

Multi-messenger and multi-use of Nordic Optical Telescope

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Nordic Optical Telescope
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Background, NOTSA

- In 1983 and 1984 agreement was reached in the four Nordic countries Denmark, Finland, Norway and Sweden concerning construction of a major observing facility for Nordic astronomers, the Nordic Optical Telescope (NOT).
- NOTSA (Nordic Optical Telescope Scientific Association) 1984
- 2.56 metre telescope at La Palma
- Jointly build by Denmark, Finland, Norway and Sweden
- First light end of 1988
- Operations autumn 1989
- Iceland joins 1997
- Spain 20% of the observing time
- ITP 5% of the observing time

Structure since 2020

- Consortium of Nordic Universities
- Hardware: University of Turku
- Software (people) Aarhus University
- National funding through universities
- Additional contributions e.g.
 - ▶ OPTICON/ORP (2019-2025)
 - ▶ ZTF / Vera Rubin transients; Stockholm university (2023-)
 - ▶ CheTEC Infra (2022-2025)
 - ▶ Spider pulsars; NTNU Trondheim (2026-2027)
 - ▶ ESA S2P Program; University of Helsinki (2023-2026)

Instruments

Core instrument plan since ~ 2000

- ALFOSC, optical imaging, low resolution spectroscopy, imaging- and spectro-polarimetry, high throughput
- FIES, high resolution echelle spectrograph (relatively stable, 5 m/s) folded Cassegrain
- NOTCAM, NIR imaging and spectroscopy, two image scales
- StanCam, optical imager folded Cassegrain
- SOFIN high resolution spectrograph with polarimetry
- DIPol-UF high speed high-precision three channel polarimetry
- FastCam IAC high speed imager
- retired
 - ▶ MOSCA imager, TurPol photo polarimeter, LuckyCam (lucky imaging), SIRCA (IR imager), PolCor "Lucky" polarimeter/coronagraph

Nordic observing time

- Visitor runs
- Rapid-response mode (RRM)
- Target of Opportunity (ToO)
- SoftToO (only Nordic Service nights)
- Monitoring
- Service programme, visitor run done in service mode
- Filler, low-ranked programmes that otherwise would not get time.
- FastTrack (\leq four hours)
- Educational programmes
 - ▶ astronomy students
 - ▶ high school students
 - ▶ on-site or remote

Rapid Response Mode, RRM

Machine-to-machine, work by Samuel Grund (Aarhus University)

GCN Circular 43581: fast X-ray transient EP260131a

"" ...Exposure starting on 2026-01-31 at 04:56:50 UTC ~2.5 min after the GCN Notice ... ""

At the moment RRM is offered ALFOSC imaging and spectroscopy only, non-sidereal tracking in development/investigation

Operations, work force

- 50% director provided by FINCA
- 2.7 staff astronomers + 60% IAC Post Doc
- Technical: 2 + 50%
- Software: 1 + 3 * 50%
- Admin 2 * 50%
- Students 6-8 * 30%

In addition, Work Experience, 2-4 students per year with 1-3 months projects.

Publications

First refereed publication March 1990.

~100 (or more) papers per year since 2011

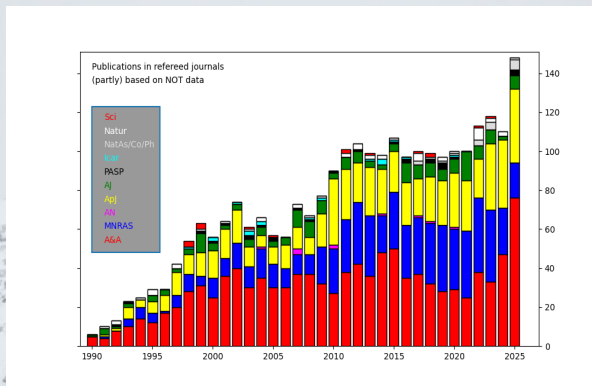
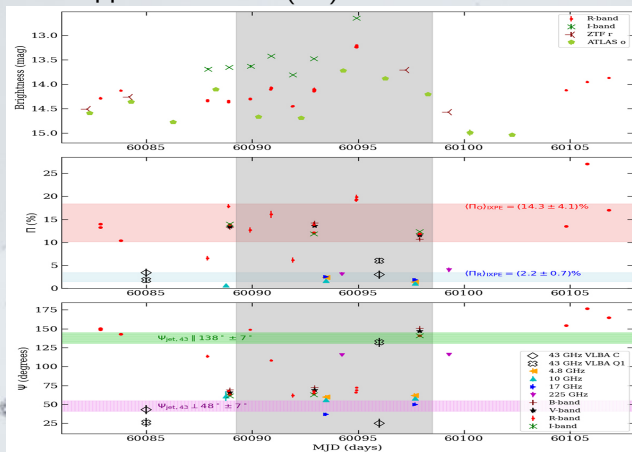


Figure: In 2025 NOT had most refereed publications amongst ORM telescopes;
NOT: 148, GTC: 123, TNG: 99

