VLTI update

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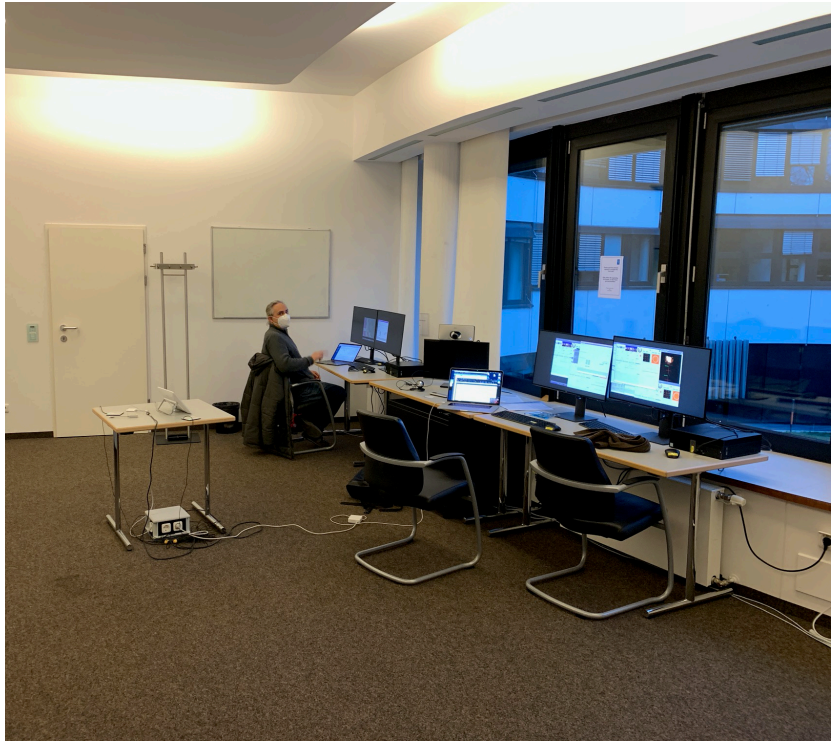
VLTI programme scientist

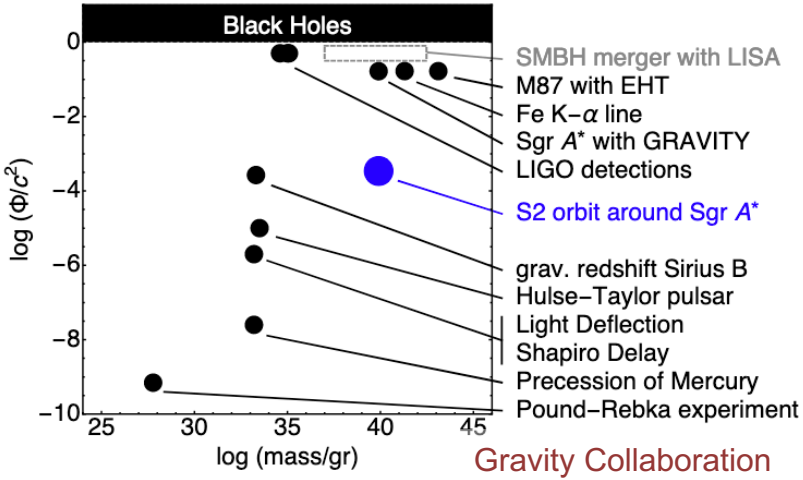
Impact of COVID

- Operations highly disturbed
  - Paranal is a remote site (commuting)
  - We lost a semester
- Travel EU -> Chile not possible
  - All science visitors observe remotely (eavesdropping)
  - Some technical activities / commissioning cancelled
  - Larger remote control room in Garching for commissioning activities

