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Researchers find new light-sensing mechanism in neurons

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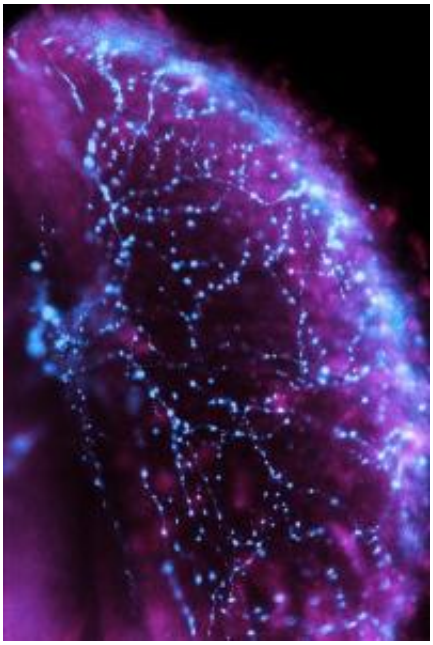

This image shows blue-light sensing arousal neurons. Credit: UCI

A UC Irvine research team led by Todd C. Holmes has discovered a second form of phototransduction light sensing in cells that is derived from vitamin B2. This discovery may reveal new information about cellular processes controlled by light.

For more than 100 years, it had been believed that the phototransduction process was solely based on a chemical derived from vitamin A called retinal. Phototransduction is the conversion of light signals into electrical

signals in photoreceptive neurons and underlies both image-forming and non-image-forming light sensing.

In discovering this new light-sensing phototransduction mechanism, the UCI scientists found that phototransduction can also be mediated by a protein called cryptochrome, which uses a B2 vitamin chemical derivative for light sensing. Cryptochromes are blue-light photoreceptors found in circadian and arousal neurons that regulate slow biochemical processes, but this is the first time they have been linked to rapid phototransduction.

Their work appears March 3 on online Express site for the journal *Science*.

"This is totally novel mechanism that does not depend on retinal," said Holmes, a professor of physiology & biophysics. "This discovery opens whole new technology opportunities for adapting light-sensing proteins to drive medically relevant cellular activities."

This basic science breakthrough – "which literally and figuratively came 'out of the blue,'" Holmes said – has implications in the fast-growing field of optogenetics. Optogenetics combines optical and genetic research techniques to probe neural circuits at the high speeds needed to understand brain information processing. In one area, it is being used to understand how treatments such as deep brain massage can aid people with neurodegenerative diseases.

Holmes' team found that cryptochrome mediates phototransduction directly in fruit fly circadian and arousal neurons in response to blue-light wavelengths. The researchers also found that they could genetically express cryptochrome in neurons that are not ordinarily electrically responsive to light to make them light responsive.