ALFOSC at the NOT: a successful loan

"The data presented here were obtained [in part] with ALFOSC, which is provided by the Instituto de Astrofisica de Andalucia (IAA) under a joint agreement with the University of Copenhagen and NOT."

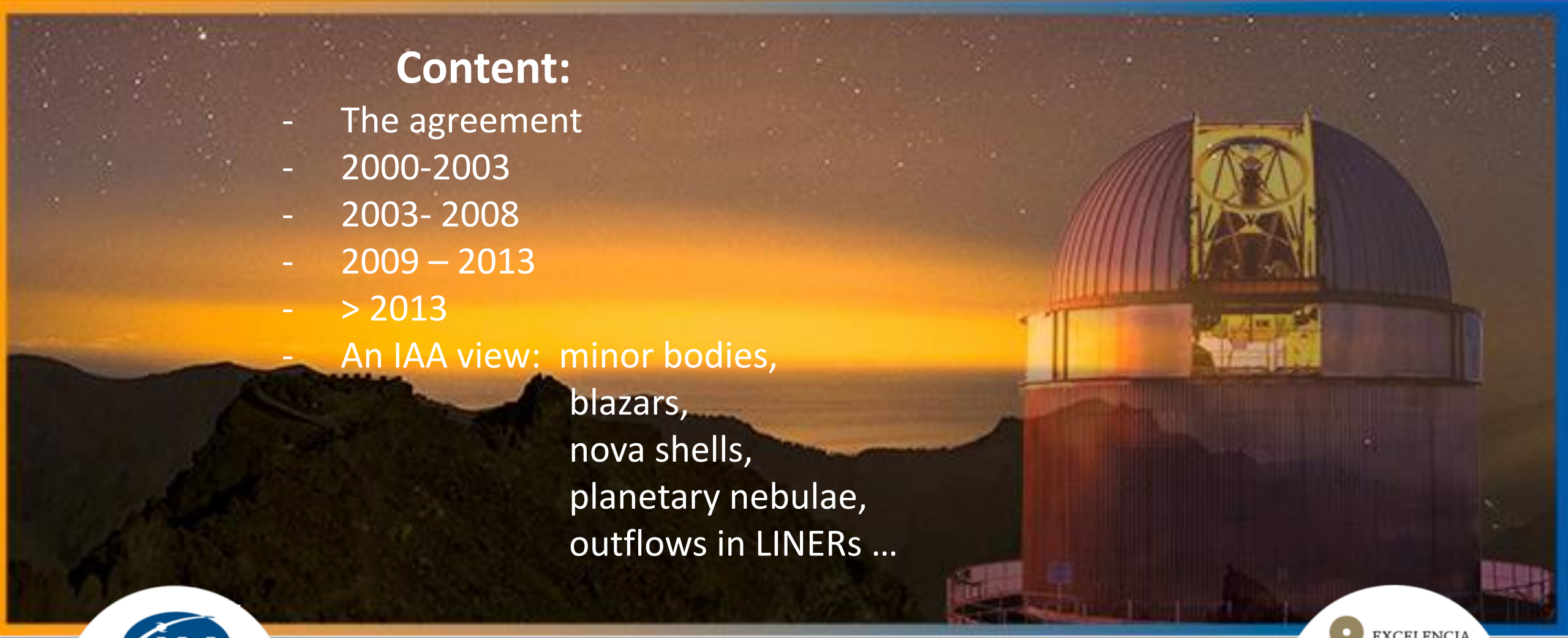
I. Márquez

Science Deputy Director IAA

Scientific Director Severo Ochoa IAA

La Palma, 9th June 2022

ALFOSC at the NOT: a successful loan



Content:

- The agreement
- 2000-2003
- 2003- 2008
- 2009 – 2013
- > 2013
- An IAA view: minor bodies,
  blazars,
  nova shells,
  planetary nebulae,
  outflows in LINERs …

ALFOSC at the NOT: a successful loan

October 1997, initially for every 3 years

1999, agreement for the use of the spectrograph, NOT provided with 14 nights (dark/grey) for the partners

Hugo Schwarz reported that *80%-90% of the NOT requested time is with ALFOSC, that is the instruments with the smallest down time being used at ORM*
First IAA projects with ALFOSC: Planetary Nebulae, proper motions in Herbig Haro objetcs, dwarf galaxies in Hickson Compact groups

2000-2003, less than 10% lost to technical problems, 30% bad weather conditions. Imaging & spectroscopy, 50/50
Projects: SED of GRB host galaxies, star formation in nearby cluster galaxies (deep Halpha imaging and spectroscopy), stellar populations in low luminosity AGN, the nature of high luminosity ULIRGs

A L F O S C : **Al**hambra **F**aint **O**bject **S**pectrograph and **C**amera

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.

ALFOSC at the NOT: a successful loan

THE SED OF THE GRB HOST GALAXIES

Only prompt optical emission was detected for GRB 000313, but no afterglow emission at all. VRIK'-band deep imaging failed to reveal an underlying host galaxy. First optical counterpart ever found for this kind of events?

Castro-Tirado et al. 2002, A&A 393, L55

GRB 030329, the nearest GRB detected so far (z = 0.1685). Optical monitoring at different, starting 0.6 days after the GRB allowed to monitor the afterglow decline. NOT observations allowed its detection 40 days after maximum.

Gorosabel et al. 2006, ApJ 641, L13

SEARCHING FOR STAR FORMATION IN NEARBY CLUSTER GALAXIES

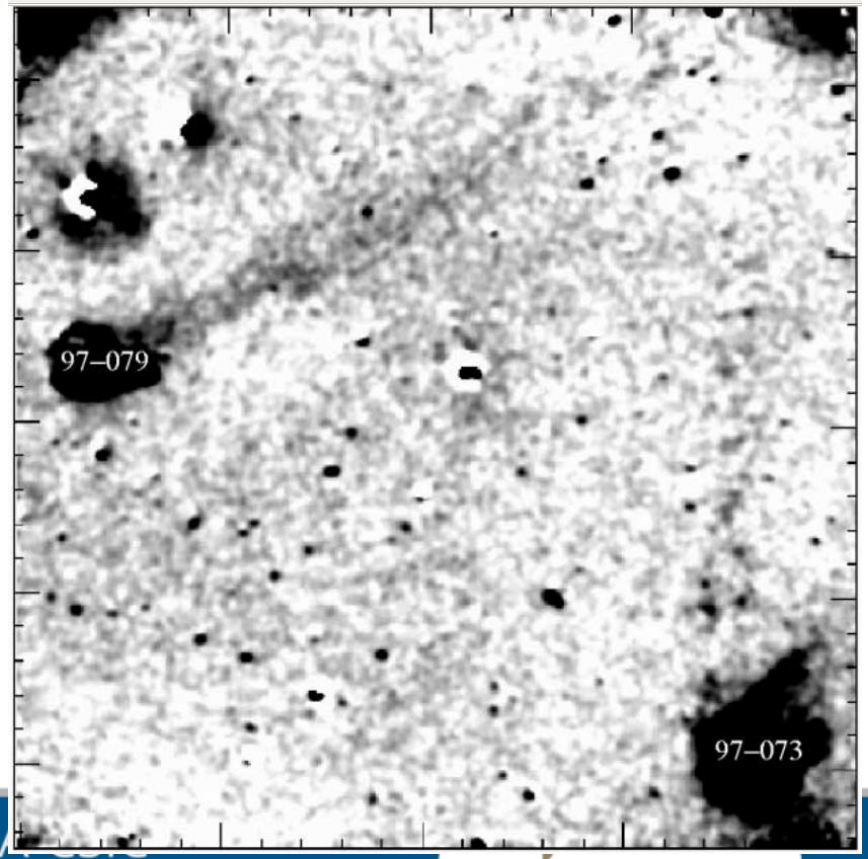
Deep Hα imaging & follow-up spectroscopy of galaxy clusters (Virgo, Coma, Hercules, A1367 among others).

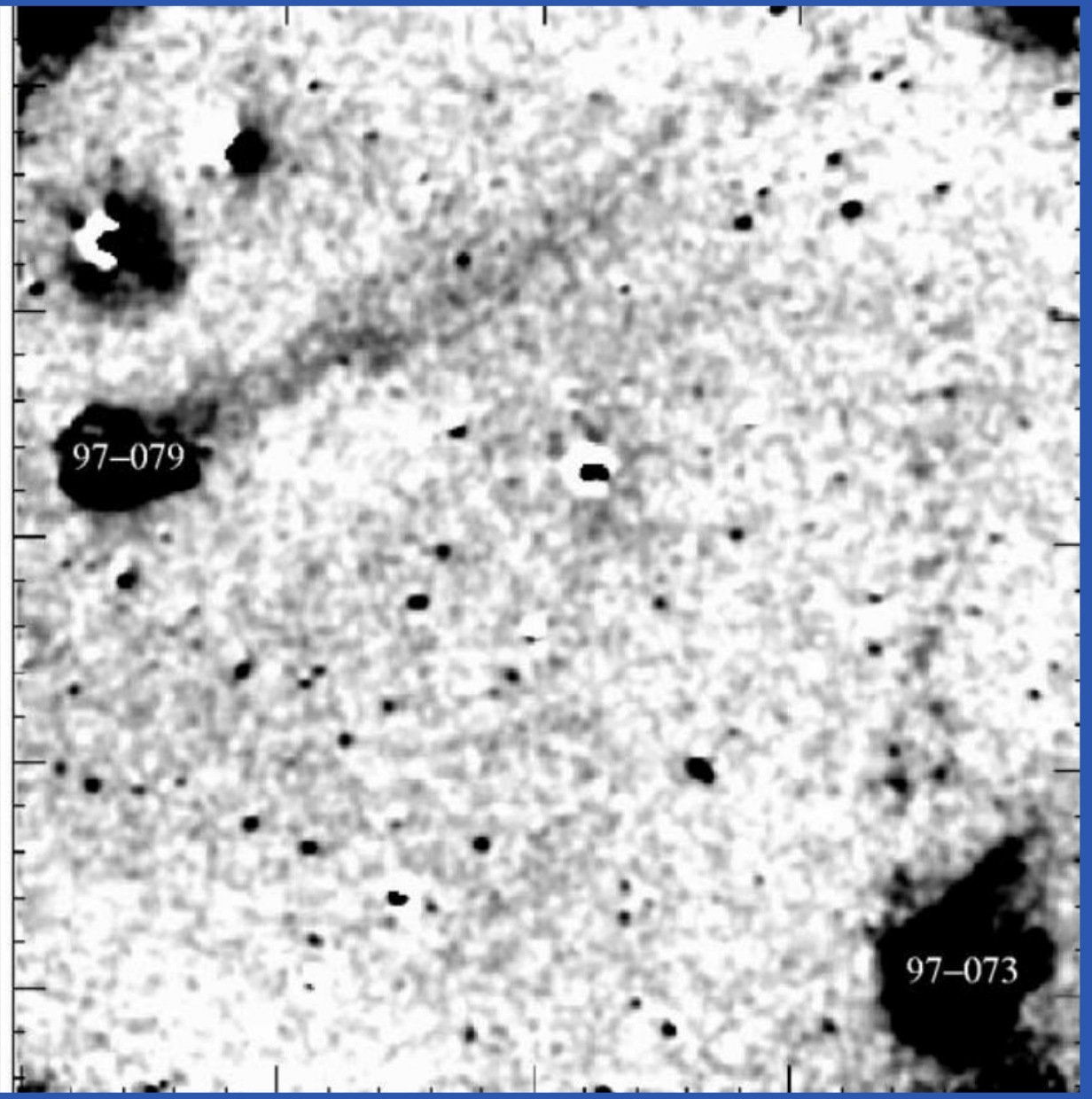
A1367: two long (>75kpc) trial ionized tails were discovered in two star-forming galaxies that are falling down to the cluster center

