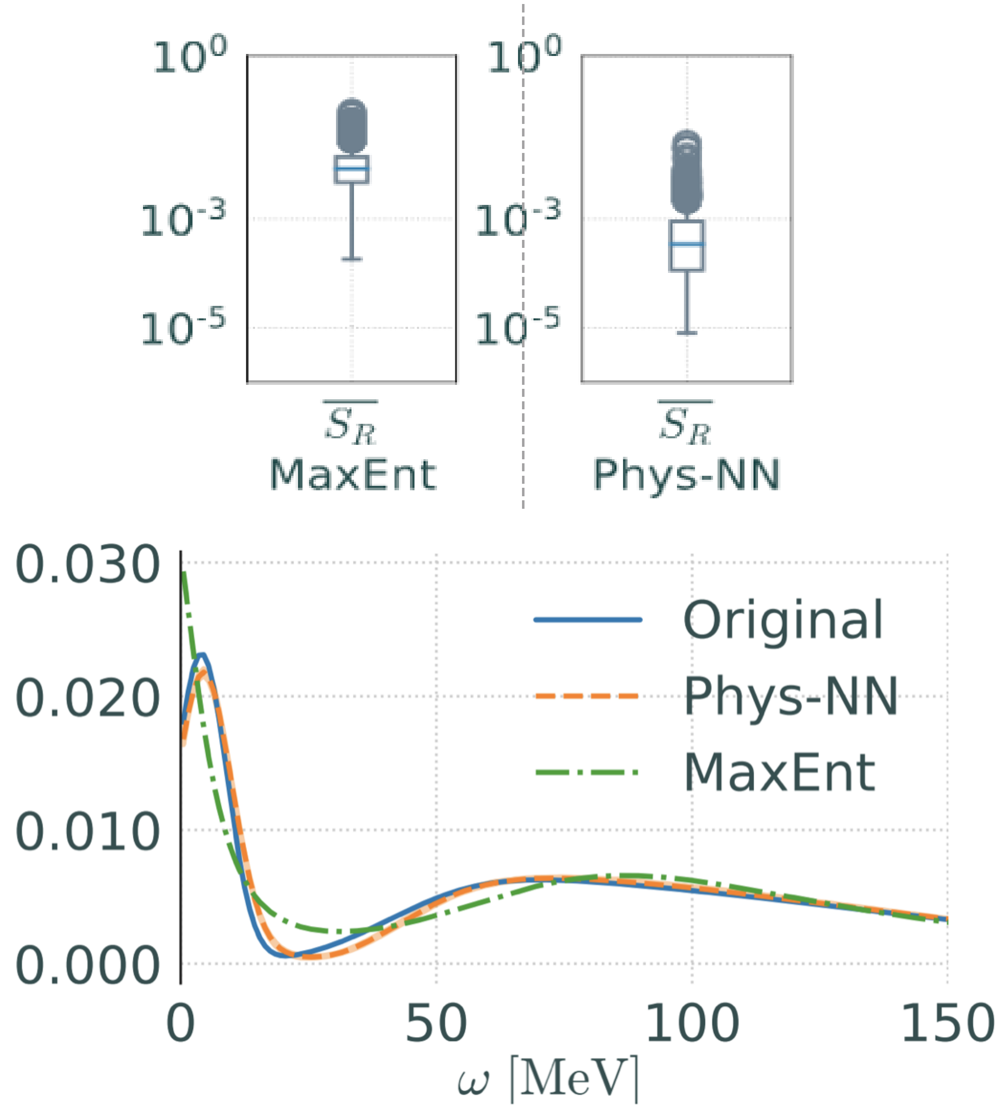
Machine Learning-Based Inversion of Nuclear Responses

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI
Nuclear Computational Low-Energy Initiative

Objectives

- Reconstruct the energy dependence of electroweak response functions from imaginary-time correlation functions computed within quantum Monte Carlo approaches



Top: Phys-NN outperforms MaxEnt as measured by the much smaller values of the entropy S_R;
Bottom: Phys-NN closer to the Original response than MaxEnt

Impact

- A microscopic description of the interaction of nuclei with electroweak probes is required for elucidating aspects of short-range nuclear dynamics and for the correct interpretation of neutrino-oscillation experiments
- Quantum Monte Carlo methods compute imaginary-time correlation functions, corresponding to the Laplace transform of electroweak responses
- We introduced a physics-informed artificial neural network ("Phys-NN") suitable to invert the Laplace transform and reliably reconstruct the electro-magnetic response functions of atomic nuclei from their corresponding Euclidean responses
- Phys-NN outperforms Maximum entropy, particularly in the low-energy transfer region that is relevant for oscillation experiments and muon-capture rates

Accomplishments

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