BACHELOR RESEARCH PROJECTS ASTRONOMY

2018-2019

https://home.strw.leidenuniv.nl/~linnartz/2019brp.html

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Dear BRP cohort 2018-2019,

on the next pages you will find the summaries of the available BRP 2018-2019 projects for A, A/N, A/W and A/I BRP students.

All these projecs are supervised by an astronomy staff member. Besides this first supervisor, a second (independent) supervisor is needed who has to be contacted by the BRP student(s). In the case of A-projects, the second supervisor is an astronomy staff member. In the case of A/N, A/W and A/I projects, the second supervisor has to be a staff member from physics, mathematics or computer sciences, respectively.

In the case of N/A, W/A and I/A projects the main responsibility for the BRP is with physics, mathematics and computer sciences. The projects listed here, are not suited for this purpose.

A-projects are typically taken care of by two A-students. In a few cases, the possibility exists for a solo project. Please discuss this with the involved supervisor(s). Double BRP students (A/N, A/W and A/I) perform their BRP alone.

Please choose your BRP wisely. With 22-24 EC the BRP comprises a substantial part of your study. It also is your first contact with a large research project in which your involvement, creativity, scientific thinking and reporting will be tested. The projects cover a wide range of research fields. In the case that you cannot find the ‘right’ project, please pass by *in time* and we will try to find an ‘à la carte’ solution. It is important that around mid january your project has been defined and accepted by all involved parties (see registration document).

I wish you a successful and interesting BRP.

Happy Researching !

Harold Linnartz

1. Simulated observations of the massive, young star cluster R136 with METIS at ELT.

SUPERVISOR(S):

Prof. dr. Bernhard Brandl, Dr. Leonard Burtscher

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https://www.univie.ac.at/simcado/Home.html

https://www.eso.org/public/news/eso1816/

DESCRIPTION:

The Mid-IR ELT Image and Spectrograph (METIS) will be one of three first generation scientific instruments on ESO's Extremely Large Telescope (ELT), which is currently under construction to see first light in 2024. METIS will provide diffraction-limited imaging at an angular resolution of 0.023 arcseconds at L-band (3.5 microns) at very high sensitivity. It will therefore be uniquely suited to study the stellar content in dense, young clusters.

This project will demonstrate the imaging capabilities of METIS, based on simulations, for a unique target: the young star cluster R136, which lies at the heart of the 30 Doradus region in the Large Magellanic Cloud (LMC). The goal of this project is threefold:

(*) investigate the sensitivity of METIS (in stellar masses) for R136

(**) investigate the confusion limit of METIS (in stellar densities) for R136

(***) produce a "pretty picture" for usage in the METIS Science Case document.

The approach will be as follows:

(1) Define the target list of stars in that region. That list, eventually containing several thousands of stars, can be based on existing source catalogues, which must be extrapolated based on density and mass function.

(2) Compute the L-band brightness for each star from its mass (assuming a constant age of 3 Myr). This will require pre-main sequence models for the low mass stars.

(3) Run simulations with SIMcado/SIMmetis to compute a METIS observation using the above source catalog.

(4) Analyze the simulated image regarding sensitivity and crowding.

COMPLEMENTARY INFORMATION: Suited as A or A/I-project.

This project will make use of an existing instrument simulator package in Python. It therefore requires python programming skills. Additional help and support can be provided by the authors of the instrument simulator at the University of Vienna. Using this communication channel requires own initiative and management skills.

2. Merger timescales of compact groups of galaxies

SUPERVISOR(S):

Dr. Sylvia Ploeckinger, Prof. dr. Joop Schaye

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SHORT DESCRIPTION:

Compact groups of galaxies (CGs) are the densest galaxy systems know. They are expected to merge into a single elliptical galaxy on a very short timescale and their relatively high abundance is therefore surprising. In a previous (master) thesis project, a sample of CGs has been identified in a large simulated cosmological volume that contains thousands of galaxies. The aim of this project is to follow individual simulated CGs from this sample over a few Gyr and compare the analytic (expected) merger times with the time it takes the CGs to merge in the simulation.

