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Synchronization of interhippocampal ripple events (80–200 Hz) by long-projection inhibitory neurons

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Network oscillations between the two hippocampi are highly synchronized. Synchronized theta is believed to be the result of the common input from the septal region, whereas the mechanism of the ripple synchronization is not well understood. It was previously demonstrated using partial coherence analysis that the "coupling" between the two CA1 regions of hippocampi during theta oscillations is stronger than that between the individual layers of the same hippocampus.

Hippocampal sharp wave-ripple complexes occur during slow-wave sleep and awake immobility and are thought to be important for memory consolidation. The delay between simultaneously recorded ripple events from the two hippocampi is remarkably short (1–2 ms). This observation suggests that some sort of fast communication mechanism should connect the two hippocampi. We demonstrate that the simultaneously occurring ripple events in the two hippocampi are highly coherent. This observation suggests an important role of the commissural projections in interhemispheric network synchronization. Using various anatomical methods we demonstrate that a subset of inhibitory neurons (NPY-expressing cells), located in the CA1, CA3 area and dentate gyrus, extensively project not only to the contralateral hippocampus, but also to the septal region. We use model simulations to determine to what extent and under which conditions the highly synchronous ripple events can be produced by long-range intra- and interhippocampal inhibitory projections.