NOT - a telescope for the future

Report of Contributions

https://indico.not.iac.es/e/workshop2022

Contribution ID: **58** Type: **Invited Talk**

Status of the NOT

Tuesday, 7 June 2022 09:30 (25 minutes)

I will provide a general overview of the current status of the NOT as for operations, and the plans for the near future.

Primary author: AUGUSTEIJN, Thomas (Nordic Optical Telescope - Aarhus Universitet)

Presenter: AUGUSTEIJN, Thomas (Nordic Optical Telescope - Aarhus Universitet)

Contribution ID: **55** Type: **Invited Talk**

Developing NTE for the NOT

Tuesday, 7 June 2022 11:30 (25 minutes)

The design, projected performance and status of NTE (NOT Transient Explorer) is described. NTE is in reality three independent instruments mounted together at the Cassegrain focus of the NOT: NTE-VIS-imager, NTE-IR-imager and NTE-spectrograph. The two imagers can be used in parallel via a dichroic and provides a FoV of 6' with a sampling of 0.18"/pix. They are in performance very similar to AlFOsc and NOTCam, respectively. The NTE spectrograph is a cross-dispersed and covers the spectral range 320 nm - 2430 nm in a single exposure, through 18 spectral orders, with a 23" long slit. The spectrograph utilizes CCDs in the visible/UV and an H2RG detector from Teledyne in the IR, with plate scales of 0.23" and 0.40", respectively. NTE is expected to have first light in 2024.

Primary author: ANDERSEN, Michael I. (Niels Bohr Institute, University of Copenhagen)

Presenter: ANDERSEN, Michael I. (Niels Bohr Institute, University of Copenhagen)

Contribution ID: **49** Type: **Invited Talk**

The NOT Transient Explore: an Odyssey

Tuesday, 7 June 2022 11:55 (25 minutes)

I will describe The NOT Transient Explorer (NTE). NTE is designed to be an instrument that can be permanently mounted (together with FIES) at the NOT where it will allow the NOT to be a powerful facility for follow-up observations of transient sources like supernovae, kilo novae end afterglows of gamma-ray bursts. In addition the instrument should provide capabilities requested from other the user community. NTE will allow spectroscopy from the UV to the K-band with resolution of about 4000 as well as simultaneous optical and near-IR imaging. Spectropolarimetry is also part of the design. The NTE project has been somewhat of an Odyssey and I will also try to describe some of the Scyllas and Charybdisses we have encountered along the way.

Primary author: FYNBO, Johan (The COSMIC DAWN Center, Niels Bohr Institute, Copenhagen Unviersity)

Presenter: FYNBO, Johan (The COSMIC DAWN Center, Niels Bohr Institute, Copenhagen Unviersity)

Contribution ID: **47** Type: **Poster**

Special Narrow Band Interline Sky Continuum Spectra with NOT/ALFOSC

Tuesday, 7 June 2022 12:50 (2 minutes)

Special narrow band spectroscopic observations with ~10nm band widths centered at wavelengths 672nm, 770nm, 870nm and 1050nm with resolution of R~4000 are presented along conclusions on how the night sky brightness affects potential future extremely large telescope (ELT) spectrograph designs . The presented observations are less prone to be contaminated by bright hydroxyl (OH) emission lines than any of the previous similar measurements, thus providing a more reliable estimate on the night sky continuum brightness than before. Despite being limited to the wavelengths detectable for a Silicon detector, the obtained measurements will indicate if more or less continuum flux should be expected at near infrared (NIR) wavelengths beyond 1um where OH lines are ubiquitous and gains from alternative, stray-light free, spectrograph design would have the highest impact on the astronomical observation.

Primary author: VIUHO, Joonas (DAWN, Niels Bohr Institute, University of Copenhagen/Nordic Optical Telescope (NOT))

Co-author: Dr ANDERSEN, Michael I. (Niels Bohr Institute, University of Copenhagen)

Presenter: VIUHO, Joonas (DAWN, Niels Bohr Institute, University of Copenhagen/Nordic Optical Telescope (NOT))

Contribution ID: **46** Type: **Poster**

Update of Fastcam, the lucky imaging instrument at the Observatorios de Canarias (OOCC)

Tuesday, 7 June 2022 12:52 (2 minutes)

FastCam is an instrument designed to obtain high spatial resolution images in the optical wavelength range from ground-based telescopes by using the Lucky Imaging technique. This technique is based on the idea of registering the instants of atmospheric stability, typically lasting just some milliseconds, using very short exposures. The instrument consists of a very low noise and very fast readout speed EMCCD camera capable of reaching the diffraction limit of medium-sized telescopes from 380 to 1000 nm.

At the beginning of 2019, a new camera was commissioned. Now the instrument makes use of an Andor iXon DU-888U3-CSO#BV back-illuminated system containing a 1024x1024 pixel frame transfer CCD sensor from E2V Technologies. The pixel size is 13 microns and the camera allows up to 30 exposures per second. A new update of the camera acquisition software is currently being worked on. A complete characterisation of the detector is also being carried out in order to better understand and exploit all the performances of the instrument, applying particular configurations for each scientific case. A standard reduction of the data is also being implemented in order to offer it to all users of the instrument.

The first FastCam was an instrument jointly developed by the Spanish Instituto de Astrofísica de Canarias (IAC) and the Universidad Politécnica de Cartagena which started in 2006. Since then, the IAC assumed the instrument and tested it on several telescopes of the OOCC, among them the Nordic Telescope (NOT) where images were obtained in the optical domain diffraction-limited with high contrast, reaching a resolution of 0.1”/px.
Currently FastCam is a common-user instrument at the Cassegrain focus of the 1.52-meter Carlos Sánchez Telescope (TCS, Teide Observatory) where observations are being made to calibrate the detector with sky tests. The idea is that in the near future it will be installed in the NOT to finish the commissioning process of the new camera and the whole acquisition system so that this instrument can be used by the international community.

Primary author: Dr CLAVERO-JIMÉNEZ, Rosa (IAC)

Co-authors: Dr NESPRAL, David (IAC); Dr LÓPEZ-LÓPEZ, Roberto; Mrs SORIA-HERNÁNDEZ, Esther (IAC); Mrs PUIG-SUBIRÁ, Marta (IAC); Dr OSCOZ, Alejandro (IAC); Dr ZAMORA-SÁNCHEZ, Olga (IAC)

Presenter: Dr CLAVERO-JIMÉNEZ, Rosa (IAC)

Contribution ID: **42** Type: **Poster**

Physical properties of near-Earth objects and space debris from multiwavelength polarimetry at the Nordic Optical Telescope

Tuesday, 7 June 2022 12:54 (2 minutes)

We describe the future potential of multiwavelength polarimetric observations of natural near-Earth objects (NEOs) and artificial space-debris objects (SDs) at the Nordic Optical Telescope (NOT). Together with state-of-the-art theoretical modeling based on the first principles of physics, the forthcoming NOT observations promise to be a game-changer in the physical characterization of NEOs and SDs. First, empirical modeling of the observations allows for the estimation of the geometric albedos and taxonomic classes of the objects. Second, full-scale physics-based modeling of the observations constrains wavelength-scale compositional and structural characteristics for the surfaces of NEOs and SDs. Third, auxiliary photometric observations in the visible and infrared parts of the spectrum impose constraints on the sizes and geometric albedos of the objects, enhancing the accuracy of the aforedescribed physics-based modeling. In particular, we describe the potential of the forthcoming NOT Transient Explorer instrument (NTE) for the polarimetric observations.

Primary authors: Prof. MUINONEN, Karri (University of Helsinki); VIRKKI, Anne (University of Helsinki; Finnish Geospatial Research Institute FGI, National Land Survey); Dr PENTTILÄ, Antti (University of Helsinki); Dr GRANVIK, Mikael (Department of Computer Science, Electrical and Space Engineering, Luleå University of Technology); Dr PELTONIEMI, Jouni (Finnish Geospatial Research Institute FGI, National Land Survey)

Presenter: VIRKKI, Anne (University of Helsinki; Finnish Geospatial Research Institute FGI, National Land Survey)

Contribution ID: **17** Type: **Poster**

A Complete Census of Quasars

Tuesday, 7 June 2022 12:56 (2 minutes)

Nowadays, there are significant selection effects in searching for quasars. To get a complete census of quasars, we can't just look at those objects which have excess UV light compared to stellar sources, because quasars reddened by dust are not negligible and should be considered. In my master's project, we mainly focus on the red quasars. We got the spectra of 50 quasars using the NOT and the GTC, among which we are attracted by the so-called detached quasars. They don't show obvious emission features in the optical band, which makes it extremely difficult to determine their redshift. However, we found a quantitative method to measure the onset of the Lyman-alpha forest, which can help in the determination of the quasar's redshift.

