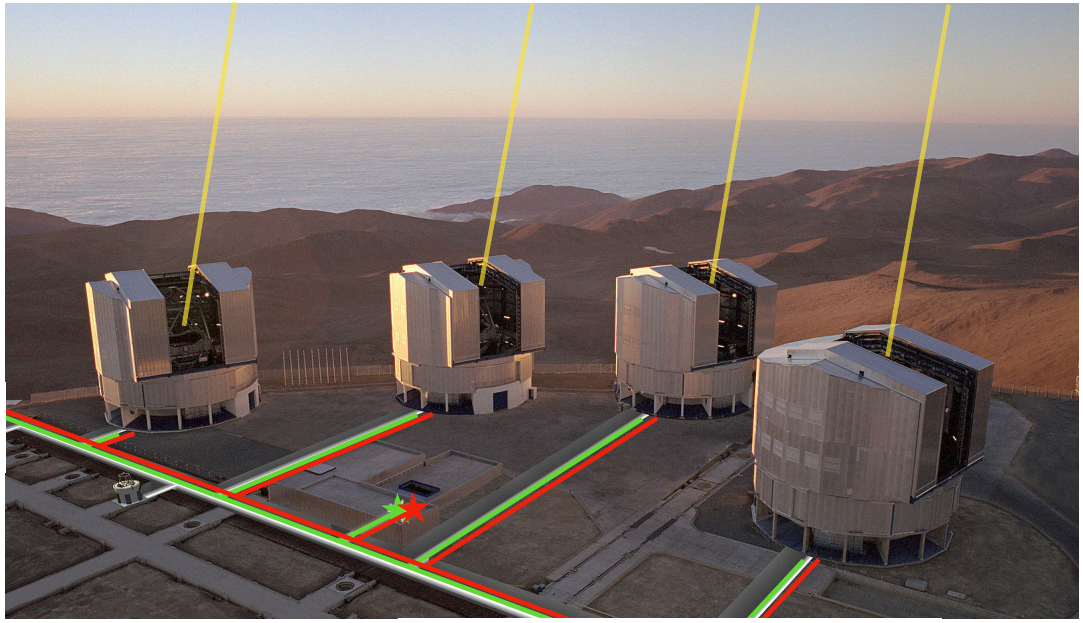
GRAVITY+



For the GRAVITY+ Consortium (MPE, LESIA, IPAG, UoC, CENTRA, MPIA, UoS):

F. Eisenhauer[1] (PI), P. Garcia[2,3,4] (CoI), R. Genzel[1,5], S. Hönig[6] (CoI*), L. Kreidberg[7,8] (CoI), J.-B. Le Bouquin[9] (CoI), P. Léna[10], T. Paumard[10] (CoI), C. Straubmeier[11] (CoI)

Senior Team Members and Associated Partners:

A. Amorim[2,12], W. Brandner[8], M. Carbillet[13], V. Cardoso[2,14], Y. Clénet[10], R. Davies[1], D. Defrère[15], T. de Zeeuw[1,16], G. Duvert[9], A. Eckart[11,17], S. Esposito[18], M. Fabricius[1,19], N.M. Förster Schreiber[1], P. Gandhi[6], E. Gendron[10], S. Gillessen[1], D. Gratadour[10], K.-H. Hofmann[17], M. Horrobin[11], M. Ireland[20], P. Kervella[10], S. Kraus[21], S. Lacour[10], O. Lai[22], B. Lopez[22], D. Lutz[1], F. Martinache[22], A. Meilland[22], F. Millour[22], T. Ott[1], R. Oudmaijer[23], F. Patru[10], K. Perraut[9], G. Perrin[10], R. Petrov[22], S. Quanz[24], S. Rabien[1], A. Riccardi[18], R. Saglia[1,19], J. Sánchez Bermúdez[8,25], D. Schertl[17], J. Schubert[1], F. Soulez[26], E. Sturm[1], L.J. Tacconi[1], M. Tallon[26], I. Tallon-Bosc[26], E. Thiébaut[26], F. Vidal[10], G. Weigelt[17], A. Ziad[13]

Supporters:

