THE AUTHOR FILE

Richard Neutze

Proteins 'breathe' in an ultrafast way that can be captured with XFELs.

A protein quake resembles an earthquake, says biophysicist Richard Neutze from the University of Gothenburg in Sweden. Energy released from its epicenter drives an internal explosion: a conformational change in a protein that lasts picoseconds.

J. Wingberg/University of Gothenburg

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Scientists cannot directly image such changes, so they generally shoot X-rays at a protein crystal and interpret the diffraction pattern to determine the protein structure. Neutze and his team took advantage of the ultrabright, fast beam pulses produced by an X-ray free-electron laser (XFEL). And instead of using crystals, the team used proteins in solution to capture events in the photosynthetic reaction center of the light-harvesting bacterium *Blastochloris viridis*.

They excited the proteins with a laser beam and then used an XFEL pulse to capture the structural changes that propagate through the protein even more rapidly than heat. "I personally think that it is remarkable that a protein can undergo breathing motions on this timescale," says Neutze. The protein's entire conformational change occurs as quickly as the time it takes for light to move 2 millimeters.

The laser excitation adds much more energy to the proteins than would be the case under natural conditions. Ultrafast motion may or may not be frequent in these proteins. The experiment opens up options to find out and to explore the functional role of motion in light-sensitive proteins, says Neutze.

Characterizing how structural changes in photosynthetic proteins shape the efficiency of photosynthesis helps researchers more deeply understand "one step in the way nature uses proteins to beat entropy," says Neutze. Life, he says, is a constant struggle against entropy and disorder. And this battle plays out in molecular biophysics, which attracts him more than other areas of physics. "I like the fact that things can be discovered in molecular biophysics—from lab bench-level science," he says, which is less possible in areas noted for big research teams and big experiments such as the hunt for the Higgs particle.

Neutze received his PhD in physics at the University of Canterbury in New Zealand, during which he

met structural biologist Janos Hajdu. They began to explore the application of XFELs, and continued after Neutze moved to Europe. "I think it's a great example of scientific collaboration and personalities working well together," says Neutze. Together they developed the concept of using XFELs to diffract protein crystals before the beam destroys them.

Neutze did a short postdoctoral fellowship with Hajdu at Oxford University, followed by a Humboldt Fellowship at the University of Tübingen in Germany. He then arrived in Sweden to join Hajdu's lab, which had moved to Uppsala University. From there, Neutze landed a professorship at Chalmers University of Technology and, in 2006, moved to his current professorship at the University of Gothenburg. He has received 15 awards for his scholarship in New Zealand, Germany and Sweden.

Neutze was born on a sheep farm in Mid Canterbury, New Zealand, and has been interested in science since he was a child. "And I like to picture things—how they work," he says, which is how he devises experimental approaches.

He met his wife in Sweden, where his two children were born. He avidly follows New Zealand's All Blacks rugby team and music artists such as Lorde and enjoys visiting his other home. But Sweden gives him better access to internationally competitive and collaborative science. And, he says, Scandinavia is the world region in which fathers spend the most time with their children. "As a university professor I can leave work to drive my son to hockey practice or my daughter to figure skating, and no one blinks an eye," says Neutze.

His free time is spent mainly with family. They boat, sail and swim in the summer and snowboard and cross-country ski in the winter. "I run more or less regularly, have sporadic bursts of yoga, and occasionally pick up the guitar and struggle my way through old David Bowie renditions," says Neutze. He is a fan of fantasy, historical and science-fiction novels, and, he says, "Ursula Le Guin is my favorite author."

"Many of my favorite people remind me of overgrown small boys with their energy, enthusiasm, willingness to be surprised," says Keith Moffat, an X-ray crystallographer at the University of Chicago. "Richard has all that and more," he says. Neutze is "unflappable" and someone who "retains his lingering smile, even under the unusual stress of conducting an XFEL experiment at the head of a large team."

Vivien Marx

Arnlund, D. *et al.* Visualizing a protein quake with time-resolved X-ray scattering at a free-electron laser. *Nat. Methods* **11**, 923–926 (2014).

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