

VLTI update

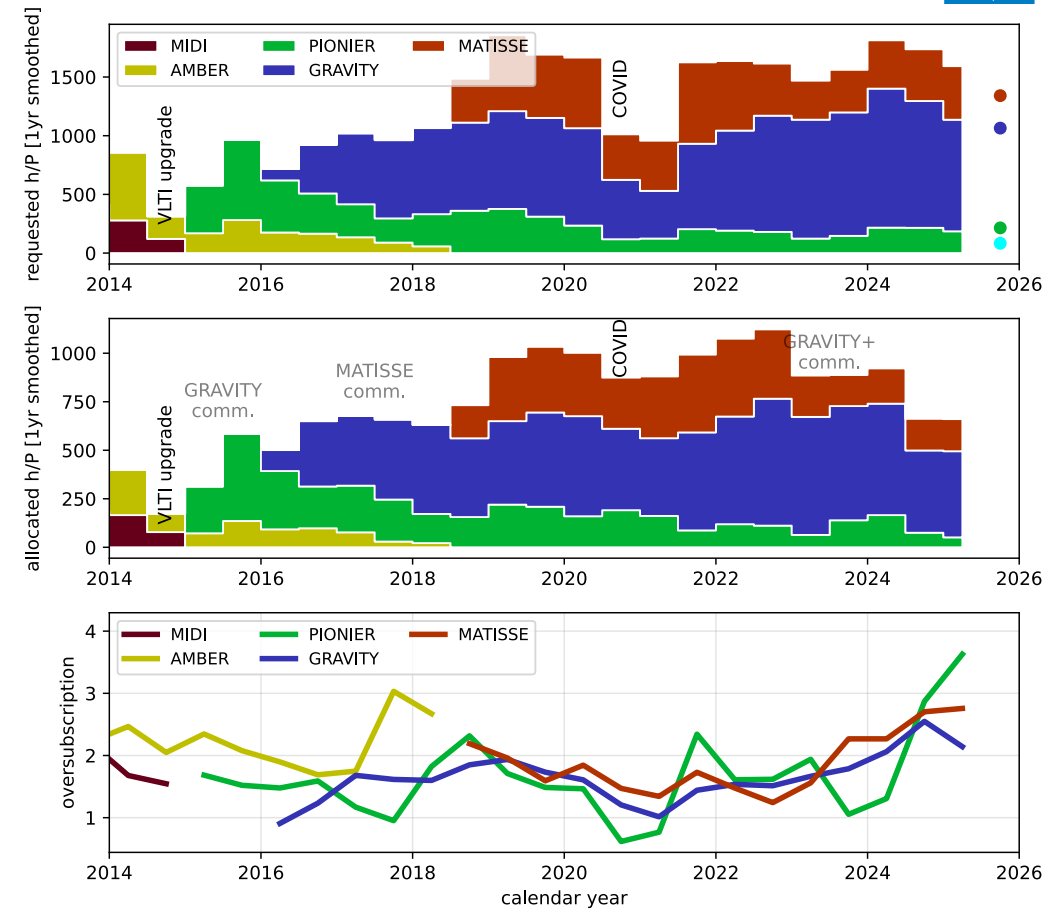
Antoine Mérand

VLTI Programme Scientist (ESO Garching)

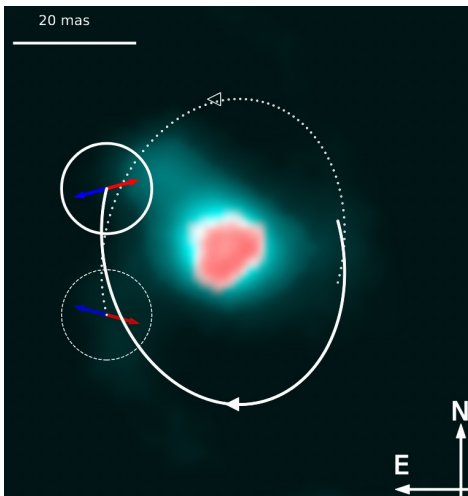


Few statistics

- Healthy requests
- Recently decrease of allocated time due to commissioning time for GRAVITY+
- Publications: 2024 best year on record! 42 refereed publications:
 - 33 with GRAVITY
 - 10 with PIONIER
 - 9 with MATISSE



Science Highlights I



AGB star V Hya by MATISSE: dust enhancement around companion (Planquart+24)

