University Long Beach, California Institute of Technology, and the University of California, Los Angeles.

It will be held at the Long Beach Convention Center, located in downtown Long Beach, California. All meeting information, including directions to the Convention Center is at: *http://www.dfd2010.caltech.edu/*

## USEFUL LINKS

Main meeting Web site: *http://www.dfd2010.caltech.edu/*
Search Abstracts: *http://meetings.aps.org/Meeting/DFD10/SearchAbstract*
Directions to Convention Center: *http://www.longbeachcc.com/*

## PRESS REGISTRATION

Credentialed full-time journalist 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 Jason Bardi (*jbardi@aip.org*, 301-209-3091).

## ONSITE WORKSPACE FOR REPORTERS

A reserved workspace with wireless internet connections will be available for use by reporters in the Promenade Ballroom of the Long Beach Convention Center on Sunday, Nov. 21 and Monday, Nov. 22 from 8:00 a.m. to 5:00 p.m. and on Tuesday, Nov. 23 from 8:00 a.m. to noon. 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 contain dozens of story tips on some of the most interesting results at the meeting as well as stunning graphics and videos. The Virtual Press Room will serve as starting points for journalists who are interested in covering the meeting but cannot attend in person. 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 stunning images and graphics from either computational or experimental studies of flow phenomena. The outstanding entries, selected by a panel of referees for artistic content, originality and ability to convey information, will be honored during the meeting, placed on display at the Annual APS Meeting in March of 2011, and will appear in the annual Gallery of Fluid Motion article in the September 2011 issue of the American Institute of Physics' journal, Physics of Fluids.

This year, selected entries from the 28th Annual 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.

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## 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/*
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