Simultaneous observations with space observatories / probes

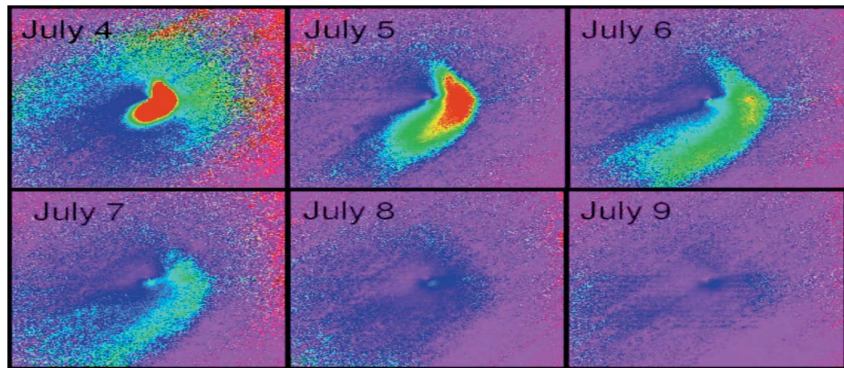
Simultaneous X-ray and optical polarisation (ALFOSC)
IXPE upper limit 14% (3σ)



ALFOSC photometry and polarimetry Kouch, et al A&A, 695, A99 (2025)

Simultaneous observations with space observatories /probes

The collision of Deep Impact with comet 9P/Tempel 1 on July 4 2005

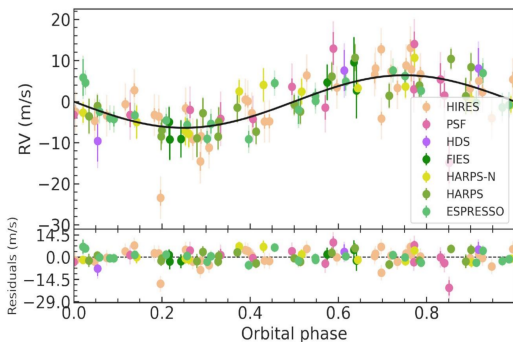


ALFOSC imaging Meech et al. Science 310, 265 (2005)

Follow-ups

FIES@NOT follow-up of TESS / Kepler exo-planet candidates, further follow-up by e.g. HARPS

Figure 6. Phase-folded RV curve of K2-106 b.



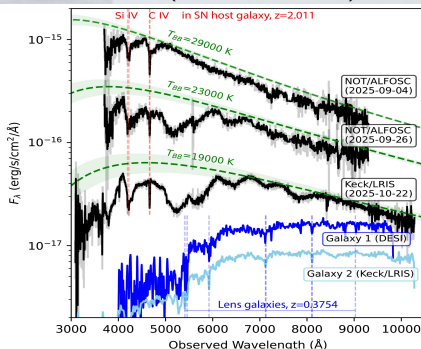
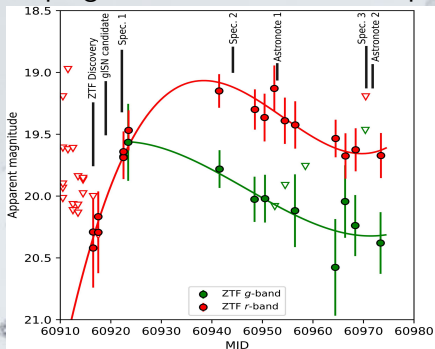
K2-109b, period 0.57 days; Guenther, et al MNRAS, 529 141 (2024)

Follow-ups

Transient follow-up, ZTF / LSST / PanSTARRS / SVOM / Swift
SN, TDE, GRB, etc.

Typically ALFOSC spectroscopy and photometry, but polarimetry and NOTCam as well.

22 programmes with Gaia in the programme title (last four years)



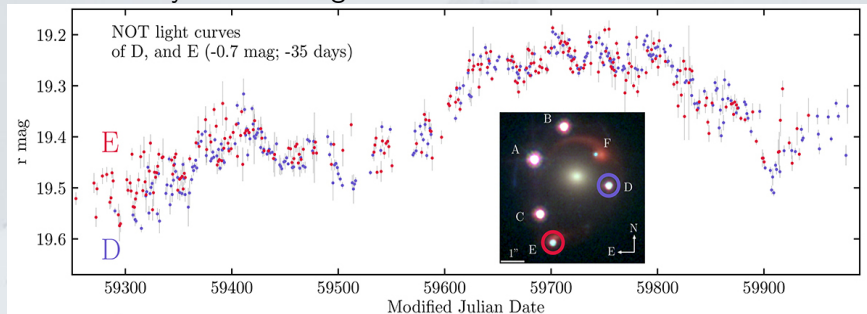
A Strongly Gravitationally Lensed Superluminous Supernova at $z = 2.01$; Johansson, et al *ApJL*, 995 L17 (2025)

Nightly monitoring

J1721+8842: The first Einstein zigzag lens

6 images of a quasar by two intervening galaxies ($z=0.184$ and $z=1.885$).

