THE AUTHOR FILE

Vladislav Verkhusha

A new near-infrared optogenetic system and science as a family business.

Vladislav Verkhusha, a researcher at Albert Einstein College of Medicine, deeply enjoys building things. He and his team have created an optogenetic system with which they have activated gene expression in the liver cells of live mice, tweaked cell shape, moved proteins in cells, and manipulated a signaling pathway. "Using near-infrared light, we can go through the whole mouse body to activate our optogenetic system," says Verkhusha. The system reaches two centimeters deep, and he hopes that in the future it will reach farther still. He wants to use his system to regulate other activities in cells and whole animals, too. The advantage of a near-infrared molecular tool is that it helps to non-invasively control biological processes and activates only the reaction of interest.

Linda Tammisto

Vladislav Verkhusha

At the heart of Verkhusha's optogenetic system is the light-induced interaction of two proteins: the bacterial phytochrome BphP1 and its binding partner PpsR2, both from *Rhodopseudomonas palustris*. The system requires light and this partnership, much like a personal interaction in which one person's help makes something else happen. Light initiates a protein–protein interaction in which one protein contacts another with a request that initiates specific cellular events. The phytochrome the team chose is particularly amenable to engineering: its chromophore uses biliverdin, which is also found in mammalian tissues.

Verkhusha is truly passionate about his science, which makes him and all those around him work harder, says Alexander Sorkin, a researcher at the University of Pittsburgh School of Medicine, who was Verkhusha's faculty supervisor when they were both at the University of Colorado. "He is highly knowledgeable in his research area," says Sorkin. "If I have any question about fluorescent proteins, I do not go to PubMed, I call Vlad."

From his professorship at the University of Colorado in Denver, Verkhusha joined the faculty at Albert Einstein College of Medicine in 2006. He is also setting up a start-up company called iLight Biotechnologies to help commercialize the genetically encoded near-infrared probes and tools from his lab, potentially for modeling human disease in animals for drug discovery.

In the lab, Verkhusha keeps his door open for chats with team members because, he says, their motivation and collaboration with one another are crucial for the lab's success. He recommends they keep several projects running and that they work with other labs, too, to ensure that they will have publications if their main project does not go as well as planned.

Verkhusha's father sparked his interest in math and physics, and his grandfather taught him joinery and locksmithing in his workshop. "I wanted to know how various devices work and be able to construct my own," says Verkhusha. Starting with his first children's construction kit, he kept building: sound amplifiers, radios, antennae, and a Galilean-type telescope, which he designed with his father and which was his first serious encounter with optics. He also liked helping his grandparents in their gardens and orchards, and that got him interested in biology. His parents were both agricultural engineers, and as a schoolboy Verkhusha did experiments with plants.

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Verkhusha trained in biophysics, engineering, photochemistry, optical spectroscopy and microscopy, immunology, and molecular and cell biology. His education in math, physics and engineering took place in the former Soviet Union; he gathered experience in molecular and cell biology and fluorescence microscopy in Japan. He studied biophysics at Moscow Institute of Physics and Technology and completed his PhD in chemistry at Moscow State University. He worked on macrophage immunology as a postdoctoral fellow at Osaka Bioscience Institute in Japan. He studied fruit fly and cell biology as a researcher for the Japan Science and Technology Agency, where he developed green and red fluorescent transgenic fruit flies and imaged them on one of Japan's first commercial confocal microscopes.

In Japan, Verkhusha was fascinated by the many small and convenient devices he discovered in and outside the lab. He liked the lab equipment geared toward an individual researcher. To this day, he orders his favorite devices from Japan. "While working in Japan," he says, "I was impressed by the power of fluorescence microscopy and how the first fluorescent proteins could change our understanding of biological processes in living animals."

Vivien Marx

Kaberniuk, A.A. *et al.* A bacterial phytochrome-based optogenetic system controllable with near-infrared light. *Nat. Methods* **13**, 591–597 (2016).