OPTICON RadioNet Pilot

WP4
Striving for Excellence
[9 activities grouped in 4 sub-WP, single-coordination for efficiency]

WP4 includes

WP4/JA3.1 “Optimising dispersive elements – Volume Phase Holographic Gratings (VPHG)”
Partners: INAF, IAC

WP4/JA3.2 “Enhancing the Capabilities of the VLTI”
Partners: MPG/MPE, ULIEGE, UL-NOVA, CNRS/LESIA

WP4/JA3.3 “Adaptive Optics in Action”
Partners: CNRS, INAF, ONERA, IOTA, UPORTO, ESO, UDUR

WP4/JA3.4 “New algorithms for interferometric image reconstruction”
Partners: ESO, IRAM, MPG, ULIEGE, UL-NOVA, CNRS

Funded by the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101004719.

WP4/JA3.1 “OPTIMISING DISPERSIVE ELEMENTS – VOLUME PHASE HOLOGRAPHIC GRATINGS (VPHG)”

Exploits Europe-leading expertise in photopolymer applications developed during OPTICON H2020. Major performance enhancements are delivered without having to redesign entire systems, by intelligent modernisation.

Activities: requirements capture – June 16, 2021 on-line workshop: “Tailored dispersing Elements for Astronomical Optical Spectrograph”

September 2021: First Call to telescope/instrument “customers”.

Select TDA SNe spectroscopy as priority, implies an R=5000 Hα VPHG + K-band grating for AFOSC at Asiago

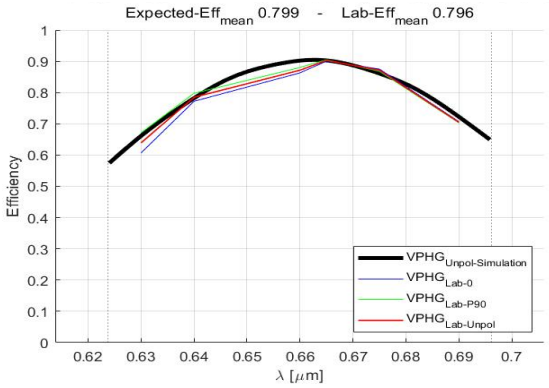
Optimise writing and characterisation facilities

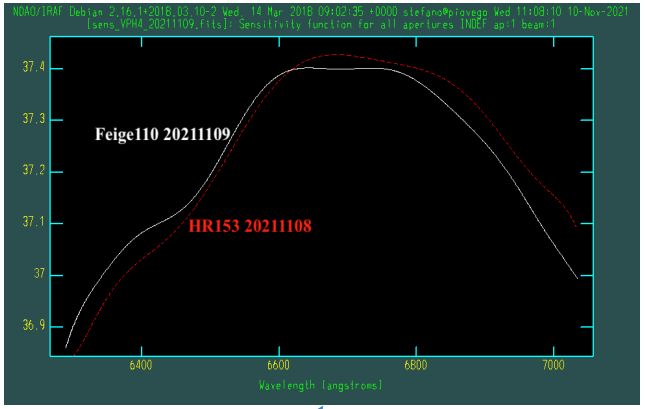
Design -> Build -> Characterise -> deliver: now on-sky

The diffraction efficiency reaches 90% at 0.665 μm and the average efficiency is almost 80%: a very good result considering the grating high dispersion.

A new large spectral range, low resolution VPHG is under assembling and will be on sky before the end of the year.

WP4/JA3.1 “OPTIMISING DISPERSIVE ELEMENTS – VOLUME PHASE HOLOGRAPHIC GRATINGS (VPHG)”





High test efficiency reflected in good on-sky performance

This work fully meets the ambitions for this stage of the ORP project.

Bianco A., et al., "New VPH based GRISMs for AFOSC," Proc. SPIE 12188, 1218853 (2022)
Bianco A., et al., "VPHGs for astronomy: what we learnt in OPTICON EU and manufacturing perspectives," Proc. SPIE 12188, 1218823 (2022)

WP4/JA3.2 "ENHANCING THE CAPABILITIES OF THE VLTI"

Three main activities to improve the scientific capabilities of the VLTI selected from an open call to the optical/infrared (OIR) interferometry community via independent peer review by a panel of international experts.

