

Recent results on the supermassive black hole in the centre of the galaxy

ANTÓNIO AMORIM & PAULO GARCIA FOR THE GRAVITY TEAM

CENTRO DE ASTROFÍSICA E GRAVITAÇÃO

FAC. CIENCIAS U. LISBOA

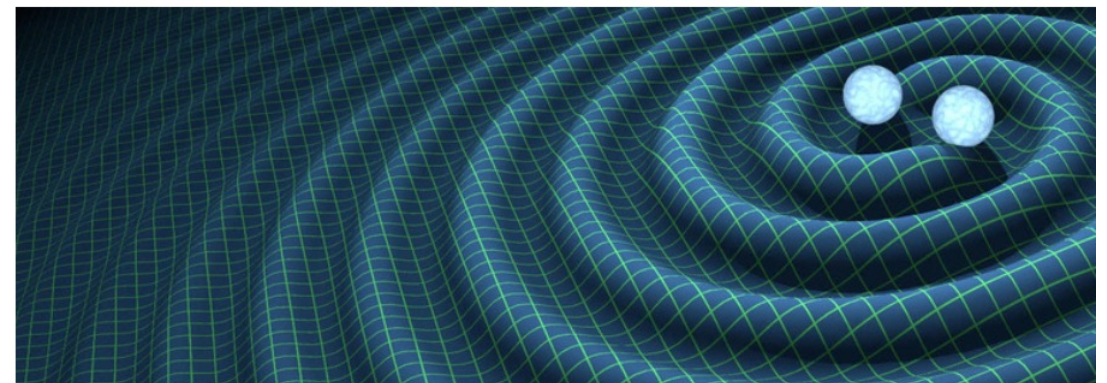
FAC. ENGENHARIA U. PORTO



centra

center for astrophysics and gravitation

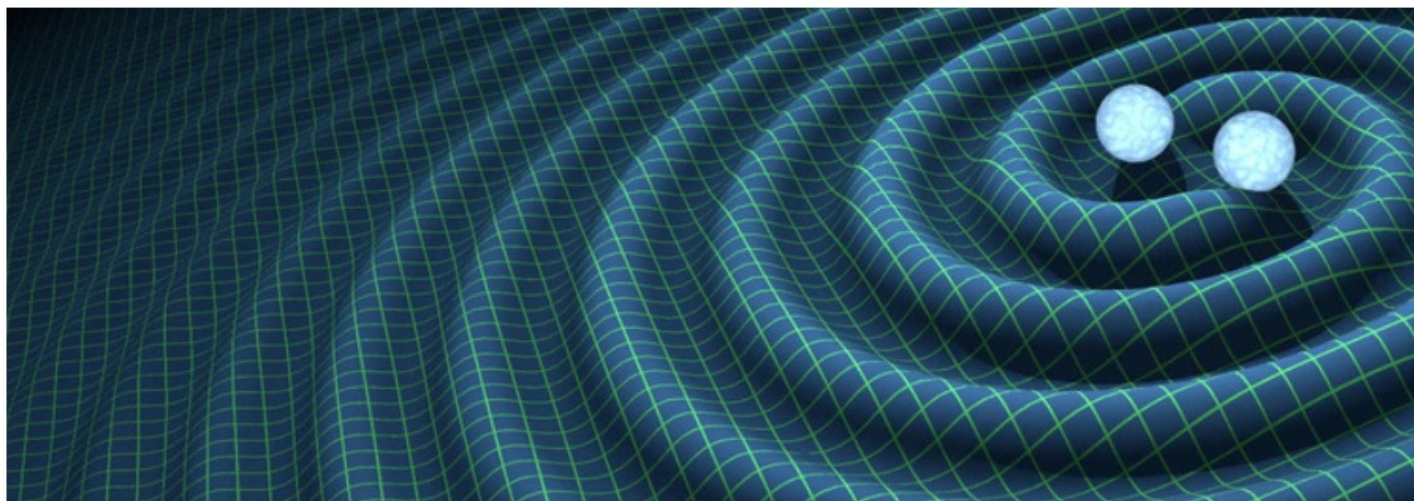
[About](#) [Team](#) [Events](#) [Publications](#) [News](#) [Outreach](#) [Contact](#)





centra
center for astrophysics and gravitation

[About](#) [Team](#) [Events](#) [Publications](#) [News](#) [Outreach](#) [Contact](#)



CENTRA

Research unit of Instituto Superior Técnico (IST),
with a branch at Faculdade de Ciências (FCUL)

