

Space, time, and biology: Stretching the

limits of biological sensing with high-

performance biomolecular probes

16:00-17:00, July 1, 2025 (Tuesday) Science Frontier Laboratory, 1st floor, Seminar Room, Large



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Living systems respond to external stimuli in useful ways through the generation of biochemical signals within and between cells. Thus understanding how biological systems or chestrate useful responses requires tracking and, ultimately, controlling how biochemical signals propagate in space and time. I will present efforts in my lab to expand the capabilities of optical imaging and control, using the brain as a testing ground. To track electrical signals, which process and transduce information at the millisecond level in the brain, we developed the ASAP family of fluorescent voltage indicators with high brightness, fast kinetics, wide dynamic range, and both one- and two-photon compatibility. Our latest ASAP5 and ASAP6 enable single-millivolt and single-millisecond recording at any point in a neuron or circuit. At the other end of the spatiotemporal range, we developed generalizable bioluminescent reporting methods to provide non-invasive readouts of biochemical activities over seconds to hours. Finally we will present new ideas for spatially regulating protein function in vivo for real time control of biological responses.

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