JA3.2.1 Development and commissioning of an off-axis tracking mode for GRAVITY to increase the sky coverage

JA3.2.2 Preparation and integration of Hi-5/VIKING into the VLTI for high-contrast imaging

JA3.2.3 A correlated flux mode for MATISSE to reach faint targets

This work will be presented with WP16 – Denis Defrere - later

WP4/JA3.3 “ADAPTIVE OPTICS IN ACTION”

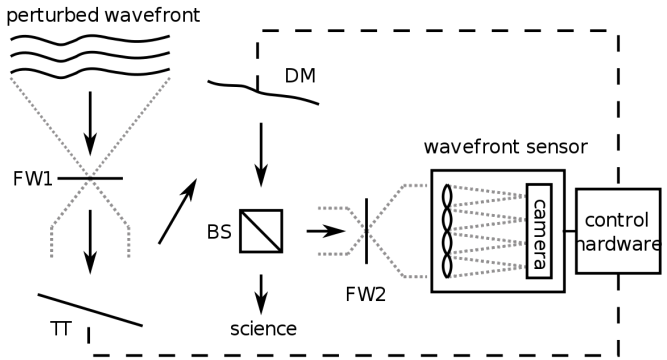
This JA was developed in response to the increased use of AO-equipped instruments and telescopes within current and future major research infrastructures, broadening community participation and building expertise. JA3.3 has four main work areas:

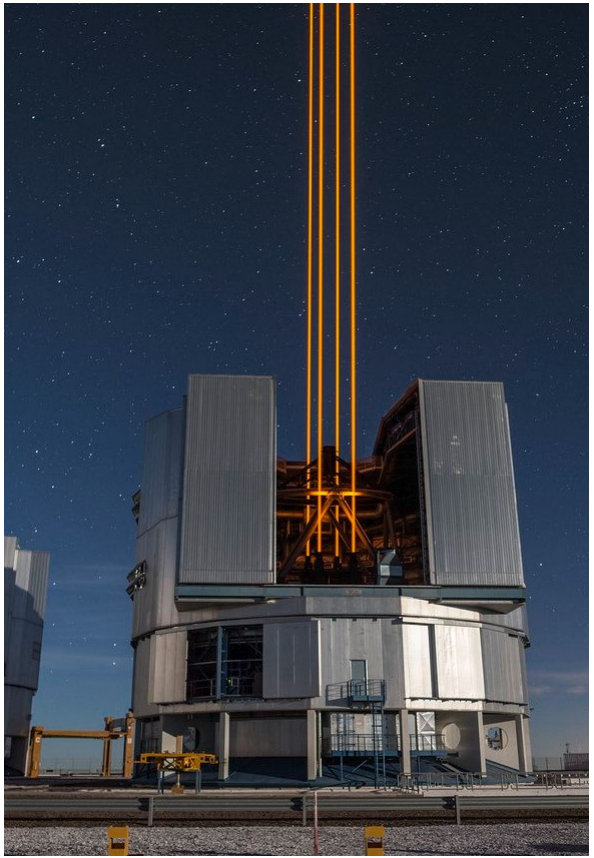
JA3.3.1 Auto-tuned AO Control for all

JA3.3.2 Towards virtual access to adaptive optics telemetry data

JA3.3.3 Workshops

JA3.3.4 Schools





OPTICON RadioNet Pilot

WP4/JA3.3 “ADAPTIVE OPTICS IN ACTION”

JA3.3.2 **Auto-tuned AO Control for all**

Building on OPTICON developments for the CANARY AO testbed facility, and new mathematical advances, it is possible to improve real-time AO control based on learning systems, without the need for expert intervention.

- Work has started on Sept 1, 2022, employment of an ORP postdoc (@IOTA + Durham) for 2 years: Nicolas GALLAND (formerly with LESIA team)

This scheduling is designed to align this work with planned on sky experiments later in ORP.

The developments are on schedule:

- DARC RTC + DASP simulator installed and working
- RTC-predictive control module is under study to better account for
  - (1) actuator saturation, larger loop delays, (2) missing measurements
  - Modifs (1) will be tested on GTCAO bench by Lucas MARQUIS (PhD) and the IAC team

WP4/JA3.3 “ADAPTIVE OPTICS IN ACTION”

JA3.3.2 **Towards virtual access to adaptive optics telemetry data**

Operating AO systems generate large and valuable datasets of control information. As of yet these data are not made available for the several possible applications – better data processing, atmospheric characterization, and improving control systems.

This activity is to *define and implement practical standards* to allow virtual access to AO data. Substantial progress has been made:

- Final stages of development of the Adaptive Optics Telemetry (AOT) standard, a FITS-based archive-ready data exchange format for sharing full AO telemetry.
- *aotpy* (helper Python package for AOT and translation from proprietary files) was presented at SPIE and is now publicly available.
- Interfacing has been demonstrated with real-world VLT data.

WP4/JA3.3 “ADAPTIVE OPTICS IN ACTION”

JA3.3.3 **Workshops**

The seventh edition of the "Wavefront Sensing in the VLT/ELT era" workshop series is scheduled for 19-21 October 2022.

