1158-94-201 **Calvin Zhang-Molina*** (calvinz@math.arizona.edu), University of Arizona, Department of Mathematics, 617 N Santa Rita Ave, Tucson, AZ 85721. *An Integrated Theoretical Framework for Understanding Synaptic Transmission: The Functional Significance of Spontaneous Vesicle Release and Undocking.* Preliminary report.

Synaptic transmission is the mechanism of information transfer from one neuron to another. A crucial step in this process is the probabilistic release of neurotransmitter vesicles, which is the most significant source of randomness in the central nervous system. To quantify stochastic vesicle dynamics and evaluate its functional role, we develop an integrated theoretical framework that bridges dynamical systems, stochastic processes, optimal filtering, and control principles for understanding neuronal information processing at synaptic and circuit levels. Using this new framework, we investigate how the rate of spontaneous vesicle release and vesicle undocking influence neuronal computation at the synaptic level. Our results indicate that spontaneous vesicle release and undocking can play a functional role in synaptic transmission by enhancing the ability of a model synapse in estimating various desired signals. We suggest that, in addition to the rate of vesicle release, experimentalists should also pay attention to the rate of spontaneous vesicle release and undocking. (Received March 01, 2020)