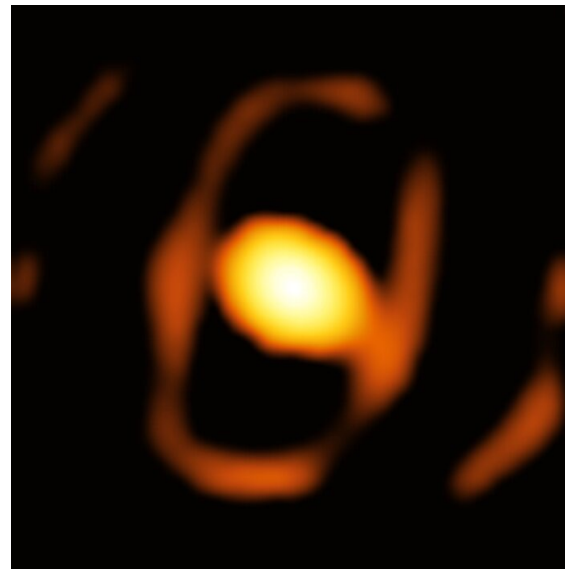
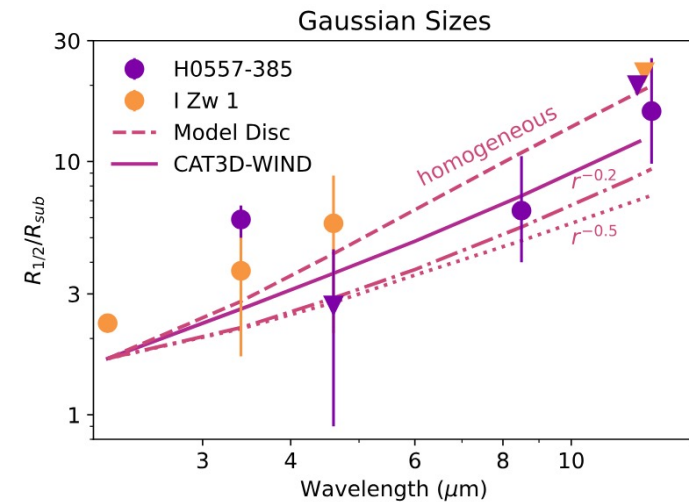


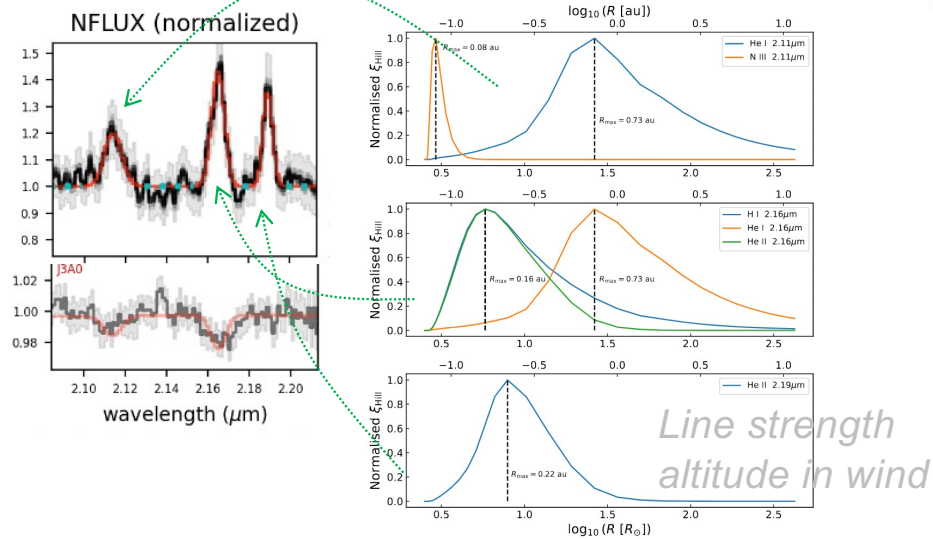
Image of WOH G64 in LMC (Ohnaka+24)



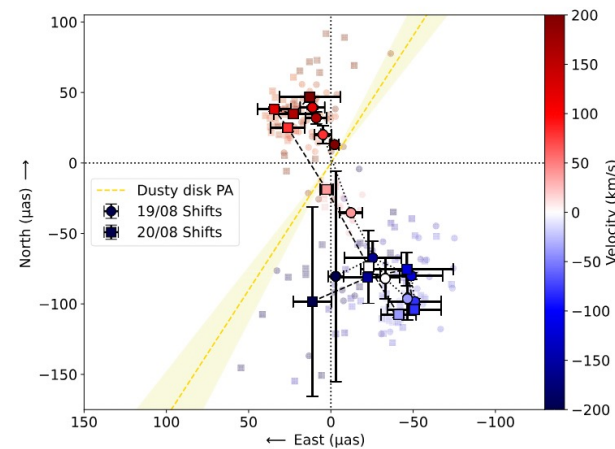
MATISSE, GRAVITY, MIDI data consistent with equatorial dust and no jets in high accreting AGNs (Drewes+25)

