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Mechanism of Wine Swirling Explained

Baltimore, Md. – Wine drinkers know that swirling a good vintage around in a glass aerates the wine and releases its bouquet. Just how the process – known as "orbital shaking" – works, however, has been something of a mystery.

Fluid dynamicists have long observed that orbital shaking generates a wave that propagates around the inner edge of the glass, churning the liquid as it travels. "The formation of this wave has probably been known since the introduction of glass or any other kind of cylindrical bowl, but what has been lacking is a description of the physics related to the mixing and oxygenation," says Mohamed Farhat, senior scientist at the Ecole Polytechnique Federale de Lausanne in Switzerland.

To figure out how the mixing occurs, Farhat and his colleagues generated such waves in clear cylinders and used state-of-the-art instrumentation to track the motion of traveling waves and measure the liquid velocity.

The researchers found that "as the wave propagates along the glass wall, the liquid is displaced back and forth from bottom to top and from the center to the periphery," Farhat explains. "This pumping mechanism, induced by the wave, is more pronounced near the free surface and close to the wall, which enhances the mixing." The research team also discovered that, "for a given glass shape, the mixing and oxygenation may be optimized with an appropriate choice of shaking diameter and rotation speed," he says.

"The intuitive and efficient motion of wine swirling has inspired engineers in the field of biopharmaceuticals," Farhat says, where cell cultures can be placed in large cylindrical containers – or bioreactors – and "shaken" in a manner similar to the aeration of a glass of wine. The new work, he says, demonstrates that "such bioreactors offer better mixing and oxygenation over existing stirred tanks, provided that operating parameters are carefully optimized. Moreover, the gentle nature of orbital shaking also ensures a better viability and growth rate of the cells at reduced cost."

Martino Reclari, a Ph.D. student and a member of the Swiss team, will present the findings in a talk at the *American Physical Society's Division of Fluid Dynamics Meeting*, which will take place Nov. 20-22, 2011, at the Baltimore Convention Center in the historic waterfront district of Baltimore, Maryland.

The talk, "'Oenodynamic': hydrodynamics of wine swirling," is at 12:01 p.m. on Monday, Nov. 21, in Room 318.

Abstract: http://absimage.aps.org/image/MWS_DFD11-2011-002246.pdf

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MORE MEETING INFORMATION
The 64th Annual DFD Meeting is hosted by the Johns Hopkins University, the University of Maryland, the University of Delaware and the George Washington University. Howard University and the U.S. Naval Academy are also participating in the organization of the meeting. It will be held at the Baltimore Convention Center, located in downtown Baltimore, Md. All meeting information, including directions to the Convention Center, is at:
http://www.dfd2011.jhu.edu/index.html

USEFUL LINKS
Main Meeting Web Site: *http://www.dfd2011.jhu.edu/index.html*
Search Abstracts: *http://meeting.aps.org/Meeting/DFD11/Content/2194*
Directions and Maps: *http://www.dfd2011.jhu.edu/venuemaps.html*

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 (cblue@aip.org, 301-209-3091).

SUPPORT DESK FOR REPORTERS
A media-support desk will be located in the exhibit area. 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 features 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