Hercules: gas-rich SF dwarf galaxies were studied spectrophotometrically, & their structural properties, colors and metallicities derived for the 1st time

Virgo: a large fraction of the Blue Dwarf galaxy population was observed with deep Hα imaging

Boselli et al. 2002, A&A 386, 134, Gavazzi et al, 2001, ApJ 563,L23





75 kpc trails of ionised gas behing two irregular galaxies in Abell 1367, due to ram-pressure stripping

ALFOSC at the NOT: a successful loan

LOW LUMINOSITY ACTIVE GALACTIC NUCLEI (LLAGN)

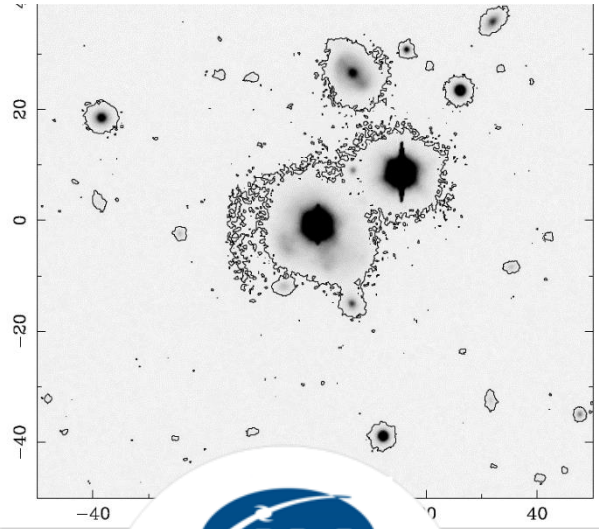
70 nearby galaxies LS (3400-5500 A), good seeing.
No WR features at 4686 A, hence massive hot stars contribute very little. 1/3 showed higher order Balmer lines (3700-3900 A) in absorption, their strengths indicate that intermediate age stellar population contribute significantly. This post-starburst stellar population is more frequent in weak-[OI] LLAGNs.
A link suggested between the stellar population and the ionization mechanism in LLAGNs

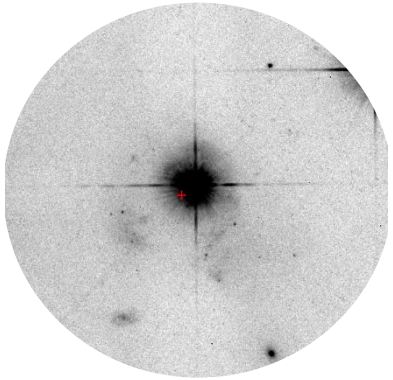
Cid Fernandes et al. 2004, ApJ 605, 105; González-Delgado et al. 2004, ApJ 605, 127; Cid Fernandes et al. 2005, MNRAS 356, 270

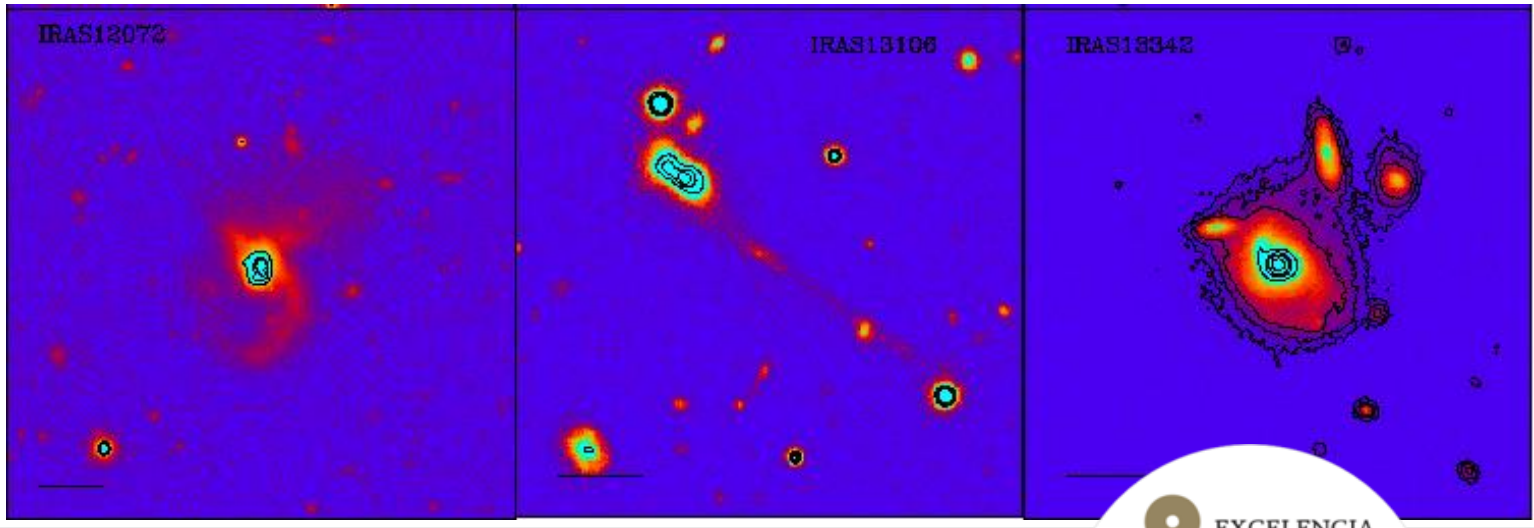
ON THE NATURE OF HIGH LUMINOSITY ULIRGs

Deep R-band imaging (3sigma 24.5 mag/arcsec2), subarcsec seeing).
43% fitted by spheroidal, 23% fitted by exponential disk. All with strong morphological perturbation (advanced mergers).

Masegosa & Márquez, 2003; Márquez & Masegosa, 2003. Proceedings...







2003 - 2008 ALFOSC at the NOT: a successful loan

PLANETARY NEBULAE

- Guerrero et al. 2008, "Multiple and Precessing Collimated Outflows in the Planetary Nebula IC 4634"

- Ramos-Larios et al. 2008, "The Unusual Distributions of Ionized Material and Molecular Hydrogen in NGC 6881: Signposts of Multiple Events of Bipolar Ejection in a Planetary Nebula", AJ 135, 1441

- Gruendl et al. 2006, "XMM-Newton Observations of the Bipolar Planetary Nebulae NGC 2346 and NGC 7026", ApJ 653, 339

HICKSON COMPACT GROUPS

- Durbala et al. 2008, "Seyfert's Sextet: A Slowly Dissolving Stephans Quintet?", AN 135, 130

- Verdes-Montenegro et al. 2005, "The Evolution of HCG 31: Optical and High-resolution HI Study", A&A 430, 443

- Verdes-Montenegro et al. 2002, "Ripples and Tails in the Compact Group of Galaxies Hickson 54", A&A 396, 815

