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BioSim Talk 2025 #4

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Institute for Protein Research,
The University of Osaka (Suita Campus)
2th floor conference room

How Multivalency, Linkers, and Competitive Binding Govern Postsynaptic Condensate Architecture

Liquid-liquid phase separation (LLPS) governs the formation of membraneless organelles and specialized cellular compartments. In neurons, LLPS involving synaptic proteins organizes postsynaptic signaling machinery and gives rise to distinct condensate architectures. In this system, PSD-95 together with STG (an auxiliary subunit of AMPARs) tends to occupy the core, while CaMKII associates with GluN2B (a core subunit of NMDARs) in the surrounding shell. We refer to these nested condensates as phase-in-phase (PIP) structures. Changes in the concentrations of STG and GluN2B alter competitive binding interactions, which can transition the PIP architecture into a fully mixed condensate. Furthermore, we find that PIP structures emerge specifically when CaMKII exhibits high multivalency and short flexible linkers, while long linkers convert PIP into partially engulfed phases. Short linkers in CaMKII lower its surface tension, thereby modifying the overall interfacial tension to stabilize PIP. These properties underscore how intrinsic features of CaMKII govern complex condensate architectures, providing new insight into its role as a molecular substrate for synaptic plasticity and memory.

Link for online participation via Zoom:
Meeting ID: 820 9184 7617, Passcode: 626775
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