

Session 615 - Cortical and Hippocampal Circuits: Timing and Temporal Processing

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## 615.18 / TT56 - An emergent model of hippocampal sharp wave ripple complexes reveals sublayer-specific stratified disparities

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Development, India**Authors****\*M. SINHA**, R. NARAYANAN;  
Mol. Biophysics Unit (MBU), Indian Inst. of Sci., Bangalore, India**Disclosures****M. Sinha:** None. **R. Narayanan:** None.**Abstract**

The hippocampal CA1 region comprises a heterogeneous population of deep and superficial pyramidal neurons whose somata manifest hyperpolarizing and depolarizing transients, respectively, during a sharp wave ripple (SPW-R) event. Here, we present a forward modeling approach that elucidates the emergence of the SPW-R complex and its relationship to the differential properties and responses of deep and superficial neurons. To generate deep and superficial neuronal populations, we accounted for deep-superficial differences in basal dendrites and  $h$  channels and employed a multi-parametric (12 active and passive properties) multi-objective (12 *in vitro* measurements) stochastic search spanning 5000 models for each population. An additional layer of search and validation, based on *in vivo* measurements, was imposed when valid models from this search (7 deep and 20 superficial) were subjected to high conductance state (HCS). Further, deep neurons received larger inhibition, and the placement of deep and superficial somata translated to iso-distant Schaffer collateral fibers establishing contacts respectively on their distal and proximal dendrites. To match electrophysiological observations during SPW-R epochs, we introduced dendritic plateau potentials (DPPs) and perisomatic ripple frequency inhibition (RFI) in these neurons. We found that HCS lowered the probability of generating an axo-somatic action potential despite the presence of a DPP. Importantly, the distally placed DPP in deep neurons attenuated to a larger extent compared to their proximal counterparts in superficial neurons, which in conjunction with enhanced inhibition in deep neurons resulted in the differential transients observed in deep *vs.* superficial somata during SPW-R epochs. Next, we built a neuropil made of 440 deep and superficial neurons (220 each), with their somata placed within the stratum pyramidale (SP). We computed local field potentials using the line source approximation method at 17 locations when DPPs and RFI impinged on these neurons. With reference to sharp waves in the SPW-R complex, DPPs in the superficial and deep neurons contributed predominantly to proximal and distal sinks, respectively, together yielding a broad spread of the sink. The ripples in the SPW-R complex and the source in the SP were primarily mediated by inhibitory afferents onto deep neurons, with relatively small contributions from superficial neurons. Our results unveil the differential contributions of deep and superficial neurons to SPW-R complexes, and suggest localized DPP as a key cellular mechanism that links the SPW-R complex to memory consolidation through plasticity induction.