O. Absil[15], A. Alonso-Herrero[27], R. Bender[1,19], M. Benisty[9,28], J.-P. Berger[9], E. Banados[8], C. Boisson[29], J. Bouvier[9], P. Caselli[1], A. Cassan[30], B. Chazelas[31], A. Chiavassa[32], F. Combes[33], V. Coudé du Foresto[10], J. Dexter[1,34], C. Dougados[9], Th. Henning[8], T. Herbst[8], J. Kammerer[20], M. Kishimoto[35], L. Labadie[11], A.-M. Lagrange[9], A. Marconi[36], A. Matter[13], Z. Meliani[29], F. Ménard[9], J. Monnier[37], D. Mourard[13], H. Netzer[38], N. Neumayer[8], B. Peterson[39,40,41], P.-O. Petrucci[9], J.-U. Pott[8], H.W. Rix[8], D. Rouan[10], H. Sana[42], D. Segransan[31], H. Sol[29], E. van Dishoeck[1,16], F. Vincent[10], M. Volonteri[30], A. Zech[29]

Max-Planck-Institut für extraterrestrische Physik

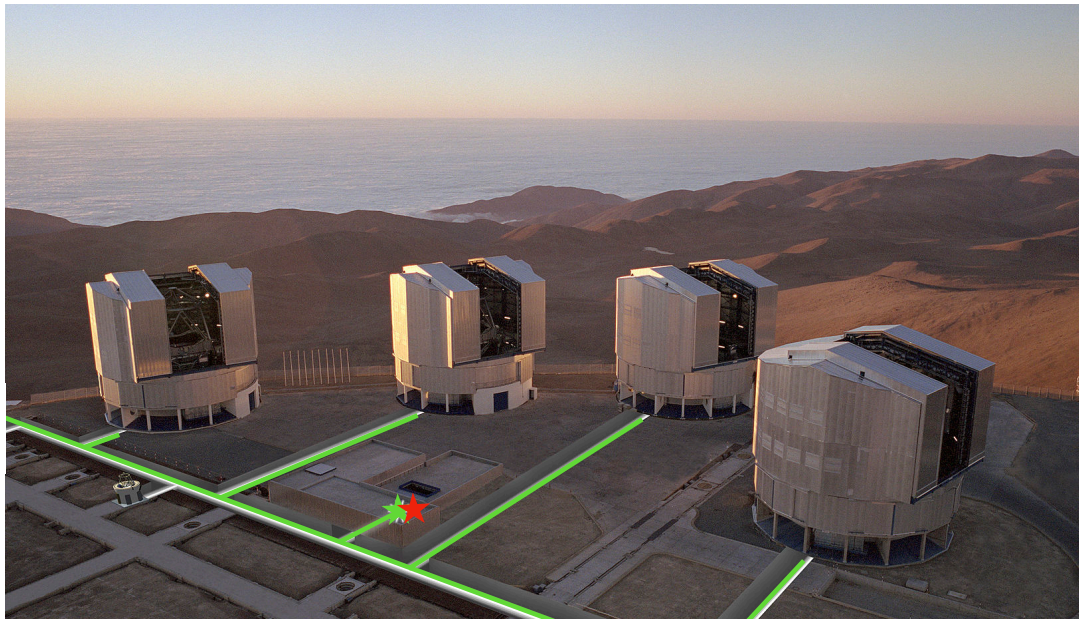
CENTRA

University of Cologne

T. Paumard, F. Soulez
JB Le Bouquin, F. Millour

UNIVERSITY OF Southampton

From GRAVITY to GRAVITY+

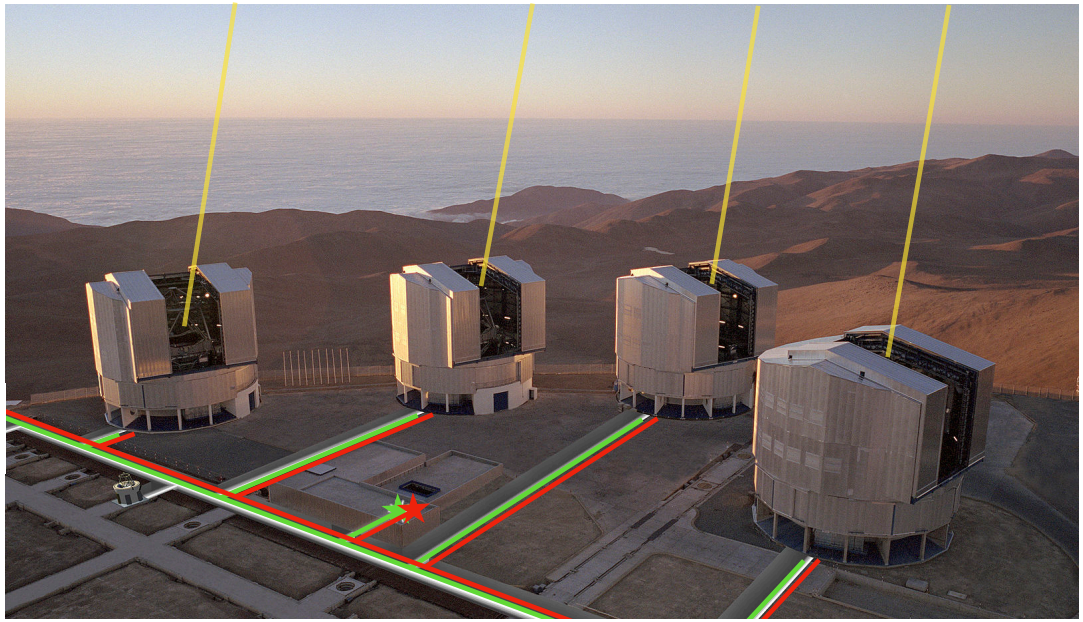


"The mission of GRAVITY+ is to implement faint, all sky, high contrast, milli-arcsecond imaging at the VLTI"
(consortium MoU, Feb. 2020)

- Reach full sky coverage in Galactic Plane and 10% in Galactic Poles
  => install LGS on all UTs
  => conclude installation of dual-beam
- Open high contrast (then shorter wavelength, nulling)