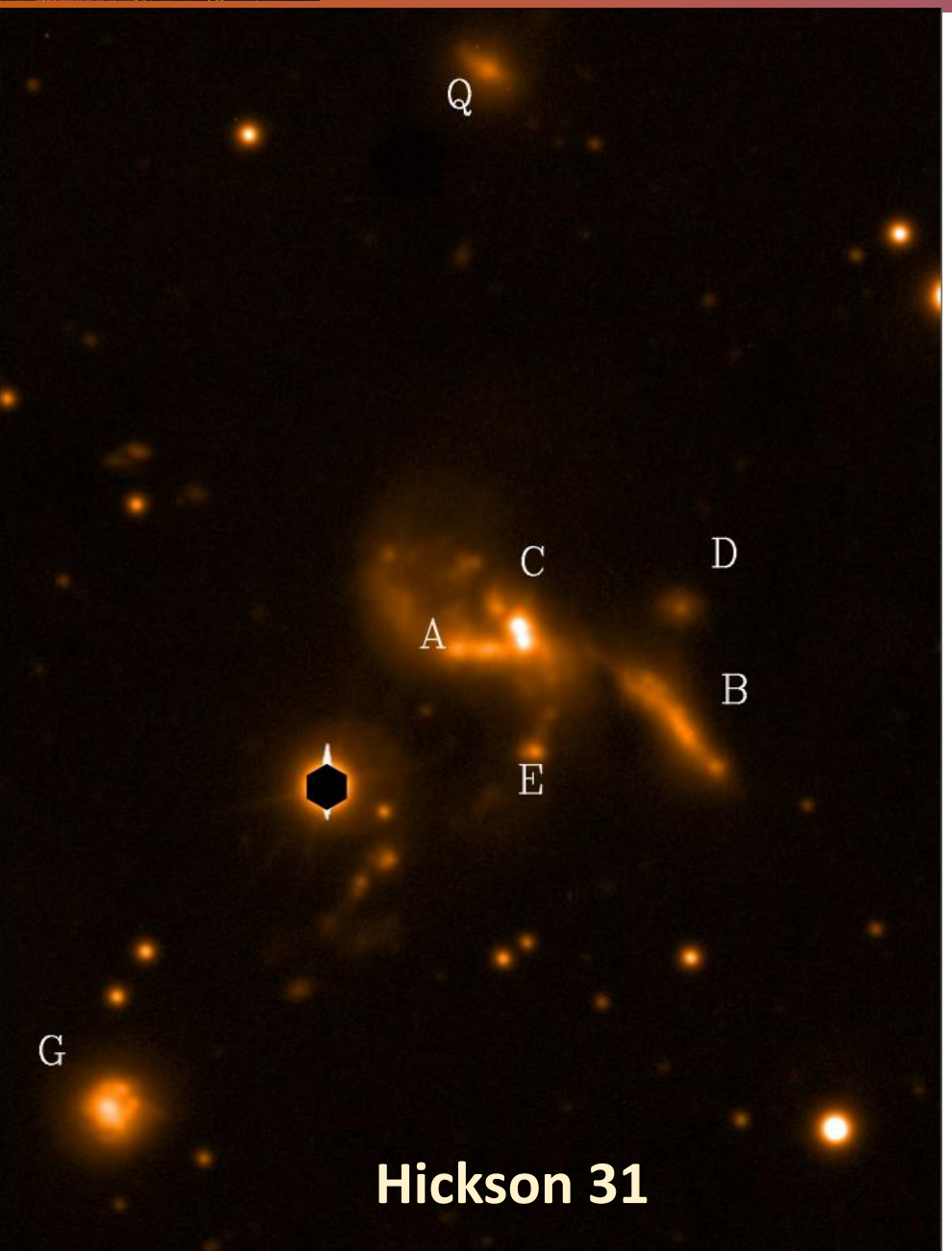
- Verdes-Montenegro et al. 2001, "Where is the Neutral Atomic Gas in Hickson Groups", A&A 377, 812

- Martinez et al. 2008, Deficiency of Broad Line AGNs in Compact Groups of Galaxies, ApJ

Hickson 95

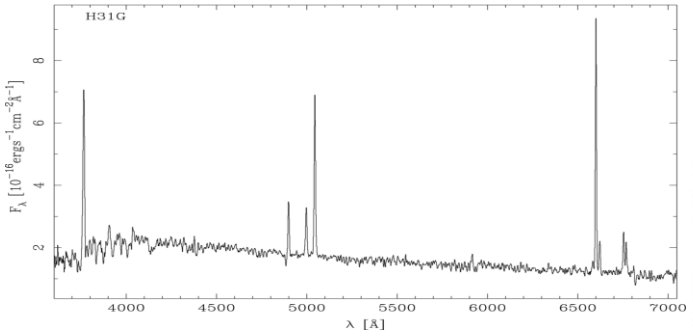
2009 - 2013

ALFOSC at the NOT: a successful loan



AGN POPULATION IN HICKSON COMPACT GROUPS. I. DATA AND NUCLEAR ACTIVITY CLASSIFICATION

65 HCGs, ALFOSC spectra of 56 galaxies (also CAHA & SPM)



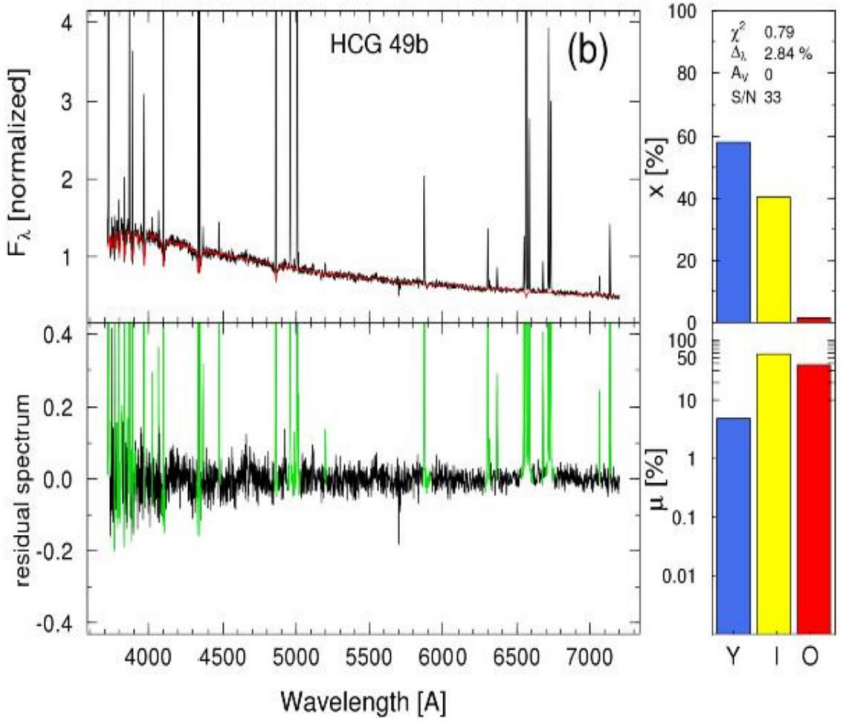
Martínez et al. 2010, AJ 139, 1199

THE STAR FORMATION HISTORIES OF HICKSON COMPACT GROUPS GALAXIES

210 galaxies in 55 HCGs + 309 CIG

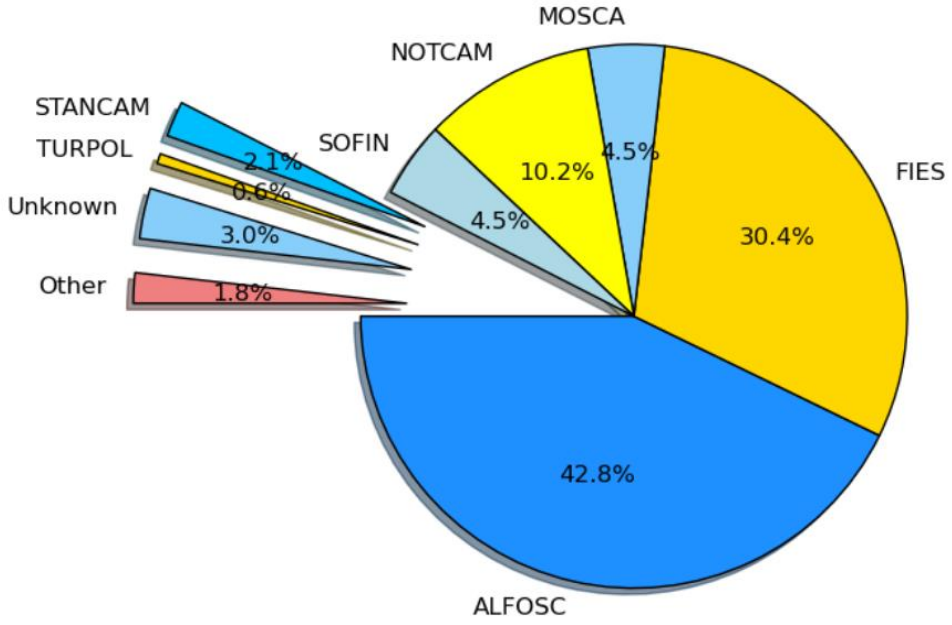
HCG gx are older, shorter SF, indep. of morphology, M or L

Plauchu-Frayn et al. 2012, A&A 546, A48



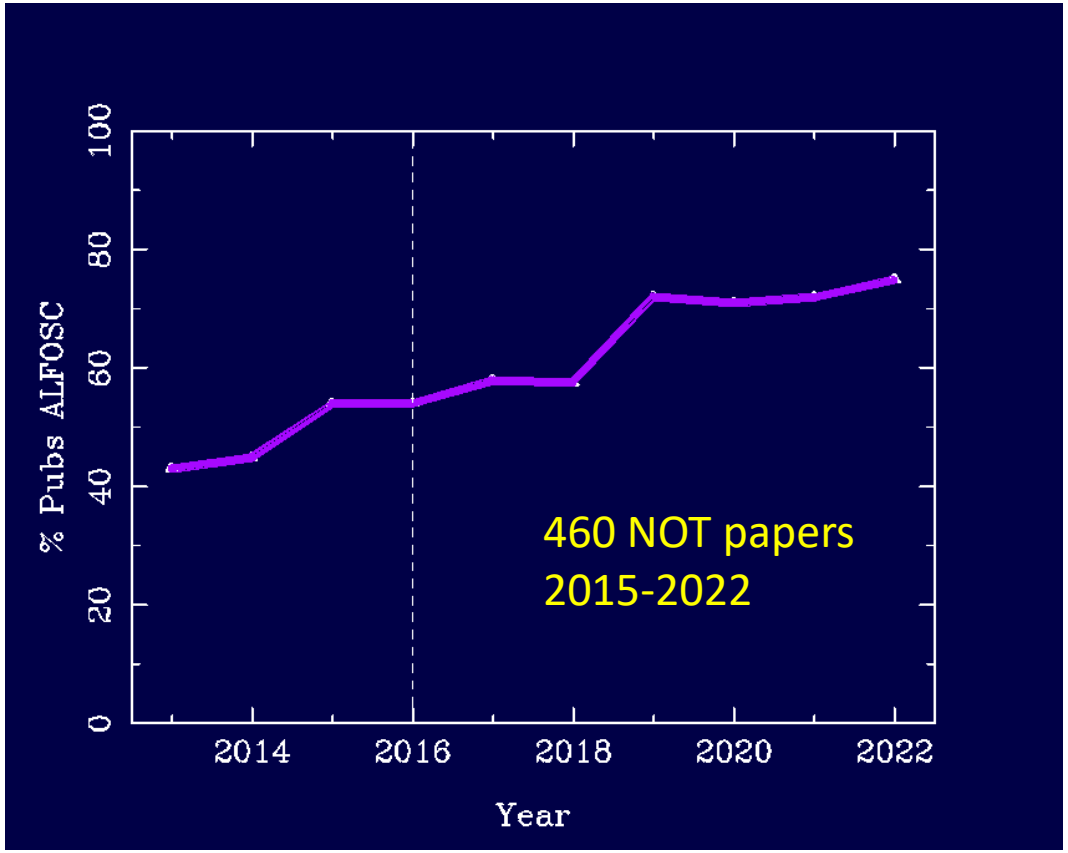
ALFOSC at the NOT: a successful loan

The use of ALFOSC: publications since 2013



Instrument use in publications in refereed journals,
(partly) based on NOT data, published in 2013, 2014, 2015

