WP17 VLTI Expertise Centres

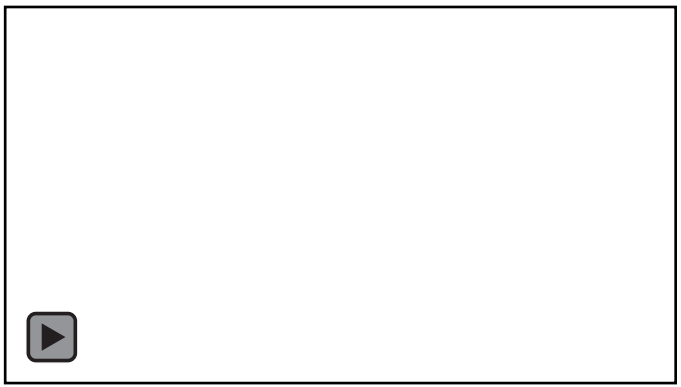
Paulo GARCIA – UPORTO on behalf of the European Interferometry Initiative (Eii)

Final Review, on-line, 2025.05.23

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

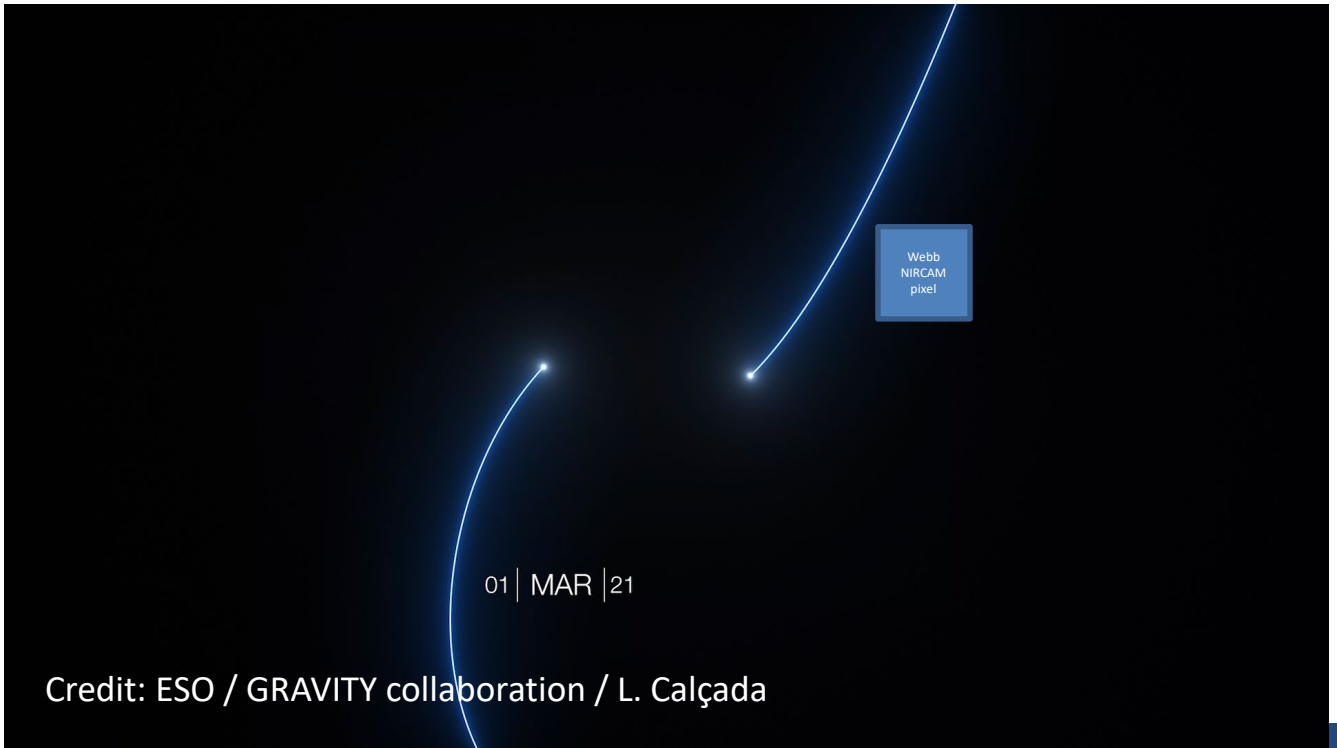
The ESO/VLTI Infrastructure

- Paranal Observatory, Chile
- Unique world leading facility with four 8-m or four 2-m class telescopes
- Baselines up to 200m
- Three instruments
  - PIONIER (H-band, 1.6 μm)
  - GRAVITY (K-band, 2.2 μm, LR, MR, and HR, now GRAVITY+ in phase A)
  - MATISSE (L to N band, 3 to 13 μm, LR to HR)
- Visitor focus available ➔ Asgard
- GRAVITY+ on it's way to completion



The ESO/VLTI Science

- Large diversity of scientific results from planets to supermassive blackholes and AGNs.
- Half of the Nobel Prize in Physics 2020 was warded jointly to Andrea Ghez and Reinhard Genzel "*for the discovery of a supermassive compact object at the centre of our galaxy.*“
- The GRAVITY instrument was key in this discovery.
- Competitive and unique infrastructure in the JWST/ELT era



Credit: ESO / GRAVITY collaboration / L. Calçada

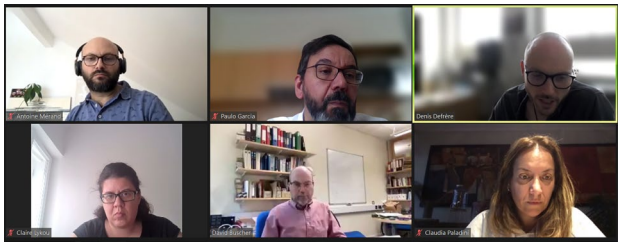
WP 17: Enhancing the access to the ESO/VLTI by providing

- Central management (Task 1)
- Support services via the VLTI Expertise Centre's network, including visitor travel (Task 2)