A leading center for astrophysics and gravitation,
evaluated as Excellent by FCT

Research on black hole physics, gravitational
waves, big bang and the inflationary universe,
supernovae, stellar physics, galaxies, dark matter
and associated instrumentation and data analysis

CENTRA has three groups

- SIM – instrumentation for space
- COSTAR – astrophysics
- GRIT – gravitation



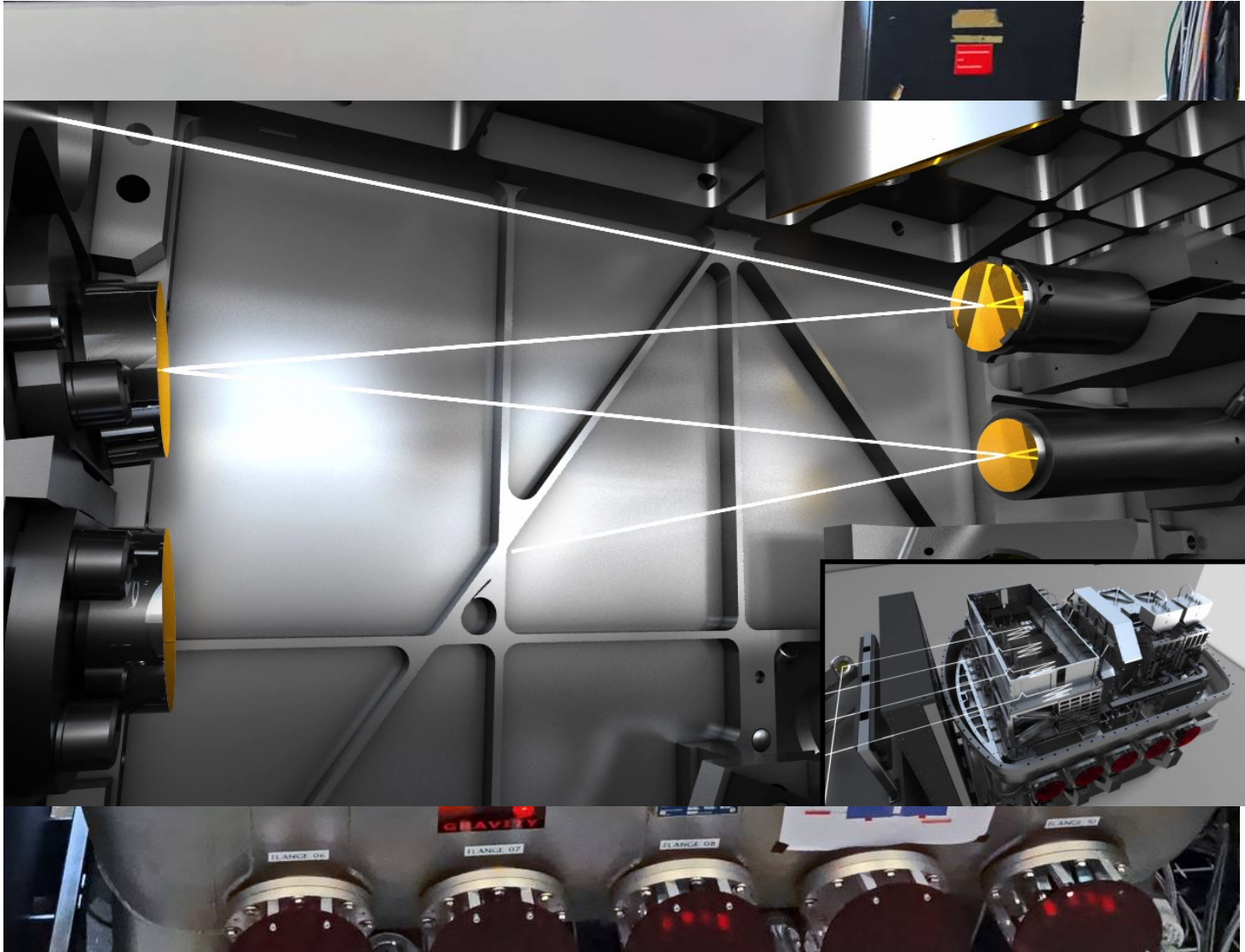
The GRAVITY instruments

The research goal of GRAVITY(+) is to probe gravity in the vicinity of the supermassive black hole at the centre of the Milky Way