Science Highlight II

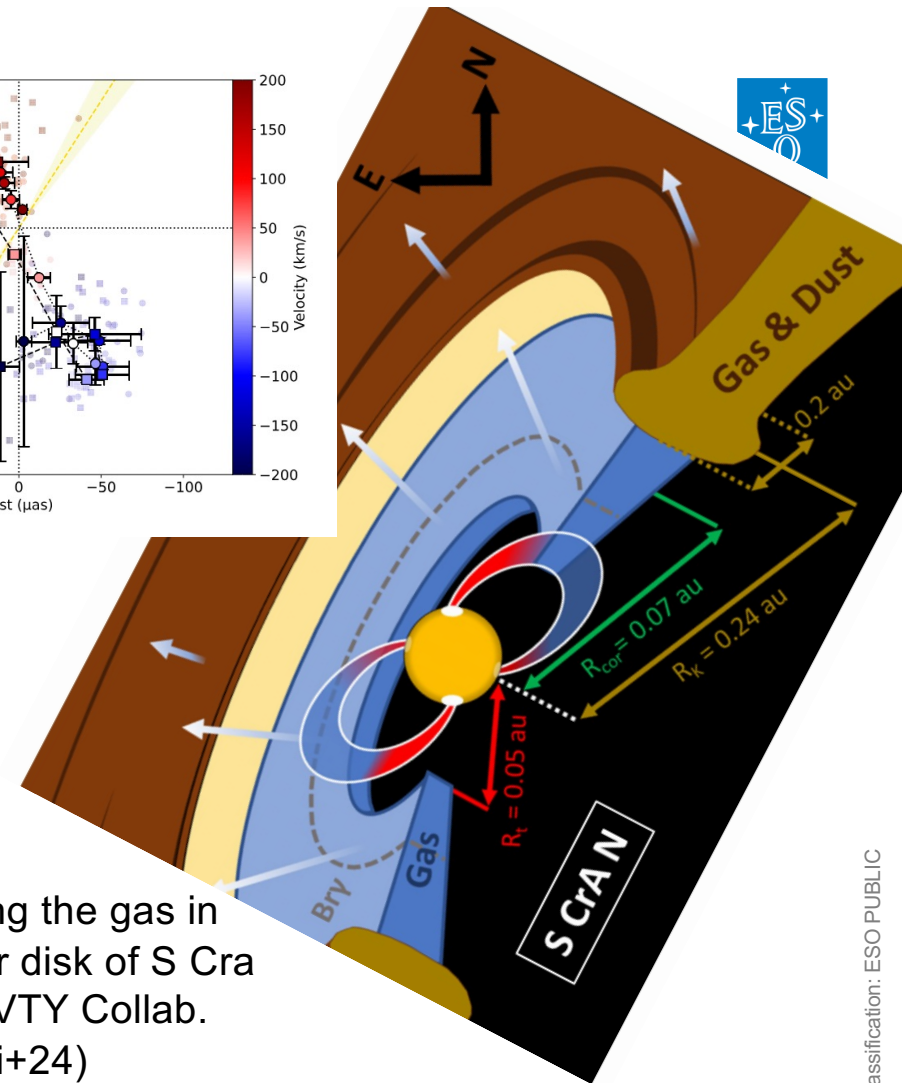
Spectro-interferometry



survey of 39 Wolf-Rayet stars:
binarity and resolved winds
(Deshmukh+24)



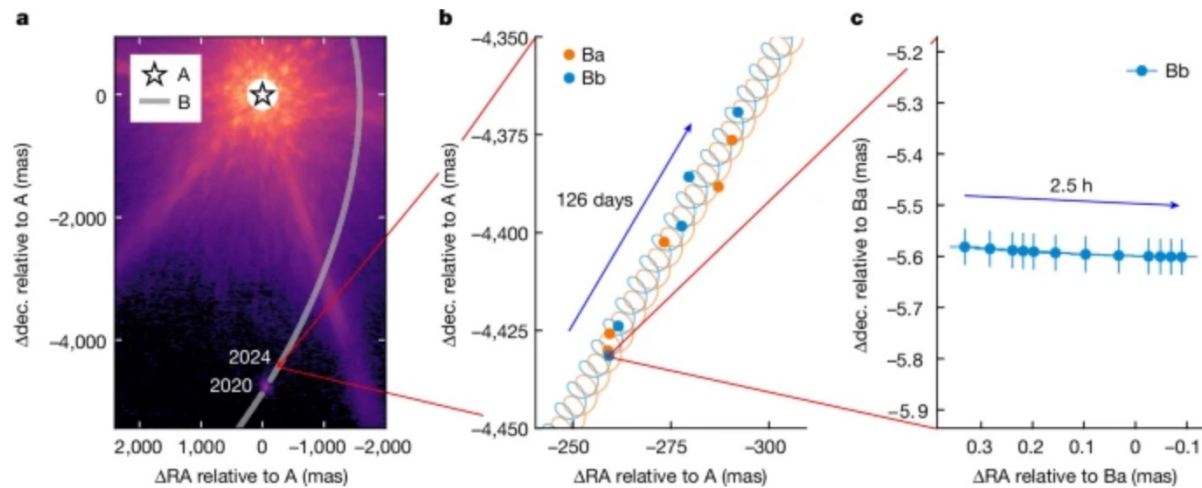
Resolving the gas in
the inner disk of S Cra
N (GRAVITY Collab.
Nowacki+24)



