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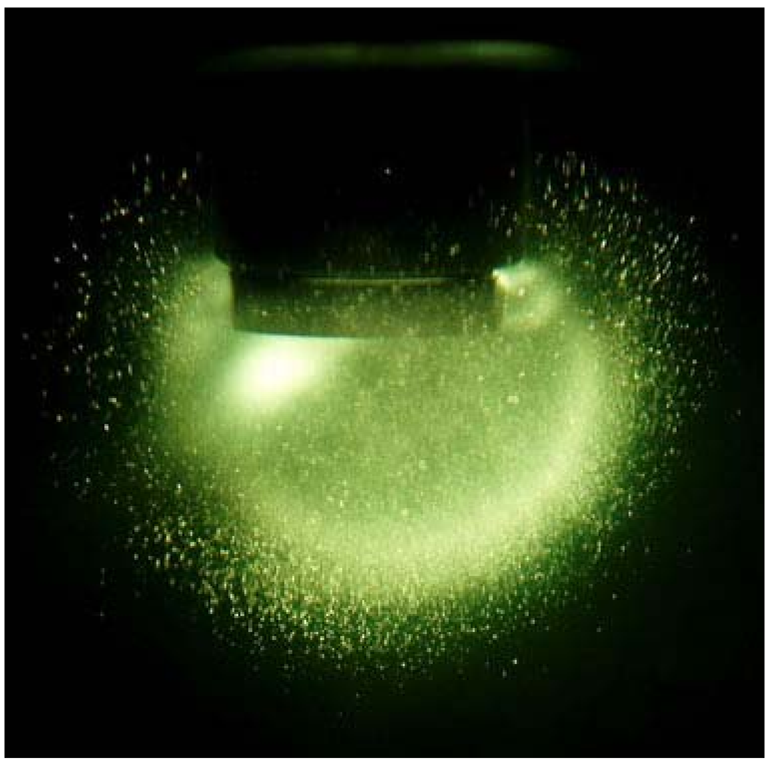
Hotter Than the Sun

When a bubble collapses, theory predicts that the gas inside should be squeezed so tightly that it becomes as hot as the surface of bright stars. Now, researchers have finally shown that this is indeed the case, using a new technique that allows them to measure the temperature created when a single bubble collapses. The method could open the door for simpler ways of studying and developing nuclear fusion systems.



The big squeeze. A cloud of bubbles collapsing near a high intensity ultrasonic horn immersed in sulfuric acid
CREDIT: D. Flannigan and K.S. Suslick/University of Illinois at Urbana-Champaign

Scientists have long suspected that the intense pressures generated within collapsing bubbles can lead to extreme temperatures and form plasma--a superhot gas that occurs in interstellar space and in the atmospheres of some stars. To study the process, researchers turned to sonoluminescence, in which bubbles in a liquid emit light when they are bombarded with sound waves. The technique has previously been used to study clouds of bubbles in different liquids. But no one had been able to study single bubbles because the light they generated was too weak to measure.

To enhance the signal, chemists David Flannigan and Kenneth Suslick at the University of Illinois at Urbana-Champaign made bubbles of xenon and argon gas inside a vat of sulfuric acid. They then bombarded the bubbles with ultrasound waves. The bubbles glowed so brightly, they could be seen in daylight with the naked eye.

Measurements of this light revealed that a collapsing bubble can generate temperatures as high as 20,000 K--4 times as hot as the sun's surface. This extreme temperature indicates that there is plasma inside the bubbles, the researchers report this week in *Nature*. Studying such conditions, they say, could aid the search for harnessing powerful sources of energy, such as nuclear fusion.

"This is a very important result," says Lawrence Crum, director of the Center for Industrial and Medical Ultrasound at the University of Washington in Seattle and one of the first people to study bubble luminescence. "Suslick has shown an elegant, simple way of studying plasma formation," he says. "In the future, this technique might offer an alternative to the expensive nuclear research labs of today."

--MARIE GRANMAR

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