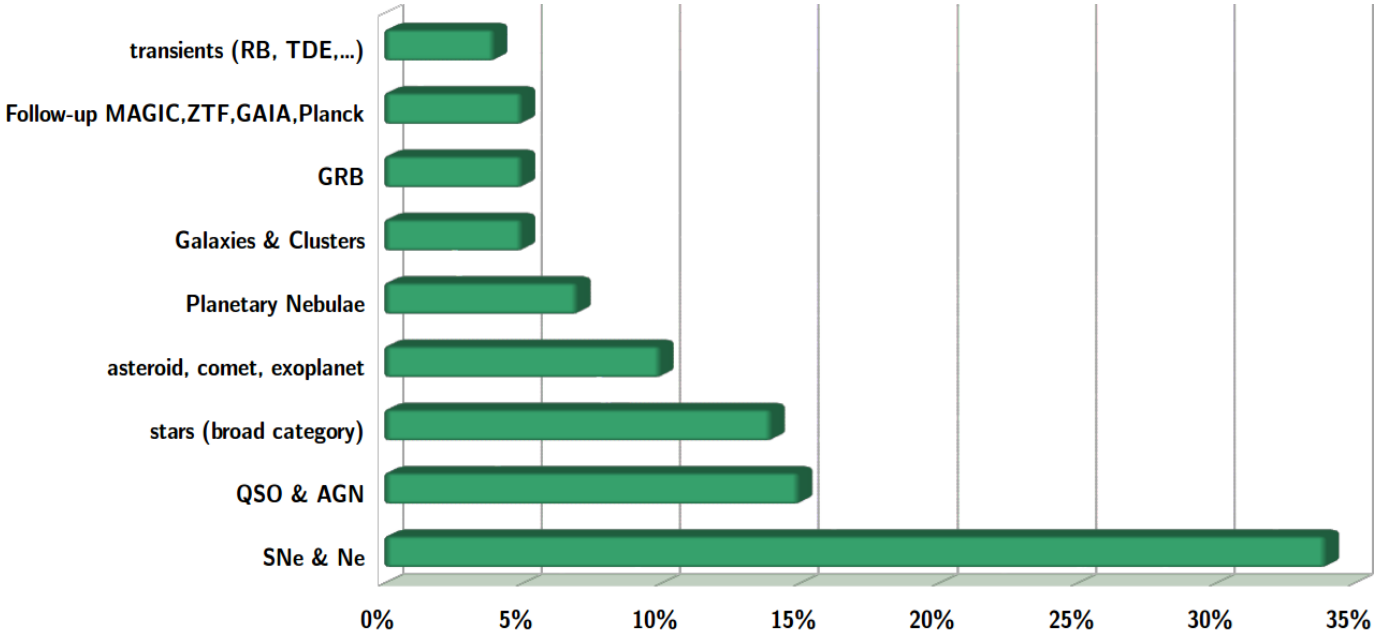
Source: NOT web

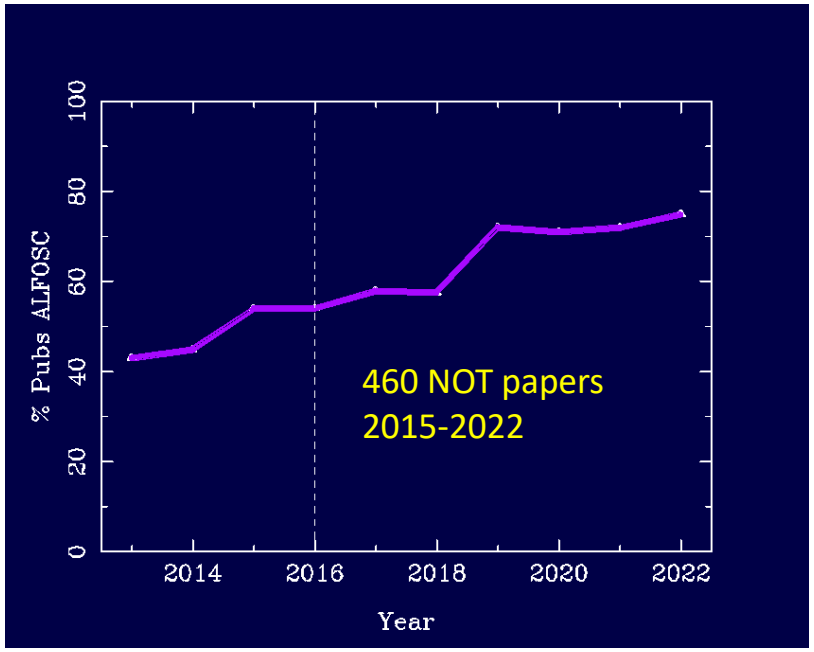


Source: own treatment of the list of publications

ALFOSC at the NOT: a successful loan

The use of ALFOSC: publications since 2015





"Observation of inverse Compton emission from a long γ-ray burst"

The Nordic Optical Telescope (NOT) observed the optical after-glow of GRB 190114C with the ALFOSC instrument. Imaging (griz, 300-s exposures), starting 24 min after the BAT trigger. ALFOSC spectrum reveals strong host interstellar absorption lines (Ca H & K, NaI D), which provided z = 0.425.

MAGIC Collaboration, 2019 Nature 575, 459

ALFOSC at the NOT: a successful loan

THE SIZE, SHAPE, DENSITY AND RING OF THE DWARF PLANET HAUMEA FROM A STELLAR OCCULTATION

Contribution to a better prediction for the occultation, ALFOSC R imaging Dec. 2016

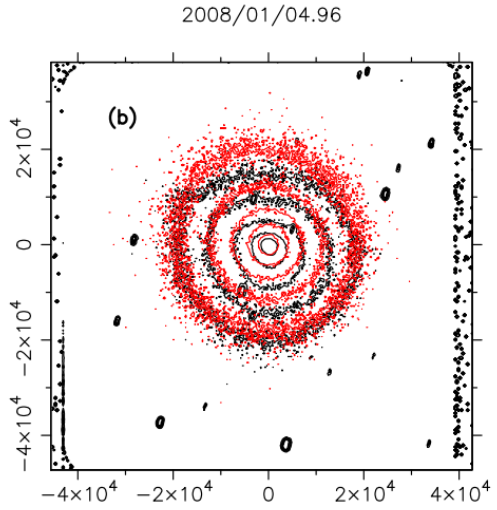
Ortiz et al. 2017, Nature 550, 219

THE DUST AND GAS ENVIRONMENT OF COMET 8P/TUTTLE

Méchain (1790), Tuttle (1858)

Data from 2008, including ALFOSC R images (dust model - red) and spectra (gas production rates)

Gutiérrez et al. 2021, MNRAS 508, 1719



ALFOSC at the NOT: a successful loan

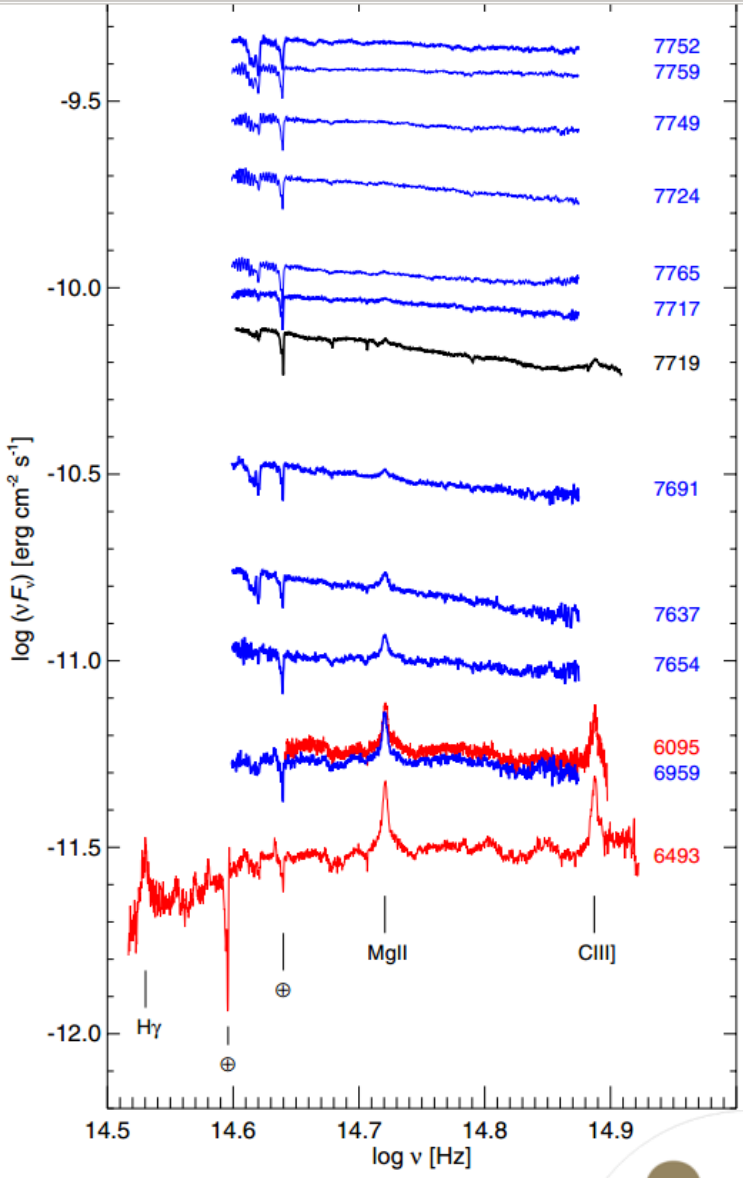
BLAZAR SPECTRAL VARIABILITY AS EXPLAINED BY A TWISTED INHOMOGENEOUS JET

Whole Earth Blazar Telescope (WEBT Collaboration), CTA102, optical-to-radio monitoring,

