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Simulation-based inference for pulsar-population synthesis

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Although about a billion neutron stars are expected to exist in the Milky Way, observational constraints limit us to only observing a few thousand. Pulsar population synthesis bridges this gap by simulating the entire population and comparing it to the observed sample to constrain neutronstar physics. In this talk, we explore the possibility of using simulation-based inference based on neural networks to estimate the parameters governing the magnetic and rotational properties of isolated Galactic radio pulsars. For this purpose, we implement a population-synthesis framework able to simulate the stars' dynamical and magneto-rotational evolution as well as their radio emission and incorporate selection biases of typical radio surveys. We then generate a dataset of mock pulsar populations to train and validate a mixture-density neural network. In particular, we demonstrate how the combined information from P-Pdot diagrams from different radio surveys can help us to recover the posterior distribution of the model parameters governing the properties of neutron stars at birth.

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