

# Preface to Special Topic: New Physics and Materials for Neuromorphic Computation

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## Preface to Special Topic: New Physics and Materials for Neuromorphic Computation

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Artificial Intelligence is a topic that is pervasive in many modern developments and not just confined to science anymore. Many practical applications are based on performing classification tasks inspired by how the natural brain processes information. This current Special Topic on New Physics and Materials for Neuromorphic Computation looks toward solutions for such computational processes that go beyond the currently well-established semiconducting digital computation paradigm.

Toward this end, neuromorphic algorithms based on neural networks have already found wide-spread application for new categorization tasks and machine learning technology. However, so far they are mainly implemented in traditional computer hardware, which is not optimized for these tasks and therefore operates at a high-power penalty. For more energy-efficient future systems, it is therefore desirable to develop new devices that take advantage of new physics and materials that enable neural and synaptic functionalities operating close to the thermal noise floor, while at the same

time offering scalable analog properties that can be used down to the nanometer scale. In this respect, there has recently been a development of a wide variety of new approaches for neuromorphic devices based on resistive, magnetic, and optic materials properties. This Special Topic highlights the different types of new physics, as well as new materials developments that are most promising for neuromorphic computation beyond the limitations of current semiconductors.

We hope that the readers find the collection of these articles an inspiration for going well outside of the box of traditional computation approaches. We strived to find a balance of tutorial articles that explain basic concepts in this rapidly developing field, as well as perspective articles that provide outlooks for future developments. Together with many additional contributed articles, this special topic should provide both a good starting point for novices in this field and useful information for experts. Thus, we want to thank the numerous contributors who made this special topic possible and hope that you enjoy the articles included in it.