  => high order AO
  => vibration tracking
- Rejuvenate VLTI for the next 20years, deal with several obsolescence.

X

From GRAVITY to GRAVITY+



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New Science

• Measure AGN mass and gas dynamics up to epoch of peak galaxy formation at z ~ 1 – 3. Together with reverberation: independent measurement of the Hubble constant.	*Improved throughput* *All sky*
• Orbit of faint and/or yet-unknown stars around Sgr A*, astrometry and polarimetry of SgrA* flares	*Better AO* *Improved throughput*
• Obtain high-quality spectra and orbits of exoplanets, closer and deeper. Characterise Gaia exoplanets.	*High Contrast xAO* *Improved throughput*
• Study accretion-ejection in large samples of HMXB, LMXB, and YSO, instead of handful of objects. Observe flares and transient.	*Improved throughput* *All sky*
• Establish whether star clusters and globular clusters harbor (the elusive) intermediate mass black holes.	*Improved throughput* *All sky*

Top Level Requirements

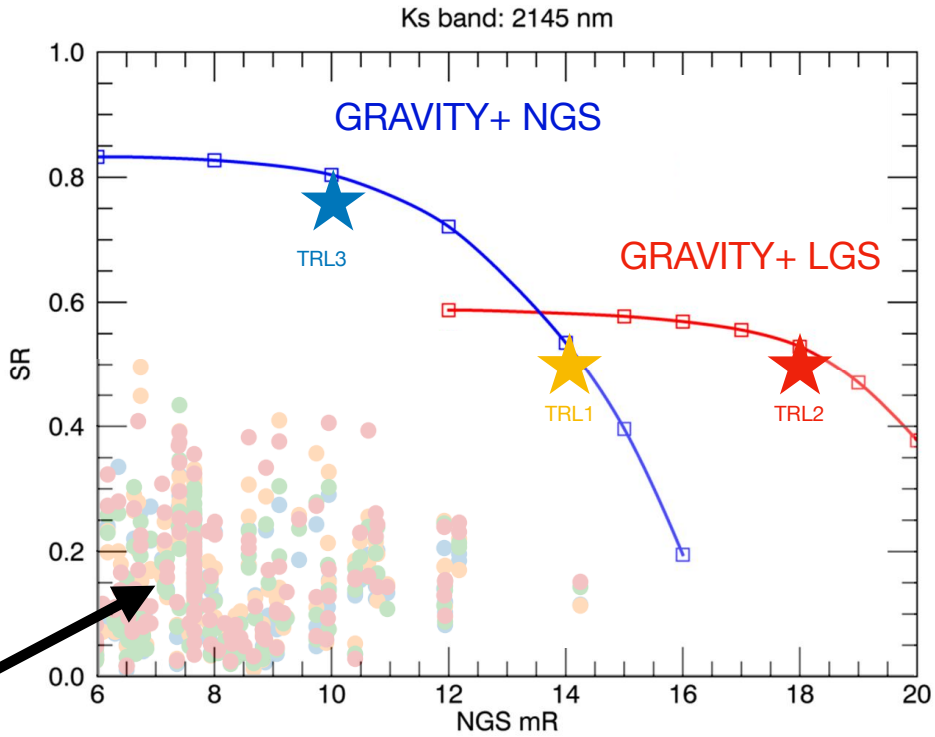
Table 1: Top-level performance specifications for GRAVITY+, the acronyms are given in appendix 1.

	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 **	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.

