AstroReach SD: Dark Matter & Python

Introduction

Welcome to **AstroReach SD: Dark Matter & Python (Winter 2025)**! This course is supported by the UCSD Astronomy & Astrophysics department.

This course combines topics in astronomy and computer programming. The scientific topics we'll cover include *astrophysics and cosmology* — the study of the contents, formation, and evolution of the universe — and *dark matter*, the mysterious substance that makes up most of the matter in the universe. You will learn *scientific programming skills* in Python, including how to visualize data. This will build up to creating your own custom dark matter simulation visualizations by the end of the course.

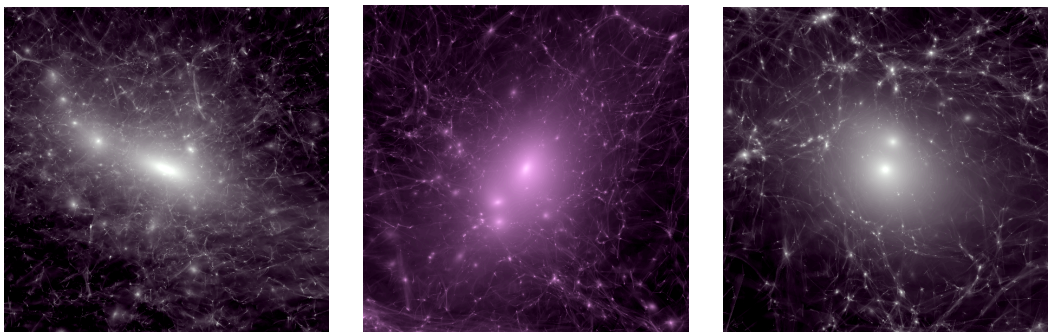
Learning Goals

Key **scientific questions** you'll be able to answer:

- What is the history of our universe?
- What is the universe made of?
- How do we know that dark matter exists, and what could it be?
- What are dark matter simulations, and why are they useful?

Key **programming skills** you'll acquire:

- How to read and write Python code.
- How to work with and visualize a dataset using Python.
- How to communicate scientific ideas through data visualization.
- How to visualize a dark matter simulation.



Schedule

Part 1: Introduction to Python

1) January 8 (10:40am-12:15pm)

Presentation: Course Overview & Tour of the Universe

Interactive: Introduction to Python

Readings: Week 1

2) January 10 (11:37am-12:52pm)

Presentation: Contents of the Universe & Dark Matter

Interactive: Plotting in Python, Part 1

Readings: Week 2

3) January 13 (10:40am-12:15pm)

Presentation: Dark Matter Open Questions

Interactive: Plotting in Python, Part 2

Readings: Week 3

Part 2: Advanced Python Skills

4) January 24 (11:37am-12:52pm)

Presentation: Dark Matter Simulations

Interactive: Exploring Dark Matter Simulations

Readings: Week 4

5) January 27 (10:40am-12:15pm)

Presentation: Dwarf Galaxies & Dark Matter

Interactive: Python Exercises

Readings: Week 5

Part 3: Final Project

6) February 3 (10:40am-12:15pm)

Presentation: Visualizing Dark Matter Simulations

Interactive: Final Project

Readings: Week 6

7) February 21 @ UCSD A&A

11-11:30: High Energy Astrophysics Lab tour (Boggs group)

11:30-12: OIR Lab tour (Wright group)

12-1: Lunch and Final Project Presentations

1-1:30: *Growing Giants: The Formation and Evolution of Galaxy Clusters* (Tae Baxter)

1:30-2: *The Cosmic Origins of the Periodic Table* (Anaya Valluvan)

2-2:30: *Thirsty for Knowledge? Explore Quenching in Dwarf Galaxies!* (Sophia Um)

Logistics

Contact Information

Please send any questions, suggestions, or concerns to:

- ***Ethan Nadler*** (Assistant Professor, UCSD A&A) – enadler@ucsd.edu
- ***Johnathan Chittuluru*** (Preuss instructor) – jochittuluru@ucsd.edu
- ***Shaoni Bandyopadhyay*** (Preuss coordinator) – sbandyopadhyay@ucsd.edu

Course Materials

Course materials will be stored on Google Drive. This link will be updated before each meeting with:

- Slides from the week's presentation
- Google Colab notebooks from the week's coding activities
- Recommended readings based on the week's content