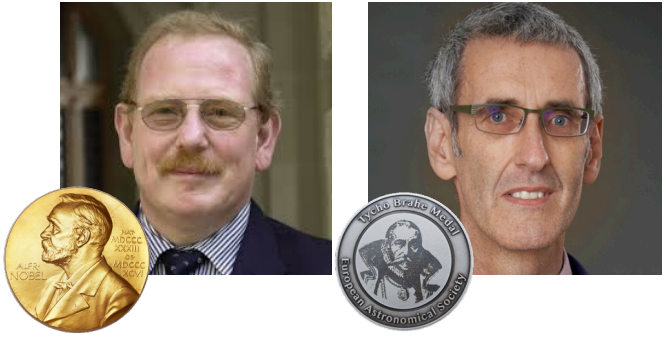


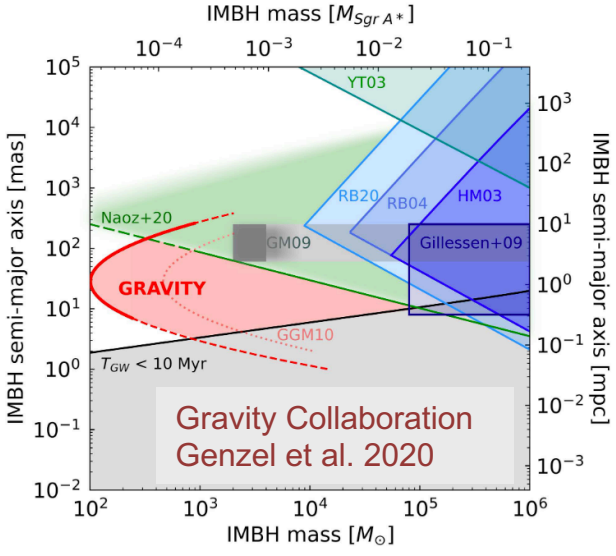
Galactic Centre

- S2 precession as test of relativity



Gravity Collaboration
Genzel et al. 2020



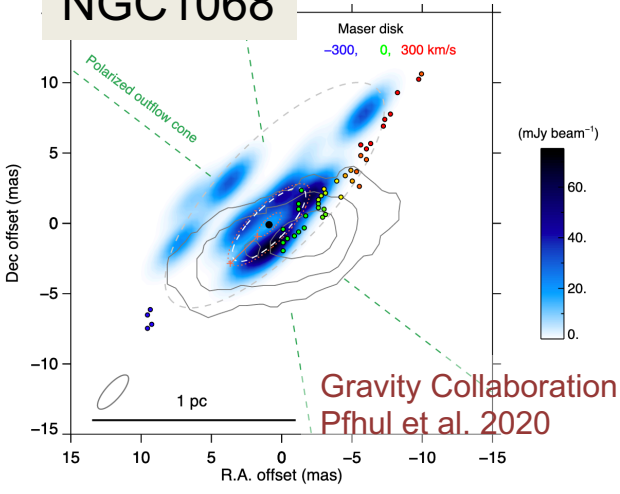


- Excluding other BH close to Sgr A*