From February 2021 to August 2023.

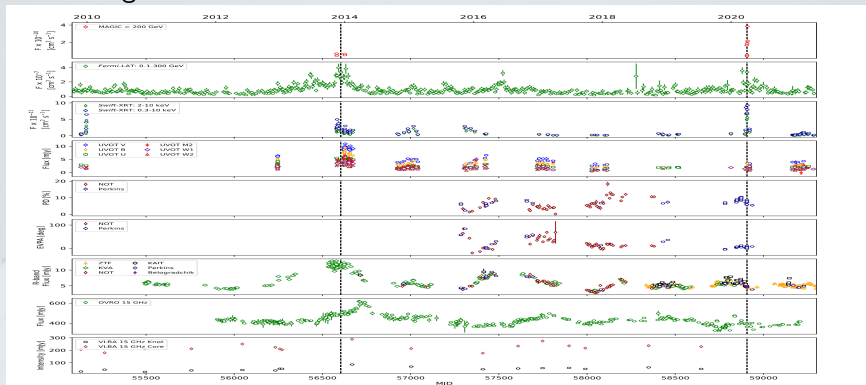


ALFOSC imaging

Dux, et al A&A, 694, A300 (2025)

Multi-wavelength multi-site monitoring

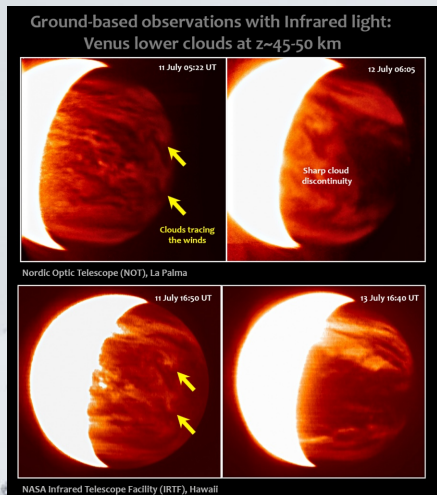
Optical / NIR observations combined with radio, UV, X-ray, γ -ray, TeV monitoring



TeV-blazar VER J0521+211 with ALFOSC data

MAGIC Collaboration Abe, et al. A&A, 694, A308 (2025)

Special observing modes / observations



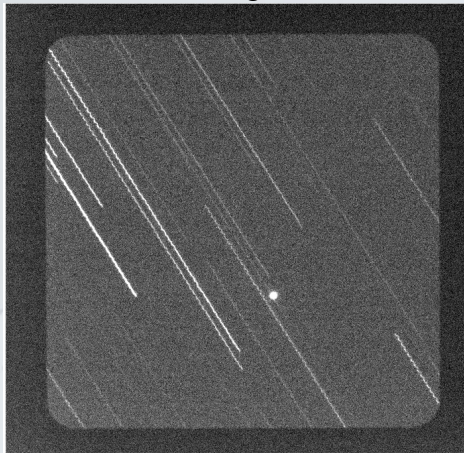
Venus: NOTCam
NIR-imaging, through narrow
band filters
Observed at Sun rise

Peralta et al. EPSC2020

At NOT there are 75 optical
and 20 NIR narrow band
filters available for ALFOSC
and NOTCam

Special observing modes / observations

Non-sidereal tracking

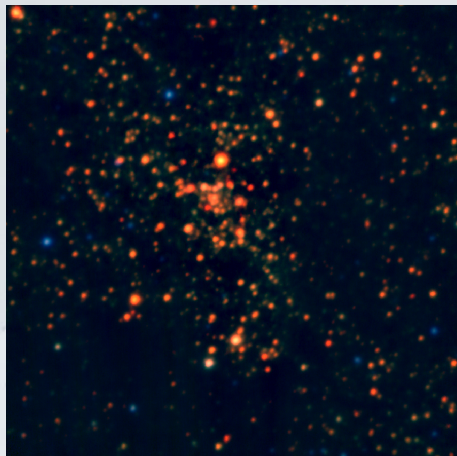


GPS satellite, NORAD 36585, with RA/DEC rates of 79640/111456 "/hour
ALFOSC

Special observing modes / observations

- The 67P/Churyumov–Gerasimenko observation campaign in support of the Rosetta mission (Snodgrass et al. RSPTA, 375, 2097 (2017) : NOT was one of the only telescopes able to follow the comet over the full observability range from both hemispheres. It was R- and V-band photometry.
- Pallé et al Nature 459, pages 814 (2009)
Observations of the lunar eclipse on 16 August 2008 have allowed us to characterise the Earth's spectrum as if it were observed from an astronomical distance during a transit in front of the Sun.
- Grimstrup et al FastTrack 72-414:
Stellar Occultations of 3I/ATLAS
Search for signatures of diffuse interstellar bands (DIBs) in the coma spectrum.

Image quality



The Galactic Centre: JHK, FWHM $\sim 0.6''$ at airmass ~ 1.8



Thank you!