The experimental technique is infrared long baseline interferometry

Light from each unit telescope (8m in diameter) is combined coherently

The angular resolution is equivalent to a 100m telescope



CENTRA

GRAVITY instrument is led by MPE, Munich

CENTRA participation was the responsibility of the end-to-end construction of the acquisition camera subsystem

A cryogenic infrared camera with several optical functions

Optomechanical design

Construction and integration

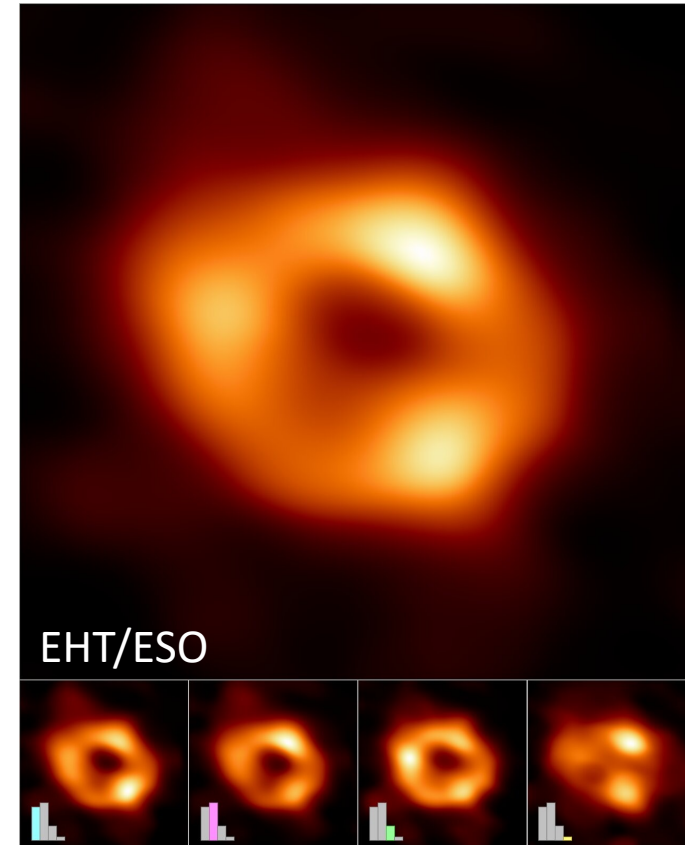
Software for continuous operation and optical functions measurement, including GUI

CENTRA also participates in the scientific exploitation of the instrument

The Milky Way supermassive black hole



The Milky Way supermassive black hole



Constraining the mass distribution around SgrA*

Sensitivity of stars up to $mK = 20$

Black hole point mass of $4.3 \times 10^6 M_{\text{sun}}$, with a precision of about $\pm 0.25\%$

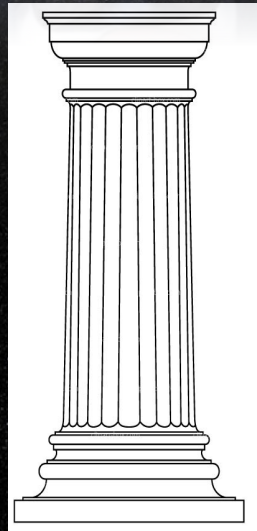
Current significance of Schwarzschild precession in the S2 orbit at 7σ

The extended mass component inside the S2 apocenter ($\approx 0.23''$ or $2.4 \times 10^4 R_S$) must be $\lesssim 0.1\%$ of M_{\bullet}

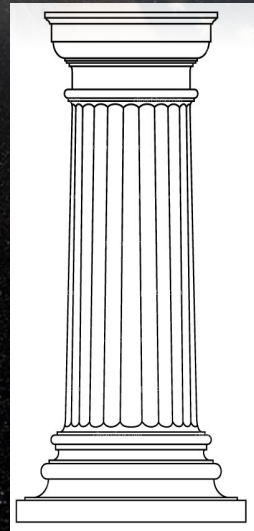
Testing the Black Hole Paradigm (2020)