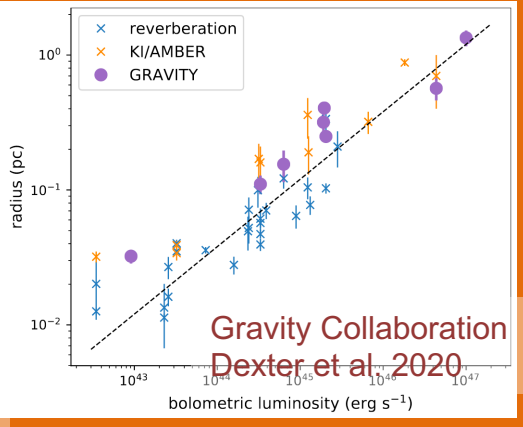
Extragalactic science

AGN

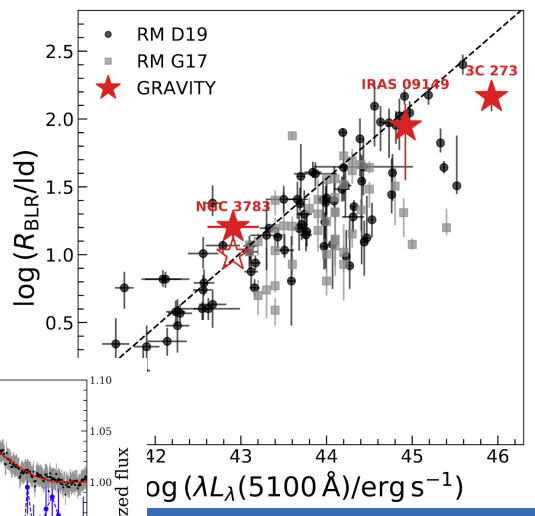
NGC1068



Gravity Collaboration
Pfhul et al. 2020

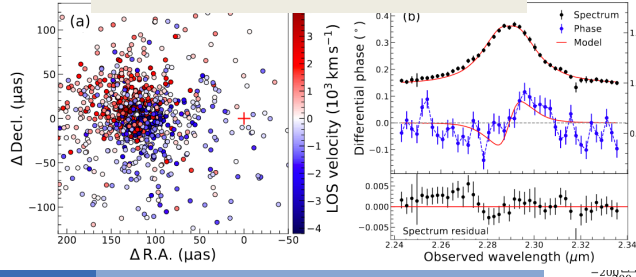


Gravity Collaboration
Dexter et al. 2020



