**Watching Single Endogenous mRNA in Neurons *in vivo***

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I will present how we could begin to understand single molecule biophysics of gene expression during brain activities. The dynamics of mRNA -­ the synthesis, transport, and degradation – plays significant roles in a variety of neuronal processes. Abnormal mRNA processing and transport are implicated in neurological disorders such as autism and Alzheimer’s disease. However, understanding the mechanistic roles of RNA dynamics has been hampered by the lack of techniques to observe the endogenous molecules in the native tissue environment. Here I will describe a novel systems approach, combining single-particle tracking, genetic engineering, and intravital microscopy. Using this technique, we found that multiple β-actin mRNAs assemble together, travel by active transport, and disassemble upon KCl depolarization in cultured neurons. Two-photon imaging of live brain tissues revealed immediate-early induction of β-actin transcription after neuronal stimulation. The technology as demonstrated in our work, including the transgenic strategy and high-resolution microscopy of living tissue, could be applied to other genes to gain insights into the dynamic regulation of gene expression within the cellular and tissue microenvironment.

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[2] H. Y. Park, T. Trcek, A. Wells, J. A. Chao, and R. H. Singer. Cell Reports **1**, 179 (2012).