- GRAVITY instrument curated data (Task 3)
- Python tools for optical infrared interferometry data analysis (Task 3)
- Collaborative & training exchanges of researchers and technical staff with the Fizeau Programme (Task 4)
- Dissemination to new users with VLTI Summer Schools and VLTI Open Days (Task 5)

- Website: https://european-interferometry.eu/

WE FOCUS ON PERIODIC REPORT 3 (SEPTEMBER 2023 ONWARDS)

Task 1: Management



- The European Interferometry Initiative (Eii) is an open association of institutes collaborating in the exploitation / development of optical / infrared interferometry.
- The Eii Bureau oversees the activities in the Opticon Radionet Pilot (ORP), it meets monthly, includes WPLs, ESO, elected community members.
- Only a small subset of Eii members are part of the ORP ➔ spreading the project impact in a wider community.
- <u>Highlights since September 2023</u>
- EII activities presentation in the ORP consortium meeting, November 2023.
- Virtual Meeting of the Science Council Meeting 15th May 2024, 22nd May 2025
- SPIE Contributed talk on EII
- EII Early Career prize (2024) organized and awarded to Tyler Gardner
- Contribution to the EXOSHARE project for the INFRATECH 2024/2024 calls
- New Bureau elected in yesterday: Claudia Paladini (President), Guillaume Bourdarot (Vice President), Foteini Lykou (Secretary)