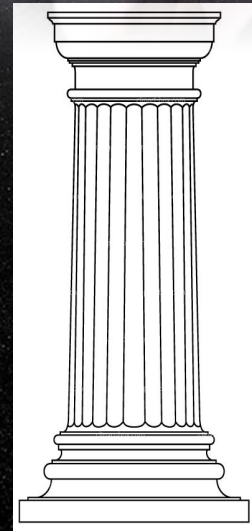
Reinhard Genzel



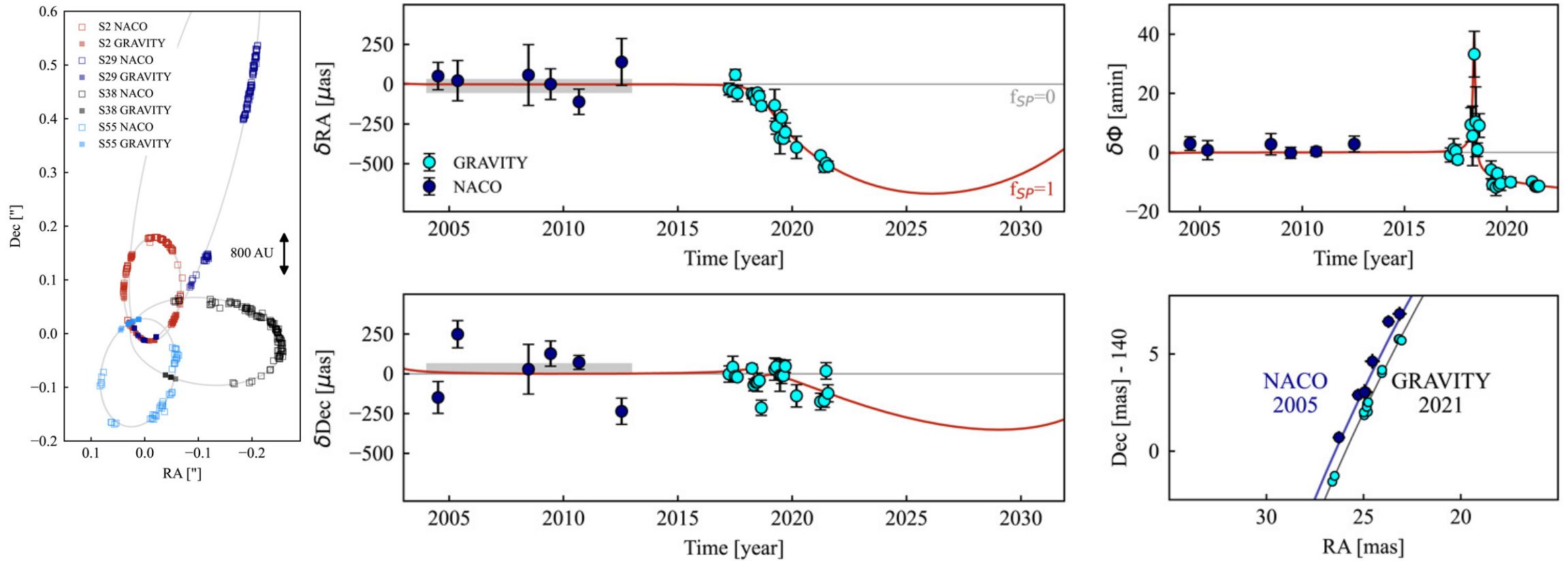
Andrea Ghez



Roger Penrose

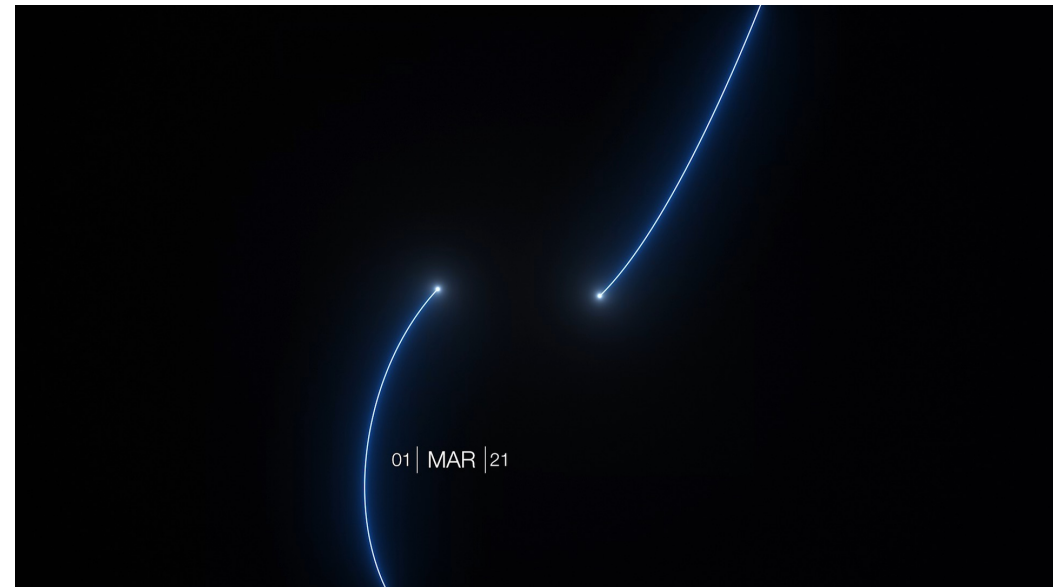
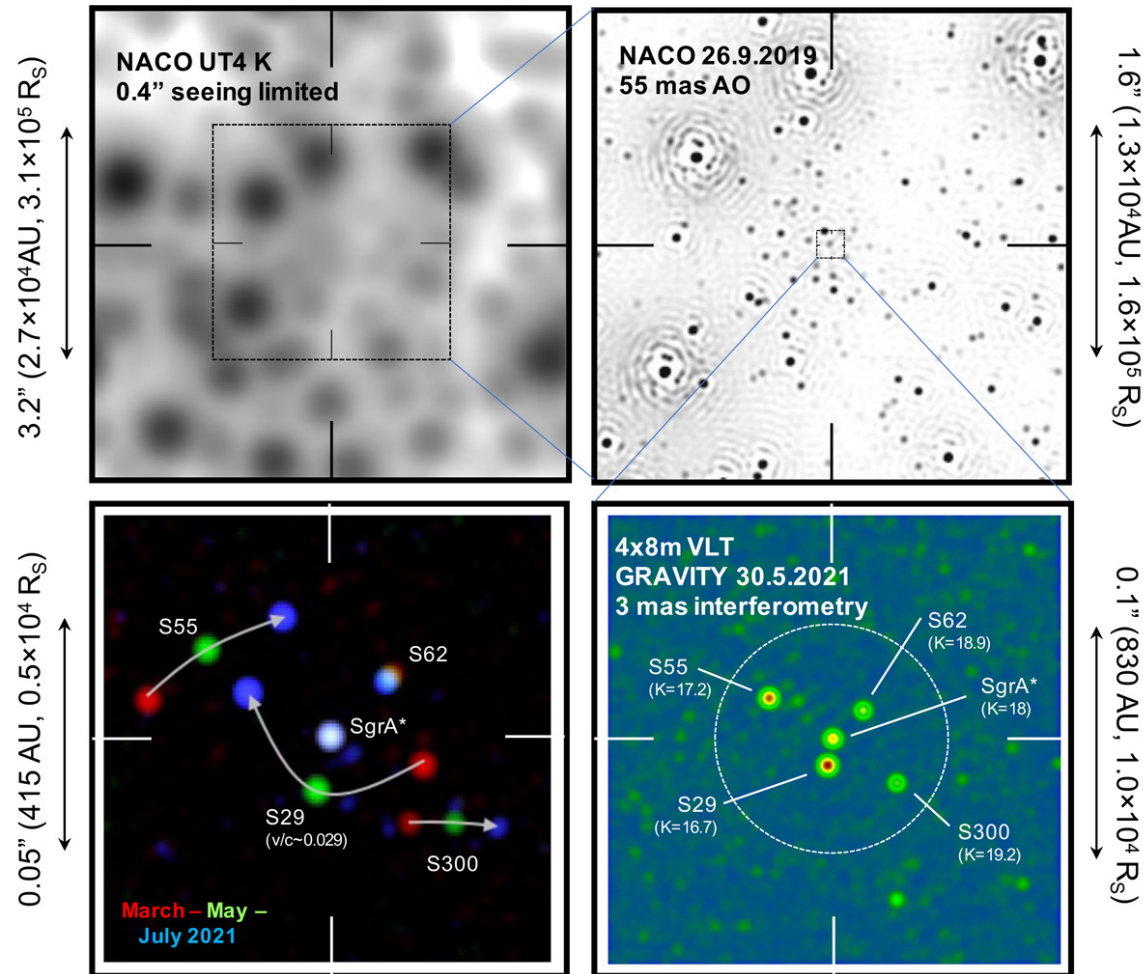


Gen. Relativity corrections around SgrA*



Detection of faint stars orbiting SgrA*

Gravity Colla: (2021), A&A 645, A127 + (2022), A&A 657, A82 + (2022), A&A, 657, L12





The GRAVITY+ instrument

GRAVITY+ enhances the VLTI with state-of-the-art adaptive optics, including laser guide stars

Greatly enhancing the sensitivity to faint targets without a direct natural reference.

CENTRA participation in the adaptive optics instrument software development

News on GRAVITY+ in Ciência 2023!