Primary authors: MA, Guozhen; Prof. FYNBO, Johan

Presenter: MA, Guozhen

Contribution ID: **41** Type: **Poster**

Photometric/Astrometric classification of quasars using machine learning algorithms

Tuesday, 7 June 2022 12:58 (2 minutes)

Quasars are manifestations of accreting supermassive blackholes in the centers of galaxies. It is currently uncertain how many quasars there are as quasar selection is known to be biased and incomplete. In this work we try to use novel more unbiased quasar selection techniques to reach a more reliable and complete census of quasars in a large section of the sky.

Primary authors: MAGEIRAS, Ioannis; Ms KOUKOUVAOU, Marina (NBI)

Presenters: MAGEIRAS, Ioannis; Ms KOUKOUVAOU, Marina (NBI)

Contribution ID: **64** Type: **Poster**

Stellar ages and how the NOT can help us

Tuesday, 7 June 2022 13:00 (2 minutes)

Unravelling the age is one of the most challenging tasks since most are subject to significant uncertainties, and their determinations face multiple observational and theoretical challenges. Ages are generally better determined in stellar associations. They usually provide a significant sample of objects when testing the hypothesis that they were born simultaneously from the same molecular cloud and identical composition. Several features and characteristics are considered when deriving ages in stellar associations. However, each of them is valid within a specific age interval. In particular, we focus on those techniques related to lithium evolution, valid for values between 20 to a few hundred Ma. To address this task, we need spectrographs with enough resolving power to determine the presence or absence of lithium in FGK dwarfs, low-mass stars and brown dwarfs. Here we present our pilot study of the observing capabilities of the NOT with ALFOSC and FIES to determine ages in several stellar associations systematically.

Primary author: GALINDO-GUIL, Francisco José (CEFCA)

Presenter: GALINDO-GUIL, Francisco José (CEFCA)

Contribution ID: **57** Type: **Invited Talk**

Supernovae and Transient Surveys

Tuesday, 7 June 2022 14:30 (25 minutes)

Supernova research is one of the transient sciences for which the flexible NOT has had significant impact. I will present on the efforts from our Stockholm supernova group over the past 25+ years, mostly focusing on the more recent Zwicky Transient Facility era, but also on ideas for follow-up of LSST targets.

Primary author: Prof. SOLLERMAN, Jesper (Stockholm University)

Presenter: Prof. SOLLERMAN, Jesper (Stockholm University)

Contribution ID: **44** Type: **Invited Talk**

The Nordic-optical-telescope Un-biased Transient Survey (NUTS)

Tuesday, 7 June 2022 14:55 (25 minutes)

The Nordic-optical-telescope Un-biased Transient Survey, aka NUTS, is a diverse collaboration of researchers spread across several Nordic and other European countries. The common goal of our group is to engage in cutting-edge transient science and research training with the NOT. Over the past six years, NUTS has obtained extensive data sets of a multitude of transients including all flavours of supernovae, as well as fast transients, ILOTs, LRNe and TDEs. In my talk I will present our team of scientist, Marshall, data reduction pipeline, as well as a tally of our impressive publication record. In doing so, recent science highlights from some of our junior scientists will be presented.

Primary author: STRITZINGER, Maximilian (Aarhus University)

Presenter: STRITZINGER, Maximilian (Aarhus University)

Contribution ID: **22** Type: **Contributed Talk**

NOT and the Young Supernova Experiment

Tuesday, 7 June 2022 15:20 (15 minutes)

The Young Supernova Experiment (YSE) is a wide-field, multiband (griz) survey using the Pan-STARRS telescopes with a unique synergistic observing strategy. YSE is able to identify the youngest transients within days and even hours of first explosion. Our large followup programme with the NOT plays a pivotal role in the classification and and followup of YSE transients. I will demonstrate how NOT observations have helped to explore the properties of a broad range of YSE transients from the first two years of the survey; from the classification of <1 day old SNe Ia, to the identification of exotic transients, to the first spectrum of a tidal disruption event from an intermediate mass black hole.

Primary author: ANGUS, Charlotte (University of Copenhagen)

Presenter: ANGUS, Charlotte (University of Copenhagen)

Contribution ID: **39** Type: **Contributed Talk**

Peculiar Supernovae observed with the Nordic Optical Telescope

Tuesday, 7 June 2022 15:35 (15 minutes)

In this talk, I will present the spectroscopic and photometric evolution of a sample of supernovae (SNe) observed with the Nordic Optical Telescope (NOT) between 2018 and 2022. This sample includes a few hydrogen-rich SNe located in low-luminosity host galaxies, a peculiar hydrogen-poor SN (SN~Ic) and one superluminous SN. I will also discuss the properties we can infer from the observations and some comparisons with models.

Primary author: GUTIERREZ, Claudia (University of Turku)

Presenter: GUTIERREZ, Claudia (University of Turku)

Contribution ID: **50** Type: **Invited Talk**

Relativistic explosions at the NOT: kilonovae and gamma-ray bursts

Tuesday, 7 June 2022 16:30 (25 minutes)

The NOT has a long tradition in the follow-up of gamma-ray bursts, starting with observations of the very first afterglow back in 1997. Focus has been both on the physics of these events and their use as probes of the distant universe. Twenty-five years later, the NOT has become a major worldwide contributor to this field. Starting in 2017, the parallel branch of gravitational wave sources has also sprouted. I will review past seminal NOT contributions and highlight new science goals which can be tackled using the forthcoming NTE, whose design has been optimized for transient sources.

Primary author: MALESANI, Daniele (Department of Astrophysics/IMAPP, Radboud University)

Presenter: MALESANI, Daniele (Department of Astrophysics/IMAPP, Radboud University)

Contribution ID: **33** Type: **Contributed Talk**

NOT enables rapid transient science; case of type Ic-BL SN2020lao

Tuesday, 7 June 2022 16:55 (15 minutes)

SN 2020lao is a fast Type Ic-BL SN, without an associated GRB, which was nevertheless discovered within 2.5 hours of explosion by ZTF. Fortuitously, TESS also captured its rise with a 30 minute cadence. Our follow-up comprising of optical spectra and multi-band light curves commenced within 24 hours of explosion. Due to disruption from the pandemic, we had to hop between a wide range of instruments located around the world. During this time, both spectra and photometry from the NOT were crucial in nailing down the observational sequence of SN 2020lao.
In this talk, I present the results of our extensive observational campaign which reveal that SN2020lao is one of the fastest Type Ic-BL SNe ever observed. It is also one of the youngest without a GRB trigger, providing a unique opportunity to study the early lightcurve and spectra of SNe Ic-BL unadulterated by afterglow emission. Interestingly, there is also evidence of short-lived early shock cooling emission hidden in the TESS lightcurve.
Finally, I will briefly present the Aarhus-Barcelona FLOWS photometry pipeline, which was used to calculate photometry of SN~2020lao. This open-source python code provides automatic PSF photometry of SNe, including with ALFOSC and NOTCAM at NOT.

Primary author: KARAMEHMETOGLU, Emir (Aarhus University, Department of Physics and Astronomy)

Co-authors: STRITZINGER, Max (Aarhus University, Department of Physics and Astronomy); GALBANY, Lluís (Institute of Space Sciences - CSIC)

Presenter: KARAMEHMETOGLU, Emir (Aarhus University, Department of Physics and Astronomy)

Contribution ID: **4** Type: **Contributed Talk**

Cosmography of Laniakea: Type Ia supernovae, peculiar velocities and dark matter

Tuesday, 7 June 2022 17:10 (15 minutes)

We are currently performing a Type Ia supernova (SN Ia) near-infrared (NIR) imaging survey in J- and H-bands at NOT, which combined with the FLOWS project efforts of building a sample of 10^3 SNe Ia observed in the NIR, will demonstrate the ability to get systematics-limited (better than 3%) distances with minimal resources, and expand our view of Laniakea out to z=0.1. Our planned analysis will make use of a state-of-the-art techniques that we have pioneered, and will employ a new NIR spectral template to compute K-corrections, offering the most significant reductions in systematics to date. The outcome of this study will include a measurement of the local Hubble constant, identify the location of the major dark matter (DM) concentration driving peculiar motion relative to the smooth Hubble flow, and in doing so will better determine how DM clusters on intermediate scales and provide significant improvements on the measurement of sigma8. Our data set will have a legacy value to the community as it will significantly extend upon numbers of previous studies. In this talk, I will summarize the project and present some preliminary results.

Primary author: GALBANY, Lluís (Institute of Space Sciences - CSIC)

Presenter: GALBANY, Lluís (Institute of Space Sciences - CSIC)

Contribution ID: **11** Type: **Contributed Talk**

Classical novae at high resolution with the NOT

Tuesday, 7 June 2022 17:25 (15 minutes)

The possibility to observe Classical (and recurrent) novae at high spectral resolution has allowed a more deep understanding of the nova phenomenon, with the discovery of 1) THEA lines; 2) lithium in their ejecta; and 3) the presence of multiple components, whose evolution is simultaneous to the high-energy (GeV) emission detected from space-based missions. In this talk, I will give a short review of CN phenomenology, concentrating on some recent results, also obtained using FIES at the NOT.

