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4D Metabolic Network in Living Cells

Increased evidence implies that cellular metabolic network is dynamic in space and time. The membrane bound organelle, mitochondria, encapsulating several metabolic pathways require highly regulated communication with cytoplasmic metabolic pathways such as glucose metabolism. Meanwhile, the cytoplasmic enzymes in glucose metabolism are spatially organized into multienzyme assemblies without membrane in human cells. However, how the formation of the enzyme assemblies and their sub-cellular locations in a cell are functionally associated with mitochondrial metabolism is largely unknown. With 4D imaging using the home-built lattice light sheet microscope, we reveal that the subcellular location of enzyme assemblies is spatially and functionally linked with mitochondrial functions. Our results further shed light on how membrane bound and membraneless organelles locally and efficiently orchestrate their metabolic functions. We envision that the presented “spatiofunctional” characteristics of the enzyme assemblies in glucose metabolism with mitochondrial metabolism are an unprecedented starting point for mapping 4D functional metabolic network in live cells.