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Machine Learning for Spectroscopy

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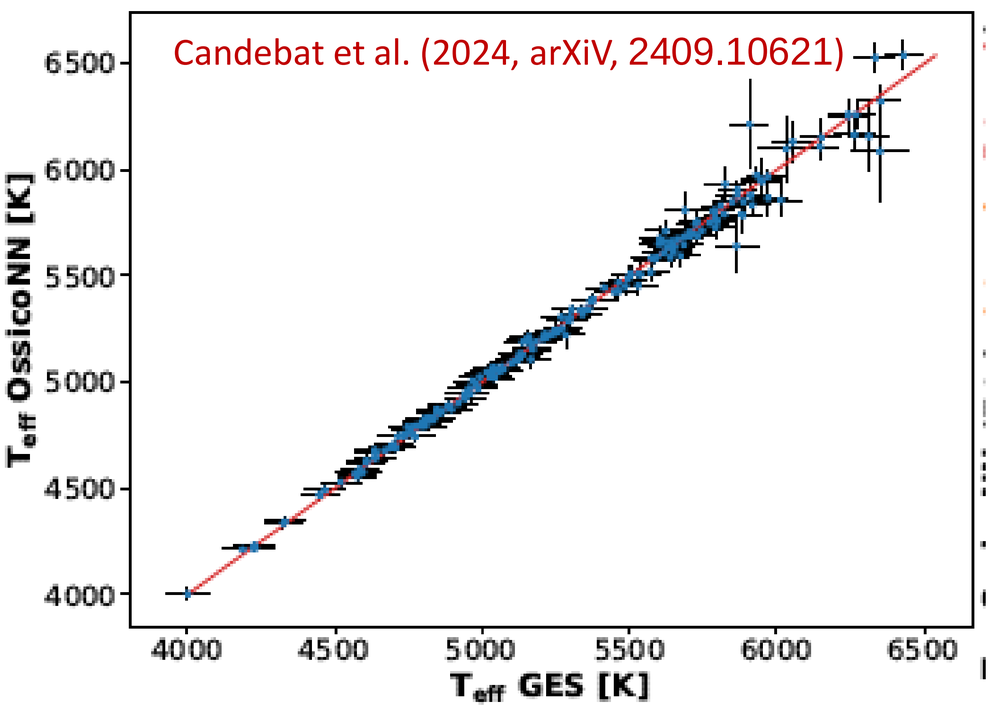
Goals of the project

Developing new tools for the analysis of optical and infrared spectra that will be able to:

1. Derive precise and accurate physical parameters from millions of spectra produced by the current and future generation of spectrographs;
2. Calculate reliable uncertainties on the parameters;
3. Work for different instruments overcoming the observational gap;

OssicoNN for stellar spectroscopy

We trained, tested and validated the NN with the spectra of the Gaia-ESO Survey using the astrophysical parameters of the public catalog, as labels. OssicoNN is able to derive parameters and errors that are consistent with those obtained from the standard Gaia-ESO pipeline, with similar or higher precision and accuracy.



A foundation model for astronomical spectroscopy

In the future we plan to take advantage of new technologies developed for Large Language Models to train a general model to process spectra. The final goal is to build a model trained with a large variety of spectra retrieved by different instruments and/or synthesized with multiple models. Such pre-trained model can be fine tuned for specific applications.