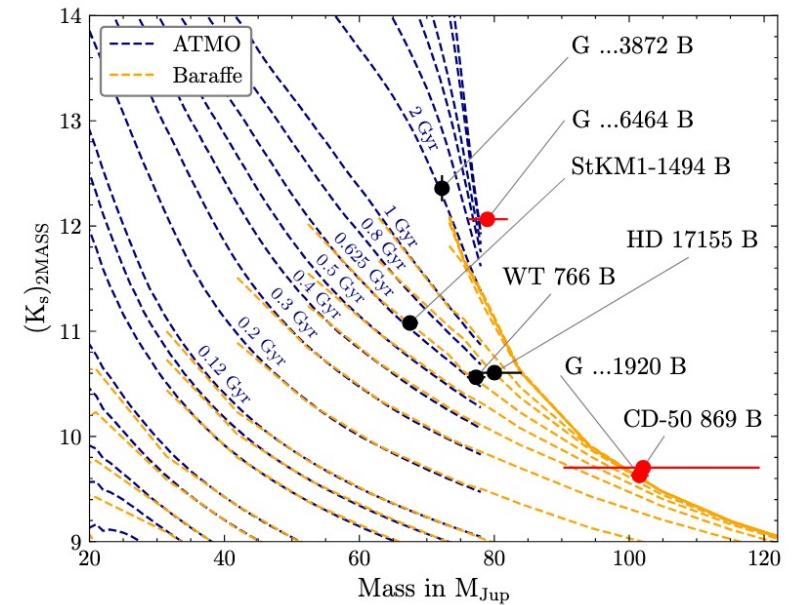
Science Highlights III

Brown dwarfs

Fig. 1: The detection and astrometric orbit of Gliese 229 BaBb.



Brown Dwarf GL229b is a binary:
38+34M_{Jup}, 16 Earth-Moon away !
(Xuan+24, Nature)

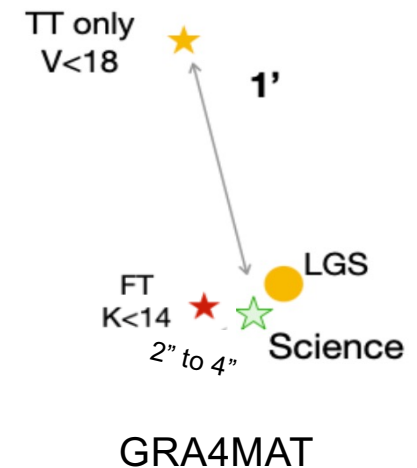
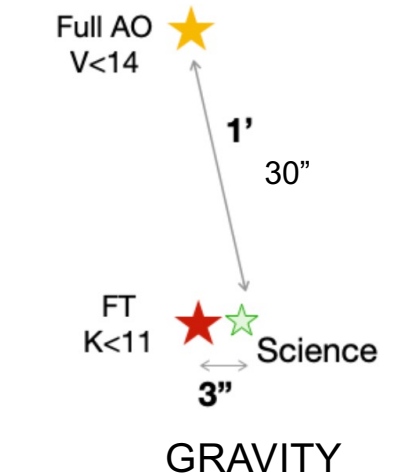
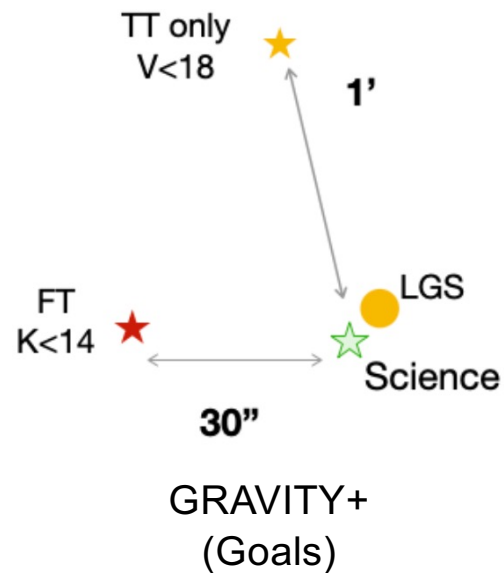


Combine Gaia + GRAVITY
BD masses and spectra
(Pourré+24, Winterhalder+24)

