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Non-Degenerate Two-Photon Excitation for Deep Tissue Imaging

Abstract: In conventional 2-photon microscopy, a fluorophore is excited by the simultaneous absorption of two photons of the same energy within the near infrared (NIR) spectrum, derived from the same pulsed laser beam. This is called "degenerate" 2-photon excitation, D-2PE. Alternatively, the same energy needed for the transition to the excited state can be delivered via absorption of two photons of different energy (i.e., different color). In this "non-degenerate" 2-photon excitation (ND-2PE) regime, the first laser beam can be tuned within the standard NIR range of excitation wavelengths used in conventional 2-photon microscopy, placing the second laser beam within the infrared (IR) wavelengths range for excitation of visible emission fluorophores. Under ND-2PE, an increase in the IR power can be used to compensate for the scattering losses of NIR power achieving deeper imaging in scattering medium. Another advantage of ND-2PE is an increase in excitation cross section leading to more efficient fluorophore excitation. The enhanced fluorescence brightness combined with a reduction in laser attenuation positions ND-2PE microscopy as a competitive alternative to conventional 2-photon microscopy and, possibly, 3-photon microscopy, for deep imaging applications.

Bio: Dr. Anna Devor received her initial research training at the interface between the experimental and computational neuroscience at Hebrew University of Jerusalem, Israel. Her Ph.D. thesis focused on biophysical mechanisms of the membrane potential oscillations in a network of electrically coupled neurons. After defending her Ph.D. thesis in 2002, she went on to specialize in optical imaging technology at the Martinos Center for Biomedical Imaging at MGH. In 2005, she established Neurovascular Imaging Laboratory at UC San Diego. The core of Dr. Devor's research program is focused on dissecting neuronal, glial and vascular mechanisms that underlie signals obtained with noninvasive brain imaging modalities. She published extensively on imaging of brain activity using 2-photon microscopy, voltage- and calcium-sensitive sensors, O_2-sensitive phosphorescent probes and intrinsic optical contrasts.