

Ripple

Definition: A **ripple** (or **sharp-wave ripple**, SWR) is a brief, high-frequency oscillatory event in the brain's local field potential, typically occurring in the **80–200 Hz** range. It is most prominently observed in the **hippocampus** during **offline states** such as **sleep**, **quiet wakefulness**, or **memory recall**.

Characteristics

- **Frequency:** ~80–120 Hz in humans; ~140–200 Hz in rodents.
- **Duration:** 50–150 milliseconds.
- **Location:** Hippocampus (CA1), entorhinal cortex, and medial temporal lobe; recently reported in neocortex.
- **Co-occurrence:** Typically accompanies a sharp wave (SWR), reflecting synchronous depolarization from CA3 to CA1.

Functional Role

- **Memory consolidation:** Supports reactivation of neuronal ensembles representing recent experiences.
- **Replay of experience:** Sequences of place cells or event-related patterns are replayed during ripples.
- **Interregional communication:** Synchronizes hippocampal activity with prefrontal cortex and other memory-related areas.

Contexts of Occurrence

- **Sleep:** Especially during slow-wave sleep (SWS), promoting consolidation of declarative memories.
- **Quiet rest:** Ripples emerge after learning, during passive states.
- **Movie-watching and naturalistic experience:** Ripple-like activity has been detected at **event boundaries** and salient within-event moments in recent intracranial EEG studies.

Clinical & Research Significance

- **Cognitive neuroscience:** Central to models of **systems consolidation** and **memory replay**.
- **Neurological disorders:**
 - Abnormal ripples are seen in **epilepsy** (e.g., high-frequency oscillations used as biomarkers).
 - Disruption of ripple dynamics may underlie **memory deficits** in aging and Alzheimer's disease.
- **Brain-computer interfaces (BCI):** Ripples are being explored as biomarkers for decoding memory states or intent.

Related Terms

- **Sharp-wave ripple (SWR):** The combined low-frequency sharp wave and high-frequency ripple; foundational for memory reactivation.
- **Replay:** The sequential reactivation of neurons during ripple events.
- **Hippocampal-cortical dialogue:** Ripple timing facilitates inter-regional communication for consolidation.

see [Sharp waves and ripples](#)

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