Primary author: IZZO, Luca (University of Copenhagen)

Presenter: IZZO, Luca (University of Copenhagen)

Contribution ID: **21** Type: **Invited Talk**

Astrometry of Small Solar System Objects with NOT

Wednesday, 8 June 2022 09:30 (25 minutes)

Telescopes of the 2-4 meter class such as the NOT can be an extremely important observational asset for the field of small solar system objects, thanks to a combination of large aperture and typically easier access compared to 8-10 meter class instruments, especially on short notice.
At the same time, the field of small bodies is characterized by the more rapid timescales on which objects change their observability circumstances. The motion of the object, both in the plane of the sky and in topocentric distance, induces observational constraints that are different from most other fields of astronomy: observability windows may be very short, pointing and tracking can become more complex, and an increased importance must be placed on the temporal accuracy of observations.
In this contribution we will present a couple of interesting results that show how NOT can provide valuable astrometric observations with good angular and temporal precision.
We will show how the telescope can provide high-precision astrometry of a challenging moving object down to magnitude ~25, a faintness level that is often assumed to be the prerogative of 8-10 meter class instruments.
We wil also briefly present how we took advantage of an international observing campaign to verify the timing accuracy of the system, another important parameter for the usability of the telescope on fast moving objects.

Primary author: MICHELI, Marco (ESA NEO Coordination Centre)

Presenter: MICHELI, Marco (ESA NEO Coordination Centre)

Contribution ID: **15** Type: **Invited Talk**

Investigation of Primitive Bodies in the Solar System with NOT

Wednesday, 8 June 2022 09:55 (25 minutes)

Comets and asteroids are remnants of the solar system's original planetesimals, and act as probes of the environment where they formed. The ice-rich comets formed beyond the snow line, while asteroids accreted inside it. Both provide information about conditions in the protoplanetary disk, but at different radial distances. The newly discovered class of "active asteroids" blurs this distinction by suddenly becoming active, i.e., shedding mass and developing a transient coma. These objects show that sub-surface ice might be prevalent even in the inner solar system, and may have been a source of water on Earth.

We have been using the Nordic Optical Telescope to observe primitive bodies. Their ephemeral nature requires a telescope that is nimble enough to accommodate sudden requests for observing time, and versatile enough to accommodate different types of observations — both of which the NOT does extremely well. In this talk I will describe how the NOT has allowed us to pinpoint the mass loss origin for the active asteroid 6478 Gault, and respond to 2 interstellar objects that visited our solar system.

Primary author: LUU, Jane (University of Oslo)

Co-author: Dr JEWITT, David (UCLA)

Presenter: LUU, Jane (University of Oslo)

Contribution ID: **20** Type: **Contributed Talk**

Characterising near-Earth asteroids using multi-wavelength observations

Wednesday, 8 June 2022 10:20 (15 minutes)

Tracking and characterisation of near-Earth objects (NEOs) are crucial aspects of planetary science by helping us to understand the formation and evolution of Solar System, and planetary defence by providing information required for impact risk mitigation strategies. As more NEOs get discovered, also the opportunities to characterise them better increase, including using the Nordic Optical Telescope for that purpose. In fact, telescopes in the size scale of NOT could be key contributors in NEO tracking and characterisation, if utilised effectively. In this presentation, I discuss characterisation of the physical properties of NEOs using optical and radar observations. I used radar disk-function analysis, i.e., modelled the observed radar reflectivity as a function of the incidence angle, which can be used to derive the effective permittivity of the surface and the decimetre-scale surface roughness. The permittivity was then used for estimating the effective regolith bulk density up to the depth of about one metre. Radar delay-Doppler observations enable imaging resolution as fine as 7.5 m. Only NEOs greater than 100 m were included in this study. The radar observations can inform better of metallicity that can be challenging to distinguish using only optical observations, whereas optical observations are better at distinguishing between S- and C-complex asteroids. The goal is to investigate the trends in composition, density, and surface-roughness for different types of NEOs, and to understand how these characteristics can be investigated most effectively at different wavelengths.

Primary author: VIRKKI, Anne (University of Helsinki)

Presenter: VIRKKI, Anne (University of Helsinki)

Contribution ID: **29** Type: **Contributed Talk**

Asteroid observations in support of space missions

Wednesday, 8 June 2022 10:35 (15 minutes)

Space exploration missions to small-bodies such as asteroids and comets typically require observational support from extensive campaigns by ground-based and Earth-orbiting facilities. These observing campaigns are necessary both for optimizing mission and instrument design and for maximizing the scientific return of a mission. In some extreme cases the mission goals cannot be met without ground-based observation support. I will describe the observational support NOT provides to ESA's Hera and Gaia missions, NASA's DART mission, and JAXA's DESTINY$^+$ mission. The rather unique capabilities and flexibility of NOT in its size class – to be further improved with the installation of NTE – also support mission planning in that they allow for rapid characterization of potential mission targets immediately after their discovery with large-scale surveys such as those to be carried out by NASA's NEO Surveyor and the Vera C. Rubin Observatory. I will provide examples of future missions such as ESA's Comet Interceptor that will benefit from the flexibility and capabilities of NOT.

Primary author: GRANVIK, Mikael

Presenter: GRANVIK, Mikael

Contribution ID: **24** Type: **Invited Talk**

Satellite Tracking with NOT – Limitations and Possibilities

Wednesday, 8 June 2022 11:30 (25 minutes)

Tracking of artificial objects in orbit around Earth (for example satellites and discarded rocket bodies), as well as characterisation of capabilities, ownership, and operational status is an integral part of space situational awareness. This activity is becoming increasingly important as space gets more congested, but it also has relevant implications in other areas, such as policy making, diplomacy, and defence.

In this talk we will be presenting the results of efforts to test the Nordic Optical Telescope (NOT) for tracking and characterising satellites in different orbits. The aim was to assess NOT:s capabilities in the use-case and evaluate both its possibilities and present limitations. The results show that NOT can track objects with angular speeds of 120”/s or slower, approximately equivalent to objects in orbits 4200 km from the surface and above. This includes for example satellites in geosynchronous orbit and navigation constellations such as GPS and Galileo.

We will also present results from characterisation of satellites using polarimetry and spectroscopy with the ALFOSC instrument, and direct lucky imaging with FASTCAM. We found that polarimetry alone is an efficient way to distinguish satellites.

Primary authors: ET AL.; PAPADOGIANNAKIS, Seméli (Swedish Defence Research Agency, FOI)

Presenter: PAPADOGIANNAKIS, Seméli (Swedish Defence Research Agency, FOI)

Contribution ID: **43** Type: **Invited Talk**

Upgrading the FIES spectrograph with the aim of attaining more precise radial velocities

Wednesday, 8 June 2022 11:55 (25 minutes)

TDB

Primary author: BUCHHAVE, Lars A. (DTU Space, Technical University of Denmark)

Presenter: BUCHHAVE, Lars A. (DTU Space, Technical University of Denmark)

Contribution ID: **25** Type: **Contributed Talk**

Planetary System Architectures

Wednesday, 8 June 2022 12:20 (15 minutes)

In the Solar System, planetary orbits are nearly circular, coplanar, and their planes are only tilted by 7° relative to the Sun's equator. It is neatly ordered with four rocky planets within 2~au, while four gas giants orbit at much larger separations. This regularity formed the blueprint of planetary formation, where planets form in the spinning protoplanetary disk resulting in configurations similar to the Solar System, or so we thought. Recent studies of extra solar planet systems has now led researchers to propose a more chaotic formation process. The diversity in these systems' architecture is huge: orbits with periods from less than a day to many years, perfectly circular and highly eccentric orbits, orbits that are prograde, polar, and even retrograde. Some systems are densely packed, others appear to harbor only a single planet.
Understanding this diversity necessitates knowledge of key orbital parameters. One particularly telling observable is the stellar obliquity–the angle between the stellar spin axis and the orbital axis of the planet. Measuring the obliquity allows us to make inferences about protoplanetary disk orientations, assess how planet-planet interactions have shaped the architecture of the system, and it provides us with insight into stellar physics through planet-star interactions. As more obliquity measurements are carried out, some interesting trends are starting to emerge, most recently a preponderance of perpendicular planets, and a possible connection between orbital eccentricity \& stellar obliquity. Through our program at the NOT we have used FIES to confirm and characterise TESS planet candidates (Knudstrup et al. submitted), as well as measure obliquities through time critical, transit observations (Knudstrup et al. in prep.). In this talk I will present how our results let us explore the eccentricity-obliquity relation, expand on the perplexing pile-up of polar orbiting planets, as well as probe protoplanetary disks. I will also explain how we intend to use FIES in the future to further evince planetary system architectures

Primary author: KNUDSTRUP, Emil (Aarhus University)

Co-author: ALBRECHT, Simon (Aarhus University)

Presenter: KNUDSTRUP, Emil (Aarhus University)

Contribution ID: **34** Type: **Contributed Talk**

The NOT in the era of the MAAT-IFU on the GTC

Wednesday, 8 June 2022 12:35 (15 minutes)

A new mirror-slicer optical instrument, named MAAT, will allow the OSIRIS spectrograph on the Gran Telescopio de CANARIAS (GTC) the capability to perform Integral-Field Spectroscopy over a seeing-limited FoV 12.0” × 8.5” with a slice width of 0.303”. MAAT will enhance the resolution power of OSIRIS by 1.6 times as compared to its 0.6” long-slit. All the eleven OSIRIS grisms and volume-phase holographic gratings will be available to provide broad spectral coverage with resolution R=600 up to 4100 in the 360-1000 nm wavelength range. MAAT top-level requirements will broaden its use to the needs of the GTC astronomical community for a wide range of competitive science topics that covers the entire astronomy given its unique observing capabilities. The GTC equipped with OSIRIS+MAAT will also play a fundamental role in synergy with worldwide facilities, in particular the NOT operating on the ORM at La Palma. I will highlight the focus on a selected set of outstanding science topics enabled by the Nordic-Spanish team supporting this project in different areas of expertise, and I will present an overview of the instrument design, performance and status.

