# Hardware Implementation of Homeostasis in Skyrmion-Based Neuron Devices

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Recent advancements in artificial intelligence (AI) have profoundly impacted our daily lives as well as various scientific fields. One of the core AI technologies is spiking neural networks (SNNs), designed to emulate the spike-based communication of biological neurons [1]. Furthermore, in the quest to develop AI edge devices beyond cloud computing, hardware-based SNNs (H-SNNs) have attracted significant attention due to their energy efficiency. H-SNNs require the hardware implementation of specific SNN algorithm operations, such as leaky-integrate-and-fire (LIF) [2] and spike-timing-dependent plasticity (STDP) [3]. Moreover, the homeostasis functionality in neuron devices, which regulates neuron firing rates, is also crucial for enhancing SNN efficiency [4]. In this context, we introduce a new type of skyrmion-based SNN neuron device, integrating temporal input signals through the skyrmion-skyrmion repulsion mechanism. Furthermore, in the skyrmion neuron device, we demonstrate the implementation of homeostasis functionality, which has never been experimentally demonstrated in device-level applications. Our findings will pave the way for new developments in neuromorphic computing, emphasizing the important impact that skyrmions can have in its wide-ranging applications.

## References

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