Glass suddenly cooled in water: The „Prince Rupert Drop“ resists even hammer blows, but breaks immediately if his tail is damaged - due to internal stresses.

A Mysterious Material

Microscope images atomic movements in glass.

October 11, 2013 - Ulm/Ithaca - **Glass is nearly ubiquitous in the modern world - but his behavior is still a mystery for physicists. Now researchers have been able to image the motion of atoms in this material. The images could clarify what happens when glass bends or breaks.**

Glass is a special and still mysterious substance: neither really solid nor really liquid. The material is widely used, but for physicists it is still difficult to understand what is going on inside it. Because glass is in constant change, its atoms „dance“ so to speak.

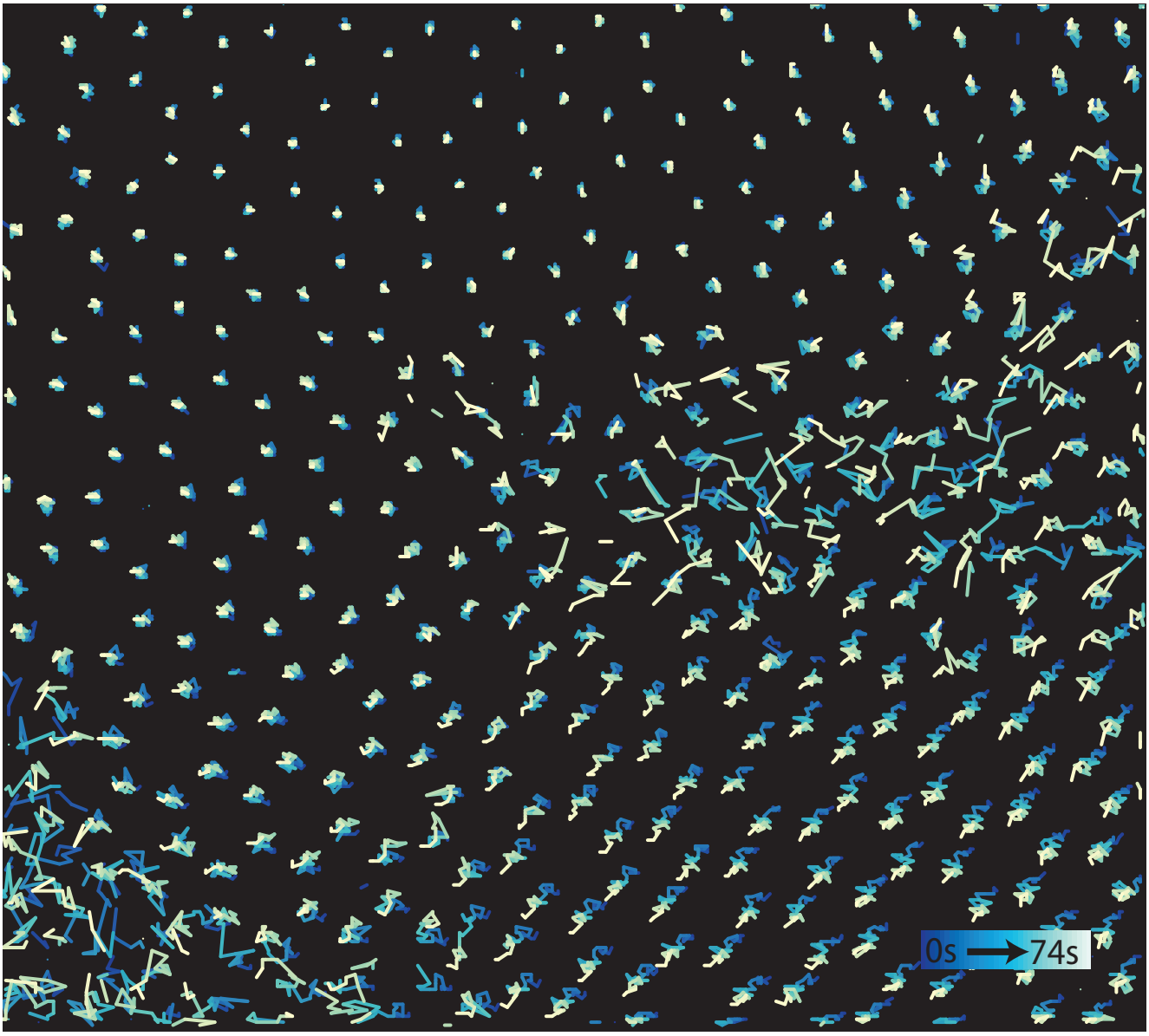
Physicists from the German University of Ulm and the American Cornell University have now managed to make the behavior of the material visible on the tiniest level. With a sort of video recording they could show the slightest movement of the atoms in the glass. For the understanding of its structure and behavior, this results shows a new perspective: A measurement method that could help to understand the interplay of atoms, the researchers around Pinshane Huang write in the journal „Science“.

To produce the images, the physicists bombarded the world-thinnest layer of glass, consisting of only a few atomic layers of silicon oxide, with electrons inside a highest-resolution transmission electron microscope. „It works like a slide projector to put it simply - only with electrons instead of light,“ explains Simon Kurasch, co-author of the study. „We bombard the sample and look at what comes through on the other side.“

Concatenated the pictures show the dancing atoms and the restructuring processes that would take place in the glass, if it was, for example, exposed to heat or is under tension. How this glass behaves has directly to do with its composition. „Glass is a supercooled liquid, which wants to become crystalline,“ explains Kurasch. Also from there, the material is particularly interesting for researchers, because the results can possibly also be applied to other materials. For the exploration of new materials, but also for the detection of vulnerabilities, the images could provide clues.

„The direct view on individual atoms gives us a unique opportunity to directly validate models and simulations of the dynamics of the atoms“, explains Kurasch.

In fact current models allowed to simulate the properties of glass or the dynamics of other atoms, for example using small, moving plastic beads. But the resolution of the new method of observation in Ulm is greater. „Our approach,“ says Kurasch, „is more realistic and 1000 to 10,000 times more accurate than simulations with small plastic beads of a few micrometers.“



Glass under the transmission electron microscope: physicists observed the movements of individual atoms and can thus better understand the behavior of glass.

Original Publication:
Huang, P. Y., Kurasch, S., Alden, J. S., Shekhawat, A., Alemi, A. A., Mceuen, P. L., Sethna, J. P., Kaiser, U. A., Muller, D. A. (2013). Imaging Atomic Rearrangements in Two-Dimensional Silica Glass: Watching Silica's Dance. *Science*, 342: 224–227

SPIEGEL ONLINE

Press article published by Peter Gotzner / Spiegel online at:
http://www.spiegel.de/wissenschaft/technik/elektronenmikroskop-verraet-bewegung-von-glas-atomen-a-926664.html