Graduate School Event

Thesis Defense: Timing and strength of synaptic transmission at hippocampal mossy fiber synapses in mice and humans

Silvia Jamrichova (Jonas Group)
Jonas Group

Host: Maria Ibáñez

A fundamental question in neuroscience is how the biophysical properties of synapses shape higher network computations. The mossy fiber synapse is a key synapse of the trisynaptic circuit of the hippocampus, a brain region central to the encoding and retrieval of declarative memory. Its unique size, large vesicle pool, wide range of plasticity, striking "detonator" properties, and involvement in several higher-order computations, namely pattern separation and pattern completion, make it an ideal model for studying synaptic mechanisms with direct relevance to memory and its impairments.Despite extensive study over the years, however, key questions remain unresolved: the molecular identity of the Ca^2 sensors driving its distinct modes of release and plasticity, and whether its fundamental properties are preserved in the human brain.Thanks to newly generated transgenic mice and a method of direct presynaptic patch-clamp recordings from mossy fiber boutons, we used a combination of electrophysiological, imaging and behavioral methods to investigate the role of synaptotagmins in timing of transmission and plasticity at this synapse.We found that Syt1 is the primary Ca^2 sensor for synchronous release, with a major trigger and minor clamping function of neurotransmitter release. Syt1 deletion led to an increase in asynchronous release converting the teacher synapse from a temporally precise conditional detonator to an asynchronous one. Moreover, at the behavioral level, desynchronized release selectively impaired pattern completion, while pattern separation remained intact, demonstrating that disruption of its precise timing and strength leads to selective impairments in behaviorally relevant hippocampal computations in mice. Interestingly, our data did not support a proposed role for Syt7 in either asynchronous release, or facilitation or pool refilling, leaving its function at this synapse enigmatic.Furthermore, utilizing non-sclerotic tissue obtained from temporal lobe epilepsy patients undergoing brain surgery, we discovered several notable species differences: human mossy fiber boutons display larger vesicle pools and amplitude responses, and — strikingly — exhibit full detonator properties in CA3. Furthermore, mossy fiber synapses targeting CA4 neurons lack such properties, suggesting a distinct functional role at this projection.Together, the findings presented in this thesis shed light on the molecular mechanisms underlying information processing at the hippocampal mossy fiber synapse, with implications for our understanding of memory, and reveal both conserved and distinct

synaptic properties between mice and humans, suggesting that human mossy fibers are not a simple scaled version of their rodent counterpart.

Wednesday, August 5, 2026 03:00pm - 04:00pm

Central Bldg / O1 / Lecture Hall (I02.O1.014) and Zoom

This invitation is valid as a ticket for the ISTA Shuttle from and to Heiligenstadt Station. Please find a schedule of the ISTA Shuttle on our webpage: https://ista.ac.at/en/campus/how-to-get-here/ The ISTA Shuttle bus is marked ISTA Shuttle (#142) and has the Institute Logo printed on the side.