The molecular mechanisms of memory persistence: imaging how single synapses learn in real time

Miquel Bosch

Memories are stored in our brain through the ability of synaptic connections to modify their structure and function in a long-lasting way. However, nobody has ever observed how these changes occur in a single synapse in real time.

I will explain how we used a new combination of optical technologies to reveal the molecular remodeling that takes place inside a synapse during the creation of a memory. We used two-photon microscopy to stimulate individual synapses and to visualize protein trafficking in real time. We identified a unique protein that is rapidly and persistently captured in potentiated synapses, forming a new macromolecule that could serve as a memory tag. We developed a novel photo-marking technique that allowed us to localize the same synapses under both two-photon and electron microscopies. This way we observed how synaptic structures evolve asynchronously in different temporal phases during synaptic potentiation.