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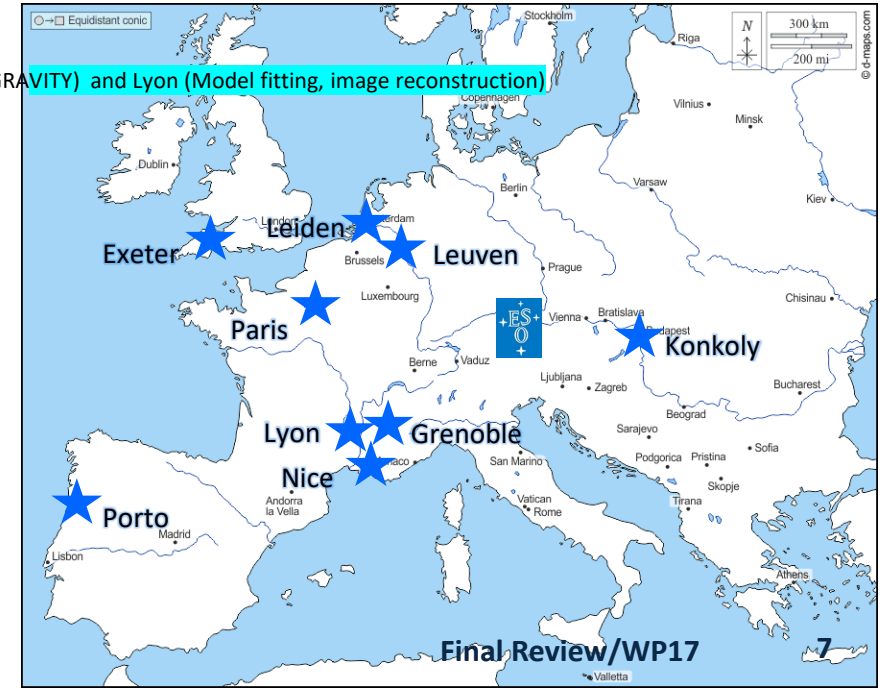
Eii European Interferometry Initiative

Task 2: VLTI Expertise Centre's network

- ESO USD (not a formal expertise centre, nor funded by the Opticon Radionet Pilot)
  - ESO user support for VLTI | https://support.eso.org
- Exeter
  - http://emps.exeter.ac.uk/physics-astronomy/research/astrophysics/facilitiesandresources/uk_vlti/
  - End-to-end user support; exchange with US interferometers
- JMMC (Paris, Lyon, Grenoble, Nice)
  - http://www.jmmc.fr/suv
  - End-to-end user support | Paris (GRAVITY), Nice (MATISSE), Grenoble (GRAVITY) and Lyon (Model fitting, image reconstruction)
- Konkoly
  - https://vlti-ec.konkoly.hu/
  - Proposal preparation, exchange with radio-interferometry
- KU Leuven
  - https://fys.kuleuven.be/ster/projects/belgian-vlti-expertise-centre
  - End-to-end user support (GRAVITY), image reconstruction
- Leiden
  - http://vlti.strw.leidenuniv.nl
  - End-to-end user support (focus on MATISSE)
- Porto
  - https://centra.tecnico.ulisboa.pt/news/?id=4719
  - End-to-end user support for GRAVITY, WP lead