COMPLEMENTARY INFORMATION: suited as A-project

More information on the cosmological simulations can be found here: http://eagle.strw.leidenuniv.nl/. Some of the tools that will be used during the project include simple SQL queries to extract information from the EAGLE database and py-sphviewer (https://alejandrobll.github.io/py-sphviewer) to visualize the simulated galaxies.

3. 3D Spectroscopy with MUSE and Hubble

SUPERVISOR(S):

Dr. Michael Maseda,

Dr. Leindert Boogaard,

Prof. dr. Marijn Franx



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SHORT DESCRIPTION:

Powerful observational facilities such as the Very Large Telescope and the Hubble Space Telescope are giving us new capabilities to study galaxies in the distant universe. In particular, we can take spectra of galaxies simultaneously over large areas and large wavelength ranges using instruments such as MUSE. The aim of this project is to combine MUSE optical spectroscopy with HST near-IR spectroscopy for a sample of distant ($z > 2.9$) galaxies in order to study how their star formation properties evolve with cosmic time, and to see how these parameters vary across the physical extent of the galaxy. This will specifically involve the Lyman-alpha emission line in MUSE and the [OII] and MgII emission lines in the HST grism spectra (probes of the physical conditions and star formation).

COMPLEMENTARY INFORMATION: suited as A-project

The primary data analysis will utilize HST/WFC3 grism spectroscopy (as well as catalogs from MUSE), and could potentially include a data-reduction component. All analysis of the grism data would be using tools developed in Python. This project will use 3D spectra from HST as well as 2D emission line maps from both HST and MUSE.

Several related papers to this project can be found at:

https://www.dropbox.com/sh/3cnevvqa5vo8umo/AAAAQeVHF8cmgtNPOJyzLu_La?dl=0

4. Red sequence to Blue cloud galaxies in EAGLE


SUPERVISOR(s):

Dr. Camila Correa, Prof. dr. Joop Schaye

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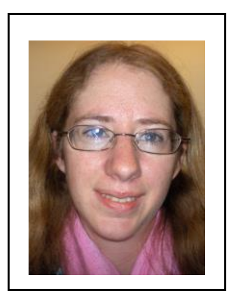
SHORT DESCRIPTION:

Passive or weakly star-forming galaxies are characterised by red colours, whereas actively star-forming galaxies are mostly blue. Correa et al. (2018) shows that the time when galaxies change from being blue to red depends on their morphology. There is a fraction of galaxies, however, that change from being red and passive to blue and star forming, usually called rejuvenated galaxies. Trayford et al. (2016) states that 10% of all galaxies are red-to-blue galaxies at z=0, however it is still unclear what drives this rejuvenation. The goal of this project is to determine what drives galaxies to move from the red sequence to the blue cloud in the EAGLE simulations. To do so, the student will first learn how to read and analyse the output of cosmological simulations. After that he/she will identify the simulated galaxies that change color from red to blue, and look into the evolution in size, morphology, merger rates and AGN activity. By carrying out this project, the student will build a very good understanding of galaxy formation.

This project will expand the previous analysis of morphology and color of Correa et al. (2018) and Trayford et al. (2016). The student will not need to do extensive calculations before analysing the evolution of galaxies. Merger trees, colors and various parameters (such as merger rates, galaxy sizes, AGN luminosity and morphology) will be provided by Dr. Correa.

COMPLEMENTARY INFORMATION: suited as A-project

5. A search for steep radio spectrum sources in the LOFAR LoTSS survey




SUPERVISOR(S):

Dr. Wendy Williams, Dr. Reinout van Weeren

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SHORT DESCRIPTION:

The LOFAR Two-metre Sky Survey (LoTSS) is the deepest and largest radio survey ever carried out and being led from Leiden. So far, the scientific exploitation of the survey has focussed on the radio continuum. The radio spectral information has not yet been utilized. For this project, a search will be carried out for radio sources that have unusual and exotic radio spectra in the first data release of LoTSS. These sources could for example be related to very old AGN radio plasma, steep spectrum pulsars, or other exotic objects. The project will involve python coding, source detection, cross-matching, and catalog manipulation.

COMPLEMENTARY INFORMATION: suited as A- or A/I-project

The project will involve python coding so requires students with an affinity for coding.