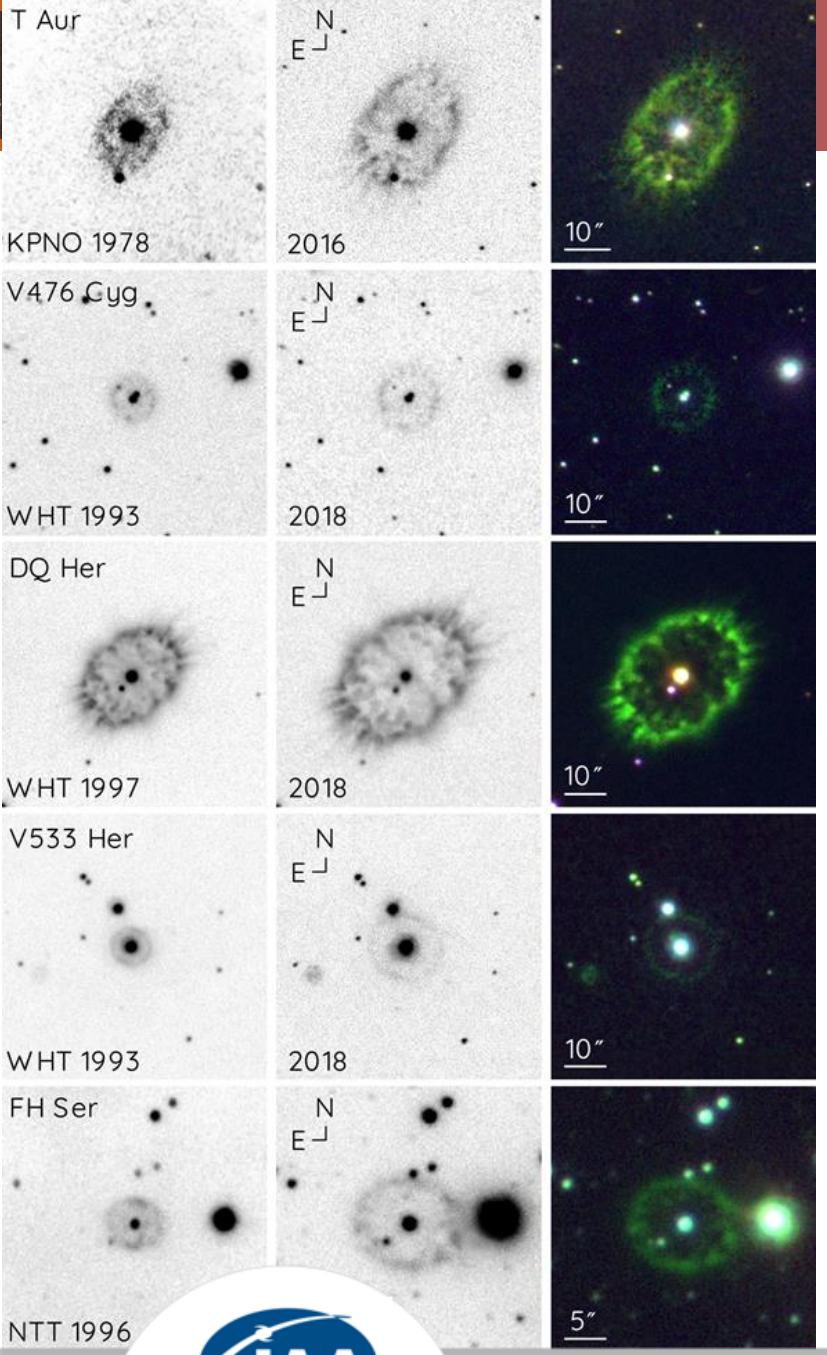
NOT images and spectroscopy

Explanation for variability based on inhomogeneous, curved jet, changing orientation (validation relativistic beamin theory)

Raiteri et al. 2017, Nature 552, 374



ALFOSC at the NOT: a successful loan



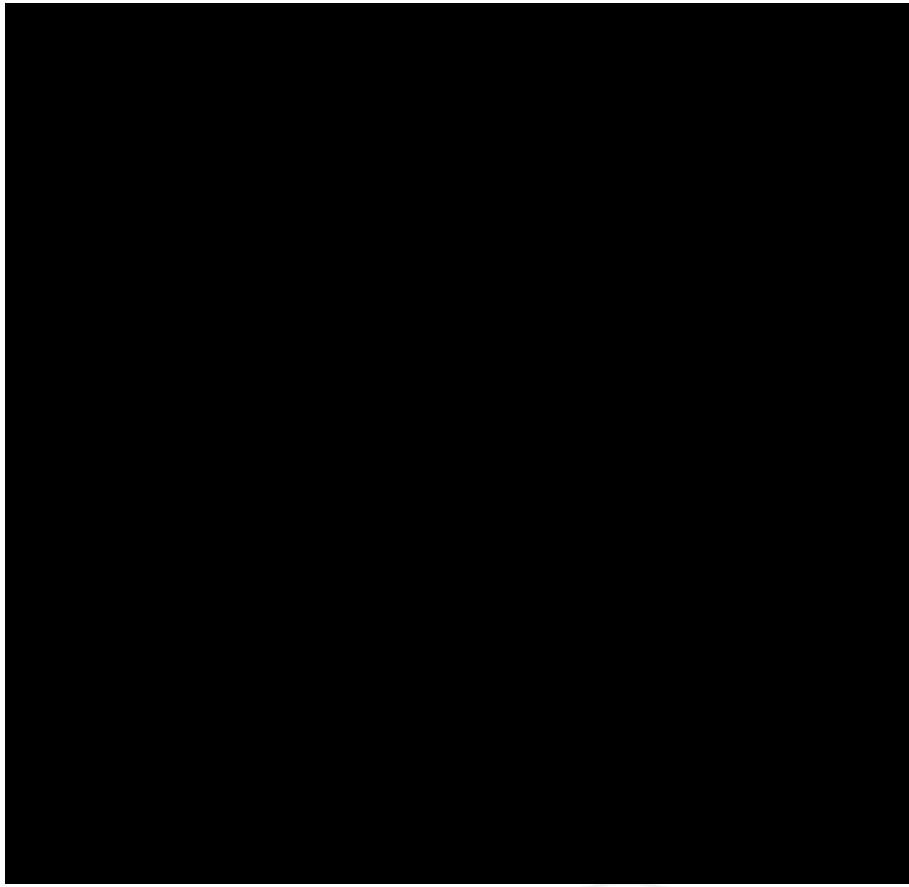
NOVA SHELLS

Novae= result of interaction of stars in close binary system: WD (accreting) + giant or subgiant low-mass star
critical mass for accretion =>
thermonuclear runaway =>
ejection.
Dynamical evol. on human timescales

ANGULAR EXPANSION OF NOVA SHELLS

Derivation of angular expansion rates (fraction of arcsec per year) unchanged => free expansion rate (20 to 130 yr), expected to last for a few 100 years