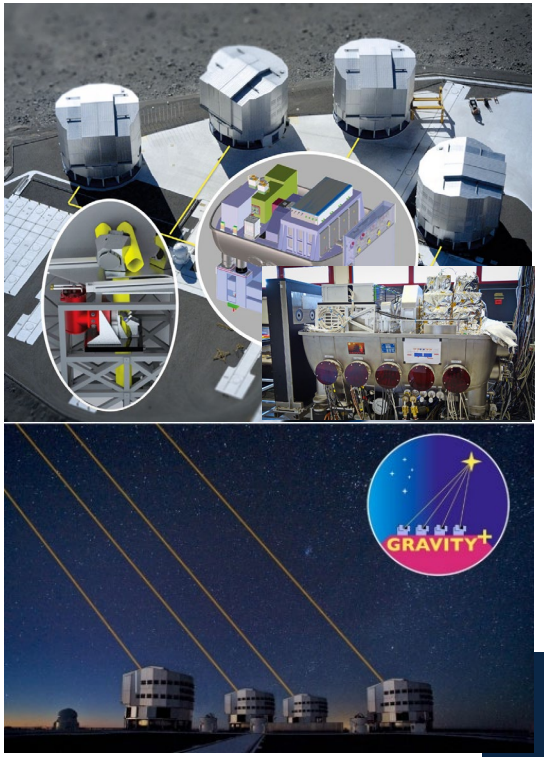


Task 2: VLTI Expertise Centre's network

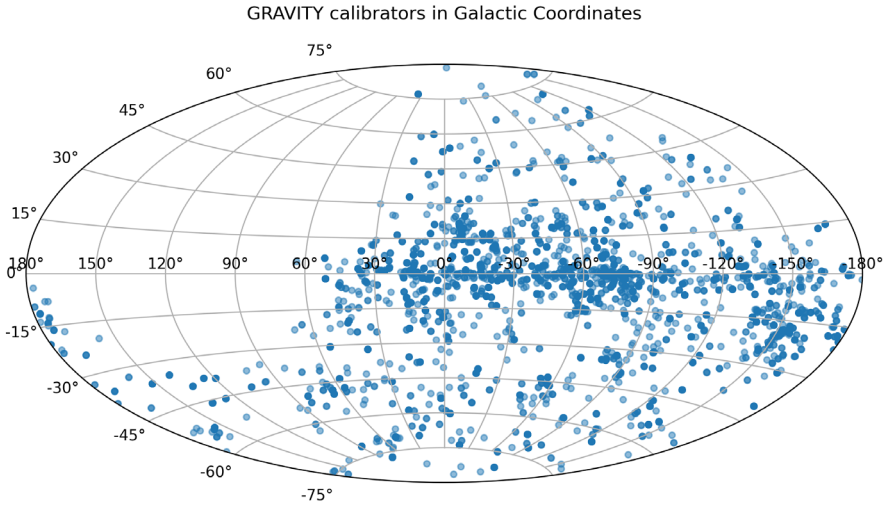
- Support scientists and local infrastructure are identified and made available at each node.
- The centres operate in close cooperation with ESO.
  - A periodic newsletter from ESO to VECs with latest information on VLTI is circulated.
- The availability of the VLTI Expertise Centres is also announced in the ESO Call for Proposals and Science Newsletters.
- Highlights Since September 2023
- 44 support requests (mostly for JMMC)
- Invited talk at SPIE 2024
- Future of VLTI Expertise Centres Discussions
- Leiden Centre discontinued at end of ORP

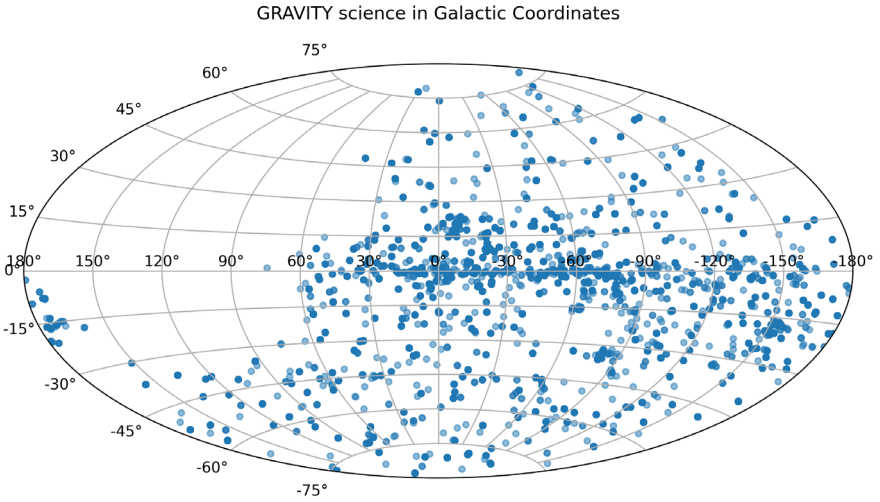
Task 3: GRAVITY data curation and tools for interferometry analysis

