Description of Masters and Ph.D. projects 2027

Amy Stutz: Masters: Cloud kinematics and cluster formation / destruction. Sub-mm, mm-wave radio (ALMA, APEX, IRAM) and catalogue data (e.g. Gaia, SDSSV) data. Observational characterization of cloud kinematics in star forming regions in the Milky Way, with a focus on more massive regions, and possibly the LVM project. Possibly also observation diagnostics of the magnetic fields (tentative) via polarization (data not yet in hand). One project will likely be offered. Ph.D.: No projects envisioned currently, but happy to discuss. **Additional ISM and Star formation projects (contact Stutz for further info):** Masters:
(1) MSF in the Bipolar HII Region RCW36: characterize pressure interface between HII and PDR. Kinematics: expanding features, velocity gradients, turbulence. Combine mm/subm/FIR/optical data.
(2) MSF in the Spherical HII Region RCW120: characterize pressure interface between HII and PDR. Kinematics: expanding features, velocity gradients, turbulence. Combine mm/subm/FIR/optical data.
(3) Ejected MCs in the GC: MW-C1: characterization of gas physical conditions, exploring excitation mechanisms, thermal properties, and densities at the H/H_2 interface. Also, kinematics analysis (infall and/or outflow). Use radio/mm/submm data.
(4) The Spherically Symmetric TELEIOS Region: gas physical conditions: characterization of excitation mechanisms, thermal properties, and densities at the H/H_2 interface. Also, kinematics of expansion, shock regions, and velocity dispersion. Combine mm/subm/optical (?, LVM -> if available by next year) data.

Neil Nagar:
Masters: all projects related to the Event Horizon and Environs (ETHER) Sample: single and binary supermassive black holes (SMBH) observed (or to be observed) with the Event Horizon Telescope (EHT) and its upgrades on the ground and in space:

1. Accurate black hole mass estimates for ETHER SMBH via optical /IR photometry and spectroscopy
2. Understanding jets and accretion inflow interplay and the Radio-X-ray 'Fundamental Plane': spectral energy density (SED) fits to ETHER SMBH with jet and accretion inflow models
3. Identifying binary SMBH candidates, and constraining their orbits, via variability in optical (ZTF and Vera Rubin) and radio.
4. SMBH mass measurements (via stellar dynamics and ionized gas kinematics) for the ETHER 'Gold Sample': individual targets as Master's thesis, but a comprehensive sample for a Ph.D. thesis.

Mary Loli Martínez Aldama: Masters: Build an NIR Spectroscopic AGN Catalog (data reduction/spectroscopy). PhD. Characterization of Super-Eddington AGN (spectroscopy/photometry)

Guillermo Cabrera-Vives: Masters: multimodal representation learning for extragalactic astronomy (Rubin, SDSS, JWST). Ph.D.: No projects envisioned currently, but happy to discuss.

Pierluigi Cerulo: Masters: study of the light profile of galaxies in clusters at z~0.4. Study of the merger rate of galaxies since z~3.

Ronald Mennickent Cid: Magister: 1-Study of the interacting binary LP Ara and its accretion disk. 2-Study of a sample of peculiar interacting binaries using the OGLE and TESS databases. **PhD:** 1-Study of disk nodal-precession in massive, Algol-like, interacting binaries.

Priscila Pessi: Master projects
i) Characterization of short plateau Type II supernova. Rare class of events. Only a handful are known. Although the plateau is associated to hydrogen recombination, it is unclear why some events show a much shorter plateau, there is also no definition on how short a plateau should be to be considered a plateau and not something else. Using one well observed event as guidance, the idea would be to characterize the group of publicly available events to understand what physical process produces their light curve. My guess is a progenitor in a binary system, but we should find out.
ii) Efficient subtraction of host contribution to nuclear transients. The light of transients occurring on top of their host galaxy is contaminated by the host, so they appear brighter than they actually are. This results in overestimation of the energetics of the source. Sceening methods have been proved useful to subtract the host contribution when template images are not available. The idea would be to explore such techniques on publicly available images to produce a robust method to implement on small telescopes.
PhD projects to be offered later on, once I settle. But if there is a lot of interest in supernovae, we can discuss.

RHC: Characterization of the interstellar medium of high-z galaxies (z~4-7) combining observations of the cold and warm, ionized gas from ALMA and JWST..

Alessandro A. Trani:
Master:

1. Incorporating black hole feedback and backreaction into semi-analytic AGN disk models and determining how they affect their thermodynamics and global structure
2. Analyzing the properties of black hole mergers, after a chaotic or regular (non-chaotic) 3-body interactions. Finding possible signatures for disentangling the two populations.

PhD:

1. Developing time-evolving semi-analytic models of AGN disks, including their stellar-mass black hole embedded population.
2. Employing the new Multi-Particle Collision for Dense Stellar Systems to model anisotropic, rotating and unrelaxed clusters, which are currently computationally inaccessible with traditional Monte-Carlo models

Jhon Yana Galarza
Master:

1. Explore the origin of r-process elements using thorium abundances of FGK type stars.
2. Detection and characterization of exoplanets around thick-disk stars.

PhD:

1. Exploring the star-planet connection using planet hosting stars across stellar populations.

Dominik Schleicher:
The James Web Space Telescope has detected so-called Little Red Dot at high redshift, which are compact (<300 pc) astronomical objects with red, V-shaped spectra. So far different possible interpretations exist for the nature of these objects, including variations of AGN, dusty starburst galaxies and gas-enshrouded black holes. The hypothesis of gas-enshrouded black holes is supported by the observation of very strong Balmer breaks and related features in the hydrogen lines. In this Master project, the goal would be to construct a large grid of models with the Cloudy code exploring different column densities in neutral and ionized hydrogen, in order to determine the conditions that allow reproducing the observed spectral features of prominent Little Red Dots and to compare and understand the differences compared to more classical AGN.