Special Issue

AI and Machine Learning in Dark Matter Searches: From Anomaly Detection to Detector Optimization

Message from the Guest Editors

Artificial intelligence (AI) and machine learning (ML) have emerged as powerful tools in the search for dark matter, revolutionizing our ability to analyze vast datasets, enhance signal sensitivity, and optimize experimental design. As dark matter remains one of the most profound mysteries in fundamental physics, cutting-edge AI-driven approaches are playing an increasingly vital role in exploring new parameter spaces and refining detection strategies. This special issue focuses on the latest innovations at the intersection of AI, ML, and searches for dark matter. Key topics include:

- Advanced anomaly detection techniques for identifying rare events within high-dimensional datasets;
- Deep learning architectures for improving signal-to-background discrimination;
- AI-driven optimization of detector development and calibration.

These methods are being actively integrated into both direct and indirect detection experiments, as well as collider-based research, providing new avenues to uncover potential dark matter signatures.

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