Kilometers Baseline Interferometer





Based on information from Frank Eisenhauer, Ric Davies, and Guillaume Bourdarot



Staged Approach

VLTI	4 UTs	
e-VLTI-1	3 UTs + ~4m	
e-VLT-4	1 UT + 3 X 4m	Tkm
KBI	4-10 × 6-15m	~10km
KBI-dream	4-6 ELTs	~20km



Kilometers Baseline Interferometer

				and whether a
Fringe-tracking lim	10	13	16	17
Limiting K mag	15	20	23	26
Astrometry (µas)	10	10	1	0.1
Spatial resolution (µas)	1000	1000	100	10
PERFORMANCES	GRAVITY	GRAVITY+	e-VLTI	KBI

Based on information from F. Eisenhauer, R. Davies, and G. Bourdarot

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From GRAVITY(+) Towards a Kilometers Baseline, Large Telescope Interferometer **Ringberg Workshop** June 2024

10 µs angular resolution

Black Holes

10 pc

1 pc

Stars/-formation

Exoplanets

Credits: F. Eisenhauer

Fundamental Physics

Cosmology Galaxies >1 Gpc 1/10 pc SN1987A 100 Mpc 1000 AU TDEs 10 AU Saturn Orbit 1 Mpc 10 kpc 0.1 AU = 1 Schwarzschild R.150 km Earth astrometry 15 km 1500 km Greenland



SMBH formation and evolution

High-z SMBH:

- many more than expected
- more massive than expected
- evolution of the MBH-Mstar relation



BH seeds, formation of SMBH at z>10:

- 1. Light: pop III (massive, metal-poor) stars
- 2. Intermediate: runaway of dense stellar systems
- 3. heavy: direct halo collapse

BH masses: from BLR line width and luminosity based on scaling relations in the local universe





Dynamical measure of SMBH masses at high z





Dynamical measure of SMBH masses at high z

VLT/GRAVITY

Few QSO at z~4

very large uncertainties due to low S/N

e-VLTI/KBI: accurate masses up to very high redshift

Gravity collab., in prep



Accretion disk around SMBHs







Binary SMBH

Tremmel et al, 2018



9

Binary SMBH





Galactic Center

VLTI/GRAVITY: motion of the flares





E-VLTI better than EHT

Imaging of planets/brown dwarfs

- Spatially-resolved atmosferic properties
- Radii
- Angular momentum





Luhman 16B, d~2pc









Crossfield+14 Bourdarot+24



Great Scientific potential.....

Limitations

- Bright fringe-tracking stars, low sky coverage (>50% if R~18)
- Bright limiting mag for science target: K~23 (e-VLTI) K~28 (ELT), limited to high SB objects
- Image reconstruction more than imaging
- Low readiness, really feasible??
- long development time, demonstrators
- Proposed for Expanding Horizons?



Opportunities

- Potentially, very high scientific impact, can be selected by ESO
- General interest, wide community: optical interferometry as in the sub-mm with ALMA?
- No competition up to ~2040
- Very early stage \rightarrow important roles for INAF
- Based on AO \rightarrow important roles for INAF
- Small group (MPE+F) \rightarrow important roles for INAF