Primary authors: PRADA, Francisco; THE MAAT COLLABORATION,

Presenter: SAGUES CARRACEDO, Ana (The Oskar Klein center, Stockholm University)

Contribution ID: **35** Type: **Poster**

Updated modelling of the oscillating eclipsing binary system AS Eri

Wednesday, 8 June 2022 12:50 (2 minutes)

We present the results of a recent study of the Algol-type eclipsing binary system AS Eri based on the combination of the MOST and TESS light curves as well as a collection of very precise radial velocities obtained with the spectrographs HERMES operating at the Mercator telescope, La Palma, and TCES operating at the Alfred Jensch telescope, Tautenburg. The primary component is a known A3 V-type pulsating, mass-accreting star. We fitted the light and RV data with the package PHOEBE, and determined the best-fitting model adopting the configuration of a semi-detached system. We used the orbital period of 2.6641496 $\pm$ 0.0000001 days obtained from an updated (O-C) analysis and the phase gap between the MOST and TESS light curves. The absence of any cyclic variation in the (O-C) residuals confirms the long-term stability of this period. We obtained the following absolute component parameters: L_1 = 14.125 $\pm$ 0.008 $L_\odot$, M_1 = 2.014 $\pm$ 0.004 $M_\odot$, R_1 = 1.733 $\pm$ 0.006 $R_\odot$, log g_1 = 4.264 $\pm$ 0.005 and L_2 = 4.345 $\pm$ 0.003 $L_\odot$, M_2 = 0.211 $\pm$ 0.001 $M_\odot$, R_2 = 2.19 $\pm$ 0.01 $R_\odot$, log g_2 = 3.078 $\pm$ 0.003 with $T_{eff,2}/T_{eff,1}$ = 0.662 $\pm$ 0.002. Although the orbital period appears to be stable on the long term and the final solution shows residuals within the expected limits (the residuals still contain the pulsation signal), we show that the models derived for each light curve separately entail small differences, e.g. in the temperature of the companion, and that the light curve is affected by a years-long modulation. We believe that this is caused by the magnetic activity of the cool companion. The next endeavour will be to study the properties of the pulsations using the residual light curves in combination with existing and new high-resolution, time-series spectra collected with the SALT spectrograph.

Primary authors: Dr MKRTICHIAN, David (National Astronomical Research Institute of Thailand); LAMPENS, Patricia (Royal Observatory of Belgium); Dr LEHMANN, Holger (Th\"uringer Landessternwarte)

Presenter: LAMPENS, Patricia (Royal Observatory of Belgium)

Contribution ID: **37** Type: **Poster**

Spectroscopic monitoring of early stage post-AGB stars

Wednesday, 8 June 2022 12:52 (2 minutes)

The role of different processes in shaping of planetary nebula (PN) around post-AGB stars is not fully understood. Recently, binary interactions have been thought of as the main shapers of PN; however, multiple studies seem to suggest that the role of companions might be overestimated or even question current post-AGB star evolutionary models. It is possible that an intrinsic change in nature of stellar wind during the post-AGB phase plays an important role in the formation of the PN. Our recent studies of the bright post-AGB stars IRAS 22272+5435 and HD 161796 have already revealed seemingly wind-related processes in their atmospheres. Shocks and both cool and warm outflows have been observed. Also, matter falling onto the star has been detected and we have embarked on determination of precise evolutionary rates for these objects.
High-resolution spectroscopic monitoring over pulsation cycle of post-AGB stars is a useful tool for study of dynamical phenomena in their atmospheres and shells. We propose to use NOT/FIES for monitoring of homogeneous sample of cool post-AGB stars to study long-term variations and to determine the evolutionary rates. Also, FIES will provide data for studies of short-term spectral variability. The forthcoming NTE instrument will allow us to extend spectral variation studies to the near infrared, unveiling variation in more spectral lines of different species and excitation energies, thereby probing dynamics in a wider range of the extended atmospheres of such stars.

Primary authors: Mr PUKITIS, Karlis (University of Latvia); Dr ZACS, Laimons (University of Latvia)

Presenter: Mr PUKITIS, Karlis (University of Latvia)

Contribution ID: **45** Type: **Poster**

Stellar evolution studies with FIES

Wednesday, 8 June 2022 12:54 (2 minutes)

I demonstrate the continued strength of FIES in studies of stellar evolution involving eclipsing binary stars and star clusters.

Primary author: BROGAARD, Karsten (Stellar Astrophysics Centre, Aarhus University)

Presenter: BROGAARD, Karsten (Stellar Astrophysics Centre, Aarhus University)

Contribution ID: **28** Type: **Poster**

New set of linear polarimetry standard stars

Wednesday, 8 June 2022 12:56 (2 minutes)

We present the preliminary results, accurate measurements
and long term monitoring,
of our on-going programme to
extend the list of well observed polarimetric standard stars.

Many of the current polarimetry standard star catalogues
have mainly
very bright (V< 9mag) stars which are not well observed
and sky coverage is very sparse
ESO presented a list of fainter standard stars, V=10-12mag,
however, only three of them are easily observable from the Northern hemisphere.
In order to improve this we have been conducting a programme to
establish standard stars with V=10.0-13.5 mag and declination > -13 deg.

Our data includes accurate, simultaneous, UBVRI measurements using
Turku UBVRI Photopolarimeter (Turpol), long term monitoring in B-band with
the Alhambra Faint Object Spectrograph and Camera, (ALFOSC), both instrumments
having been mounted at the Nordic Optical Telescope (NOT)
and multi epoch measurements in NIR through yzJHK-bands with
Long-slit Intermediate Resolution Infrared Spectrograph, LIRIS,
mounted at the William Herschel Telescope (WHT).

Primary author: PURSIMO, Tapio (NOT)

Presenter: PURSIMO, Tapio (NOT)

Contribution ID: **48** Type: **Poster**

Unveiling the host extinction of type Ia supernovae with the NOTCam instrument at Nordic Observatory Telescope

Wednesday, 8 June 2022 12:58 (2 minutes)

Type Ia supernovae (SNe Ia) are among the best standard candles for obtaining an accurate measurement of the Hubble constant (H0) in late times and can help us shed light on the apparent discrepancy with the estimated value in the opposite edge of the universe, early times. This may indicate additional new physics beyond the standard cosmological model or significant systematic errors in the local measurement that need to be accounted for.

We propose to use the NOTCam instrument mounted on the 2.5 m telescope in the NOT to obtain near-infrared (NIR) photometry of nearby (z <0.06) type SNe co-observed in optical bands by the Observatorio de Sierra Nevada (OSN) within the "SN2 Project".The main goal of the project is to build a statistically significant and homogeneous photometric sample of about 70 type Ia SNe for which we have spectroscopic data for their host galaxies. With 2-3 epochs of each SN Ia NIR observations between the peak brightness peak and 20-30 days after the maximum, we can cover the secondary peak of SN. By including the NIR light curves (LCs) of the SNe we can obtain accurate values with the SNooPy (SuperNovae in Object-Oriented Python) LC fitter of the decline-rate parameter Δm15(B) and the main luminosity SN parameters. Furthermore, we can determine the extinction curves of the host galaxies for each SN Ia, which is of paramount importance to unravel possible systematics related to their physical properties.
The proposed NIR observations and the optical data obtained through the SN2 project allow us to constrain the main physical properties of the type Ia SNe and provide accurate systematics in its luminosity measurements, which will contribute to understanding the origin of the "constant of Hubble".

