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Using the whole optical spectrum to classify activity in S0 galaxies

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Abstract

The BPT and WHAN diagrams are well-known emission-line classifiers extensively used for identifying the dominant ionization source in galaxies. However, their reliance on the fluxes contained within specific emission lines limits their applicability, particularly in the study of early type galaxies, which are systematically excluded from these classifications. We present the DPS-PC3 diagram, a new and inclusive activity classifier that does not suffer from this limitation, as it harnesses the information contained within the entire optical spectrum. The classification is based on the projections of the spectra of S0 galaxies onto their first three principal components derived in Tous et al. (2020). The vertical dimension of our classifier condenses the information of the first two principal components into a single parameter, DPS, that aligns with the equivalent width of the Hα line and therefore sorts galaxies according to their global activity status, from active to fully passive. On the horizontal axis, the third principal component allows to disentangle ionization by star formation processes from that related to nuclear accretion. The segregation power of this latter component arises from the fact that it reflects the variance associated with almost all the emission lines used in the BPT diagrams. While in this work we demonstrate the effectiveness of our taxonomic framework in segregating S0 galaxies by their activity, its extension to the entire Hubble sequence should be a natural step.

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