- Original proposition: pilot programme to curate GRAVITY data (science ready, following FAIR guidelines).
- Highlights since September 2023
- Contributed talk at SPIE 2024
- This evolved into a **full archive data curation** (work is in progress)
- Calibrators
  - science object files: 3 TB
  - sky files: 1.6 TB
- Science
  - object files: 11 TB
  - sky files: 3 TB
- All GRAVITY modes being curated except astrometric mode
- GRAVITY+ modes will not be curated
- Delivery of D17.3: GRAVITY curated data (pilot)

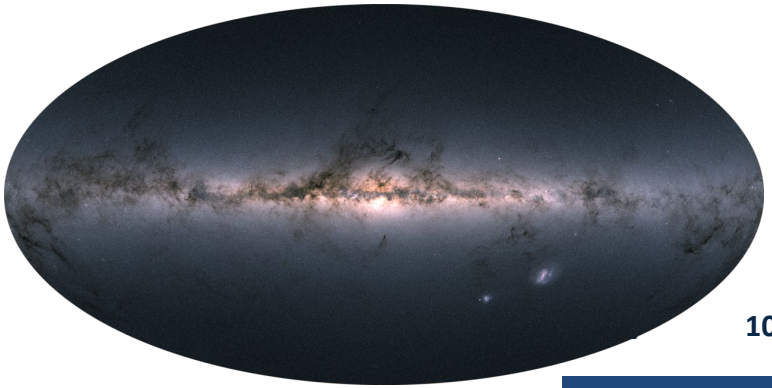


Task 3: GRAVITY data curation and tools for interferometry analysis





Science: 13 k files
Calibrators: 4.4 k files



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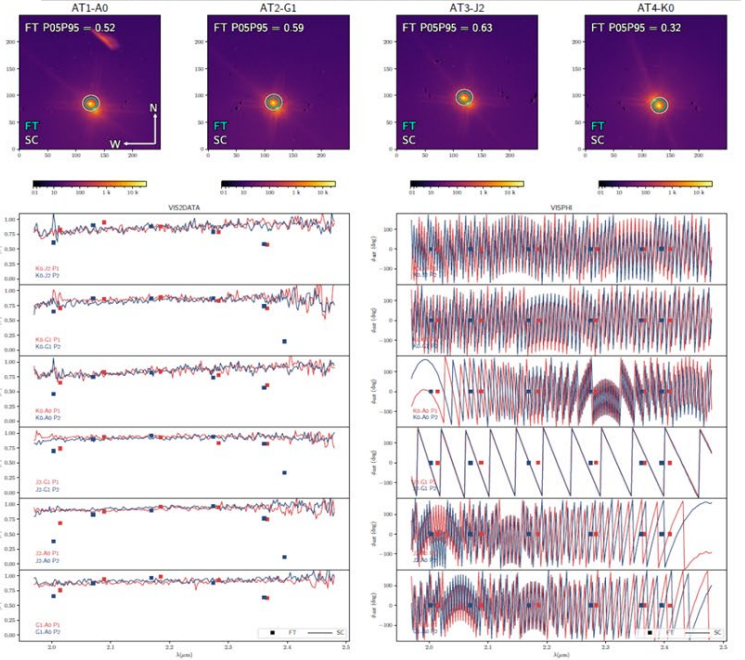
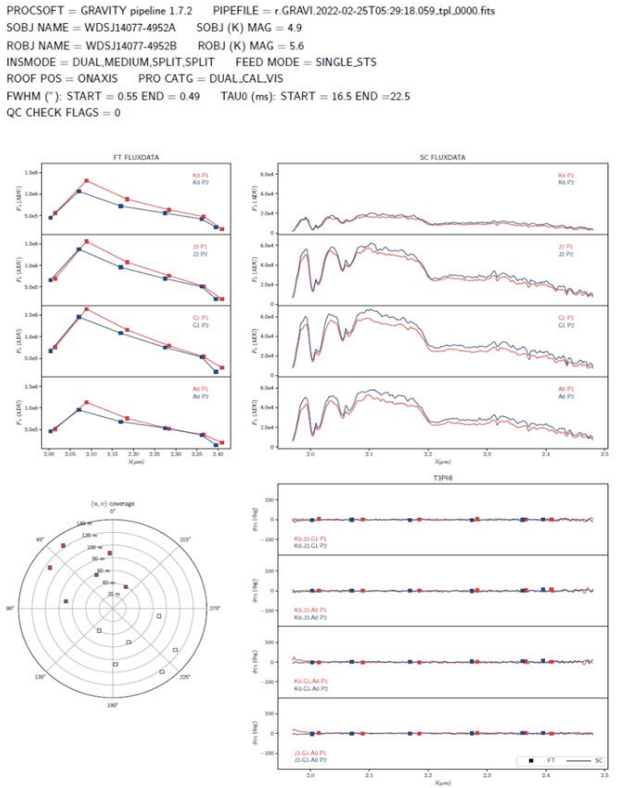
Task 3: GRAVITY data curation and tools for interferometry analysis

