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Nuclear Fission with Neural Networks[1] DANIEL LAY, ERIC FLYNN, SAMUEL GIULIANI, LEO NEUFCOURT, WITOLD NAZAREWICZ, NSCL Cyclotron Lab — Nuclear fission yields are important for determining the abundances and cosmic origin of r-process elements. The neutron-rich actinides and transactinides that are involved are inaccessible experimentally, and so theoretical computations are required to determine their properties. In this study, energy density functional theory is used to compute nuclear potential energy surfaces (PES) which are essential theoretical ingredients to determine fission yields. Multi-dimensional PES computations, covering the full fission trajectory from the ground state to scission, are too expensive to perform across the large region of the nuclear chart that is relevant for the r-process.

To reduce the computation effort, we (i) employ the recently proposed efficient method for estimation of fission fragment yields [1] and (ii) we train a neural network (NN) using PES determined for selected nuclei, and then use machine learning to make predictions on the full region of interest in the nuclear chart. In this talk, we present the performance of this approach to global fission calculations.
[1] *Efficient method for estimation of fission fragment yields of r-process nuclei*, J. Sadhukhan, S. A. Giuliani, Z. Matheson, and W. Nazarewicz, Phys. Rev. C 101, 065803 (2020

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