

Welcome to the 2023 Ariel Biarritz summer school

The school will include general courses listed in the attached agenda. These will be introductions to specific matters, not requiring previous knowledge above standard maths & physics at master level. Participants from various countries and cursus will join, so the choice of matters has been made in order to give a common background to all of you in the exoplanet field.

Training session Biarritz –

The 2023 Ariel Biarritz school will include sessions called “training” including computing on several aspects of data retrieval techniques. The work will be done by yourself in binomes (or quadrinomes) under the supervision of Yassin Jaziri and Lorenzo Mugnai (retrieval) and Orphée Faucos and Denis Standrovski (Machine Learning).

1) Forward and retrieval models of transit spectroscopy :

In the context of characterizing exoplanetary atmospheres from model to observation, students will explore the possible atmospheres of sub-Neptunes exoplanets (*K2-18 b*, *TOI-421 b*, *V 1298 tau c*, *LTT 9779 b*, and may be others) and their observability. Using python tools, they will model atmospheric chemistry in 1D atmospheres, exploring the differences between equilibrium and non-equilibrium chemistry under such conditions. Next, they will generate transmission spectroscopy observables, modeling JWST and ARIEL observations. Finally, they will explore the possibility of analyzing these observables and disentangling observational biases.

2) Introduction to Machine Learning :

You will explore the Machine Learning techniques of retrieval through the scope of the Ariel Data Challenge 2023. Firstly by analyzing the data : the task, the input data and the specificity of the dataset. Then by applying different models of Machine Learning to predict the same set of 7 atmospheric properties given the spectrum of an observed planet. You will be able to be creative and try your own model ! The goal of the TP is to give a broad view of a Machine Learning project with the insights and limitations of those techniques.

In order to compute on site on your own laptop, you will have to upload in advance some environments (if you have problems, we will solve them at your arrival, don't worry):

- For retrieval, Anaconda (including python environment) will be mandatory. If you can upload radiative transfer software in advance (taurex and exo-k), we will gain time on site to anticipate any problems. Just do : “pip install taurex” and “pip install exo-k” in anaconda environment.
- For Machine Learning, the framework that will be used is Pytorch Lightning, please have a jupyter kernel ready linked to a conda env with pytorch lightning and necessary librairies (nestle, corner, taurex, tensorboard, h5py). There is an attached .yml file with a complete conda env. For those not able to create such environment, a collab notebook will be given.