- Curated data will be associated with a dashboard
- Color blind inclusion

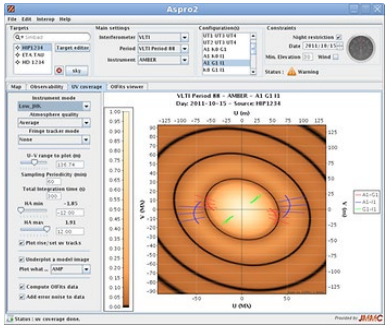
	K0-J2	K0-G1	K0-A0	J2-G1	J2-A0	G1-A0
FT PFACTOR	0.96	0.97	0.95	0.97	0.95	0.95
FT VFACTOR	0.94	0.95	0.94	0.93	0.93	0.95
FT SNRB AVG	12.4	12.3	11.8	13.0	12.1	12.5
PHASE FT RMS (rad)	0.36	0.38	0.41	0.38	0.42	0.37
SC SNRB AVG	23.0	24.3	147.1	167.2	24.3	24.3
TRACKING RATIO FT (%)	99	99	99	99	99	99
PBL START to END (m)	70.3 to 70.5	113.5 to 113.7	123.4 to 123.5	58.0 to 58.0	87.5 to 87.5	39.8 to 39.9
PBLA START to END (deg)	80.4 to 80.6	55.3 to 55.6	36.6 to 36.9	24.5 to 24.7	2.8 to 3.0	330.2 to 330.3