Primary author: GALLEGO CANO, Eulalia (IAA-CSIC)

Co-authors: Dr IZZO, Luca (DARK, Niels Bohr Institute, University of Copenhagen); Dr PRADA, Francisco (IAA-CSIC)

Presenter: GALLEGO CANO, Eulalia (IAA-CSIC)

Contribution ID: **32** Type: **Poster**

NOT Applied Comics Collaboration

Wednesday, 8 June 2022 13:00 (2 minutes)

The NOT was approached by Graphic Storytelling students from VIA University College in Viborg, Denmark, to work on an Applied Comics collaboration. Applied Comics are a powerful tool to communicate factual information to all target audiences. In their collaboration with the NOT, the students developed comics about various NOT-related subjects, with the intent of informing people of some of the work that is done at the NOT. There were four total comics made, with the following topics: a day in the life of an astronomer; observing exoplanets; supernovas; and a comic about the NOT itself. The final product will be shared in all of the NOT's social media as an outreach mechanism to advertise the telescope and hopefully raise people's interest on the NOT.

Primary authors: RASMUSSEN, Kira (VIA University College); BOMHOLT, Anne (VIA University College); EJERSBO, Tea (VIA University College); SACHSE, Hannibal (VIA University College)

Co-authors: Mr FETZNER KENIGER, Marcelo Aron (NOT, Aarhus University); SORENSEN, Peter (NOT)

Presenter: Mr FETZNER KENIGER, Marcelo Aron (NOT, Aarhus University)

Contribution ID: **12** Type: **Invited Talk**

DiPol-UF simultaneous three-color (BVR) polarimeter with EM-CCDs

Wednesday, 8 June 2022 14:30 (25 minutes)

DiPol-UF is a new instrument capable of high precision (10–5) polarimetric observations simultaneously in three passbands (BVR). The instrument utilizes electron-multiplied EM CCD cameras for high efficiency and fast image readout. The key features of DiPol-UF are: (i) optical design with high throughput and inherent stability; (ii) great versatility which makes the instrument optimally suitable for observations of bright and faint targets; (iii) control system which allows using the polarimeter remotely. The DiPol-UF is equipped with a retractable calcite unit and can be used also as a high-speed simultaneous three-band photometer. Polarimeter is equipped with exchangeable half and quarter-wave plates and capable to measure linear and circular polarization.
Examples are given of the first results obtained from high signal-to-noise ratio observations of bright nearby stars and fainter sources, such as X-ray binaries in their quiescent state and magnetic white dwarfs.

Primary author: BERDYUGIN, Andrei (Dept. of Physics and Astronomy, University of Turku, Finland)

Co-authors: Dr PIIROLA, Vilppu (Dept. of Physics and Astronomy, University of Turku, Finland); Dr KOSENKOV, Ilia (Dept. of Physics and Astronomy, University of Turku, Finland)

Presenter: BERDYUGIN, Andrei (Dept. of Physics and Astronomy, University of Turku, Finland)

Contribution ID: **36** Type: **Invited Talk**

Surface imaging of active stars at the NOT

Wednesday, 8 June 2022 14:55 (25 minutes)

Throughout its operation the NOT has offered a valuable resource for studying the spot coverage and surface magnetic fields of late-type active stars. Such stellar surface maps can be constructed from high resolution spectroscopy and spectropolarimetry using the Doppler imaging and Zeeman Doppler imaging methods. These methods provide a uniquely detailed look at the stellar dynamo generated magnetism and act thus as crucial input for constraining theoretical dynamo models. I will present a review of the past and current studies of stellar activity and magnetism using high resolution spectropolarimetry from SOFIN and high resolution spectroscopy from FIES. These include extended longitudinal studies, which make the NOT dataset uniquely valuable, as well as current efforts of using simultaneous TESS photometry to connect the surface magnetic fields to the stellar differential rotation profile.

Primary author: LEHTINEN, Jyri (Finnish Centre for Astronomy with ESO (FINCA))

Presenter: LEHTINEN, Jyri (Finnish Centre for Astronomy with ESO (FINCA))

Contribution ID: **14** Type: **Contributed Talk**

A polarimetric census of Be X-Ray Binaries with FAPOL@NOT

Wednesday, 8 June 2022 15:20 (15 minutes)

Late O or early B stars showing Balmer lines in emission and infrared excess are classified as Be stars. Both, the emission in Balmer lines and the infrared excess, have their origin in a circumstelar disk-alike decretion sctructure. Rapid rotation and pulsations are known to be part of the mechanism of formation of such a structure but the process is still unknown. Be stars are also known to show a characteristic polarization due mainly to electron scattering of photons in the disk. Size of the disk, density and orientation with respect to the observer are factors that influence the total degree of polarization observed. They also present a characteristic variation of polarization with wavelength. Be stars accompanied by a compact object (neutron star or black hole) are the most common type of x-ray binary systems with massive optical companion. In these systems, known as Be X-Ray Binary systems (BeXRBs), the disk-alike structure is more compact and dense than that in isolated Be stars. We have started the very first polarization census of BeXRBs, with the goal to identify peculiar objects and compare the polarimetric porperties of Be stars in binary systems with the isolated ones. We present here the very first results of the survey, showing that Be stars in BeXRBs tend to show higher degrees of polarization than those of isolated Be stars and helping to identify and study some peculiar targets.

Primary authors: Dr REIG, Pablo (Department of Physics, University of Crete); BLAY, Pere (Valencian International University)

Presenter: BLAY, Pere (Valencian International University)

Contribution ID: **27** Type: **Contributed Talk**

Following V509 Cas into the void with FIES

Wednesday, 8 June 2022 15:35 (15 minutes)

Yellow hypergiant stars are objects of great interest because they are in an extreme transition phase of evolution, in which the stars have dynamically unstable atmospheres and undergo recurring mass loss outbursts. As post-red supergiants, they are a possible bridge in the evolutionary gap between red supergiant and B[e] supergiant or luminous blue variable phases. On the Hertzsprung-Russell diagram they are located in the upper part near the luminosity limit and in an instability region labelled as the 'yellow evolutionary void'. V509 Cas is a variable yellow hypergiant with an interesting history.

Over the 20th century V509 Cas has travelled into the 'yellow void' and suffered several large-scale eruptions, during which the star's luminosity and temperature rapidly decreased. However, at the start of the 21st century, the star has shown signs of approaching stability (Nieuwenhuijzen et al. 2012). In Tartu Observatory we have monitored the spectroscopic variability of V509 Cas for over 7 years. These observations are complemented by recent FIES measurements with a higher resolution and significantly wider wavelength range.

Could the recent changes in the variability of V509 Cas be a sign of the star reaching a calmer phase? We will characterise the surface movements of the star using FIES for precise radial velocities of strong Si II spectral lines. Also, we evaluate the surface temperature of V509 Cas by relative intensities of temperature sensitive spectral lines and show how the amplitude of short-term temperature fluctuations has decreased. Additionally, thanks to FIES data of [Ca II] lines, we can offer an explanation to the emission components in some absorption lines (e.g. Sc II) that confirms the hypothesis of a disk surrounding the star (Aret et al. 2017). Similar disks have been found around B[e] supergiant stars, is this what the future holds for V509 Cas?

References:
Aret, A., Kolka, I., Kraus, M., Maravelias, G., 2017. The B[e] Phenomenon: Forty Years of Studies, 508, 239
Nieuwenhuijzen H., De Jager C., Kolka I., Israelian G., Lobel A., Zsoldos E., Maeder A., et al., 2012. A&A, 546, A105

Primary author: Ms KASIKOV, Anni (NOT, University of Tartu)

Co-authors: Dr KOLKA, Indrek (Tartu Observatory, University of Tartu); Dr ARET, Anna (Tartu Observatory, University of Tartu)

Presenter: Ms KASIKOV, Anni (NOT, University of Tartu)

Contribution ID: **51** Type: **Invited Talk**

Stellar outflows with the NOT

Wednesday, 8 June 2022 16:30 (25 minutes)

NOT has been an important telescope in studying galactic nebulae and stellar outflows since its inauguration more than 30 years ago. Superb observational capabilities provide simultaneous imaging and 2D spectral data, which is indispensable when investigating occasionally rapidly evolving stellar ejecta. In this talk I will provide an overview of various types of stellar outflows within my research interests which have been studied with the NOT. Outstanding examples are the ejecta of the symbiotic binary R Aquarii, the B[e] supergiant MWC 137, nova GK Per, and the bipolar nebula M2-9

Primary author: LIIMETS, Tiina (Astronomical Institute AVCR)

Co-authors: CORRADI, Romano; SANTANDER-GARCÍA, Miguel; KRAUS, Michaela; JONES, David

Presenter: LIIMETS, Tiina (Astronomical Institute AVCR)

Contribution ID: **53** Type: **Invited Talk**

Stellar Archaeology with the NOT

Wednesday, 8 June 2022 16:55 (25 minutes)

Stellar archaeology seeks to use information gathered from old, metal-poor stars (pop II stars) in the Milky Way and its satellites to place constraints on the first generation of stars to form in the Universe (pop III stars), which we can no longer directly observe. I will present the results of two observing campaigns carried out with the NOT (and other similar sized telescopes). The first project aims to determine the binary nature of a sample of chemically peculiar metal-poor stars. When using the abundance pattern of metal-poor stars to investigate nucleosynthesis channels in the early Universe, it is vital to verify that the abundances reflect the star's birth cloud and have not been altered by mass transfer from a binary companion. To this end, we monitored a sample of 63 stars over eight years with the NOT collecting over 900 FIES spectra. Resulting in binary frequencies being determined for three types of chemically peculiar stars; CEMP-*s*, CEMP-no, and *r*-process enhanced stars. The second campaign is part of the *R*-Process Alliance (RPA) which seeks to constrain the nature and astrophysical site of the rapid neutron-capture process. The first phase of this project focuses on increasing the sample of metal-poor stars exhibiting large enhancement in *r*-process elements for which detailed abundances can be derived.