GRAVITY+

Higher sensitivity and better sky coverage from $V, K < 14, 11$ to $< 18, 14$

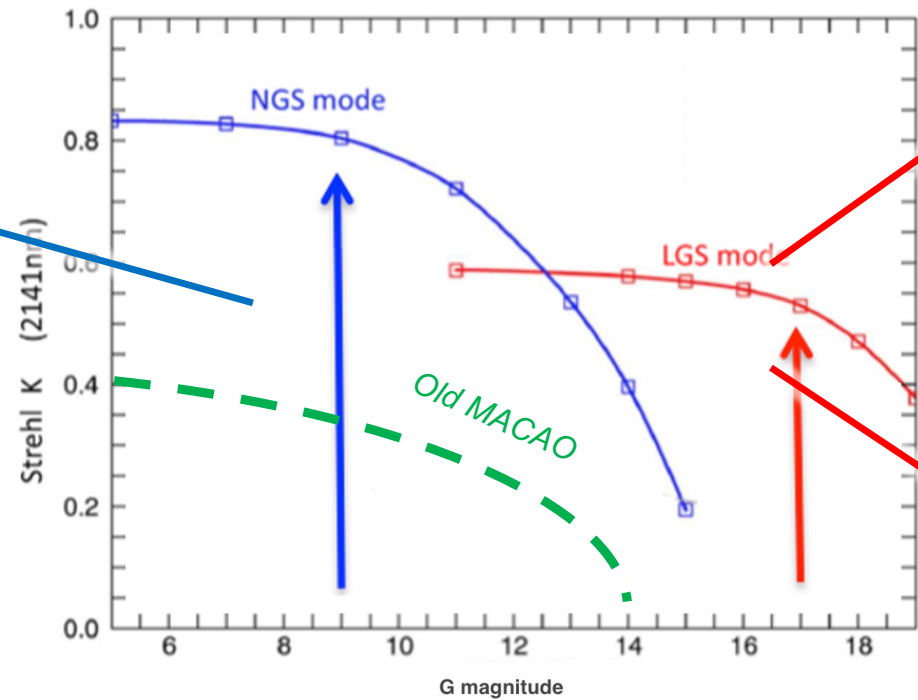
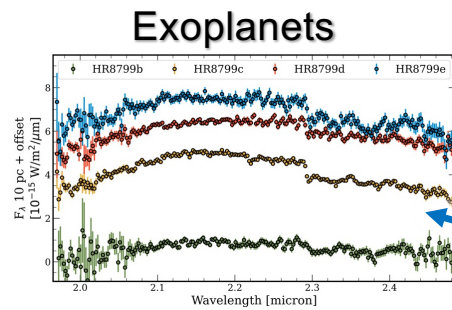
- Off-axis capabilities: 3'' to 30'' (GRAVITY Wide)
- Better Adaptive optics: better and more stable strehl
- Laser Guide Stars to improved sky coverage



Check <https://searchft.jmmc.fr/> to check if AO/FT stars are available for your favourite targets!

GPAO: New adaptive optics on UTs

Scientific objectives



Stellar black holes

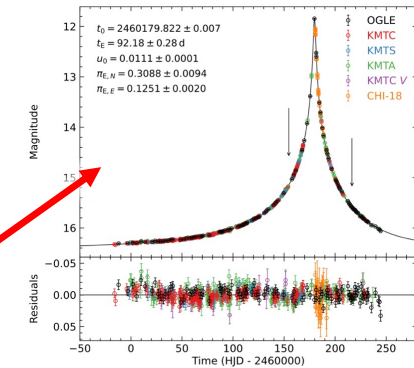
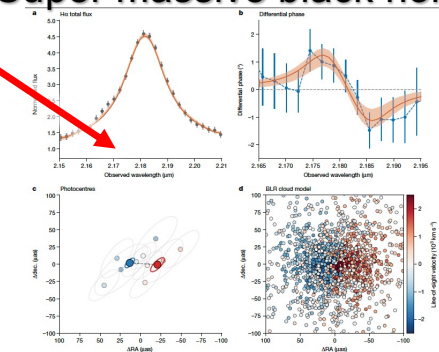


Figure 2. Light curve of OGLE-2023-BLG-0061. The black line marks the best-fit model with $u_0 > 0$. Arrows mark the two epochs of VLTI observations.

Super massive black holes



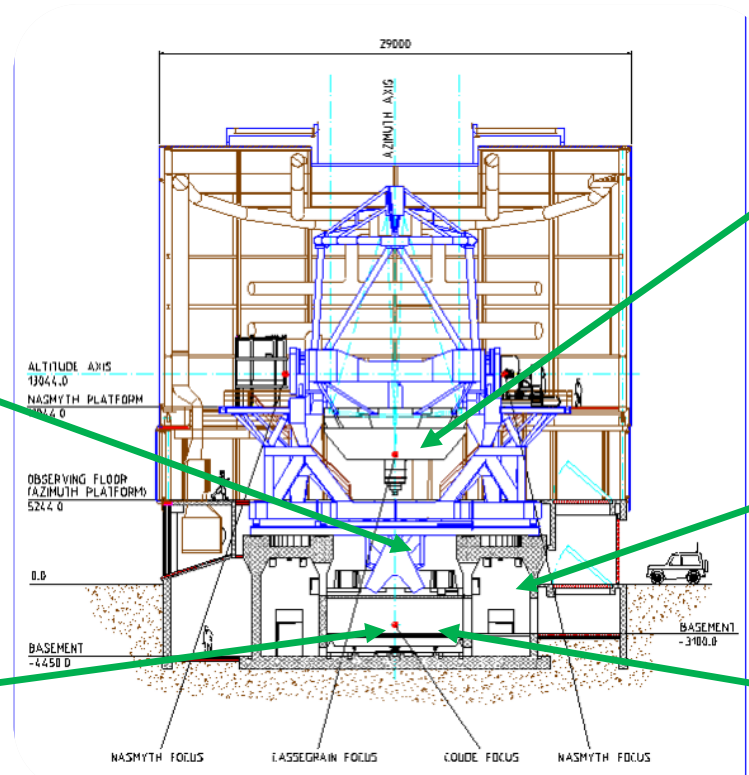
GPAO: New adaptive optics (installed in July 2024)

