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Machine Learning Strategies for a Global Equation of State and a Better Description of Neutron Stars

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Extremely massive objects such as neutron stars serve as unique laboratories that allow the study of nuclear matter in exotic environments impossible to be reproduced on Earth. The microscopic description of the nuclear structure of neutron stars represents a big challenge for theoretical models. The large densities present in these stars, possibly beyond the nuclear density equilibrium, lead to strong sensitivity of the mass-radius relation. This, opens space for several theoretical parameterization and constraints that are often applied case by case or to different classes of stars.

Even though the first observations and theoretical models were proposed several years ago, a complete description of such objects is still missing due to the complexity of the calculations involved. Today's successful approaches require many constrains in a variety of nuclear models in an attempt to reproduce astrophysical observations.

In this work, we make use of modern supervised machine learning techniques that allow us to determine different properties present in a sample of EoS generated from different physical models. Our objective is to obtain a global parameterization of different classes of equations of states. We will present selected results for representative cases.

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