Santamaría et al. 2020, ApJ 892, 60

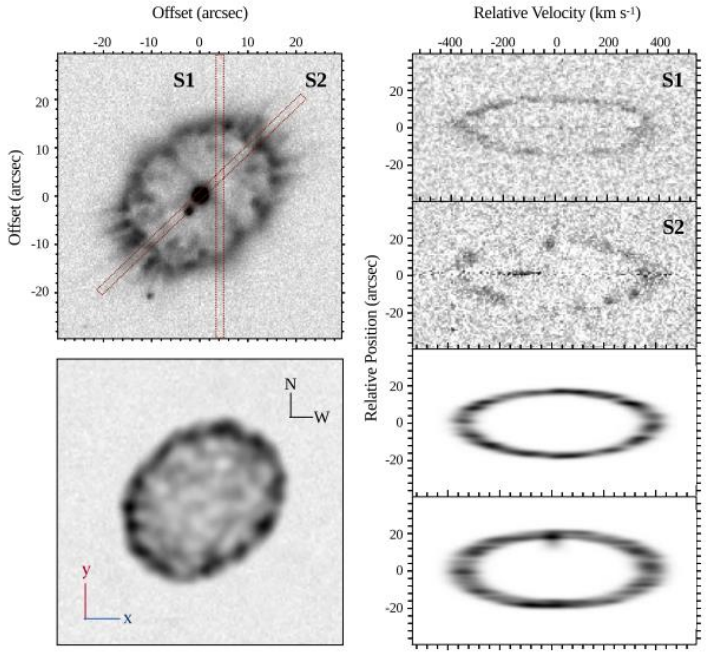


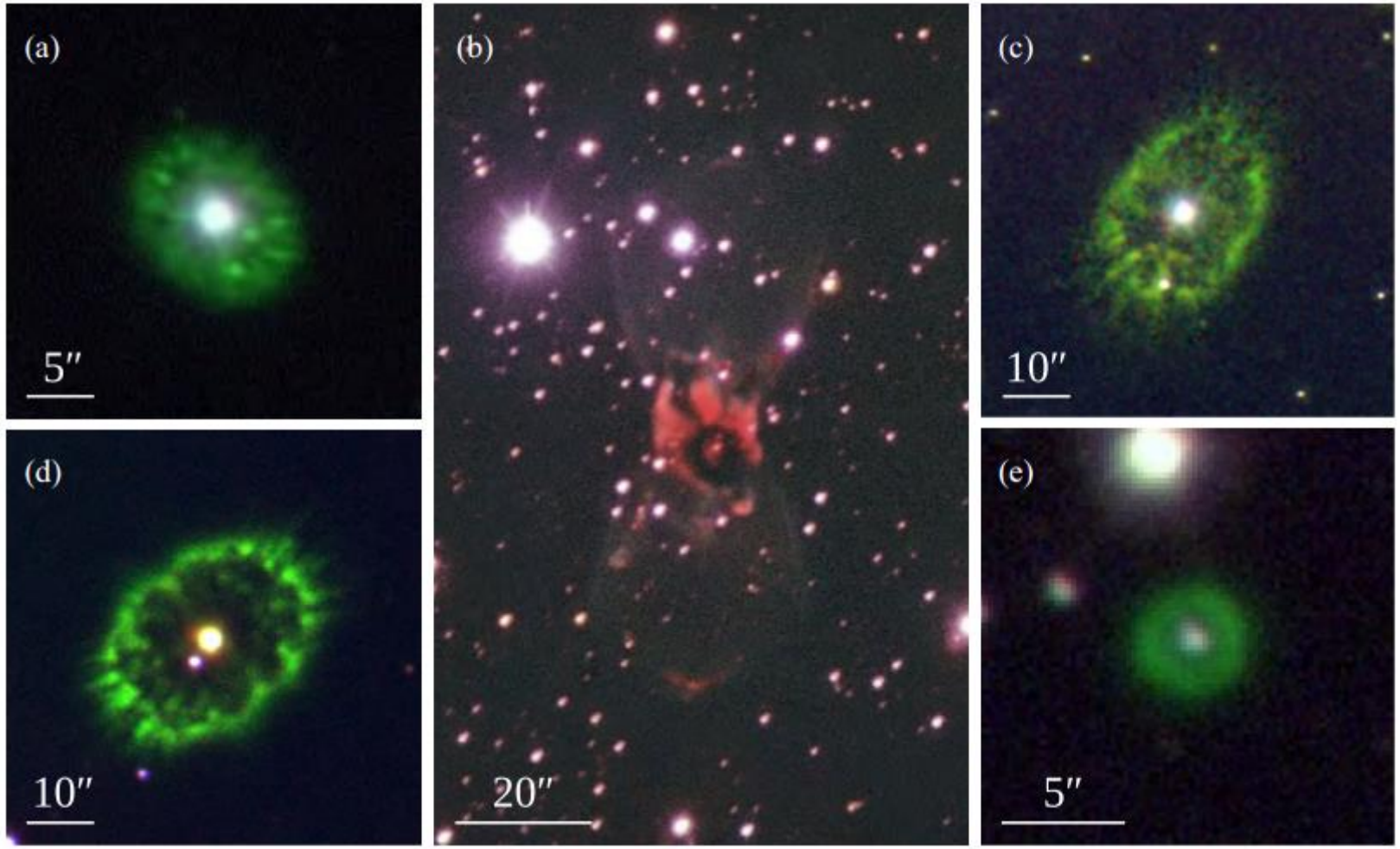
ALFOSC at the NOT: a successful loan

SPATIO-KINEMATIC MODELS OF FIVE NOVA REMNANTS: CORRELATIONS BETWEEN NOVA SHELL AXIAL RATIO, EXPANSION VELOCITY, AND SPEED CLASS

Intermediate and high-dispersion LS spectra
+ narrow-bang imaging
+ 3D SHAPE software

Santamaría et al. 2022, MNRAS 512, 2003



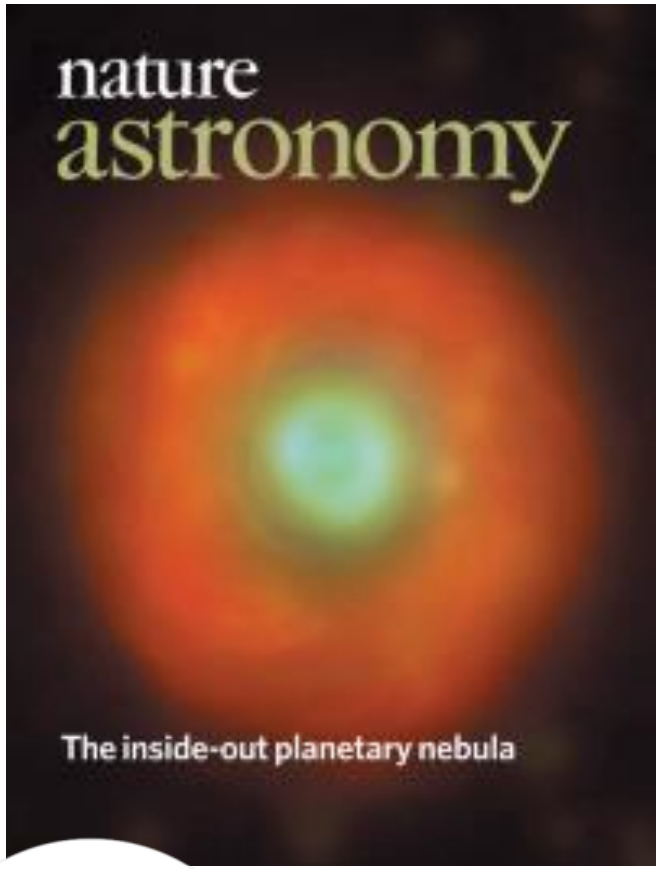


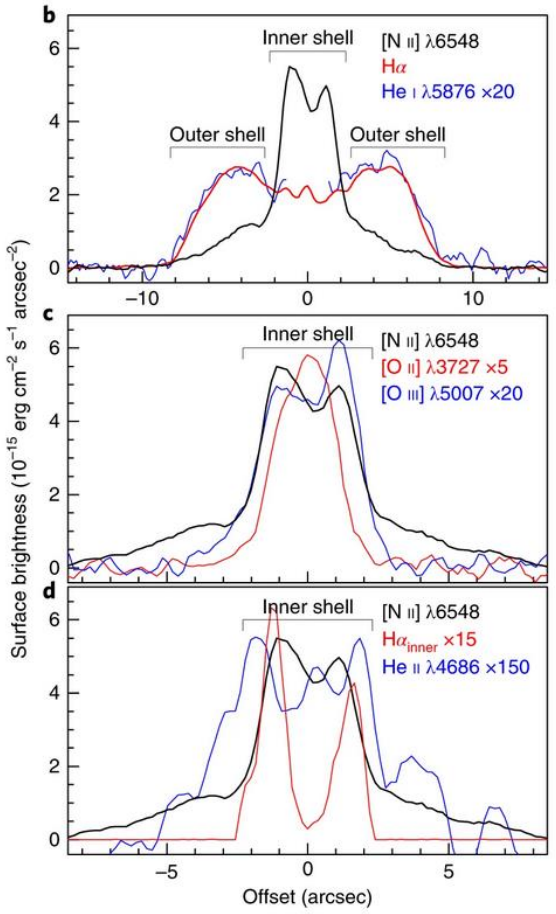
ALFOSC at the NOT: a successful loan

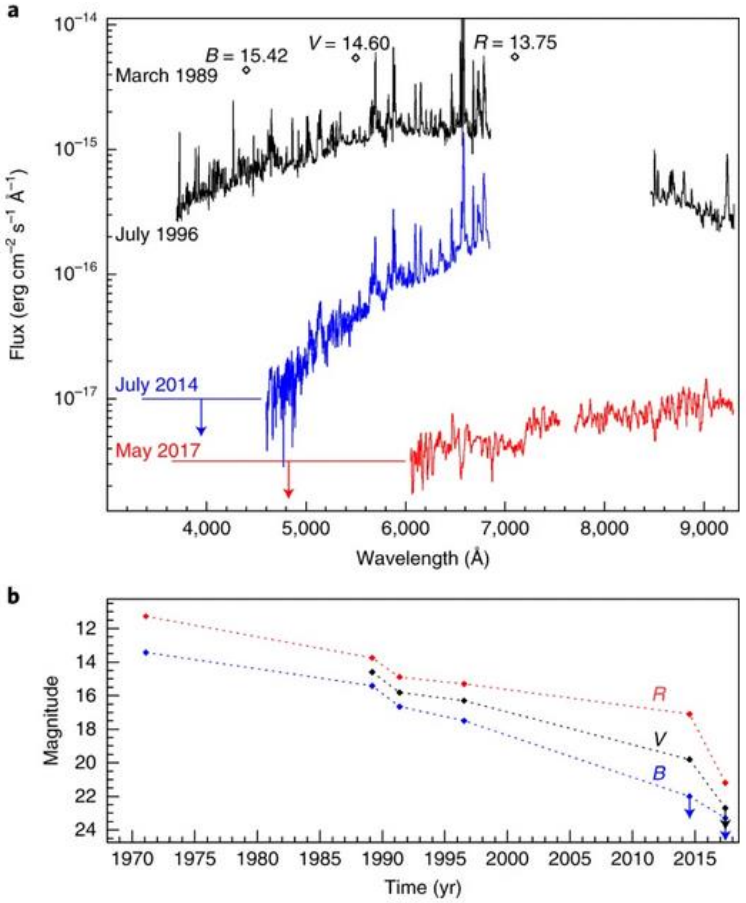
THE INSIDE-OUT PLANETARY NEBULA AROUND A BORN-AGAIN STAR

The inverted ionization structure of the inner shell of HuBi1, with lower excitation ionic species at the inner regions and highly excited ions at the outer regions, defies the thermodynamics laws in photoionized nebulae and points out to a “born-again star”

