THE CHINESE UNIVERSITY OF HONG KONG
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The Selective Phase Model in Nucleocytoplasmic Transport: From Cell Biology to Physics

by

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ALL INTERESTED ARE WELCOME
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Abstract

Genetic materials of eukaryotic cells are stored in an enclosed compartment called nucleus. To maintain life, messages encoded by the genetic materials need to be exported to the cytoplasm and certain machineries need to be imported into the nucleus. Therefore, channels bridging the nucleus and cytoplasm are crucial, and they are called Nuclear Pore Complexes (NPCs). Simple diffusion of materials through these channels would not be sufficient to maintain life, because materials have to be transported against a concentration gradient. The solution developed by nature is the establishment of a permeability barrier inside the NPCs. The barrier retains most macromolecules >30 kDa but selectively allows the passage of specialized proteins called Nuclear Transport Receptors (NTRs), which can pick up the "cargoes" and shuttle between nucleus and cytoplasm. How can this selective passage be established? The selective phase model describes the barrier as a condensed phase assembled from phase separation of cohesive protein domains, while NTRs (but not OTHER molecules) can dissolve into such phase.

Recombinantly expressed and purified cohesive protein domains phase-separate into condensed phases *in vitro* which recapitulate nuclear-pore-like selectivity. Such an experimental system provided a platform for biophysical insights. Recently a perfectly repeated peptide was engineered, which still captures the barrier functions of wild-type protein domains and thus represents an even more simplified experimental model. The speaker would summarize recent advances using this system. In particular, by a thermodynamic model originated from old theories of micellization, free energy parameters of phase separation and cohesion were derived.

References:
Ng, Güttler & Görlich, Recapitulation of selective nuclear import and export with a perfectly repeated 12mer GLFG peptide. *Nat Commun* (2021).
Ng & Görlich, A simple thermodynamic description of phase separation of Nup98 FG domains. *Nat Commun* (2022).

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