6. Gravitational wave background from supermassive black hole mergers

SUPERVISOR(S):

Dr. Elena M. Rossi, Valeriya Korol (PhD)

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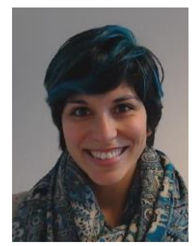
SHORT DESCRIPTION:

The Laser Interferometer Space Antenna (LISA) is a ESA mission that will be launch in ~10 years time. It is an unprecedented Observatory of gravitational waves in Space. Among the wide variety of Sources, it will detect coalescence of supermassive black hole binaries at the centre of merging galaxies. If a few to several per year will produce a strong signal in the detector, the majority will instead give rise to weak signals forming an overall stochastic background in the data. With this project, we aim at characterising this background and the information that may be extracted.

COMPLEMENTARY INFORMATION: suited as A and A/W-project

A minimal mathematical positive attitude and basic knowledge of general relativity is required.

7. Exploring the chemistry of hot exoplanets



SUPERVISOR(S):

Dr. Yamila Miguel

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http://www.YamilaMiguel.com

SHORT DESCRIPTION:

In this project we are going to explore the chemistry of hot exoplanets changing the composition of the atmosphere and the semi-major axis of the planets to study the effect of different chemical abundances on possible exoplanet atmospheres.

COMPLEMENTARY INFORMATION: suited as A-project

The students will use chemical codes and need to have some programming skills.

8. Characterization of infrared sky fluctuations

SUPERVISOR(S):

Prof. dr. Walter Jaffe

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SHORT DESCRIPTION:

The sensitivity of mid-infrared spectra at wavelengths of 8-13 microns is often limited by fluctuations of the sky background around and in front of the source. This study aims to apply simple AI techniques: Principle Component Analysis to characterize the fluctuations as a function of position and wavelength with the goal of more accurately removing their effect on the source spectrum.

COMPLEMENTARY INFORMATION: suited as A (A/W, A/I)-project

Requires some programming and numerical mathematics background.

9. Quasar activity and the shape of galaxies

SUPERVISOR(S):

Prof. dr. Huub Rottgering

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SHORT DESCRIPTION:

A large fraction of massive galaxies emit luminous radio emission. This emission is due to jets of relativistic particles that originate from an accretion disk associated with a supermassive black hole. LOFAR is a new an-European radio telescope that is producing enormous images of the low frequency sky at unprecedented quality. Recently it has been found that such luminous radio emitters are predominantly found in round galaxies. With the new LOFAR images we will verify this result and test whether this is related to other properties of the galaxies such as mass, star formation and colours.

COMPLEMENTARY INFORMATION: suited as A-project

10. Making moons out of planets

SUPERVISOR(S):

Prof. dr. Simon Portegies Zwart

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SHORT DESCRIPTION:

The recently found moon around the super jupiter planet Kepler 1625B could originally have been another planet in the same system that was captured in a tidal interaction. The objective is to test this hypothesis by performing N-body simulations of planetary systems including the effects of a disk, the two planets and the effects of tidal interaction. It required the development of a bridge with tidal energy dissipation between two bodies.

COMPLEMENTARY INFORMATION: suited as A or A/I-project

This is a computational project, affinity with numerical methods and computing, and in particular the Python language, is required.

11. Interaction between Betlegeuze and it's environment

SUPERVISOR(S):

Prof. dr. Simon Portegies Zwart

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SHORT DESCRIPTION

Betlegeuze is a red giant star with a strong stellar wind. this wind interacts with the interstellar medium, generating a bow shock. In the near future, this wind will start to interact with a large molecular structure in the vicinity. The objective is to understand this interaction and what we can learn from either wind or interstellar medium by simulating the interaction. This will require performing simulations of the stellar wind and it's environment using the AMUSE framework.

COMPLEMENTARY INFORMATION: suited as A or A/I-project

This is a computational project, affinity with numerical methods and computing, and in particular the Python language, is required.