Primary author: HANSEN, Terese (Stockholm University)

Presenter: HANSEN, Terese (Stockholm University)

Contribution ID: **19** Type: **Contributed Talk**

FIES and the Gaia Benchmark stars

Wednesday, 8 June 2022 17:20 (15 minutes)

In the panorama of Galactic astronomy, the characterization of Milky Way stellar populations and chemical abundances is of crucial importance for revealing the structure and evolution of the Galaxy. For this reason, hundreds of thousands of spectra have already been obtained by high resolution spectroscopic surveys, and the main challenge for building an accurate picture is the homogenization of these samples from different surveys (Gaia-ESO, RAVE, LAMOST, GALAH and APOGEE) and instruments (MIKE, FEROS, ESPADONS, HARPS, UVES, NARVAL, ELODIE and CAFE). Especially important is to understand the systematic uncertainties from the different surveys and to have comprehensive and consistent validation samples. In 2014 and 2015 the first attempt at a set of reference FGK-type stars called the Gaia FGK benchmark stars (GBS) was published (Heiter+2015, Jofre+2014). In the past 7 years much progress has been made regarding the performance of parallaxes and angular diameter measurements of stars in general and the sample has been noticeably enlarged.
Currently, it comprises around 200 stars observed in both hemispheres with a magnitude range of $0 < V < 10$ covering most of the parameter spaces. Among these stars 48 were observed with FIES. I conducted the observations for 15 of these stars during the NOT intership period. Their spectra have been recently analyzed using a pipeline developed in Casamiquela+2020 together with other observations of the same stars with different instruments. I will present the preliminary results of the analysis of the FIES observations, and the comparison between different instruments. The full sample of the GBS will be used as a future reference sample for stellar galactic surveys, in particular the ASTRA pipeline of SDSS-V, the upcoming ESA PLATO mission, WEAVE and 4MOST.

Primary author: Ms VITALI, Sara (Universidad Diego Portales)

Co-author: Ms CASAMIQUELA, Laia (GEPI - Observatoire de Paris, PSL Research University)

Presenter: Ms VITALI, Sara (Universidad Diego Portales)

Contribution ID: **10** Type: **Contributed Talk**

Carbon and nitrogen abundances as indicators of material mixing in evolved stars

Wednesday, 8 June 2022 17:35 (15 minutes)

Carbon and nitrogen abundances are among most useful quantitative indicators of mixing processes in evolved stars. Because of the first dredge-up abundances of 12^C decrease while abundances of 13^C and 14^N increase. These alterations become efficient again on the red giant branch when stars reach the so-called luminosity bump, and depend on stellar evolutionary stage, mass, metallicity, rotation, magnetic activity and other parameters and processes. An overview will be provided on observational analyses of evolved low mass giants accomplished using the Nordic Optical Telescope.

Primary author: TAUTVAISIENE, Grazina (Vilnius University)

Presenter: TAUTVAISIENE, Grazina (Vilnius University)

Contribution ID: **52** Type: **Invited Talk**

ALFOSC at the NOT: a succesful loan

Thursday, 9 June 2022 09:30 (25 minutes)

The Alhambra Faint Object Spectrograph and Camera, ALFOSC, is provided by the Instituto de Astrofisica de Andalucia (IAA) under a joint agreement with the University of Copenhagen and NOT. With a field of view of 6.4 x 6.4 arcminutes in imaging mode, it can also be used for low/medium resolution spectroscopy, and polarimetry. In this talk I will present a selection of scientific results to which ALFOSC has contributed in the last years, and that demonstrate the success of the combination of instrument and telescope.

Primary author: MÁRQUEZ, Isabel (IAA-CSIC)

Presenter: MÁRQUEZ, Isabel (IAA-CSIC)

Contribution ID: **26** Type: **Invited Talk**

Past, Present and Future of NOT from the IAC perspective

Thursday, 9 June 2022 09:55 (25 minutes)

In this talk I will review some of the major scientific highlights produced in the past decade by Instituto de Astrofisica de Canarias (IAC) researchers using the Nordic Optical Telescope. I will present their main scientific lines of research and potential future areas of development for the telescope from the IAC perspective.

Primary author: FALCON-BARROSO, Jesus (Instituto de Astrofisica de Canarias)

Presenter: FALCON-BARROSO, Jesus (Instituto de Astrofisica de Canarias)

Contribution ID: **16** Type: **Contributed Talk**

The OCCASO survey: The NOT contribution to the understanding of Open clusters

Thursday, 9 June 2022 10:20 (15 minutes)

Open clusters are ideal laboratories to investigate a variety of astrophysical topics, from stellar physics to galaxy disk evolution. The Gaia mission and the complementary, ground-based massive spectroscopic surveys have led to a revolution in our knowledge of the Milky Way and its companion dwarfs galaxies including, of course, open clusters. However, they need complementary observations with high-resolution and large wavelength coverage spectrographs like FIES, allowing the determination of radial velocities and chemical abundances with higher accuracy and precision, and to investigate other chemical species. For this purpose, we are developing the Open Clusters Chemical Abundances from Spanish Observatories (OCCASO) project with the initial goal of investigating the chemical distribution of the Galaxy disk. Almost 500 stars belonging to about 60 clusters have been already observed. Derived radial velocities have a precision of about 15 km/s and chemical abundances a typical uncertainty of 0.03 dex. The OCCASO results are being used as calibrators for large surveys such as Gaia or APOGEE. In this talk, I will present the main results of OCCASO in the framework of the open clusters research, focusing on the contribution of FIES.

Primary author: CARRERA JIMENEZ, Ricardo (INAF-Osservatorio Astronomico di Padova)

Presenter: CARRERA JIMENEZ, Ricardo (INAF-Osservatorio Astronomico di Padova)

Contribution ID: **40** Type: **Contributed Talk**

FIES@NOT: a crucial workshorse for the new era of study of Galactic massive OB stars

Thursday, 9 June 2022 10:35 (15 minutes)

IACOB is an ambitious long-term observational project which is contributing to the new era of investigation of massive stars by concentrating on Galactic OB stars. More specifically, the main scientific goal of the IACOB project is to provide a complete empirical overview of the physical properties of a statistically significant sample of OB stars. In particular, the ultimate driver of the project is that the compiled information can be used as a strong and long-lasting anchor point for our theories of stellar atmospheres, winds, interiors and evolution of massive stars.

In this endeavour, the FIES instrument operating in an incredible efficient and stable manner at the Nordic Optical Telescope, has been (and still is) a crucial workhorse. Indeed, first spectroscopic observations for the IACOB project were obtained with FIES in October 2008, and have continued routinely since then. After 14 years and more than 100 observing nights, the IACOB spectroscopic database comprises more than 3000 high-quality, multi-epoch, optical spectra of about 700 bright Galactic OB-type stars obtained with the FIES spectrograph. In addition, the scientific exploitation of this unique spectroscopic dataset has lead to more than 50 publications covering different aspects of interest for the massive star community.

In this talk I will briefly summarize some of the most important milestones reached by the IACOB project to date, the crucial impact that the availability of the FIES spectrograph has had (and still is having) in the project, and how the upcoming availability of the NTE instrument will also help us in our attempt to drive a real breakthrough in our understanding of the physical properties and evolution of high-mass stars.

Primary author: SIMON DIAZ, Sergio (Instituto de Astrofísica de Canarias)

Presenter: SIMON DIAZ, Sergio (Instituto de Astrofísica de Canarias)

Contribution ID: **6** Type: **Invited Talk**

Blazar jets through Nordic eyes

Thursday, 9 June 2022 11:30 (25 minutes)

Active galactic nuclei with jets are the most persistently bright objects in the observable Universe. A subclass called blazars, whose jets are oriented within a few degrees of the Earth's line of sight, are the most extreme particle accelerators observed across the electromagnetic spectrum. For over 30 years the Nordic Optical Telescope has played a vital role in the multimessenger studies of blazars. I will review some of NOT's key contributions as well as an outlook of what future instruments can bring to blazar science.

