

Yuliya V Gorbunova * , Nicholas C. Spitzer **

Dynamic Interactions of cAMP Transients and Spontaneous Calcium Spikes

The universally demonstrated functions of cAMP and Ca²⁺ as second messengers in organisms from bacteria to yeast, plants, and animals make it important to experimentally investigate and model the complex signaling network they generate. Previous work has characterized the production and function of Ca²⁺ oscillations, and the physiological significance of the temporal patterns of these transients. Here we report the real-time observation of spontaneous cAMP transients and kinetic interactions between Ca²⁺ and cAMP in embryonic spinal neurons. We find that only specific patterns of Ca²⁺ transients elicit cAMP transients, and that transient elevations of cAMP briefly increase Ca²⁺ spike frequency. Using these data we construct a mathematical model of Ca²⁺-cAMP crosstalk that reproduces the experimental observations and demonstrates the role of feedback loops in the system. The model predicts that Ca²⁺-cAMP network is tuned to optimize production of cAMP transients, and defines domains in which stimuli generate distinct temporal patterns of Ca²⁺ and cAMP. Our findings may be relevant to regulation of gene expression by patterns of second messenger oscillations, since similar frequencies of cAMP transients induced by serotonin modify gene expression in the nervous system.

(*)-presenter

Dept. of Neuroscience and Cell Biology
UMDNJ-Robert Wood Johnson Medical School
675 Hoes Lane, Piscataway, NJ 08854
Ph.: (732) 235-5087
Fax: (732) 235-4029
E-mail: gorbunyv@umdnj.edu

(**)
Neurobiology Section and Center for Molecular Genetics
UCSD, Gilman Dr., La Jolla, CA 92093
Ph.: (858)534-2456
E-mail: nspitzer@ucsd.edu