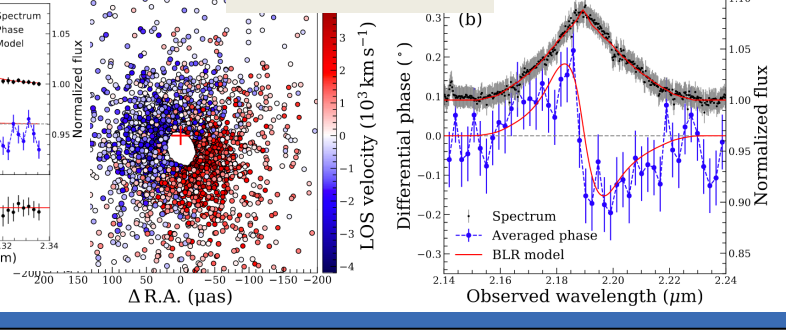
QUASARS

IRAS 09149−6206



Gravity Collaboration 2020

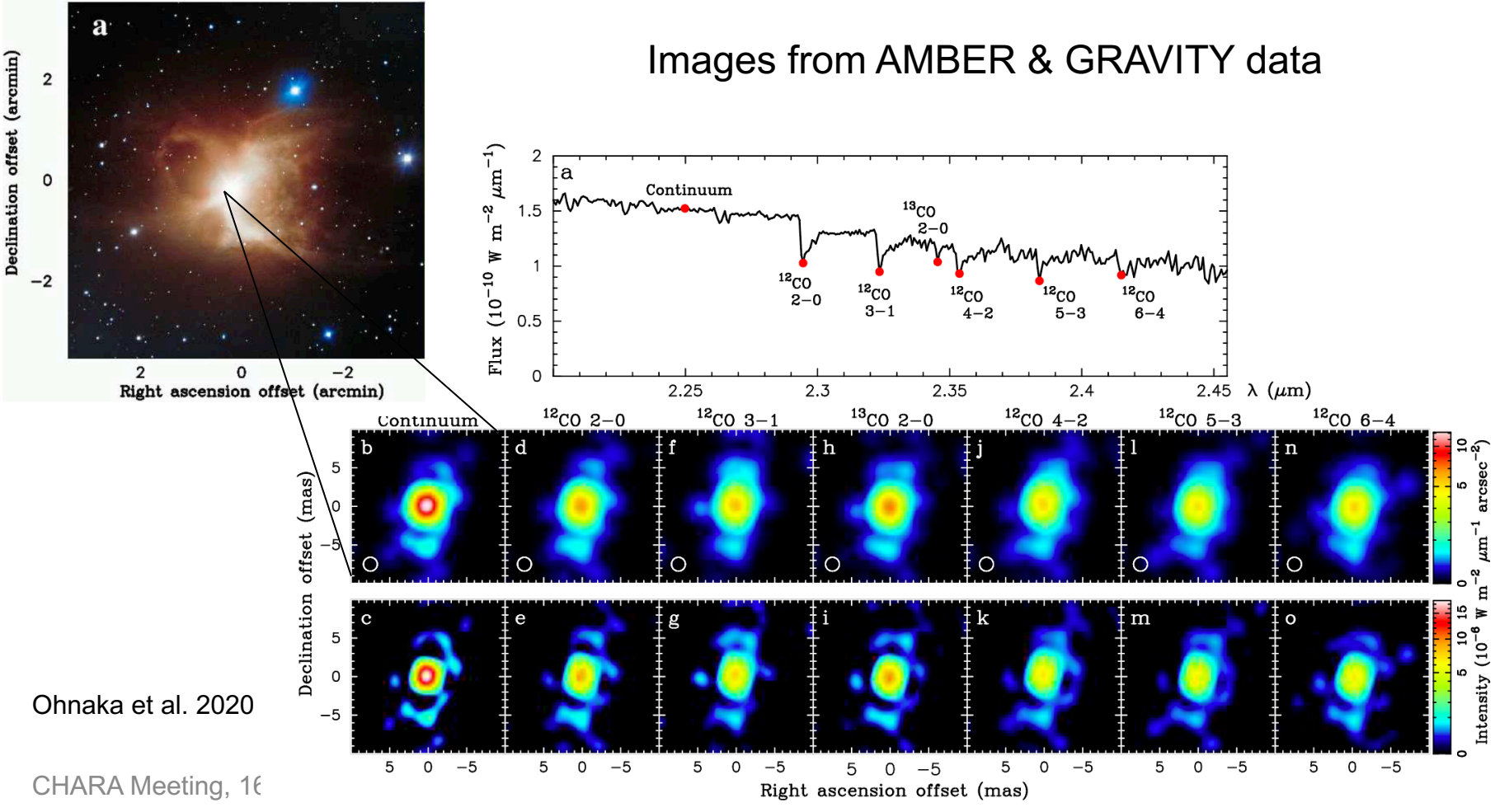
NGC 3783



Gravity Collaboration
2021

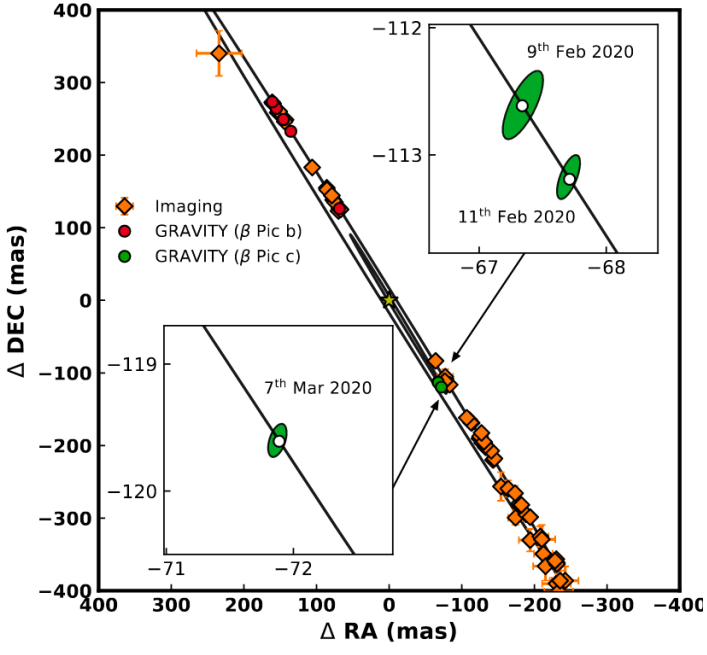
Imaging the central source of the bipolar nebula IC2220

