ISYA
INTERNATIONAL SCHOOL FOR YOUNG ASTRONOMERS

UNIVERSIDAD YACHAY TECH

PYTHON FOR ASTROPHYSICS

Lecture 5

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Lecture 5 goals:

1. Utilise YT to open simulation files.

2. Utilise H5PY to open and visualise simulation files.

3. Visualise simulation files with matplotlib and plotly.

What do you need for the practicals?

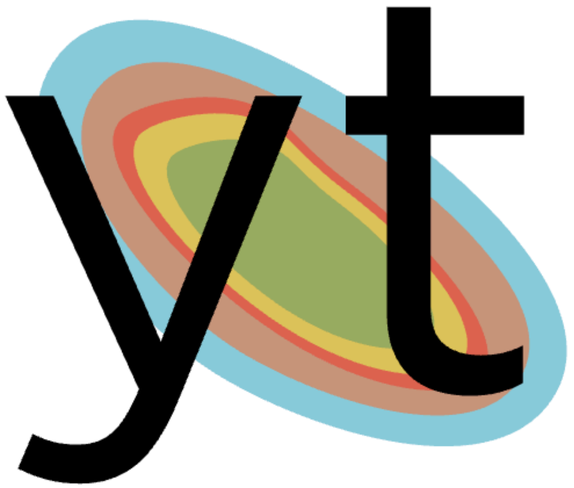
- A PC/laptop with any OS.
- Internet access.
- A Google/gmail account.
- A GitHub account (desirable, not strictly needed).

The YT project

The YT package in Python is a versatile and powerful open-source library designed for **analysing and visualising volumetric data.**

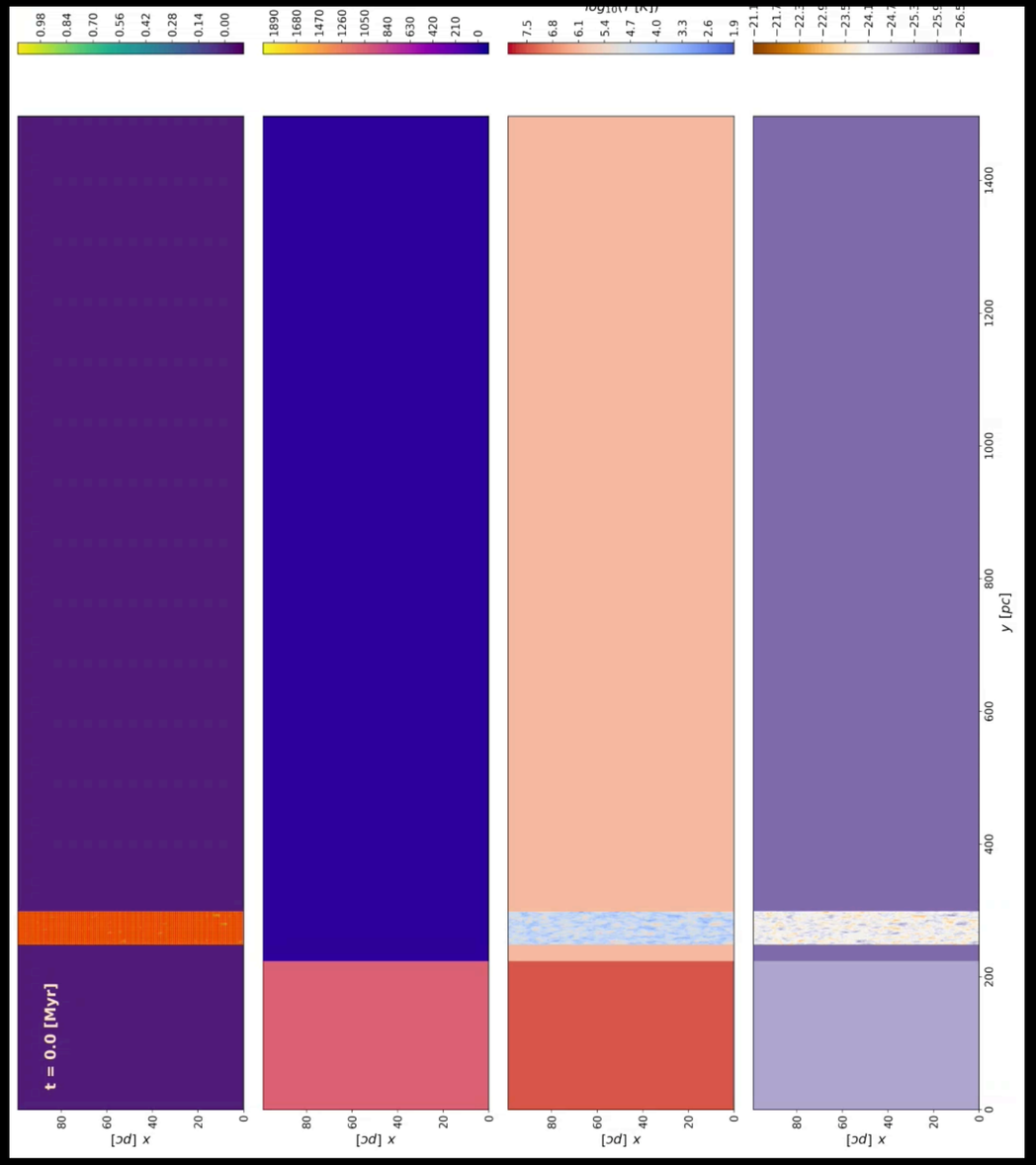
It supports a wide range of data formats and simulation codes, enabling users to perform complex **data analysis** tasks such as creating **projections, slices**, and **profiles**.

