Learning Machine Learning techniques to dig up high-z AGN in the Rubin-LSST Survey

Main goal: develop knowledge and skills in Machine Learning for the selection of high-z AGN in order to be ready and competitive once the Rubin-LSST data will be available

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Scheda Collegata: High-z AGN as seen by Rubin-LSST (Rubin-LSST 16)

Commento: I progetto e' in ritardo e sono stati spesi pochi soldi rispetto a quanto pianificato. La ragione e' che la PI e' stata in maternità per una buona parte del primo anno e il dottorando (di conseguenza) ha lavorato principalmente ad un altro progetto durante questo tempo.

Milestones for year 1

★ **T0+4 months:** An innovative ML technique studied in detail (e.g. eXtreme Gradient Boosting) and robust results obtained when applied to real catalogs.

- **Tool studied:** Probabilistic random forest, CATBoost and Convolutional Neural Network
- **Samples:** QUBRICS (Boutsia+2020), an assembled X-ray selected sample (CDFS+COSMOS+XXL) and the LSST AGN Data Challenge sample (e.g. Savic et al. 2023)

★ **T0+8 months:** A sample of high-z QSO candidates produced and tested with first spectroscopic observations.

- partially done with the QUBRICS sample (Calderone et al. subm.).

★ **T0+12 months:** The first results presented at international/national conferences.

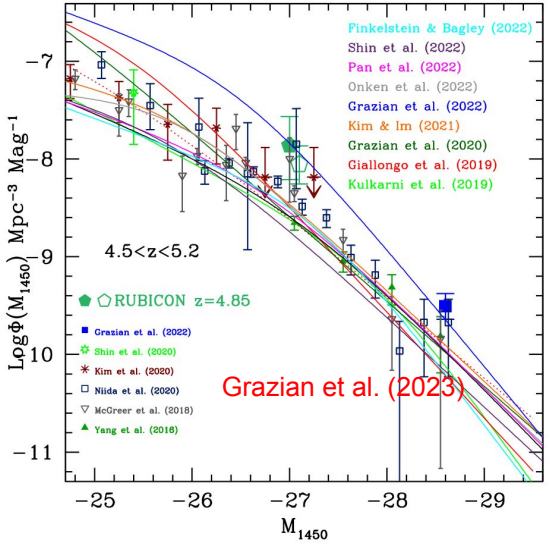
- “New Era of AGN Science with the Vera C. Rubin LSST” Conference in Charlottesville, Virginia, July 24-26 2023 (Ivano Saccheo)

Schools and Collaborations

- ★ 4th Italian Astrostatistics School, Milan, Oct 16-20 2023. Participant: Ivano Saccheo
- ★ Cycle of lessons on Machine and Deep Learning, Milan, Jan 15-19 2024. Participant: Ivano Saccheo
- ★ Collaboration with the QUBRICS team (INAF-Trieste/Padova). We are working on new ML techniques to be applied to the QUBRICS sample (which is a clean AGN+galaxy+stars sample). The goal is to compare the results we obtain with what already done (e.g. Guarnieri et al., 2021, 2022)
- ★ Collaboration with Andjelka Kovacevic and Dragana Ilic (University of Belgrade). We are currently working with them on improving the LSST ML AGN selection tool developed for the LSST Data Challenge (Savic et al., 2023, arXiv:2307.04072)
- ★ Visit (planned for early 2024) of the PhD Student Ivano Saccheo to the University of Belgrade, Department of Astronomy to finalize the work

Publications

★ **Grazian, …, Bongiorno, …, Saccheo 2023, ApJ 955, 60:** 9 z>4.5 QSOs in ~100 sq. deg. of deep Subaru HSC images at magZ<=20.0 AB (Rubicon survey). This survey can be considered the precursor for Vera Rubin LSST Surveys, where thousands of high-z QSOs will be discovered, even at fainter luminosities.



★ **Saccheo et al., in prep**: Improvement of AGN selection methods for Rubin-LSST implementing advanced deep learning networks such as AutoEncoder, and RNN-Long-Short term memory.