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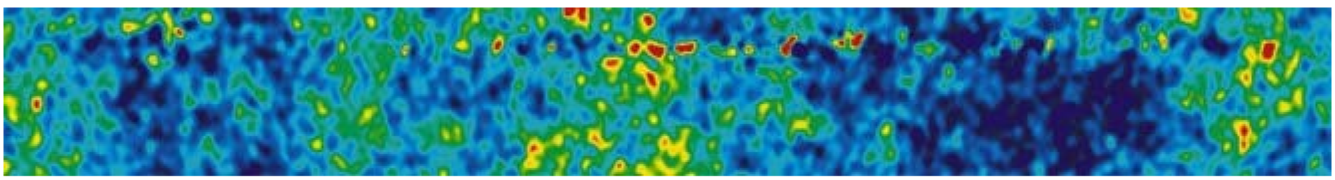

Ultrasonic plasma bubbles implode

science **Tuesday**, August 10, 2010 . ***This is a SciScoop post by David Bradley***

If you're having a baby scan, rest assured there's nothing to worry about here, this piece of research is about high-energy ultrasound. The difference is like comparing a research laser beam to the light from a cheap flashlight…

Anyway, according to Ken Suslick, when high-intensity ultrasound passes through a liquid, the expansi the sound can create isolated bubbles, which can be driven into implosive collapse. Under the right conc collapse of the bubble is so extreme that light is emitted in a process called sonoluminescence. The orig light comes from the intense heating that occurs during the collapse, which can be hot enough to break ı bonds (sonochemistry) and trigger sonoluminescence.

Plasma emission from a collapsing bubble. The collapsing bubble moves around after each collapse, tracing out a lit path, like a person flinging their arm around while holding a flashlight. (Credit: Hangxun Xu and Ken Suslick, UIUC)

Recent experiments have shown that the gas atoms and molecules inside these bubbles are ionized (they plasma), and that the temperature can be several times that of the surface of the sun and the pressure gre that at the bottom of the Mariana Trench.

By studying sonoluminescence from liquids, such as concentrated sulfuric acid, Suslick's team at the Ur Illinois at Urbana-Champaign working with David Flannigan, now at Caltech, have quantified the prope plasma inside these imploding bubbles. They could also determine how these properties are affected by with which the bubble collapses, and they found that the plasma conditions generated may indeed be ex Astoundingly, the maximum plasma electron density that they are able to experimentally measure (more per cubic centimeter) is comparable to the densities generated by the Nova Inertial Confinement Laser F installation at Lawrence Livermore National Laboratory. Such laser installations cost billions of dollars, Suslick, "the apparatus we put together was just a few thousand."

The effective plasma temperatures ranging beyond five-times the temperature of the Sun's surface (mor 16000 Kelvin). The results of this work are reported in the journal Nature Physics.

In 2005, Suslick and Flannigan reported in the journal Nature (PDF) their observation of light emission atomic excited states during sonoluminescence from sulfuric acid solutions. The energies of the populat levels suggested a plasma, but at that time there was no estimate of the density of the plasma, a crucial p understanding the conditions created at the core of the collapsing bubble. The new report makes use of t system, but now with a detailed analysis of the shape of the observed spectrum, which contains informa pertaining to the conditions of the region around the atoms.

The plasma properties extracted from these analyses show a strong dependence on the violence of bubb implosion, and the observable physical conditions suggest the limits of energy focusing during cavitatio approach those achievable only by much more expensive means.

It is evident from these results that the upper bounds of the conditions generated during bubble implosic to be established.

Flannigan and Suslick have not, however, observed evidence for thermonuclear fusion during bubble cc way of background, in 2002, Rusi Taleyarkhan (then at Oak Ridge National Laboratory and now at Purc University) reported controversial evidence that suggested acoustic cavitation in deuterated acetone indu thermonuclear fusion, calling this "sonofusion".

The results of this work was never reproduced outside of Taleyarkhan's labs, however, and the validity claims is still in doubt. In 2008, Purdue found Taleyarkhan guilty of research misconduct, stripped him chaired position, and forbade his supervision of graduate students; in 2009, the Federal government deb Taleyarkhan from future research funding for two years.

Flannigan, D., & Suslick, K. (2010). Inertially confined plasma in an imploding bubble *Nature Phys* 10.1038/nphys1701

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