HAMLET
How to Apply Machine Learning to Experimental & Theoretical PHYSICS
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AI for fusion, plasma simulations, and experiment control

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We give an overview of the work in AI within a joint research endeavour between the UKAEA and the STFC Hartree Centre, the *Fusion Computing Lab*, to accelerate discovery and design of complex facilities in magnetic-confinement fusion.
We illustrate how we are enhancing the "classical" real-time control of tokamak shots with AI techniques of emulation and reinforcement learning, both for the shape of the confined plasma and for the cooling of the exhaust fusion byproducts in the divertor region, as well as the fast prediction of disruptive instabilities from heterogeneous and gappy measurements.
We also present ongoing work to accelerate demanding simulations in plasma physics, to quantify turbulent transport in different regimes across the tokamak, from the core to the scrape-off-layer region, highlighting the importance of domain-aware AI.
The techniques developed in this collaboration also have applications to the efficient planning of experiment campaigns, and optimal design of complex facilities, in other areas of physics.

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