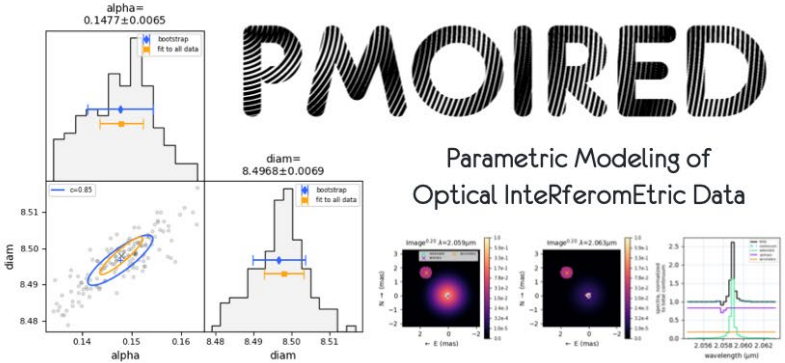


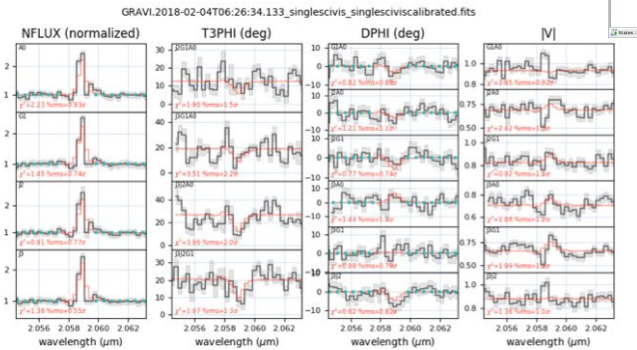


Task 3: GRAVITY data curation and tools for interferometry analysis

- Approach:
  - Review the state-of-the art in supporting tools for optical long baseline interferometry (and also radio)
  - Define the data analysis tools requirements
  - Implement and document the tools
- Outside scope
  - Observation preparation solved (Aspro2)
  - Data visualization solved (OIFits Explorer)
  - Imaging
- <u>Highlights since September 2023</u>
- PMOIRED packaged for easy installation and available
- Jupyter notebooks being developed highlighting use of PMOIRED
- Delivery of D17.4: Interferometry data analysis tools

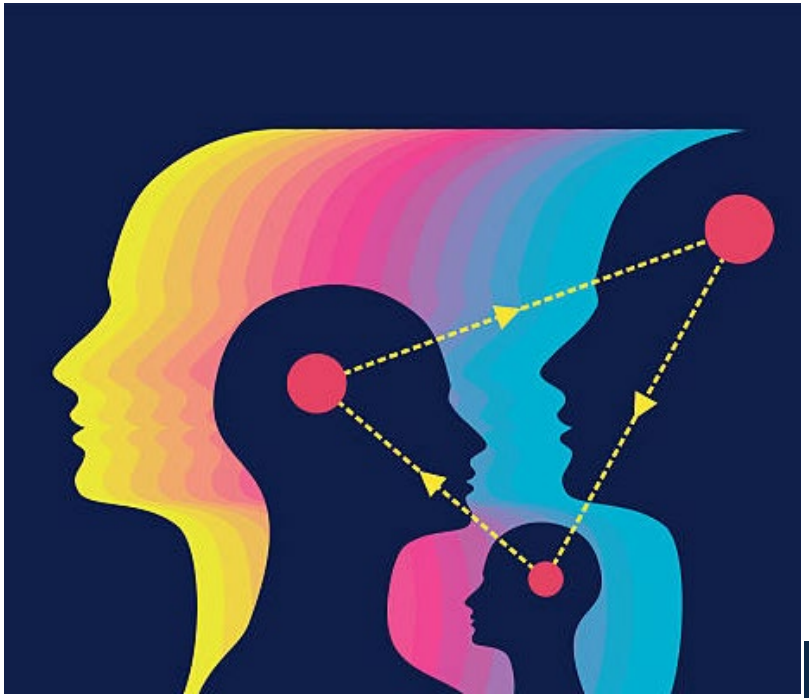






Task 4: Fizeau Exchange Visitors Programme

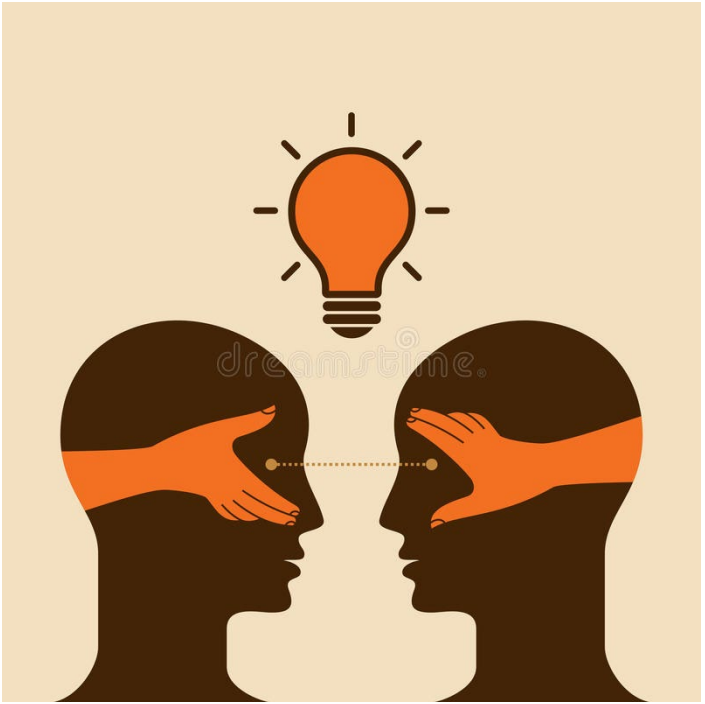
- The selection committee is composed of researchers not affiliated to the expertise centres.
  - Claudia Paladini (ESO, Chair),
  - Alessandro Marconi (IT),
  - Jose C. Guirado (ES),
  - Krzysztof Hełminiak (PL),
  - Rebeca Garcia Lopez (IE).
- The Fizeau programme is announced in several newsletters
  - the OLBIN newsletter
  - as well as in ESO dissemination channels (e.g. https://www.eso.org/sci/publications/newsletter/may2022.html).