12. Interaction between supernova and progenitor wind in SN1979C

SUPERVISOR(S):

Prof. dr. Simon Portegies Zwart

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SHORT DESCRIPTION

Supernova SN1979C has shows interesting features in the radio 4.88GHz observations. these rippels are explained by the interaction between the copious stellar wind of the progenitor star and the supernova blastwave. The objective is to understand the hydrodynamical effect of this interaction by simulation the wind and the supernova blast wave. This will require performing simulations of the stellar wind and it's environment using the AMUSE framework.

COMPLEMENTARY INFORMATION: suited as A or A/I-project

This is a computational project, affinity with numerical methods and computing, and in particular the Python language, is required.

13. Dissociation and ionization of interstellar benzonitrile

SUPERVISOR(S):

Dr. Jordy Bouwman

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SHORT DESCRIPTION

Observational studies have shown that large (aromatic) hydrocarbons are present in the nterstellar medium (ISM). Particularly, the recent detection of benzonitrile through microwave observations is interesting, as this molecule plays an important role in a chain of reactions that may eventually also lead to the formation of the building blocks of life.

Little is known about the stability of this particular species under interstellar conditions, i.e. harsh radiation fields.

For this project, the student will analyze experimental data on the vacuum ultraviolet ionization and dissociation of benzonitrile. The data are obtained at the Swiss light Source (synchrotron). Insight into the energetics of dissociation and the various fragmentation pathways will be acquired using quantum chemical computations. The data flowing from this work is critical in understanding the presence of organic molecules in the ISM.

COMPLEMENTARY INFORMATION: suited as A or A/N-project

Affinity with understanding chemical reaction mechanism of astronomical interest is required and trip to the Swiss Light Source for performing additional measurements is amongst the possibilities.

14. Variable Illumination in the near face-on PDS 66 protoplanetary disk


SUPERVISOR(S):

Dr. Schuyler Wolff, Dr. Matt Kenworthy

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SHORT DESCRIPTION:

Scattered light observations of PDS 66 (with SPHERE and GPI) show temporally variable shadowing of the disk surface. The aim of this Ba project is to characterise the degree of polarisation in self-shadowed regions and track the time variability of the disk and thus constrain the physical mechanisms responsible.

Disks that exhibit variable illumination of the outer disk provide a valuable new means of investigating the innermost regions of young disks to understand the physical processes inherent in terrestrial planet formation. The PDS 66 disk is viewed close to face-on and thus, retrieving an image in total intensity is difficult without advanced post-processing methods. The student will first use a reference star to perform reference differential imaging on the SPHERE dataset to retrieve the disk flux in total intensity and consequently the degree of polarisation. The polarisation scattering phase function can then be measured to probe the dust content of the disk and the rotation timescale of the shadow will be linked to dynamical timescales in the inner regions of the disk.

COMPLEMENTARY INFORMATION: suited as A or A/N-project

Provided PDS 66 data quality is insufficient, alternative targets with existing data include HD 97048 and TW Hya.

15. What does Gaia see in Andromeda?

SUPERVISOR(S):

Dr. Anthony Brown

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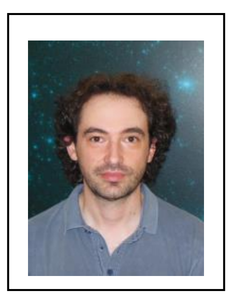
SHORT DESCRIPTION:

Although the Gaia mission is designed primarily to observe stars in our own galaxy, it will observe any point source brighter than magnitude ~20, including in other galaxies. The goal of this project is to explore what Gaia is actually detecting as sources in the Andromeda (M31) galaxy. Is it observing individual stars, clusters, star forming regions? This inventory is a first step to understanding what scientific results can be obtained from a study of M31 with Gaia (for example, can we measure the rotation of this galaxy at 2 million light years distance?).

COMPLEMENTARY INFORMATION: suited as A-project

This will involve a cross-matching between the Gaia catalogue and other observations, primarily images from the Hubble Space Telescope. The ESA-sky tool (http://sky.esa.int/) is well suited for this.