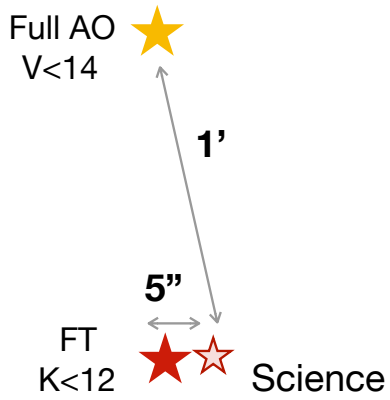
** The available patrol field of the current PRIMA STS is about 1' radius

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



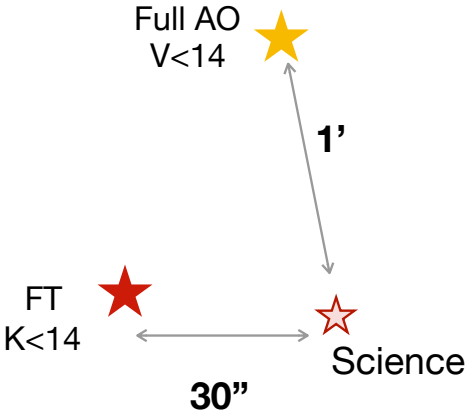
Current MACAO measured performances

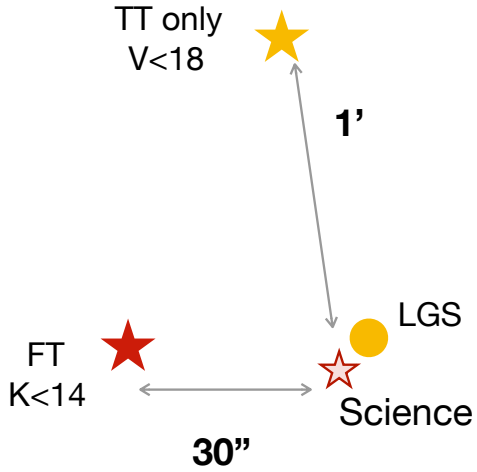
Reaching “all sky”