Images from AMBER & GRAVITY data



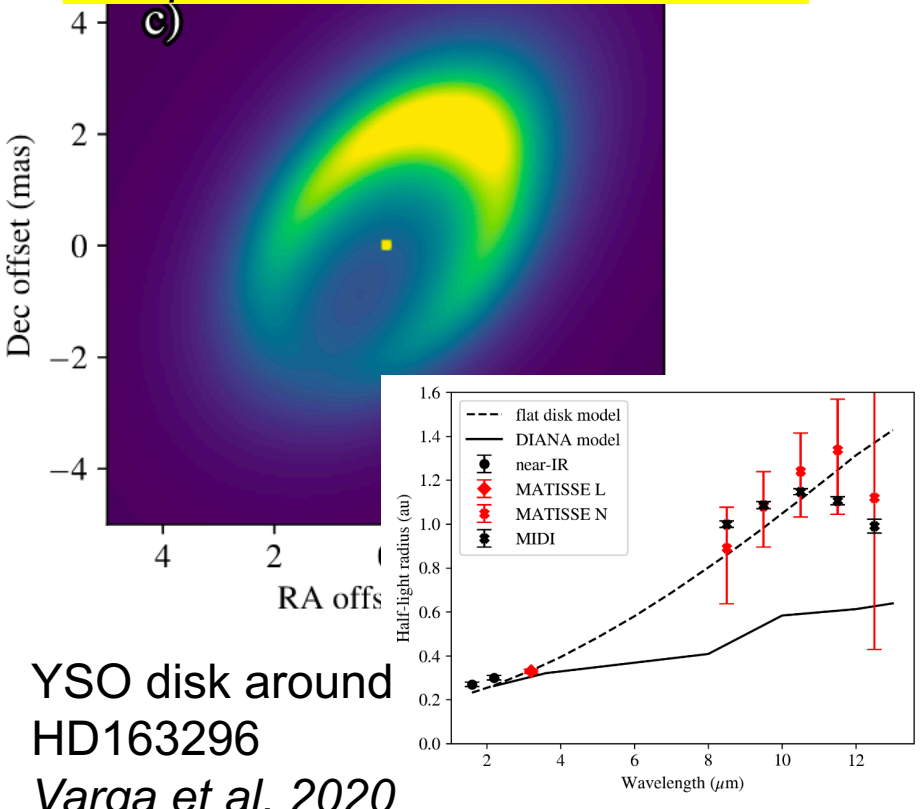
Ohnaka et al. 2020

Exoplanets & YSOs



Direct detection of radial-velocity planet Beta pic C using GRAVITY
Nowak et al. 2020

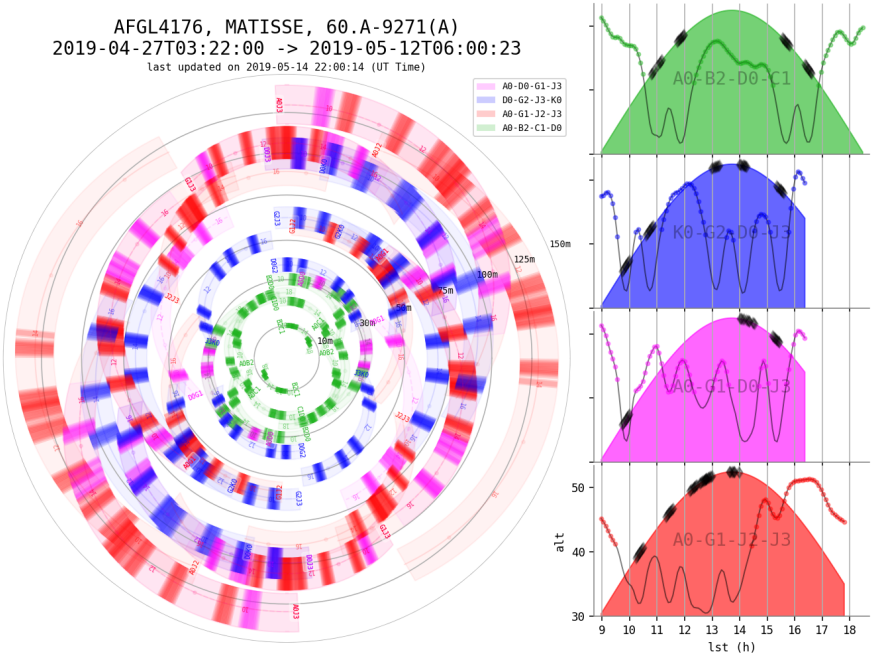
First published result for MATISSE!