Proven implementation (based on VLT/ERIS)

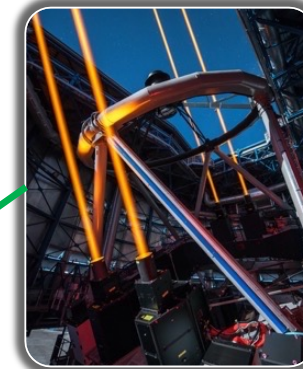
40x40 ALPAO deformable mirror



Wavefront sensors:
40x40 Visible Natural Guide Star
30x30 Sodium Laser Guide Star



Laser Guide Star



SPARTA-based
real-time computer



Infrared wavefront sensor (CIAO)



AO performances

Results from late 2024 commissioning

- Higher strehl than MACAO (x2)
- More stable strehl -> stable flux coupling
- Lower OPD residuals (MACAO mirror was coupling AO modes with piston)
- +1mag for FT sensitivity!
 - K=11.5 in off-axis mode
 - K=11.0 in on-axis mode
- Sensitivity K~18 for SC

Bourdarot, Le Bouquin, Berdeux et al. (in prep)

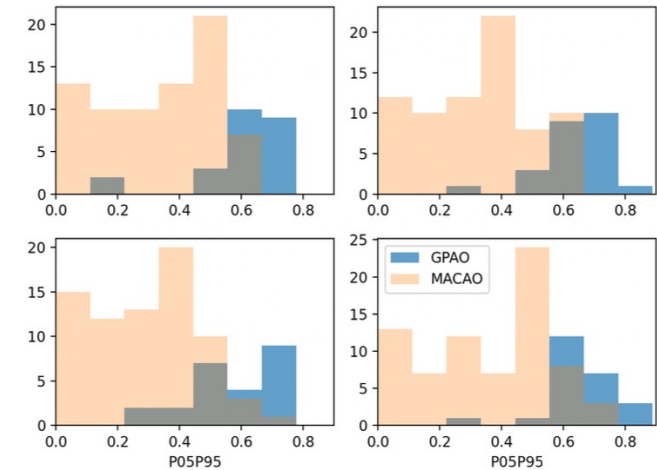
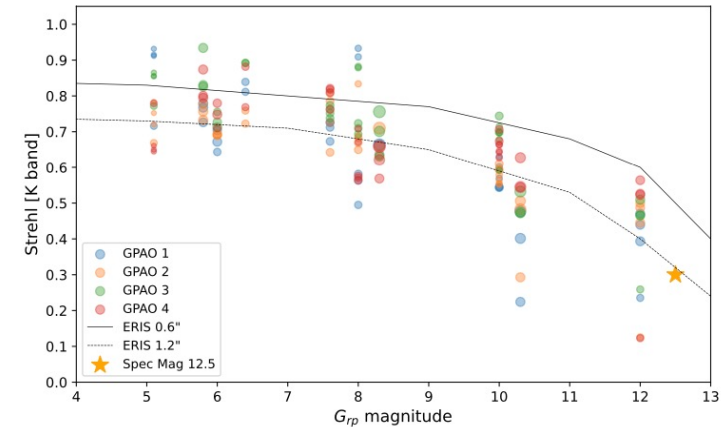
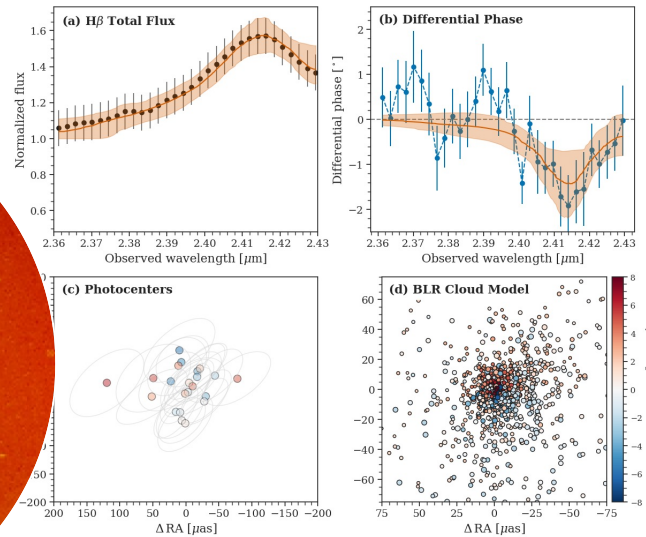
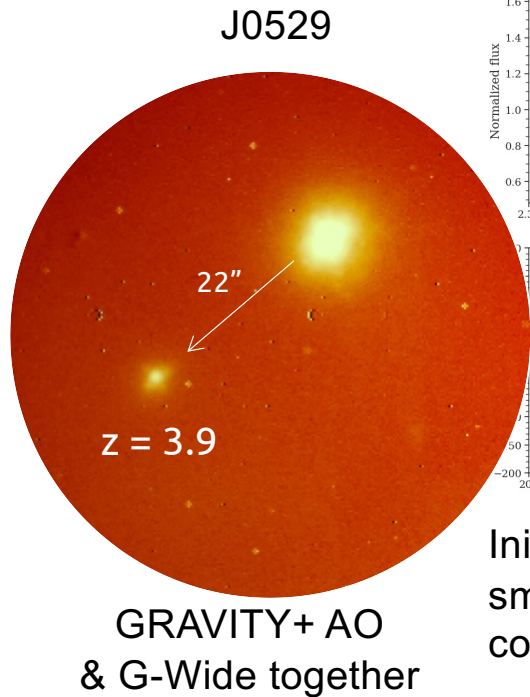