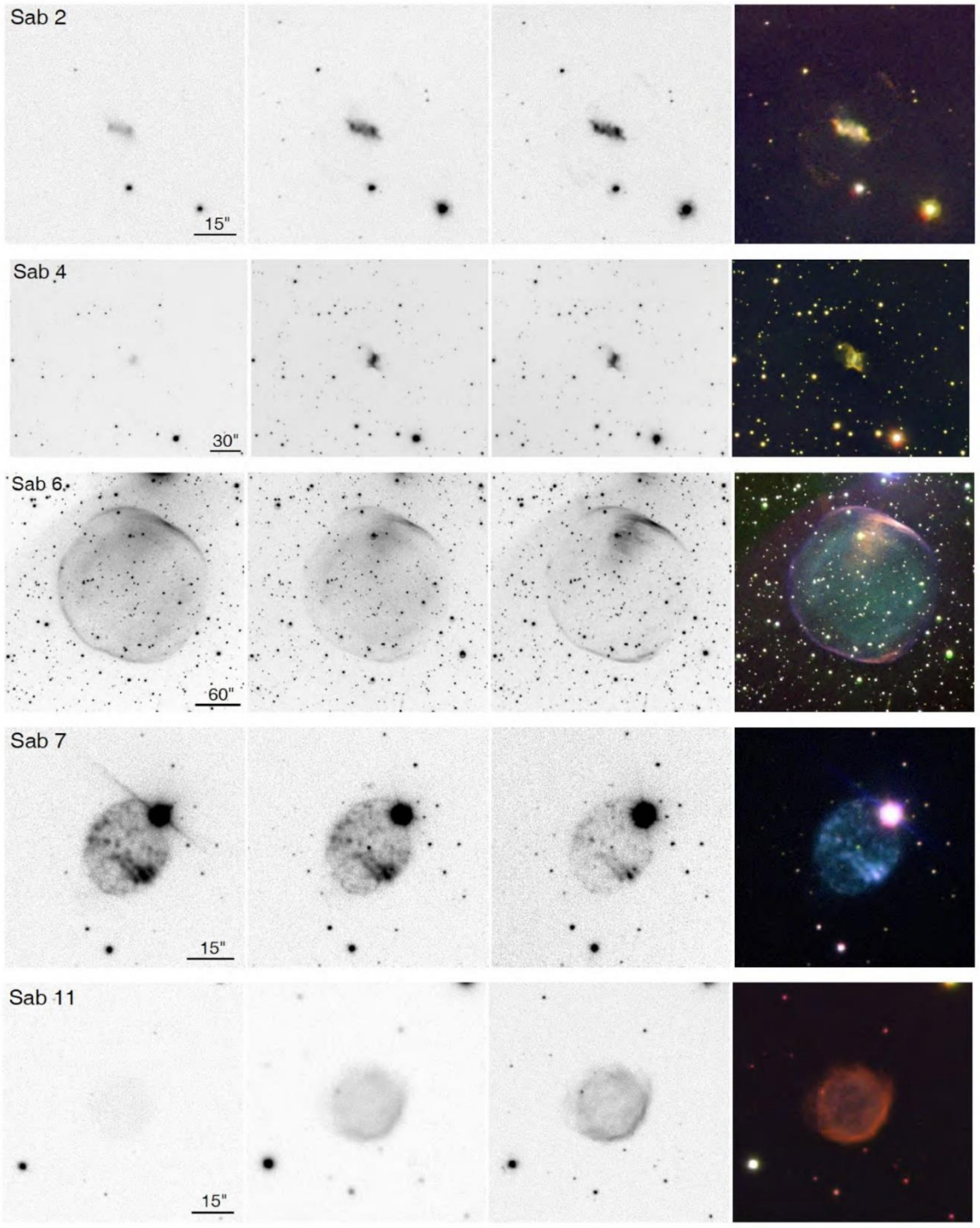
Guerrero et al. 2018, Nature Astronomy 2, 784







ALFOSC at the NOT: a successful loan



FIRST DEEP IMAGES CATALOGUE OF EXTENDED IPHAS PNE

New set of 58 deep images of true, likely and possible extended PNe detected with IPHAS ([OIII]-blue, Hα-green and [NII]-red)

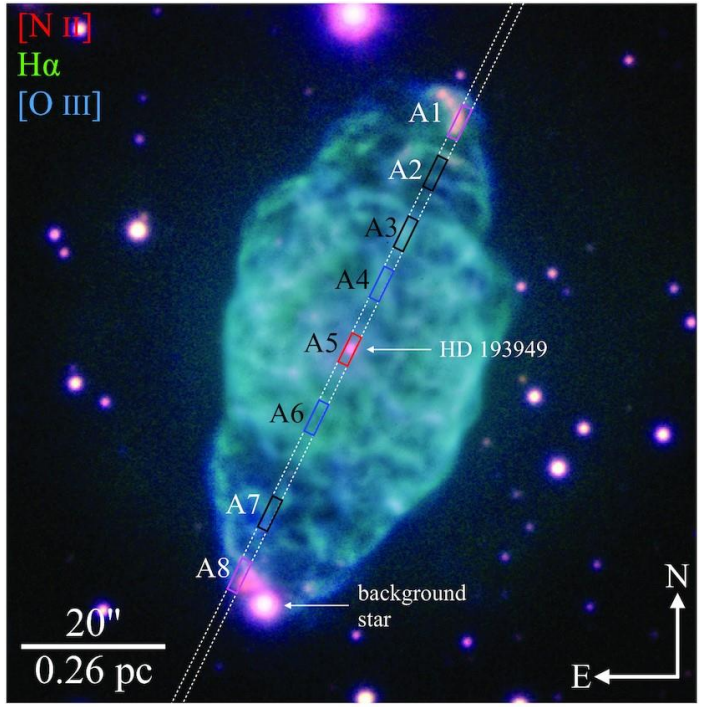
Sabin et al. 2021, MNRAS, 508, 1599

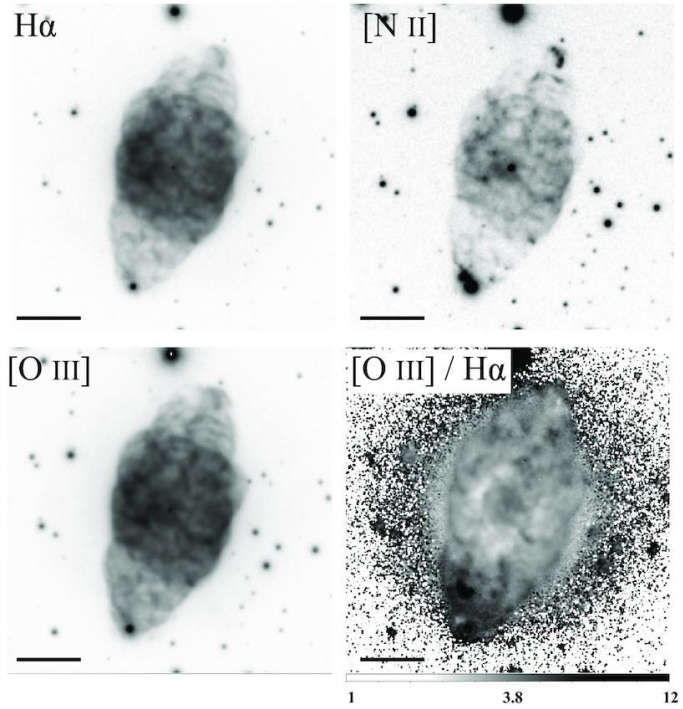
ALFOSC at the NOT: a successful loan

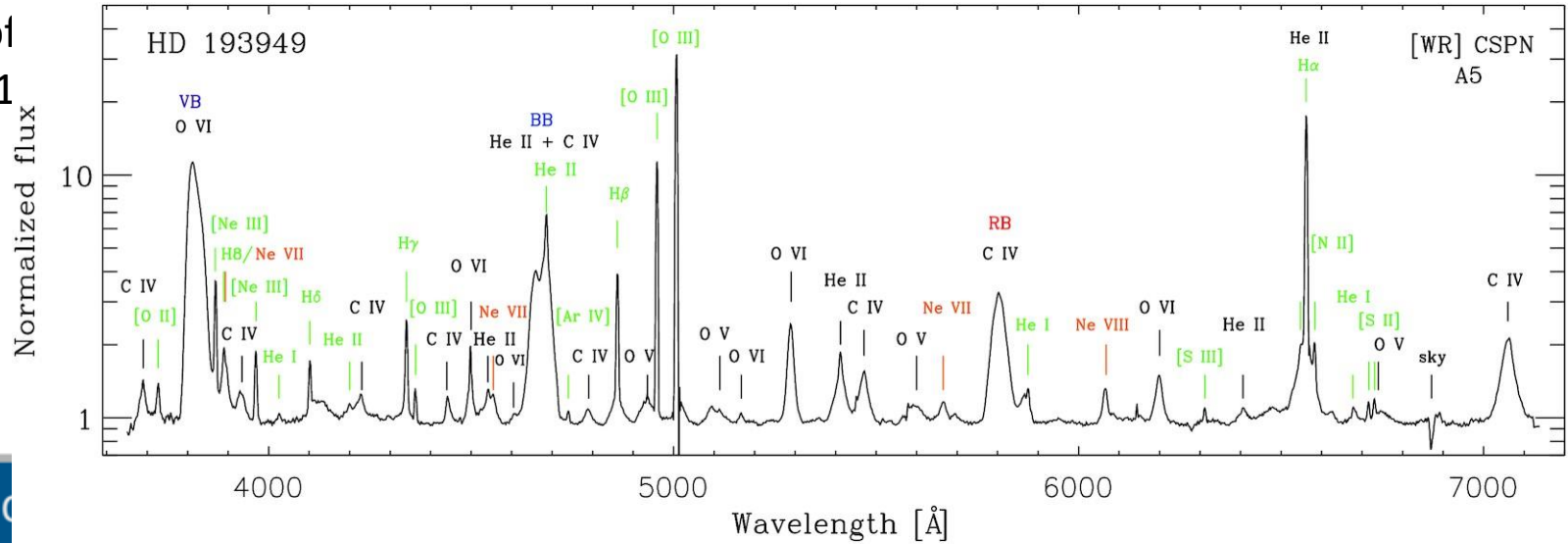
PLANETARY NEBULAE WITH WOLF-RAYET-TYPE CENTRAL STARS - III. A DETAILED VIEW OF NGC6905 AND ITS CENTRAL STAR

