Contribution ID: **172** Type: **Parallel talk**

Large Physics Models: Towards a collaborative approach with Large Language Models and Foundation Models

This work explores ideas and provides a potential roadmap for the development and evaluation of physics-specific large-scale AI models, which we call Large Physics Models (LPMs). These models, based on foundation models such as Large Language Models (LLMs) - trained on broad data - are tailored to address the demands of physics research. LPMs can function independently or as part of an integrated framework. This framework can incorporate specialized tools, including symbolic reasoning modules for mathematical manipulations, frameworks to analyse specific experimental and simulated data, and mechanisms for synthesizing theories and scientific literature. We begin by examining whether the physics community should actively develop and refine dedicated models, rather than relying solely on commercial LLMs. We then outline how LPMs can be realized through interdisciplinary collaboration among experts in physics, computer science, and philosophy of science. To integrate these models effectively, we identify three key pillars: Development, Evaluation, and Philosophical Reflection. Development focuses on constructing models capable of processing physics texts, mathematical formulations, and diverse physical data. Evaluation assesses accuracy and reliability by testing and benchmarking. Finally, Philosophical Reflection encompasses the analysis of broader implications of LLMs in physics, including their potential to generate new scientific understanding and what novel collaboration dynamics might arise in research. Inspired by the organizational structure of experimental collaborations in particle physics, we propose a similarly interdisciplinary and collaborative approach to building and refining Large Physics Models. This roadmap provides specific objectives, defines pathways to achieve them, and identifies challenges that must be addressed to realise physics-specific large scale AI models.

AI keywords

Large Language Model, Foundation Model

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Track Classification: Foundation Models