Contribution ID: **15** Type: **Open Data Challenges**

Machine-learning to better understand radiation emitted by laser-plasma interactions

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Radiation signatures emitted by Laser-plasma interactions are ubiquitous and are straightforward to experimentally acquire via imaging and spectroscopy. The data encodes phase-space dynamics on the smallest temporal and spatial scales. Yet such data is hard to interpret and thus is frequently discarded as being too complex. For theory and data analysis this raises several central questions: What are experimentally promising radiation signatures? What do they mean physically and are these robust and unambigous indicators?

Calculating classical radiation emitted by relativistic plasmas from all charged particles across the entire spectrum from the IR to the x-ray range and emitted into the full solid angle, while retaining coherence and polarization properties, is a prime HPC data challenge, currently requiring exascale compute capabilities. These calculations, are successfully perfomed in-situ by the particle-in-cell code PIConGPU at the cost of increasing computational requirements by several orders of magnitudes.

By exploiting machine learning techniques we aim for two goals: Speeding up calculations of these radiation signatures, as well as for improving knowledge extraction, i.e. connecting simulated and experimentally relevant radiation signatures, ideally unambigously, to the initial radiation sources and physics processes.

We introduce the data challenge and motivate how a large-scale distributed analysis of a huge set of unstructed point cloud data via an autoencoder approach, can be used to map a compressed representation to radiation diagnostics via invertible neural network. Initial results on a smaller scale of a specialized application have been encouraging: invertible neural networks based on variational autoencoders successfully have been trained on flashes of radiation in Laser-wakefield accelerators to identify and spatially localize the instances of electron injection.

Physical Presentation

I am not so sure at this point if I would present physically.

Primary author: Dr DEBUS, Alexander (Helmholtz-Zentrum Dresden-Rossendorf)

Co-authors: Mr LEINHAUSER, Matthew (Center for Advanced Systems Understanding, University of Delaware); Dr PAUSCH, Richard (Helmholtz-Zentrum Dresden-Rossendorf); Mr LEBEDEV, Anton (Helmholtz-Zentrum Dresden-Rossendorf); Prof. CHANDRASEKARAN, Sunita (University of Delaware); Dr BUSSMANN, Michael (Center for Advanced Systems Understanding, Helmholtz-Zentrum Dresden-Rossendorf); Mr BETHKE, Friedrich (Helmholtz-Zentrum Dresden-Rossendorf); Mrs WILLMANN, Anna (Helmholtz-Zentrum Dresden-Rossendorf); Mr DIECKMANN, Jakob (Helmholtz-Zentrum Dresden-Rossendorf); Dr NICO, Hoffmann (Helmholtz-Zentrum Dresden-Rossendorf)

Presenter: Dr DEBUS, Alexander (Helmholtz-Zentrum Dresden-Rossendorf)

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