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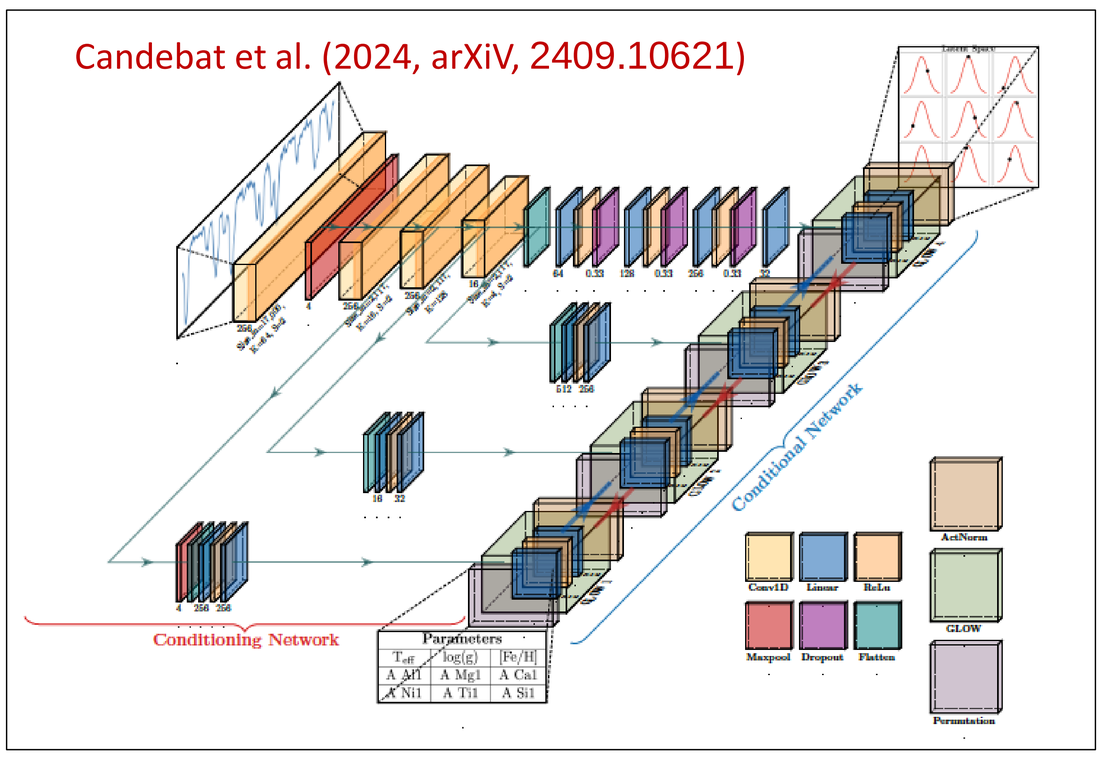
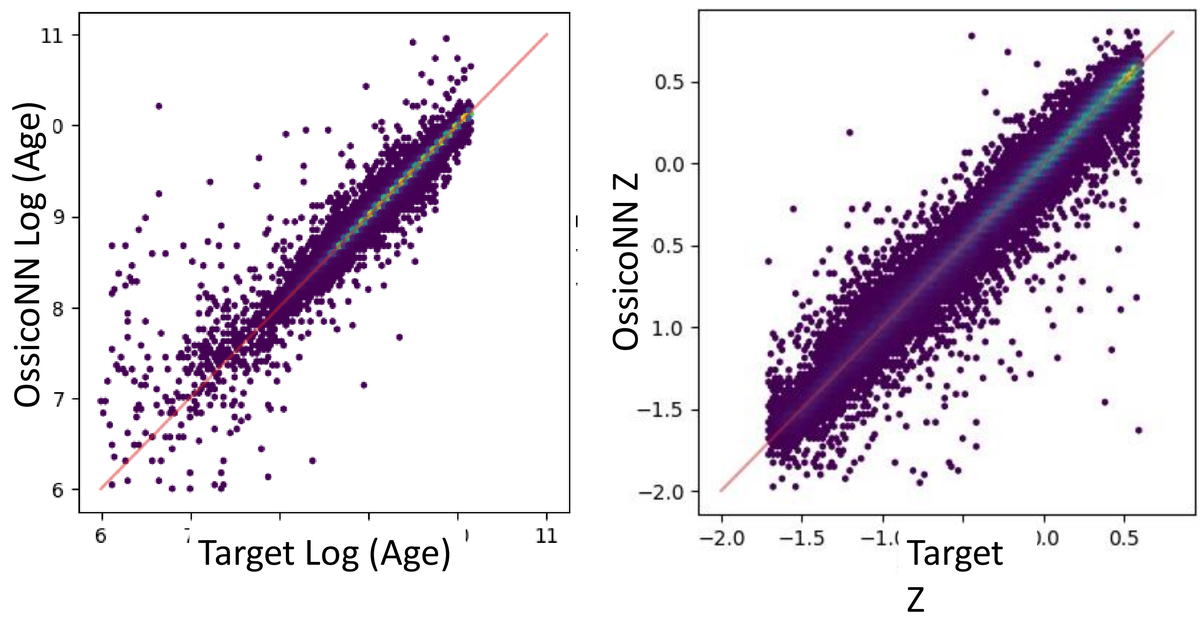
OssicoNN

We designed a NN based on the concept proposed by Ardizzone et al. (2019, arXiV:1808.04730), which is composed of conditioning NN which extracts high-level features from the spectra and feed them on a conditional Invertible NN (cINN), which, during training, converts the stellar parameters to an equal number of Gaussian–distributed latent variables. For the inference, the data flow of the cINN is inverted and parameters are derived from spectra and gaussian distributed input variables.



OssicoNN for extragalactic spectroscopy

We are now training the NN with a set of about 400,000 spectra of galaxies with the aim of using OssicoNN to derive ages and metallicities, and, eventually, to reconstruct the star formation history of the galaxies.



Acknowledgments

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