Primary author: LIODAKIS, Ioannis (Finnish center for Astronomy with ESO)

Presenter: LIODAKIS, Ioannis (Finnish center for Astronomy with ESO)

Contribution ID: **13** Type: **Contributed Talk**

How common are outflows in low luminosity AGNs?

Thursday, 9 June 2022 11:55 (15 minutes)

Outflows play a major role in the evolution of galaxies and are said to be ubiquitous within the Active Galactic Nuclei (AGNs) population. However, we are far from having a complete picture of their properties, specially considering their impact on the evolution of Low-Ionisation Nuclear Emission-line Regions (LINERs).
Although resolved kinematic information has proven to be crucial for the fully characterisation of these phenomena, imaging techniques can be really useful for the systematic search of outflow candidates.
We have obtained narrow-band optical Hα images with ALFOSC/NOT and retrieved soft-X ray and narrow-band Halpha images from Chandra and HST archives, respectively, for a total of 70 LINERs. We classified the ionised gas morphologies based on the extension and overall shape of the Halpha emission.
We find that the soft X-ray and ionised gas emission coincide in the great majority of LINERs (60%), as previously seen for Seyferts (Bianchi et al. 2006), suggesting a common origin for both emissions.
Our results show that approximately one third of the targets present extended, filamentary emission with a distinguishable bubble-shaped morphology. When combining NOT imaging data and spectroscopic data from the current literature we find that outflows are present in 48% of the nearby LINERs.

Primary author: HERMOSA-MUÑOZ, Laura (Instituto de Astrofísica de Andalucía - CSIC)

Co-authors: Dr MÁRQUEZ, Isabel (IAA-CSIC); Dr CAZZOLI, Sara (IAA-CSIC); Dr MASEGOSA, Josefa (IAA-CSIC); Dr AGÍS-GONZÁLEZ, Beatriz (IAA-CSIC)

Presenter: HERMOSA-MUÑOZ, Laura (Instituto de Astrofísica de Andalucía - CSIC)

Contribution ID: **30** Type: **Contributed Talk**

Changing State QSO's: a clue to understand their physics

Thursday, 9 June 2022 12:10 (15 minutes)

We present preliminary results from our on-going NOT programme
"Changing State QSO's: a clue to understand their physics".
Extreme photometric variations in
AGN's are often accompanied by large spectral changes whose origin
is not yet understood. This includes Changing Look or Changing State Quasars
(changes in the BLR), candidate Tidal Disruption Events, Erratic Blazar
Variability. Spectral analysis of more cases with large
photometric changes, is necessary to disentangle the role of
reddening variations, changes in the structure of the BLR or
variations in the accretion rate, among others.
The Gaia Alerts provide an all-sky photometric transient survey,
based on the repeated, high-precision measurements made by the Gaia satellite.

Our spectroscopic data suggest that in many cases about one magnitude
long term out burst is associated with a significant spectral change,
such as changing from LINER to Seyfert 1 or strong change in Balmer lines.
The time scales of the spectral changes after the initial change appear
to be rather slow from months to years.
As many objects were detected in the raising phase, those should
be monitored particularly to detect their possible decreasing again and the
associated spectral changes.
In addition, we have been monitoring rare Fast Rise and
Exponential decay (FRED) events among others.

Primary author: PURSIMO, Tapio (NOT)

Presenter: PURSIMO, Tapio (NOT)

Contribution ID: **31** Type: **Contributed Talk**

The past and future power of the NOT to study tidal disruption events and their infrared echoes

Thursday, 9 June 2022 12:25 (15 minutes)

The study of tidal disruption events (TDEs) presents a new opportunity to investigate the nuclear regions of galaxies and the supermassive black holes (SMBHs) therein. The luminous outburst produced by the accretion of a star onto a SMBH heats nearby interstellar dust, which then re-radiates this energy producing a so-called infrared (IR) echo. Observations of IR echoes, and the outbursts which cause them, can reveal the geometry and quantity of the surrounding dust, as well as the intrinsic energy released by the TDEs themselves, as the dust efficiently absorbs and re-emits UV photons that would otherwise remain unobserved.

The recent emergence of the field of study of optical TDEs over the past decade has also led to the discovery of associated IR echoes, enabling the study of dust in the nuclear regions of TDE host galaxies. Additionally, the recent discoveries of particularly long lasting and luminous IR echoes in the heavily obscured nuclei of luminous infrared galaxies has revealed the presence of TDEs that could never be discovered through optical or UV observations alone. Here we present our use of the IR observing capabilities of the NOT+NOTCam to systematically discover and follow IR echoes from TDEs. Furthermore, we describe the exciting future capabilities of the NTE instrument to continue this work and how its simultaneous coverage of the optical and IR range will be especially well suited to very efficiently characterise the spectral energy distribution of TDEs and their associated IR echoes.

Primary author: REYNOLDS, Thomas (The Cosmic Dawn Center (DAWN), Niels Bohr Institute, University of Copenhagen)

Co-authors: Dr KOOL, Erik (The Oskar Klein Centre, Department of Astronomy, University of Stockholm); Prof. MATTILA, Seppo (Tuorla observatory, Department of Physics and Astronomy, University of Turku)

Presenter: REYNOLDS, Thomas (The Cosmic Dawn Center (DAWN), Niels Bohr Institute, University of Copenhagen)

Contribution ID: **38** Type: **Contributed Talk**

AT2020wey and the class of faint and fast Tidal Disruption Events

Thursday, 9 June 2022 12:40 (15 minutes)

AT2020wey is a member of the growing class of "faint and fast" tidal disruption events (TDEs) (peak blackbody luminosity $\log(L/erg\,s^{-1}) < 43.5$ and exponential rise time $t_r < 20d$) and it shows the fastest decline in the UV from any other TDE to date. Critical spectroscopic observations were performed with the NOT in order to reveal that it is part of the Hydrogen TDE spectroscopic class. I will present the photometric and spectroscopic properties of this interesting object and state the importance of the "faint and fast" class of TDEs for probing the properties of low-mass supermassive black holes (SMBHs).
Furthermore, I will briefly speak about the critical photometric coverage with the NOT of the fascinating (only a handful discovered to date) relativistic jetted TDE AT2022cmc and will refer to the importance of the upcoming NOT Transient Explorer (NTE).

Primary author: CHARALAMPOPOULOS, Panos (DTU Space)

Presenter: CHARALAMPOPOULOS, Panos (DTU Space)

Contribution ID: **9** Type: **Contributed Talk**

Shocking news - a polarizing study of a tidal disruption event

Thursday, 9 June 2022 12:55 (15 minutes)

Supermassive black holes have been known to disrupt passing stars producing outbursts called tidal disruption events (TDEs) offering a unique view on the early stages of the accretion disk and jet formation. The advent of large-scale optical time-domain surveys has significantly increased the number of known events and challenged our understanding of their dynamics and emission processes. Especially, the so-called *optical TDEs* have shown late-time X-ray and radio emission years after the optical peak emission indicating delayed accretion disk formation and long timescales for the circularization process. In this seminar, I will present our study on the most polarized TDE up-to-date without any indication of contribution from a jet to the emission. Our observations demonstrate that optical TDE emission can be powered by tidal stream shocks.

Primary author: KOLJONEN, Karri (NTNU)

Co-authors: LIODAKIS, Ioannis (FINCA); BLINOV, Dmitry (FORTH); LINDFORS, Elina (FINCA); ALEXANDER, Kate (Northwestern University); HOVATTA, Talvikki (FINCA); BERTON, Marco (ESO); HAJELA, Aprajita (Northwestern University); JORMANAINEN, Jenni (FINCA); KOUROUMPATZAKIS, Konstantinos (FORTH); MANDRAKAS, Nikos (FORTH); NILSSON, Kari (FINCA)

Presenter: KOLJONEN, Karri (NTNU)

Contribution ID: **23** Type: **Invited Talk**

Finding and investigating the brightest galaxies at redshift z > 3

Thursday, 9 June 2022 14:30 (25 minutes)

We have conducted searches of recent wide-field survey data such as from the DESI Legacy Imaging Surveys to identify a large sample of >1000 gravitationally lensed galaxies. The much improved red-sensitivity compared to previous surveys such as SDSS dramatically increases our ability to efficiently select galaxies in the redshift range z=3-6 from the new surveys. While good progress has recently been made in characterizing global properties of galaxy populations at these redshifts, such as the stellar masses and total star formation rates, much less is known about their detailed internal structure and the fundamental astrophysical processes that act on sub-galaxy scales to grow and shape the population of galaxies we see around us today. Such internal structure can only by accessed through the magnification produced by strong gravitational lensing. Some examples of science results will be shown. Current data suggest e.g. that the escape of ionizing radiation from production sites may occur primarily at massive star-cluster scales, and as such may only be resolved in strongly lensed galaxies. By following up new lens candidates at NOT, Magellan and VLT we have strongly increased the population of bright galaxies known beyond z=3. These are typically several magnitudes brighter than the brightest unlensed field galaxies. Results from a poor-weather filler VLT+XSHOOTER programme are presented as an illustration of what will be achievable with NOT+NTE.

