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Integration of Squid/Memristor Neurons with Precision Space and Time Particle Physics Detectors for 4D Image Reconstruction using Neuromorphic Computing

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Neuromorphic computing (NC), which uses a network of artificial synapses and neurons to construct individual neural units, can enable the information processed and storage in the same units. If networks are formed with these neural units and new algorithmic models using the neuron's spike capabilities are used, NC is expected to provide critical computing hardware for emerging artificial intelligence and machine learning applications, and may converge with quantum computing for quantum neuromorphic computing. Meanwhile, recent advances in sensors used for particle physics applications have allowed the possibility of detecting signals with both fine spatial resolution (~⊠m) and time resolution (~10ps). New paradigms for using this 4-dimensional information are also needed in order to achieve on-detector, real-time, continuous data processing which enables the scalability to large channel counts. An application is discussed whereby a neuromorphic readout system could be used as the backend for an AC coupled, Low-Gain Avalanche Detector front end to provide good spatial and temporal resolution.

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