YSO disk around HD163296
Varga et al. 2020

Imaging Optimisation

- Images requirements:
  - Multiple AT configurations
  - Multiple pointings per configuration, different LST
  - Within a limited amount of time (~<1mo)
- Historically,
  - observations over constrained (explicit config and LST range)
  - Mix of Visitors / Service mode
  - Fixed schedule for AT movements
- New scheme:
  - Reserved “only service” time for images, cycling through all AT configurations
  - Flexible constraints + u,v monitoring



VLTI expertise centres

- Goal: end-to-end support for users
  - ESO does not support everything: e.g. observation strategy, data interpretation, etc.
  - ALMA has great success thanks to end-to-end community support (ALMA ARC nodes)
- VLTI ECs:
  - EU funded until 2025
  - Face-to-face support with traveling funds
  - Close coordination with ESO

The present network of VLTI Expertise Centres includes three partners from the OPTICON Horizon 2020 networking activity:

- Jean-Marie Mariotti Centre (JMMC) - Service aux Utilisateurs du VLTI, (SUV) France
- Portuguese VLTI Expertise Centre, Portugal
- University of Exeter, United Kingdom

two interferometry JRA (Joint Research Activites; WP8) lead partners:

- Observatoire de la Cote d'Azur, France (cf. contact at SUV page);
- KU Leuven, Belgium

and two new nodes from the OPTICON/RadioNet Pilot (ORP) program:

- Leiden Observatory, The Netherlands
- Konkoly Observatory, Hungary

Visitors wishing to travel to the above centres to reduce their VLTI data or prepare observations are encouraged to use the Fizeau Programme.

https://european-interferometry.eu/centres-network/

Technical activities: past year

- MATISSE
  - Last Commissioning activities affected by COVID
- GRA4MAT
  - Use GRAVITY as a fringe tracker for MATISSE (increase spectral coverage in L and M): MATISSE GRISM failure interrupted the commissioning, will be fixed traveling permited
- NAOMI (AO on ATs)
  - Heaters installed on DM to avoid adverse cold temperature effects
- Doubling of delay line pathelength
  - Postponed due to COVID (fabrication)

GRAVITY+

https://www.mpe.mpg.de/ir/gravityplus

- GRAVITY Consortium + new collaborators
- Improve sensitivity / sky coverage of GRAVITY+
  - Updated AO for high strehl
  - Better of-axis FT
  - LGS on all UT
  - Goal of K=22
- 3 main science cases:
  - Galactic Centre
  - AGNs
  - Exoplanets
- Currently in Phase A (design study)

Future: GRAVITY+

Top Level Requirements

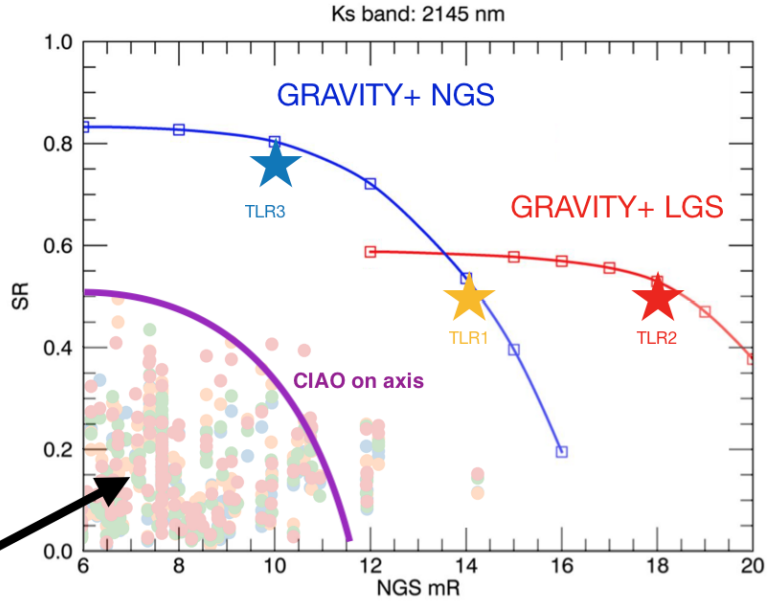
Table 1: Top-level performance specifications for GRAVITY+, the acronyms are given in appendix 1.

