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Probing primordial non-Gaussianity by reconstructing the initial conditions with convolutional neural networks

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Inflation remains one of the enigmas in fundamental physics. While it is difficult to distinguish different inflation models, information contained in primordial non-Gaussianity (PNG) offers a route to break the degeneracy. In galaxy surveys, the local type PNG is usually probed by measuring the scale-dependent bias in the power spectrum. We introduce a new approach to measure the local type PNG by computing a three-point estimator using reconstructed density field, a density field reversed to the initial conditions from late time. This approach offers an alternative way to the existing method with different systematics and also organically follows the procedure of BAO analysis in large galaxy surveys. We introduce a reconstruction method using convolutional neural networks that significantly improves the performance of traditional reconstruction algorithms in matter density field, which is crucial for more effectively probing PNG. This pipeline can be applied to the ongoing Dark Energy Spectroscopical Instrument (DESI) and *Euclid* surveys, as well as upcoming projects, such as the *Nancy Roman Space Telescope*.

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