Fig. 4. Comparison between MACAO and GPAO AO of the $P_{5\%}/P_{95\%}$ injection metric histograms for the GRAVITY fringe tracker. The flux dropouts, represented by $P_{5\%}/P_{95\%}$ values close to zero, are significantly reduced by GPAO.



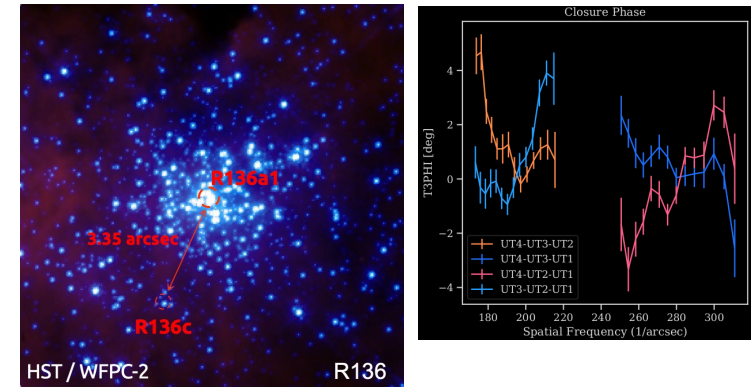
Early Science from Commissioning

New capabilities and much improved past results



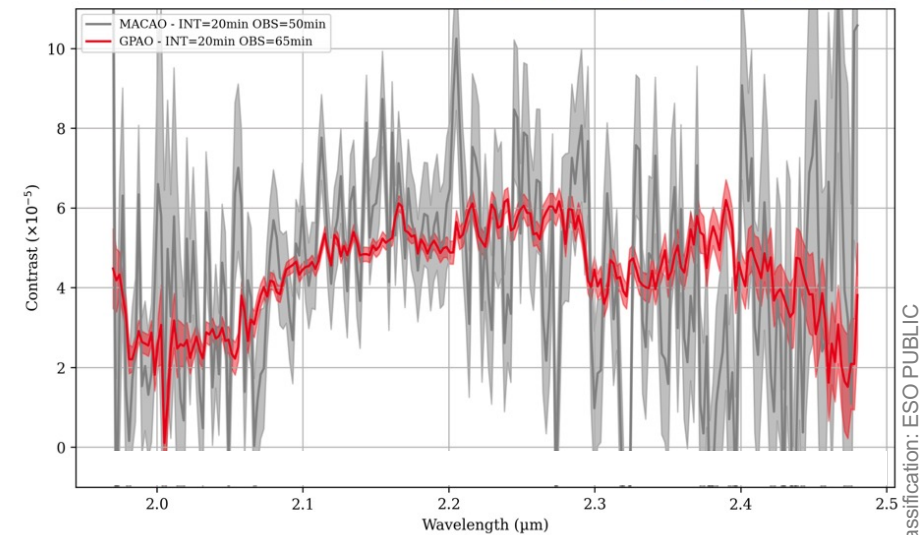
Initial modelling suggests much smaller BLR and SMBH by 1 dex compared to Reverberation Mapping

Bourdarot, Le Bouquin, Berdeux et al. (in prep)