	Science case	AO mode	FT mode	AO star R mag	SR* in K-band	FT star K mag	FT rms OPD for K = 10	SC-FT distance	SC star K mag*
1	Galactic Center	LGS	off-axis	14	> 50%	10	< 100 nm	Up to 30"	22
2	Extragalactic, faint galactic	LGS / NGS	on/off-axis	18 (LGS) 10 (NGS)	> 50%	13 (goal 15)	< 100 nm	Limited by STS ** Text	22
3	Exoplanet & high contrast	NGS	on-axis	10	> 75%	10	< 100 nm	Limited by GRAVITY ***	22

* When operating close to the guide-star. For off-axis operation, the performance will be reduced by atmospheric anisoplanetism.

** The available patrol field of the current PRIMA STS is about 1' radius

*** Separation between exoplanet and host star limited by GRAVITY dual field FoV of 2'' UT



Current MACAO measured performances

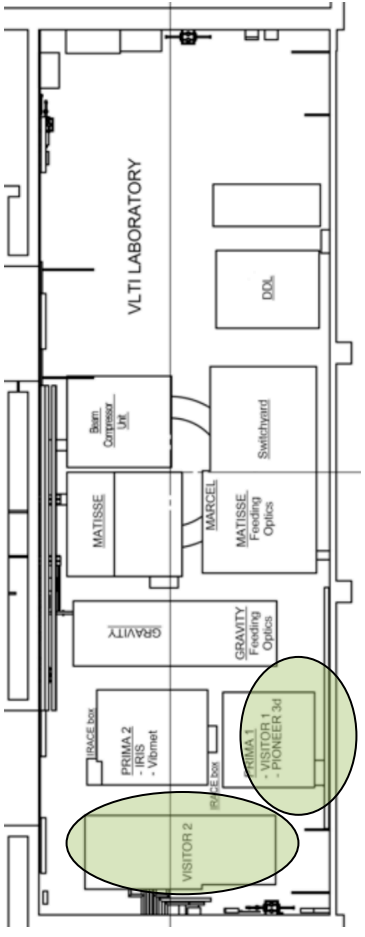
GRAVITY+ Science Workshop

https://sites.google.com/view/gravityplus/home

- 200+ registered, >50% non-interferometrists
- Fascinating extra galactic science case
  - 100x more AGNs accessible, up to z~7
  - BH in globular clusters
  - …
- Strong exoplanet science case
- Stellar community want higher spatial resolution and higher spectral resolution…

Visitor instruments

- VI and not facility instruments:
  - Build with less constraints
  - Operated by PI team
  - Focused science case, not offered to community
- Removal of AMBER, FINITO and PRIMA liberated space in the focal lab
- Many ideas presented in a 2019 workshop
  - https://www.eso.org/sci/meetings/2019/VLT2030/program.html
  - 2 funded by ERCs!



Funded VIs (ERC)

Hi-5 high contrast at 3-5um

http://www.biosignatures.ulg.ac.be/ddefrere/hi5.php

- PI: Denis Defrère (KU Leuven, BE)
- Science case: find exoplanets by nulling
- Timeframe 2021-2025
- They are hiring!
  https://fys.kuleuven.be/ster/vacancies

BIFROST J spectrograph

http://www.skraus.eu/presentations/kraus.GAIA-BIFROST.pdf

- PI: Stefan Kraus (Exeter, UK)
- Science cases: YSOs, binary survey
- Timeframe 2021-2025
- Talk tomorrow at 13:10 PDT by S. Kraus

Conclusions

- Exciting new sciences cases:
  - AGN, Quasars
  - Galactic Centre
  - Microlensing
  - Exoplanets
  - …
- Generalisation of AO, Spectroscopy, Fringe Tracking
- Ongoing call for proposal (P108):
  - http://www.eso.org/sci/observing/phase1/p108/CfP108.pdf
  - Deadline 25 March 2021, 12:00 noon CET
  - NEW: GRA4MAT, imaging runs
  - Ask Expertise Centre for help!
- Improving Support
  - Expertise Centres
  - Imaging optimisation
- Future is bright:
  - Strong instruments: GRAVITY and MATISSE
  - Community support: Expertise Centres + JMMC
  - Projects: GRAVITY+, Hi-5, BIFROST