YT integrates well with other scientific libraries like **NumPy** and **Matplotlib**.



https://yt-project.org/

Simulation Types



Antipov, Banda-Barragán et. al. 2025
https://ui.adsabs.harvard.edu/abs/2025MNRAS.540.3798A

Grid-based discretisation (Mesh)
Shock-cloud models

Friends-of-friends algorithm

Simulation Types

Particle-based discretisation (SPH)

Relativistic disc break up around a Black Hole

Bardeen-Peterson effect: Nealon et. al 2015
(https://www.youtube.com/watch?v=AaNTY42zgtA)

The HDF5 data format

This is also a self-descriptive format, which is widely used in many physics sub-fields because of its versatility.

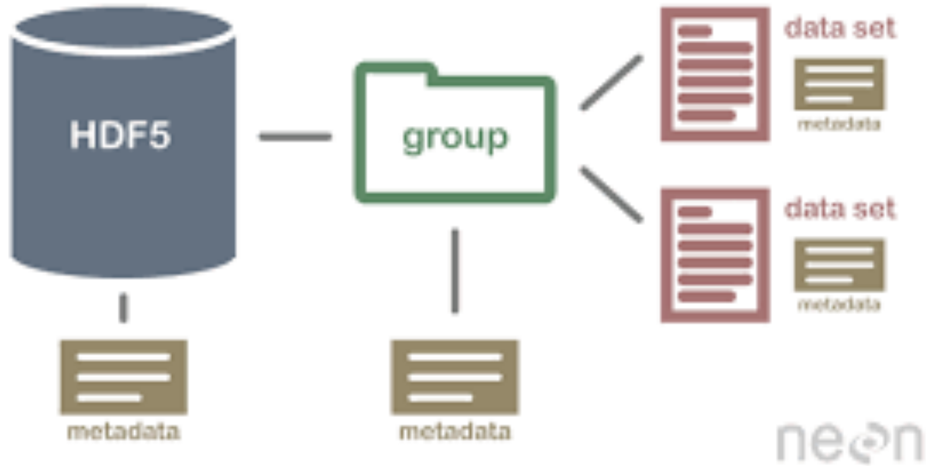
The **data** stored here can be **very large**!

Data don't have to be of the same type, you can save **numbers, units, strings, images**, etc, all in the same file.

It uses the structure of a file directory, organising information in **GROUPS**.