Primary author: DAHLE, Hakon

Co-authors: Dr RIVERA-THORSEN, T. Emil (Stockholm University); Dr KIM, Keunho (University of Cincinnati); Prof. GLADDERS, Michael (University of Chicago); Ms NAPIER, Kate (University of Michigan); Prof. SHARON, Keren (University of Michigan); RIGBY, Jane R. (NASA Goddard Space Flight Center); Prof. BAYLISS, Matthew (University of Cincinnati); Mr KHULLAR, Gourav (University of Chicago)

Presenter: DAHLE, Hakon

Contribution ID: **8** Type: **Invited Talk**

Strong Lens Monitoring at High Cadence: Cracking the Hubble Tension

Thursday, 9 June 2022 14:55 (25 minutes)

The measured Hubble constant between cosmological probes in the early or late universe are different. This may be real, with profound implications for physics, or due to observational flukes. Measuring the Time Delays between strongly lensed images of quasars or supernovae provides a single-step measurement of H0 in the late universe, fully independent of any other cosmological probe. This requires good lens models as well as precise and accurate time delay measurements from well-sampled (daily) light curves of lensed quasars. Few telescopes around the world offer flexible service mode observations with large collecting area and good seeing. NOT is one of them! I will present results obtained by the TDCOSMO collaboration with the NOT and plans to obtain more in the future, in combination with other telescopes, in the LSST and SKA era.

Primary author: Prof. COURBIN, Frédéric (EPFL)

Presenter: Prof. COURBIN, Frédéric (EPFL)

Contribution ID: **5** Type: **Contributed Talk**

Near field cosmology accessible for the NOT

Thursday, 9 June 2022 15:20 (15 minutes)

Thanks to the accurate astrometry and kinematics provided by the Gaia mission the complex formation process of the Milky Way is now being understood. The halo of the Milky Way has suffered from the continued merging process with dwarf and primitive satellites. Luckily, a substructure originating in a single accretion event can be identified as a tight cluster of stars in phase space sharing chemical properties.
The Gaia-Sausage-Enceladus event, the subsequent Splash, and the residuals of several old systems are living in the solar neighborhood and could be chemically characterized by high-resolution spectrographs mounted in 2-4m class telescopes. We are entering the era of the nearest field cosmology where the relics of ancient systems are around and accessible for facilities such as the Nordic Optical Telescope.

Primary author: AGUADO, David (University of Florence)

Presenter: AGUADO, David (University of Florence)

Contribution ID: **18** Type: **Contributed Talk**

Python notebooks as a pedagogical tool to teach NOT data reduction

Thursday, 9 June 2022 15:35 (15 minutes)

We will present a series of seven Python Jupyter Notebooks designed to teach master-level students the basic steps of data reduction for observations with the Alhambra Faint Object Spectrograph and Camera (ALFOSC). This pedagogical tool, which translates IRAF tasks into the widespread Python language, has been successfully deployed for the course "Observational Astrophysics II" at the Department of Astronomy of Stockholm University. Each notebook introduces the students to one specific task of the data reduction explaining the purpose of that task, how it is implemented and guiding the students through the completion of the task. With a hands-on approach, this allows the students to understand the reason behind each step and to test directly what is the effect of each step, thanks to interactive plots of the data and the intermediate products. In addition to its educational value, this material can be expanded to reach the quality needed for scientific works. Therefore it could offer a starting point for developing a personalised data reduction for a given scientific problem. A complete version of the material is publicly available at https://github.com/astrojuggler/data-reduction-Obs-II-course. This project has been financed by Stockholm University - Department of Astronomy with a grant earned by Professor Matthew Hayes.

Primary authors: SIRRESSI, Mattia (Stockholm University); Prof. HAYES, Matthew

Presenter: SIRRESSI, Mattia (Stockholm University)

Contribution ID: **59** Type: **Invited Talk**

Educational use of the NOT

Thursday, 9 June 2022 16:30 (15 minutes)

I will give an overview of the educational use of the NOT.

Primary author: AUGUSTEIJN, Thomas (Nordic Optical Telescope - Aarhus Universitet)

Presenter: AUGUSTEIJN, Thomas (Nordic Optical Telescope - Aarhus Universitet)

Contribution ID: **63** Type: **Invited Talk**

Johannes Andersen Student Program at the NOT

Thursday, 9 June 2022 16:45 (25 minutes)

Since the beginning of the NOT operations in 1990 we have had students working as an integral part of the operational staff at the telescope. When Johannes Andersen was the NOT director he expanded the size of the NOT student program to the present size with 5-6 students at any given time. Studentships at NOT are typically one year in length. In the era of large telescopes, it makes good sense to use part of the observing time at NOT as a tool to attract and train the next generation of observational astronomers. We offer several educational activities at NOT and the Johannes Andersen Student Program is together with the observing schools a very successful activity at the NOT. The students are fully integrated in the NOT team and the students divide their time between their individual thesis projects and practical work at the telescope, such as further development of the telescope services and support of visiting astronomers. The hands-on experience with advanced state-of-the-art instrumentation and the experiences gained by the students working in an international setting have proven to be an important asset in the future careers, not only in astrophysics, but also outside astronomy. In this presentation, I will discuss the status and the future of the student program.

Primary author: KJELDSEN, Hans (Aarhus University)

Presenter: KJELDSEN, Hans (Aarhus University)

Contribution ID: **56** Type: **Invited School Presentation**

Danish Observing Summerschools

Thursday, 9 June 2022 17:10 (10 minutes)

Since 2007 we held summer schools with students from Copenhagen University and lately with students from (almost) all Danish Universities. The purpose is twofold. Primarily, the objective is to give the students hands-on experience with astrophysical observations in all aspects, i.e.,proposal-writing, planning, execution, analysis and presentation. The projects have included exoplanet observations (transients, radial velocities), transients (novae, supernovae, grb afterglows), lensed objects, new quasars and galaxy rotation curves. Using the NOT to train the next generation of Nordic observational astronomers is something we should keep and possibly further develop. An interesting suggestion would be to arrange a conference for Nordic students where they can present results from dedicated student observations.

Primary authors: Prof. GRUNDAHL, Frank (IFA, University of Aarhus, Denmark); Prof. FYNBO, Johan (The Cosmic DAWN Center)

Presenter: Prof. FYNBO, Johan (The Cosmic DAWN Center)

Contribution ID: **62** Type: **Invited School Presentation**

Finnish observing courses with the NOT

Thursday, 9 June 2022 17:20 (10 minutes)

A national hands-on course on observational astronomy has been organised annually by the University of Turku since 2013 to carry out remote observations with the NOT from the Tuorla observatory. Typically, the course has had around 20 MSc/PhD students, who come from all the four Finnish universities that teach astronomy (Turku, Helsinki, Oulu, and Aalto). The students are divided into research groups of 4-5 with different science projects to be carried out, supervised by researchers of the participating universities, covering a wide range of topics. Usually the course is executed in the format of 3 ALFOSC nights and 2 NOTCam nights, and all the students have an opportunity to carry out both spectrophotometric optical and photometric near-IR observations. In addition to intensive format course lectures and remote observations, students work on the reduction and analysis of the obtained data using astronomical data processing software, write their own project reports, and provide a group presentation of the results. Furthermore, a smaller scale NOT remote observing science school aimed at upper secondary school students has also been carried out annually in Finland over several years now, to promote natural sciences among students and to offer an insight into what it is like to be a researcher.

Primary author: KANKARE, Erkki (University of Turku)

Co-authors: Prof. MATTILA, Seppo (University of Turku); Dr NURMI, Pasi (University of Turku)

Presenter: KANKARE, Erkki (University of Turku)

Contribution ID: **61** Type: **Invited School Presentation**

Observational Astrophysics II at Stockholm University

Thursday, 9 June 2022 17:30 (10 minutes)

Observing with the Nordic Optical Telescope has, for many years, been an integral part of the course Observational Astrophysics II (ObsII) offered to masters and PhD students at Stockholm University. I will review the activities related to the course in Stockholm, which also includes observations with the 20m radio telescope at the Onsala Space Observatory.

Primary author: HANSEN, Terese (Stockholm University)

Presenter: HANSEN, Terese (Stockholm University)

Contribution ID: **60** Type: **Invited School Presentation**

Teaching observational astrophysics with the NOT

Thursday, 9 June 2022 17:40 (10 minutes)

I will present a new course on observational astrophysics offered since the spring of 2022 at the Norwegian University of Science and Technology in Trondheim, Norway. The course is mainly aimed at 3d-4th year students of the BSc-MSC program in Physics and includes lectures, data analysis "AstroLAB" sessions and an observing project with the Nordic Optical Telescope. In this project the students design, propose, perform and analyze their own photometric/spectroscopic observations.

Primary author: LINARES, Manuel (NTNU)

Presenter: LINARES, Manuel (NTNU)