https://www.istockphoto.com/

Task 4: Fizeau Exchange Visitors Programme

- Highlights since September 2023
- During the reporting period the following calls were managed (https://european-interferometry.eu/fizeau-program/23-funding_results):
  - 2023B – 3 funded applications
  - 2024A – 5 funded applications
  - 2024A-VLTI School – 8 funded applications
  - Programme closed after full execution of funds and closure of ORP (no 2024B call in November 2024)



https://www.dreamstime.com/

Task 5: Outreach to new users

Highlights since September 2023

An invited VLTI talk was presented at the "First European ALMA school" on 12th June 2024. https://www.alma.ac.uk/index.php/meetings/upcoming-meetings/568-eu-alma-school-2024

Oral communication on the EII activities at the 2024 European Astronomical Society Meeting Special Session "European Forum of Astronomical Communities", 4th July 2024. https://eas.unige.ch/EAS2024/session.jsp?id=SS22

Organisation of the Special Session "The VLTI at the ALMA, JWST and ELT era", the 5th July 2024, during the 2024 European Astronomical Society Meeting. https://eas.unige.ch/EAS2024/session.jsp?id=SS20

Lecture "Introduction to Optical Interferometry" by Foteini Lykou, the 23rd October 2024 at the 2024 NEON School.

Lecture "Introduction to Optical Interferometry" by Foteini Lykou, the 13th February 2025 at the 2025 NEON School.

The co-organisation of the special session at EAS 2025, 23rd – 24th June 2025, "The future of visible/infrared High-Angular Resolution Astronomy in Europe" https://eas.unige.ch/EAS2025/session.jsp?id=S6

Organisation of the lunch session at EAS 2025, 27th June 2025, "Your science with the VLTI: easier than you think!". https://eas.unige.ch/EAS2025/session.jsp?id=LS7

Task 5: Outreach to new users

12th VLTI School of Interferometry, 23-28 September 2024, Porquerolles, FR (https://vltischool2024.sciencesconf.org/resource/page/id/7) with a talk on radio interferometry and ALMA

On-line: 16-19 September 2024 and on-site: 22-28 September 2024 in Porquerolles,

- ESO's "Expanding Horizons" Process called for defining the next flagship project after the ELT, with operations envisioned in the 2040s.
- Unique Opportunity for Optical Long Baseline Interferometry
  First step: workshop organised in France January 2025
  - Identify transformative science cases
  - Discuss required technologies & infrastructures
  - Shape the community's vision
- Community Engagement:
  - Broad participation
  - Discussions on future, community, and post-workshop planning
- Legacy & Vision:
  - Commemorating the 1985 VLTI Interim Report—its vision now realized with GRAVITY+
- Next step: Call for white papers

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Pilot

Conclusions

Structuring effect in bringing long-baseline optical interferometry to the mainstream.

Lasting impact is foreseen due to the training, the curated data, and the tools that are made available.

Challenges remain in the horizon.

Although some Centres will remain active due to in-house expertise, the services scope will be greatly reduced (except JMMC).

Shared challenges (e.g. VLTI schools and NEON schools, Fizeau and ARC nodes) are opportunities for joint approaches.