This will be a in-person workshop in Porto, Portugal.

https://wfs2022.sciencesconf.org/

WP4/JA3.3 “ADAPTIVE OPTICS IN ACTION”

JA3.3.4 **Schools**

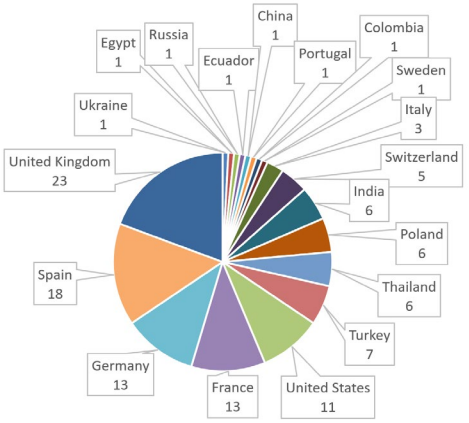
ORP provided support for the online European AO summer school in 2021 and 2022

School goal: Introduce and train attendees to all aspects of astronomical and *non-astronomical* AO instrumentation

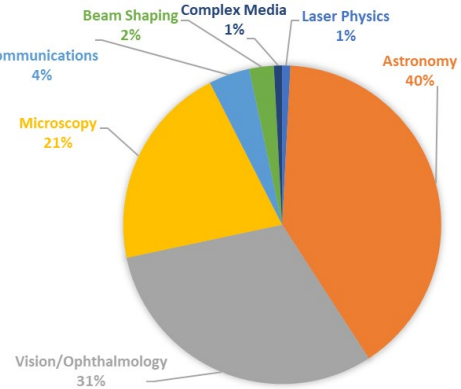
Fit to JA3.3.4: Train participants to understand, simulate and analyse AO system data through online worksheets and tutorials – focused on astronomical AO

Live demonstration of the VLT laser guide star AOF facility showing AO observational overheads and acquisition sequences

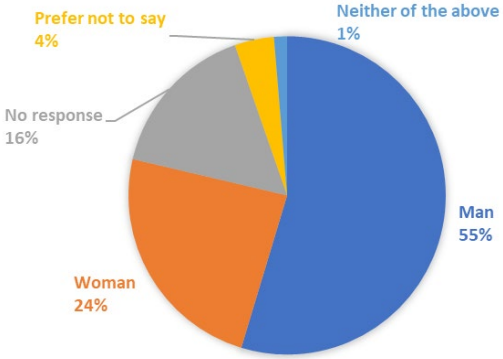
- **183 attendees** across 2 schools
- Mostly MSc/PhD students and Early Career Researchers
- Academic and industrial attendees
- Attendees from **25 countries**



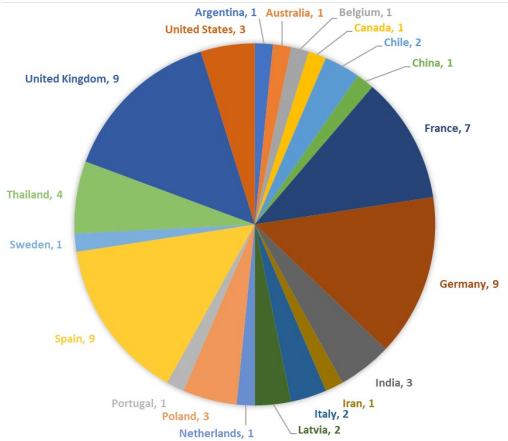
2021 attendees by country



2022 attendees by field



2022 attendees by gender



2022 attendees by country

WP4/JA3.4 “New algorithms for interferometric image reconstruction”

The aim of this activity is to explore innovative interferometric image reconstruction algorithms applied to data from instruments across the optical/infrared, and millimetre/radio domain. The two communities have complementary constraints and expertise. New Bayesian and machine learning methods are being expanded and tested.

Tests on simulated data including extended sources with superimposed point-like sources of different intensities already provide superior results compared to standard CLEAN.

A planned workshop involving imaging experts from the VLTI and (sub-) millimetre communities, scheduled for M12 (March 2022) has been postponed due to Covid and key people availability.

Deliverable D4.1, the report on this workshop, is consequently delayed.

The workshop will take place at ESO from January 9 to 11. The main organiser is Fabrizia Guglielmetti (ESO).

query

- b) Deviation on effort per WP
- Ben. 1 - CNRS over-consumed their planned effort for WP4 .
- *Please ensure that CNRS will have enough resources to continue working on WP4, as they exhausted their initial allocation of PM*.
- Allocation is 4pm each to CNRS and OBSP, total 8. The allocation is not “exhausted”. CNRS reported 5.49pm, which was work on Adaptive optics.
- Simple mistake – CNRS will correct report to 4pm.
- Full planned VLTI effort of 4pm still available.