16. Dissecting the UVJ diagram: high-z galaxy demographics



SUPERVISOR(S):

Dr. Mauro Stefanon, Dr. Rychard Bouwens

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SHORT DESCRIPTION:

The superb sensitivity at near- and mid-infrared wavelengths provided by the James Webb Space Telescope will open new windows on our knowledge of the physical properties of high-redshift (z>6) galaxies. A growing number of studies based on broad-band photometry suggest that these galaxies are characterized by very intense emission lines in the rest-frame optical, likely reflecting extreme conditions of star formation. The aim of this project is to first locate strong emission-line galaxies on the UVJ diagram (usually adopted to separate (dusty) star-forming from quiescent galaxies) using a broad set of spectral templates ranging from AGNs to extreme emission line objects. The newly dissected UVJ plane will then be applied to samples of galaxies at intermediate redshifts, to select high-z analogs in preparation for JWST.

COMPLEMENTARY INFORMATION: suited as A-project

17. Predicting ALMA observations of water from planet forming disks

SUPERVISOR(S):

Prof. dr. Michiel Hogerheijde

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SHORT DESCRIPTION:

Water is a key ingredient for life, and we know that planet forming disks are rich in water ice. The amount and location of water ice is betrayed by the presence of small amounts of water vapour, that is relased continuously from the ice. So far, we have only been able to detect water vapor in spatially unresolved observations from space. With ALMA we may be able to image the location of the water vapor inside disks, but we need accurate model predictions of the expected signal strengths. In this project, you will work with advanced computer codes that describe the chemistry of planet forming disks, the excitation of molecules, and the ALMA signal detection path to predict if ALMA can find water vapor in planet forming disks.

COMPLEMENTARY INFORMATION: suited as A-project

18.Chemical evolution of planet forming disks


SUPERVISOR(S):

Prof. dr. Michiel Hogerheijde, Dr. Leon Trapman

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SHORT DESCRIPTION:

Planet forming disks are rich in molecules that trace the different physical conditions across the disk. One of the most important factors impacting the chemistry is the evolution of the dust: as the dust grows and settles to the midplane, stellar ultraviolet photons can penetrate deeper into the disk gas and alter the chemistry. Using a set of model calculations of the evolving dust content of disks, you will explore the effects on the chemistry of the disk and make predictions on how ALMA may detect the chemical differences in real disks.

COMPLEMENTARY INFORMATION: suited as A-project

19.Determining morphological properties of galaxies by accurate Hubble Space Telescope data simulations


SUPERVISORS:

Dr. Arun Kannawadi, Prof. Henk Hoekstra

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SHORT DESCRIPTION:

Images taken from the Hubble Space Telescope (HST) are one of the highest quality astronomical images taken at optical wavelengths and are used as a gold sample that describes the true Universe. A catalogue of galaxy morphologies estimated from the HST image may show somewhat false trends that might not be actually present. Identifying such false trends are important because galaxy formation theories make predictions about the light profile, size and ellipticity etc. and observation studies that verify the theories must not be biased due to image artefacts. Moreover, galaxy catalogue obtained from HST are used to simulate images in gravitational lensing studies.

While true trends among galaxy properties do exist, a small correction might be required to remove the false trends. To identify the trends introduced by the noise, the student will run GalFit, a software that measures the morphological properties of galaxies, on simulated images that do not have any trend to begin with. After a correction, simulations with trends regarded as true will be generated and the process is repeated a few times until the observed trends are reproduced in the simulations.

COMPLEMENTARY INFORMATION: suited as A-project

Coding skills are not required, although basic familiarity with numpy and matplotlib in Python (or any equivalent software) may be helpful.

20. Shining light on interstellar ice


SUPERVISOR(S):

Ing. Jeroen Terwisscha van Scheltinga,

Prof. dr. Harold Linnartz,

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SHORT DESCRIPTION:

In the laboratory for astrophysics, a setup has been constructed – CRYOPAD2 - to investigate the interaction between hard UV radiation and interstellar ice analogues. This allows to quantitatively derive thermal and photo-desorption as well as photo-dissociation rates. These numbers are needed to characterize the process of planet formation and understand the or9igin of molecular complexity in space and the proposed BRP work is linked to existing ALMA data.

The goal of this BRP project is to characterize in the laboratory the photo-induced behavior of interstellar ice analogues. A special focus will be on ices relevant for the formation of molecules that are considered building blocks of life.

