

Illuminating the Low Surface Brightness Galaxies in Dark Energy Survey with Transformers.

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Low surface brightness galaxies (LSBGs) are defined as galaxies that are fainter than the night sky ($\mu(g) > 22 \text{ mag arcsec}^{-2}$). LSBGs are hypothesized to be dominated by dark matter halos and contain a significant fraction of the missing baryons, making them an ideal laboratory to test cosmological models. Upcoming large-scale surveys like Rubin Observatory Legacy Survey of Space and Time (LSST) and Euclid are expected to observe approximately 10^9

astronomical objects. In this context, using semi-automatic methods to identify LSBGs while rejecting artefacts would be highly challenging and time-consuming. Therefore, alternative approaches such as automated or machine learning-based methods will be necessary to overcome this challenge. We study the use of transformers or, more generally, the self-attention-based machine learning models in separating LSBGs from artefacts from the Dark Energy Survey (DES). In addition, we also searched for the presence of new LSBGs from DES that the previous searches may have missed. Using an ensemble model, we identified 4083 LSBGs from the DES data release 1 (DR1), adding an additional $\sim 17\%$ LSBGs to the known LSBGs. We analyze the properties of these new LSBGs and the general properties of LSBGs in DES.

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