Binary separation detected in the LMC

MACAO SNR=2.2 per spectral channel /// GPAO SNR=15 per spectral channel

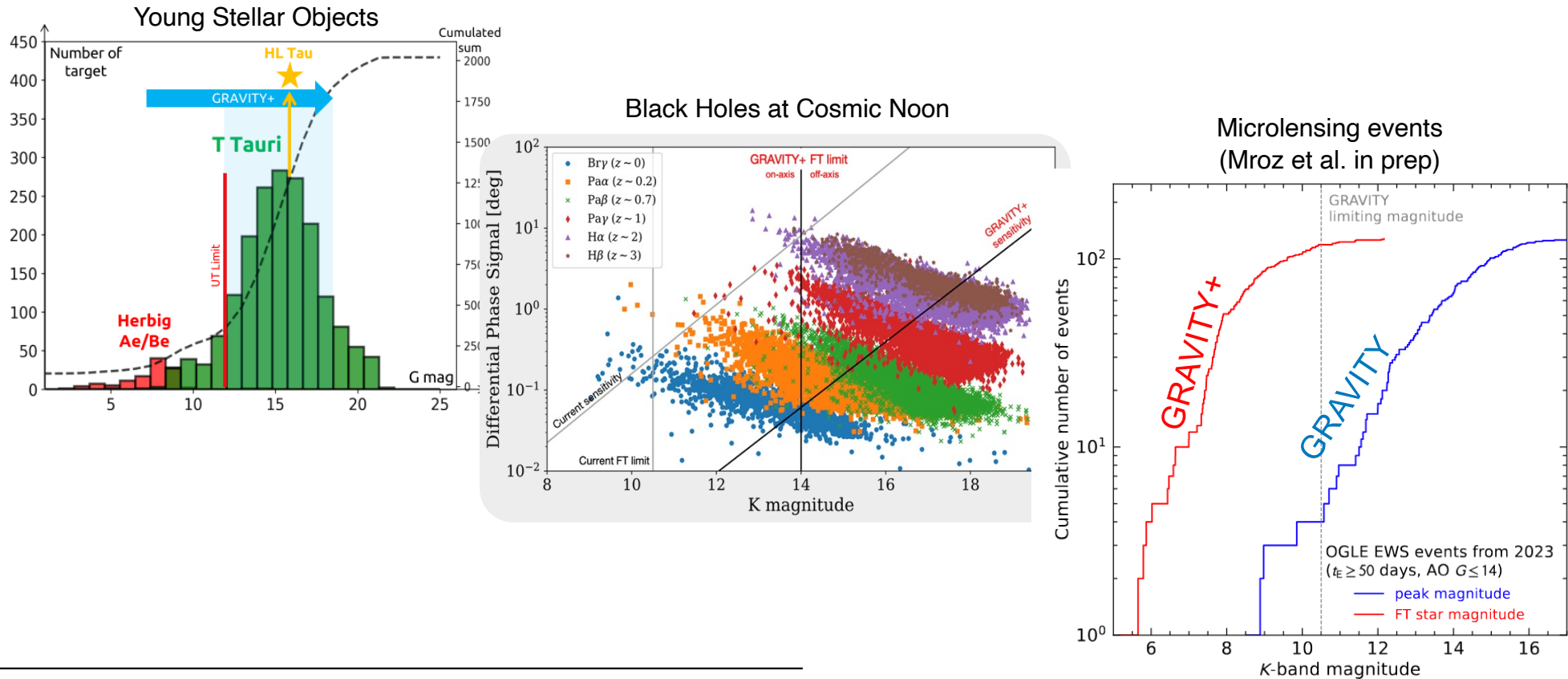


x5 improvement in SNR for spectrum of planet HR8799e

Data Classification: ESO PUBLIC

Improvement of sensitivity: get ready!

From a dozen of targets to hundreds (or even thousands)



Timeline

- Q3.2024: GPAO with natural guide star commissioning (NGS)
- Q4.2024: NGS operations started
- Q1.2025: Laser Guide Star (LGS) early commissioning with UT4
- Q3.2025: LGS 1,2,3 to be shipped and installed
- Q4.2025: LGS commissioning with 4 UTs
- Q1.2026: GRAVITY+ Science Verification (**call in Q3.2025**)
- May 2026 – May 2027: GRAVITY+ first cycle (**call in Q3.2025**)
- 2027: low aberrations optics, R=15000 around Bry



Opportunities

- Science Verification for GRAVITY+:
 - Call ~June 2025 to run in Jan-Apr 2026: open to all, data public immediately

Next VLT/I Call (August 2025) will be **yearly**:

- Call Aug 2025: observations in May 2026-May 2027
- GRAVITY, MATISSE and PIONIER (+all La Silla / Paranal instruments)
- Joint ALMA/VLTI proposals
- ASGARD is a visitor instrument from S. Kraus, M. Ireland, F. Martinache, D. Defrère et al.:
Access only via collaboration