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Cellular Transport: Environmental Interactions lead to new Insights for in Vivo Motor Assisted Transport

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ABSTRACT

The inner workings of a single cell rely on the constant trafficking of cellular material from inside/outside the cell. Passive diffusion is much too slow and undirected for cells to maintain an efficient flux of material. As such, nature has found a better way - molecular motors. Nanometer scale macromolecules dubbed "molecular motors" represent a class of protein complexes that can convert chemical energy into mechanical work in the form of displacing molecular cargo and organelles over vast cellular distances. These cargos can be thousands of times larger than a single molecular motor, yet transport is achieved with a couple molecular motors per cargo. Much is already known about how these motors work and their physical properties when they are transporting cargo along cytoskeletal filaments in both in vitro and in vivo settings. However, not much is known about how the surrounding cellular environment affects transport in general. Cells are not just tiny bags of water; internally they are very dense with free protein and organelles that constantly bombard cargo as its being transported over filamentous protein networks. These filamentous networks (actin and microtubules) that molecular motors are associated with and move along are also very dense and can interact strongly with cargo as its being transported. Focusing on kinesin, a microtubule associated motor, and reconstituted microtubules in vitro, we have explored the connection between motor mediated cargo trafficking and the surrounding environment through both experiment and theoretical approaches. What we have uncovered is that the surrounding environment and its composition plays a significant role in regulating cargo-motor dynamics. These interactions can also be leveraged to optimize transport for a range of cargo sizes. I will present our recent work and reflect on this new and exciting pathway to understanding cellular transport from a whole cell prospective.

BIO:

I am a California native and my training as a scientist started at UC Santa Cruz where I received a BS in physics (2003). I then moved to the east coast and earned my PhD from Syracuse University in physics (2011). My first postdoc was here at UC Merced with Prof. Gopinathan (2011-2014). My second postdoc was at Stanford University in KC Huang's group in bioengineering (2014-2016). Currently I am a project scientist with the Center for Biological Machines (CCBM) at UC Merced (~2 yrs.). At CCBM my work centers on computational science and its application to solving complex problems in biology.