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Extracting physical rules from ensemble machine learning for the selection of radio AGN.

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Studying Active Galactic Nuclei (AGN) is crucial to understand processes regarding birth and evolution of Super-Massive Black Holes and their connection with star formation and galaxy evolution. However, few AGN have been identified in the EoR ($z > 6$) making it difficult to study their properties. In particular, a very small fraction of these AGN have been radio detected. Simulations and models predict that future observatories might increase these numbers drastically.

It becomes fundamental, then, to establish connections between radio emission and other multi-wavelength properties at high z. Recent wide-area multi-survey data have opened a window into obtaining these connections and rules.

At the same time, the development and operation of large-scale radio observatories, renders the use of regular AGN detection and redshift determination techniques inefficient. Machine Learning (ML) methods can help to predict the detection of AGN and some of their properties. We have developed, then, a series of ML models that, using multi-wavelength photometry, can produce a list of Radio Galaxy candidates, with their predicted redshift values.

More importantly, we have also applied some state-of-the-art feature importance techniques to understand which physical properties drive the predictions made by our models. From these techniques, it is possible to derive indicators for the selection of studied sources.

We will present the results of applying these models and techniques on near-infrared (NIR)-selected sources from the HETDEX Spring Field and the Stripe 82 Field. Furthermore, using feature importances, we will describe which properties hold the highest predicting power and the derivation of a efficient colour-colour criterion for the identification of AGN candidates. Moreover, we will introduce our efforts to apply said models and procedures to data in the area of the Evolutionary Map of the Universe (EMU, a precursor of the SKA Observatory) Pilot Survey.

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