Ph.D. in Information Technology
Thesis Defense

June 30th, 2026
at 4:00 pm
Room PT3 – building 20A

Nicolo' Oreste PINCIROLI VAGO – XXXVIII Cycle

Making discoveries with multimodal astrophysics

Supervisor: Prof. Piero Fraternali

Abstract:

Astrophysical surveys generate unprecedented quantities of multimodal data, including spectra, images and time series. Scientists interpret the data and write scientific papers and textual summaries. All such data form the basis for further research and discovery. This thesis investigates how multimodal deep learning can reveal new information about astrophysical sources, with a focus on transient processes and gravitational lensing systems. The thesis shows a progression from unimodal representational learning of X-ray spectra to multimodal contrastive alignment with text and spatio-temporal analysis of gravitationally-lensed supernovae. The results reveal that while spectral data contains a limited amount of information, considering additional modalities allows a more comprehensive analysis and enables the discovery of rare phenomena. The proposed architectures achieve state-of-the-art performance on test metrics and are able to identify and analyze candidate gravitational lenses and candidate pulsating ultraluminous X-ray sources in real observations, opening new frontiers for automated astronomical exploration. By combining deep learning and observational astrophysics, this work aims to accelerate scientific discovery, demonstrating that intelligent multimodal systems can serve as powerful tools for transforming raw data into astrophysical insight.

PhD Committee

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