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On the Confluence of Data-Driven Techniques and Laser-Plasma Acceleration

Monday, 18 September 2023 12:00 (30 minutes)

Over the past several decades, the domain of laser-plasma acceleration has witnessed remarkable progress, largely credited to the escalating potency and availability of high-power lasers. Unlike the earlier phases of research where investigations were primarily confined to singular experiments with limited parameter probing, today's experiments and simulations afford exhaustive data harvesting. Consequently, the community is increasingly leveraging data-driven techniques to augment both understanding and control of laser-based accelerators.

This evolution can be systematically understood through three intertwined phases: Firstly, as an essential foundational step, research groups are mandated to institute cohesive data acquisition and management systems, ensuring the efficient collation and utilization of emergent data. Following this, the availability of data paves the way for the application of standardized machine learning techniques. The final, holistic phase involves deployment of bespoke machine learning solutions, which are adapted to the requirements and nuances of laser-plasma acceleration.

I will present two recent examples from the Centre for Advanced Laser Applications in Garching for such "tailor-made" solutions. Specifically, I will delve into Bayesian for managing a laser-powered accelerator, and introduce the FALCON technique for measuring spatio-temporal couplings in high-intensity lasers. Lastly, I will give an outlook on future developments towards "intelligent" accelerator facilities.

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