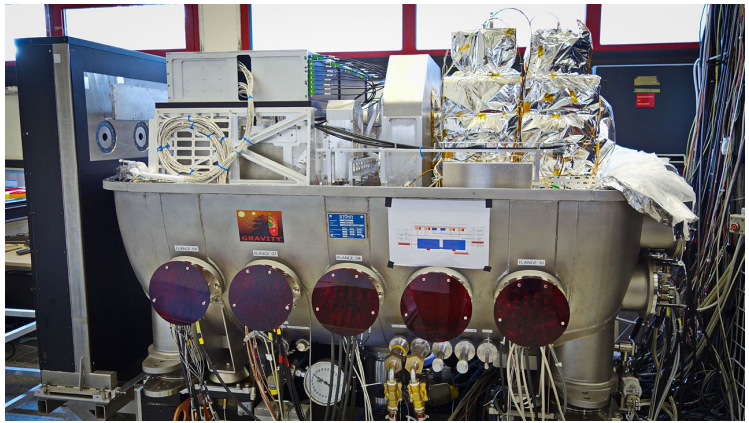
WP4/JA3.2 “ENHANCING THE CAPABILITIES OF THE VLTI”

JA3.2.1 Development and commissioning of an off-axis tracking mode for GRAVITY to increase the sky coverage

First Light for GRAVITY Wide: Large Separation Fringe Tracking for the Very Large Telescope Interferometer 15 pages, 12 figures, 5 tables. Accepted by A&A [arXiv:2206.00684]

ORP postdoc hired (F. Widmann) technical work late 2021. Commissioning description and results published (above). Offered for community use in late 2022.

Designs for further improvements and upgrades continue.

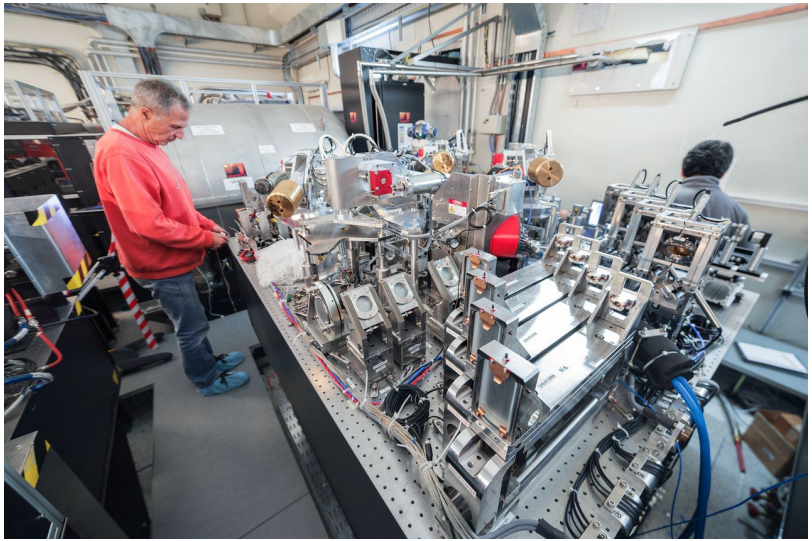


WP4/JA3.2 “ENHANCING THE CAPABILITIES OF THE VLTI”

JA3.2.3 A correlated flux mode for MATISSE to reach faint targets

Status: not started. Ongoing discussions with a potential candidate who could start in early 2023. S/w upgrade of extant system.

Will commission a new correlated-flux mode of MATISSE that will allow observation of the faintest accessible sources with much improved signal-noise ratio compared to the standard observing mode in which visibilities are observed.



WP4/JA3.2 "ENHANCING THE CAPABILITIES OF THE VLTI"

JA3.2.2 Preparation and integration of Hi-5/VIKING into the VLTI for high-contrast imaging

The technology for the Hi-5/VIKING instrument is a result of previous OPTICON funding under the JRA umbrella. Its capabilities cater to direct exoplanet detection at separations <0.1" and L-band spectroscopy, probing the snow line where most exoplanets are located.

ORP postdoc (M-A Martinod) started at KU-Leuven Feb 2022.

Martinod is coordinating work across the (Europe-Australia) consortium to prepare and organise the integration of the visitor instruments at the VLTI. A science case (step 1) has been submitted to ESO, and documents prepared for end-July ESO technical review.

While Hi-5/VIKING nominally is a Visitor Instrument, with support through the Pilot call we will open the instrument to the community through the "PIONIER model", where interested users will contact and collaborate with the instrument team on proposal planning, submission, and data reduction.