ALFOSC spectra + images unveil in unprecedented detail the high-ionization structure of NGC6905.
PoWR stellar atmosphere code to model the spectrum of HD193949
CLOUDY reproduces the nebular and dust properties for a total mass in the 0.31–0.47Msun range and a mass of C-rich dust of ~2 × 10−3 Msun. Adopting a current stellar mass of 0.6Msun, our model suggests an initial mass ~1 Msun for HD193949, consistent with the observations

Gómez-González et al. 2022, MNRAS 509, 974







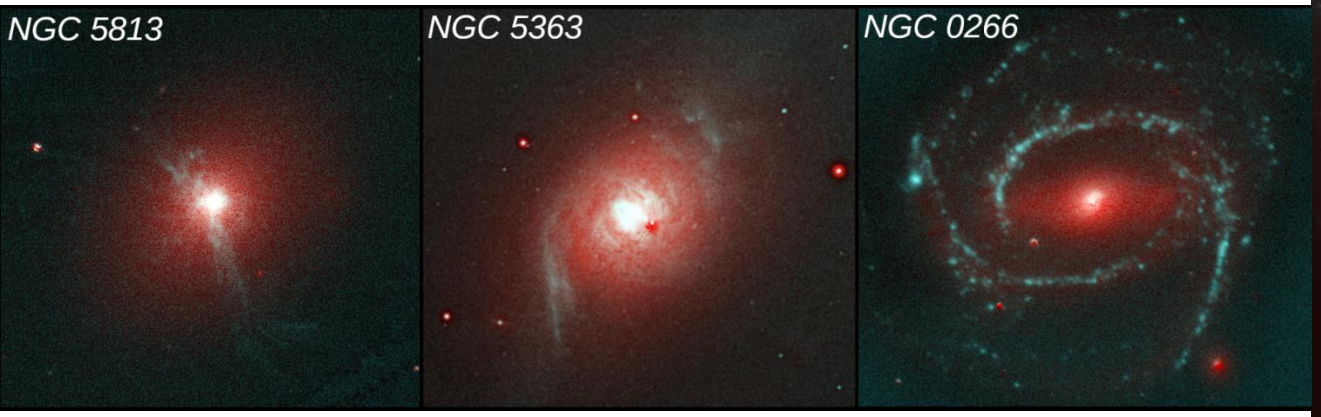
ALFOSC at the NOT: a successful loan

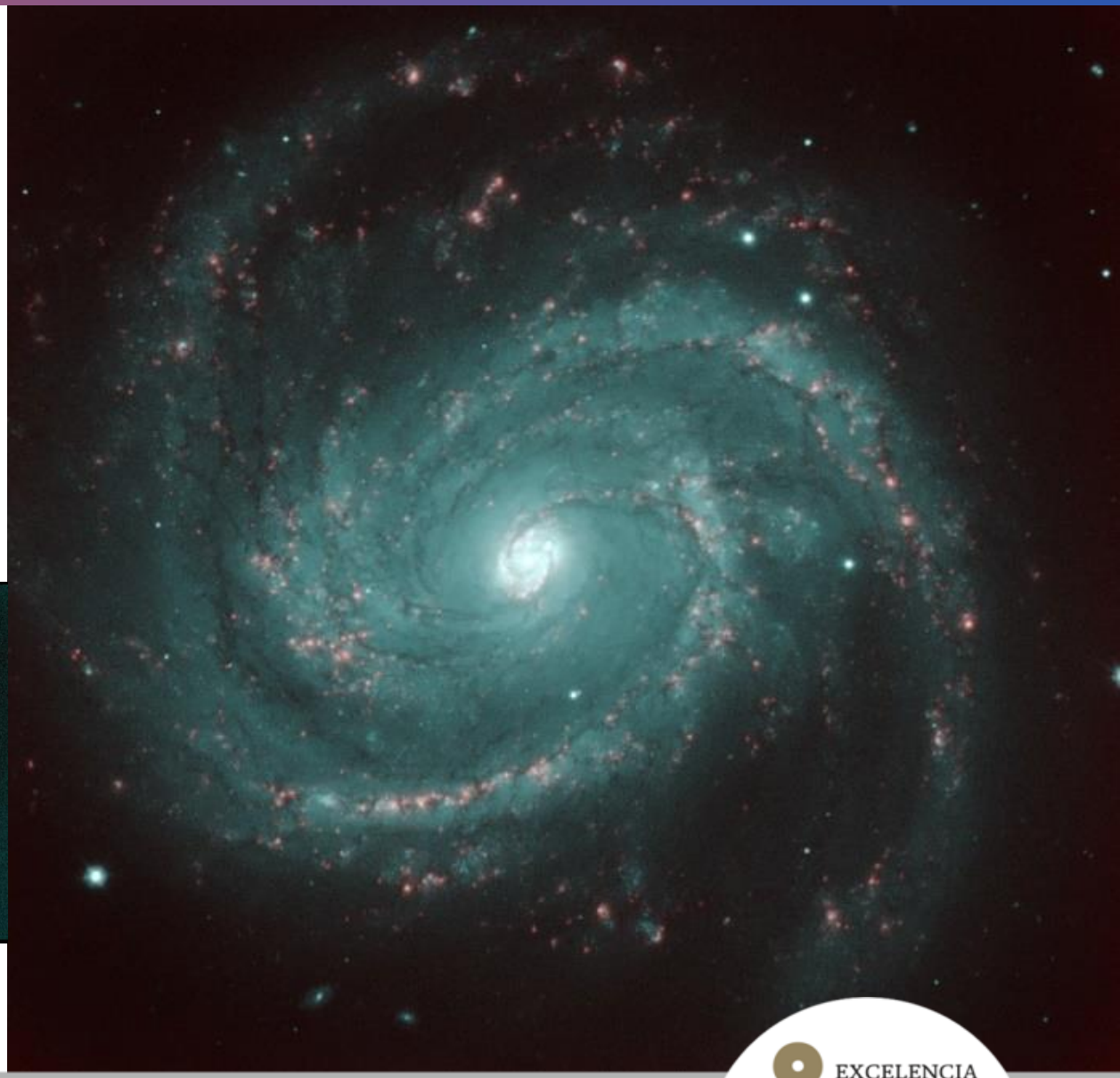
A SEARCH FOR IONISED GAS OUTFLOWS IN AN Hα IMAGING ATLAS OF NEARBY LINERS

ALFOSC/NOT + HST
Hα imaging for 70 nearby (z<0.025), non-interacting LINERs

Systematic search for outflows:
the largest atlas to date of ionised gas morphologies

Hermosa-Muñoz et al. 2022, A&A 660, A133





NOT - a telescope for the future

2022 Jun 7-10

H10 Hotel Taburiente Playa La Palma Spain

INVITED SPEAKERS

Michael Andersen, University of Copenhagen
Thomas Augusteijn, Nordic Optical Telescope
Andrei Berdyugin, University of Turku
Lars Buchhave, Technical University of Denmark
Frédéric Courbin, Swiss Federal Institute of Technology in Lausanne
Håkon Dahle, University of Oslo
Carolina von Essen, Aarhus University
Johan Fynbo, University of Copenhagen
Terese Hansen, Stockholm University
Hans Kjeldsen, Aarhus University
Jari Kotilainen, University of Turku
Jyri Lehtinen, University of Helsinki
Tiina Liimets, Czech Academy of Sciences
Yannis Liodakis, University of Turku
Jane Luu, University of Oslo
Daniele Malesani, Radboud University
Isabel Márquez, Instituto de Astrofísica de Andalucía
Marco Micheli, ESA NEO Coordination Centre, Frascati
Semëli Papadogiannakis, FOI, Swedish Defence Research Agency
Nikolai Piskunov, Uppsala University
Jesper Sollerman, Stockholm University
Max Stritzinger, Aarhus University

In memoriam
Johannes Andersen

SCIENTIFIC ORGANIZING COMMITTEE

Simon Albrecht, Aarhus University
Ainaug Amanda Djupvik, NOT
Mikael Granvik, University of Helsinki
Kasper Elm Heintz, University of Copenhagen
Erkki Kankare, University of Turku (Chair)
Ragnhild Lunnan, Stockholm University
Kari Nilsson, University of Turku
Birgitta Nordström, University of Copenhagen
Mia Sloth Lundkvist, Aarhus University
Ása Skúladóttir, University of Firenze
Luc Rouppe van der Voort, University of Oslo

Coming together to explore science, instrumentation and education with the Nordic Optical Telescope.

Local Organizing Committee:
Sergio Armas, Thomas Augusteijn, Enrico Biancalani, Jacob Clasen, Rosa Clavero, Graham Cox, Ainaug Amanda Djupvik (Chair), Loida Fernandez, Anni Kasikov, Raquel López, Peter Meldgaard Sørensen, Carlos Perez, Tapio Pursimo, Ingvar Svärdh, John Telting, Angela Toledo (Designer), Aleksi Viitanen.

Photo: Joonas Viuho and Giovanni Tessicini

AARHUS UNIVERSITET
UNIVERSITY OF TURKU

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

La Palma

Science, instrumentation and education…

Thanks !