Capturing the physics of MaNGA galaxies with self-supervised Machine Learning

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Résumé

As available data sets grow in size and complexity, advanced visualization tools enabling their exploration and analysis become more important. In modern astronomy, integral field spectroscopic galaxy surveys are a clear example of increasing dimensionality and complexity of datasets, which challenge the traditional methods used to extract the physical information they contain. We present the use of a novel self-supervised Machine Learning method to visualize the multi-dimensional information on stellar population and kinematics in the MaNGA survey in a two dimensional plane. Our framework is insensitive to non-physical properties such as the size of integral field unit (IFU) and is therefore able to order galaxies according to their resolved physical properties. Using the extracted representations, we study how galaxies distribute based on their resolved and global physical properties. We show that even when using exclusively information about the internal structure, galaxies naturally cluster into two well-known categories from a purely data driven perspective: rotating main-sequence disks and massive slow rotators, hence confirming distinct assembly channels. Low-mass rotation-dominated quenched galaxies appear only as a third cluster if information about the integrated physical properties is preserved, suggesting a mixture of assembly processes for these galaxies without any particular signature in their internal kinematics that distinguishes them from the two main groups.

To further study the impact of interactions in the observable properties of galaxies, we extend the analysis to simulated galaxies, as their assembly history is known. For this purpose, a set of simulated galaxies is processed to emulate the MaNGA pipeline. We later use the self-supervised representations to compare the simulated and observed sets in a common space. Preliminary results will be presented.
Video: https://youtu.be/GJdT7gHcglk

Mots-Clés: Galaxies, Deep Learning, Integral field spectroscopy

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