GROUPS are then comprised of data fields with their own metadata.

https://www.hdfgroup.org/



https://www.neonscience.org/resources/learning-hub/tutorials/about-hdf5

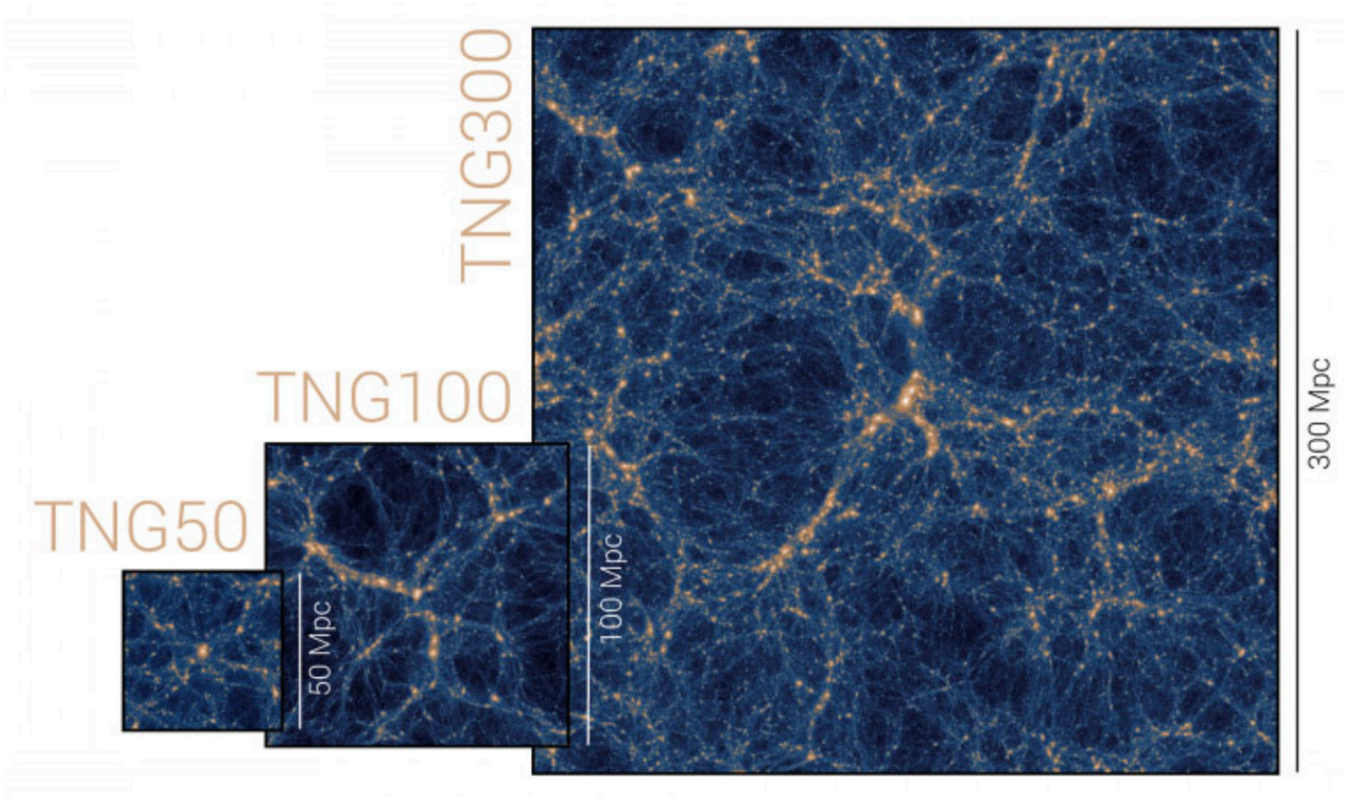
IllustrisTNG-3 simulation

IllustrisTNG-3 is one of the large-scale **cosmological simulations**, used to model galaxy formation & evolution in **ΛCDM.**

https://www.tng-project.org

TNG-3 simulates a cube of the universe **~302.6 Mpc/h on a side**, evolving

- dark matter
- gas
- stars
- black holes
- from the early universe (z ~ 127) to the present day (z = 0),



Illustrious 3 is publicly available!

Tutorial Time

1. Please log into your gmail accounts:

2. Open this lecture on GitHub:

https://github.com/wbandabarragan/ISYA2025/blob/main/Python_for_Astrophysics/4_tutorial_py4astro.ipynb

3. Click on the "**Open in Colab**" icon and you are ready to code!