COMPLEMENTARY INFORMATION: suited as A or A/N-project

This project is largely laboratory based and affinity with experimental techniques is required. A detailed safety training is obligatory.

21. A new Xe-gas tripling gas cell for direct ionization mass spectrometry

SUPERVISOR(S):

MSc. Michal Bulak, Prof. dr. Harold Linnartz

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HL501 / linnartz@strw.leidenuniv.nl , www.laboratory-astrophysics.eu

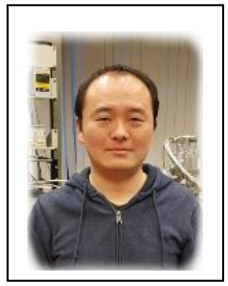
SHORT DESCRIPTION:

This project focuses on the construction of a new spectroscopic device in which the pulsed light of an intense Nd:YAG laser is tripled in a Xe-gas cell to generate deep UV light. This light is subsequently used to ionize laser desorbed ice molecules with the specific aim to prohibit molecular fragmentation. The main goal of this project is the characterization of the properties of this cell and its implementation in an existing setup – MATRI2CES – that studies the formation of large complex molecules in interstellar ice analogues upon irradiation with Ly-alpha radiation. The operation of the new cell will be compared with that of an existing electron-impact gun.

COMPLEMENTARY INFORMATION: suited as A or A/N-project

This project is largely laboratory based and affinity with experimental techniques is required. A detailed safety training with a focus on the use of CLASS IV lasers is obligatory.

22. Wavelength dependent refraction curves - n(λ) – for mixed amorphous ices




SUPERVISOR(S):

Dr. Jiao He, Prof. dr. Harold Linnartz

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SHORT DESCRIPTION:

Last year a new technique has been developed in the Laboratory for Astrophysics to determine the wavelength dependent refraction properties of interstellar ices. This is realized through broadband spectroscopy, using a Xe-arc lamp and monitoring the interference patterns that arise during ice deposition. Whereas n(λ) data exist for crystalline ice, such data is not available for amorphous ice, that is of much higher relevance in astronomical environments. The goal of this project is to measure for the first time (temperature dependent) n(λ) curves for the most important mixed ices that exist in space, starting with H_2O:CO_2 ices.

COMPLEMENTARY INFORMATION: suited as A or A/N-project

This project is largely laboratory based and affinity with experimental techniques is required. A detailed safety is obligatory.

23. Studying high-redshift galaxies with ALMA: biases due to complex source structure and companion sources


SUPERVISOR(S):

Dr. Matus Rybak, Dr. Jacqueline Hodge

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SHORT DESCRIPTION:

Large millimeter-wave interferometers such as ALMA in Chile and NOEMA in the French Alps have revolutionized our understanding of galaxies at high redshift. However, due to the high resolution and sensitivity of these instruments, current techniques for estimating e.g. the source size that rely on a number of simplifications (e.g. a circularly symmetric source) might introduce bias into the inferred properties of the high-redshift galaxies. In addition, recent deep observation with ALMA found that sub-mm bright galaxies often have nearby, fainter companions, which might contribute to some of the observed signal. This project will use simulated ALMA observations of high-redshift galaxies to study the impact of complex galaxy structure and companion sources on the measured properties of high-redshift galaxies.

COMPLEMENTARY INFORMATION: suited as A-project

The project is suitable for 1 student. Familiarity with Python is necessary.

24. Star formation in dusty galaxies – does redshift make a difference?


SUPERVISOR(S):

Dr. Matus Rybak, Dr. Jacqueline Hodge

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SHORT DESCRIPTION:

During the peak of star-forming activity of the Universe (~10 billion years ago), up to 50% of all stars resided in dusty, intensely star-forming galaxies (DSFGs). However, it is unclear if these are just a scaled-up version of the present-day dusty starburst galaxies, or a distinct type of galaxy. In particular, how do the temperature, density and stellar FUV field in their star-forming regions compare? The aim of this project is to compare published far-infrared and mm-wave observations of present-day dusty star-forming galaxies to predictions from radiative transfer models to infer physical properties of their star-forming regions, and look for similarities and differences with high-redshift DSFGs.