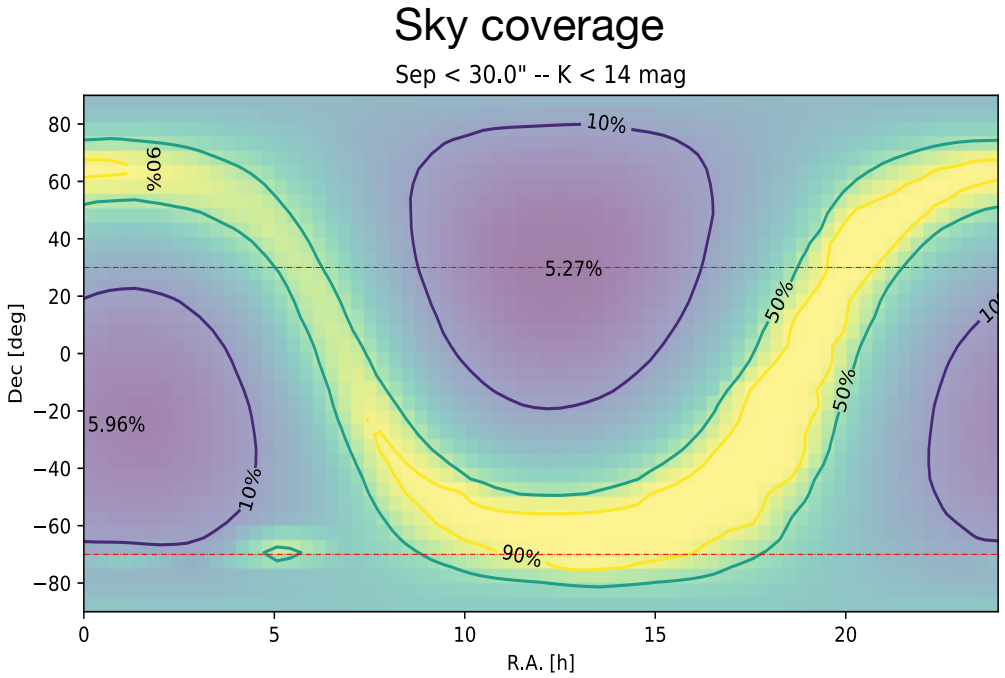


Now

Then







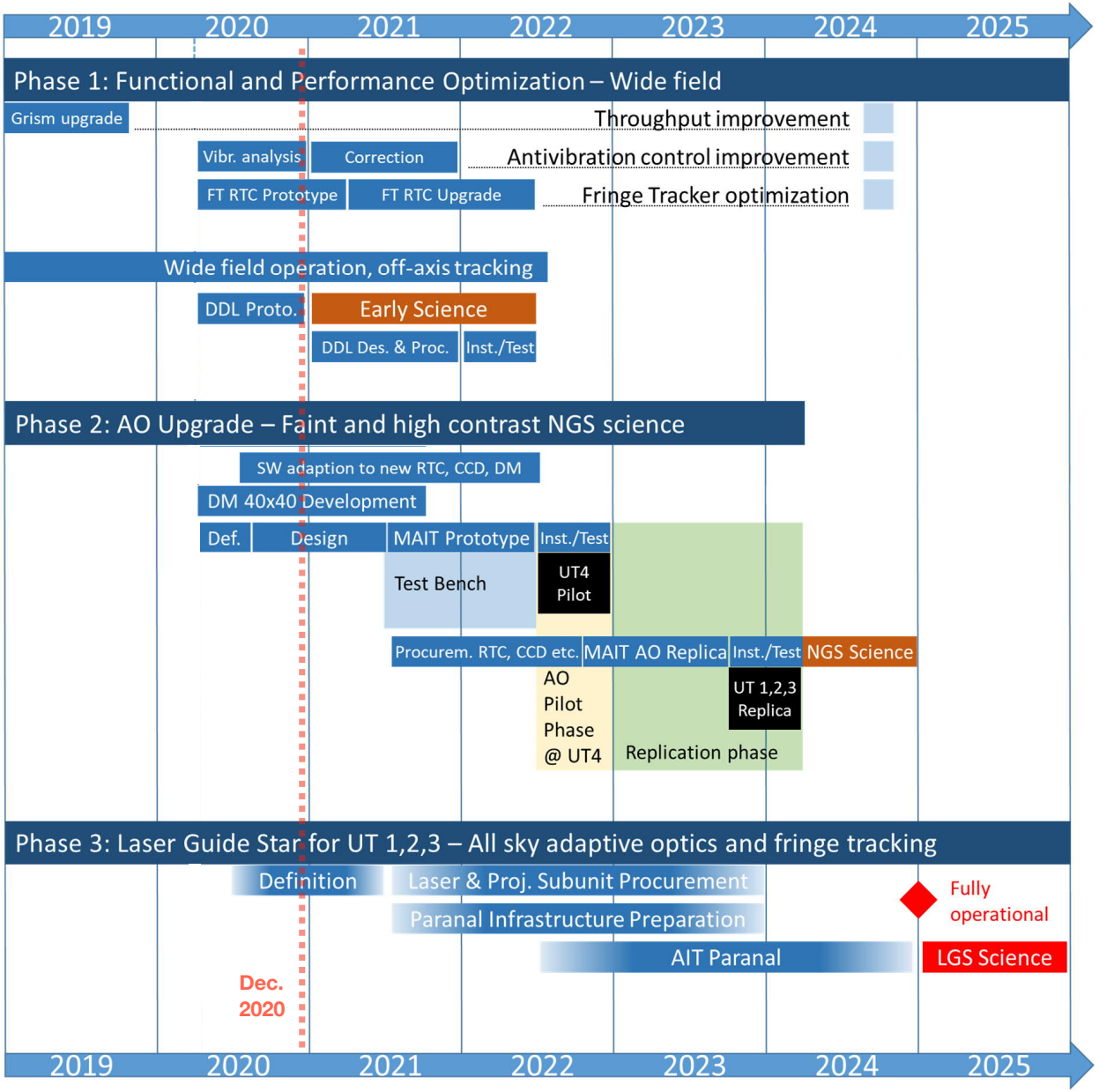
Few thoughts on JMMC / GRAVITY+

- Most JMMC efforts related to GRAVITY are relevant for GRAVITY+
- Aspro2, SearchCal, OiFitsExp are the most used and recognized tools by GRAVITY users/ consortium.
- Preparation of observation for faint objects will be a big deal
  - Need to search for 2 reference stars
  - Need to compare LGS / NGS modes
- Pipeline still under leadership of consortium. Possible evolutions are stilll being explored by experts.

Ideas ?

- Work on Aspro2 noise model including the basic effect of AO with on/off-axis and lgs/ngs modes ?
- Think of a way to search AO/FT references sources around science coordinates ?
- OiFits explorer basics (e.g click to discard point, make the top-left browser usefull…)

Planning

In short:

- The project is on a “success oriented” schedule.
- On-track so far.
- Dual-field observations start now, but LGS arrive 2025