COMPLEMENTARY INFORMATION: suited as A-project

25. Three-wave shearing interferometry for FAME Deformable mirror characterization



SUPERVISOR(S):

MSc. Emiel Por,

Dr. Michiel Rodenhuis,

Dr. Frans Snik

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SHORT DESCRIPTION

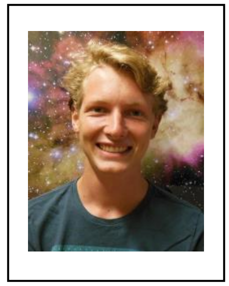
Shearing interferometry has always been seen as an extremely simple but effective way for measuring of aberrations in an optical system. Conventionally only two pupils are used for this interferometer requiring two images (one horizontal and one vertical). Only recently the concept of using more that two interfering pupils was proposed, where only one image is needed. Their implementation however was inherently monochromatic. It turns out that using liquid crystal phase plates we can make this interferometer work in broadband light. Additionally, the sensitivity and dynamic range can be tuned continuously by moving the optical components. This principle can be used to optimize adaptive optics performance by actively controlling the sensitivity of the wavefront sensor.

The student will implement a prototype using liquid crystal phase plates in the optical laboratory and perform end-to-end adaptive optics simulations that include specialized wavefront reconstruction and control for this new wavefront sensing concept.

NOVA has been part of an international consortium (FAME) that has developed a radically new type of curved deformable mirror. In this project, the student will apply and the novel wavefront sensor to perform quantitative tests of the mirror shape with and without actuation.

COMPLEMENTARY INFORMATION: suited as A or A/N-project

26. Measuring aerosols with milk cartons




SUPERVISOR(S):

MSc. Olivier Burggraaff

Dr. Frans Snik

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SHORT DESCRIPTION

Aerosols, small particles floating in the air, have a significant impact on our health and environment, yet very little is known about them. Aerosols come in all shapes and sizes, and from many sources: car exhausts, flower pollen, soot from barbecues, and many more. Many satellites and ground-based sensors are devoted to measuring the amount of aerosols in the atmosphere. These provide great data but are often extremely expensive, and may have poor coverage over time and space. Since aerosols affect each of us, ideally we would want each of us to measure them for ourselves. In this project we want to answer the question: Can we use milk cartons as a cheap and simple method to measure aerosols? We want to develop a method for measuring aerosols that involves simply cutting a piece of white cardboard from a milk carton, putting some vaseline on it, and sticking it on your outside wall. The aerosols then naturally stick to the cardboard, and it will slowly become darker. This change in colour can be measured with a technique like smartphone photography. Within this project we want to develop the milk carton method and test its accuracy. This will also require building a robust calibration method for smartphone colour measurements. The project will involve mostly lab work and field work, with some software development mixed in.

COMPLEMENTARY INFORMATION: suited as A or A/N-project

27. Exoplanet Phase variations in NASA TESS
28. The mystery of Gamma Doradus stars in MASCARA

SUPERVISOR(S):

Prof. dr. Ignas Snellen

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SHORT DESCRIPTION:

Extra information will be provided through the website or please pass by with Prof. Snellen.

COMPLEMENTARY INFORMATION: suited as A-project

29. A search for radio transients

SUPERVISOR(S):

Dr. Jacqueline Hodge

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SHORT DESCRIPTION:

This Bachelor research project will utilize some ultra-deep radio continuum data from the Very Large Array to search for transient and variable sources. Radio transients/variables can be caused by a wide range of astrophysical phenomena, from flaring stars to the jets of supermassive black holes in the centers of galaxies.

The prevalence of the variability can give us insight into the physical processes. This data-intensive project will mine the data to identify such sources.

COMPLEMENTARY INFORMATION: suited as A-project

30. The ultra-faint radio galaxy population

SUPERVISOR(S):

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SHORT DESCRIPTION:

Our team has recently completed the deepest ever radio survey of the extragalactic sky, allowing us to probe the star formation and active galactic nuclei (AGN) activity in 'normal' galaxies through the majority of cosmic time. This bachelor research project will explore this unique dataset to help understand the radio AGN phenomenon and its importance for galaxy evolution.

COMPLEMENTARY INFORMATION: suited as A-project