Obří černá díra

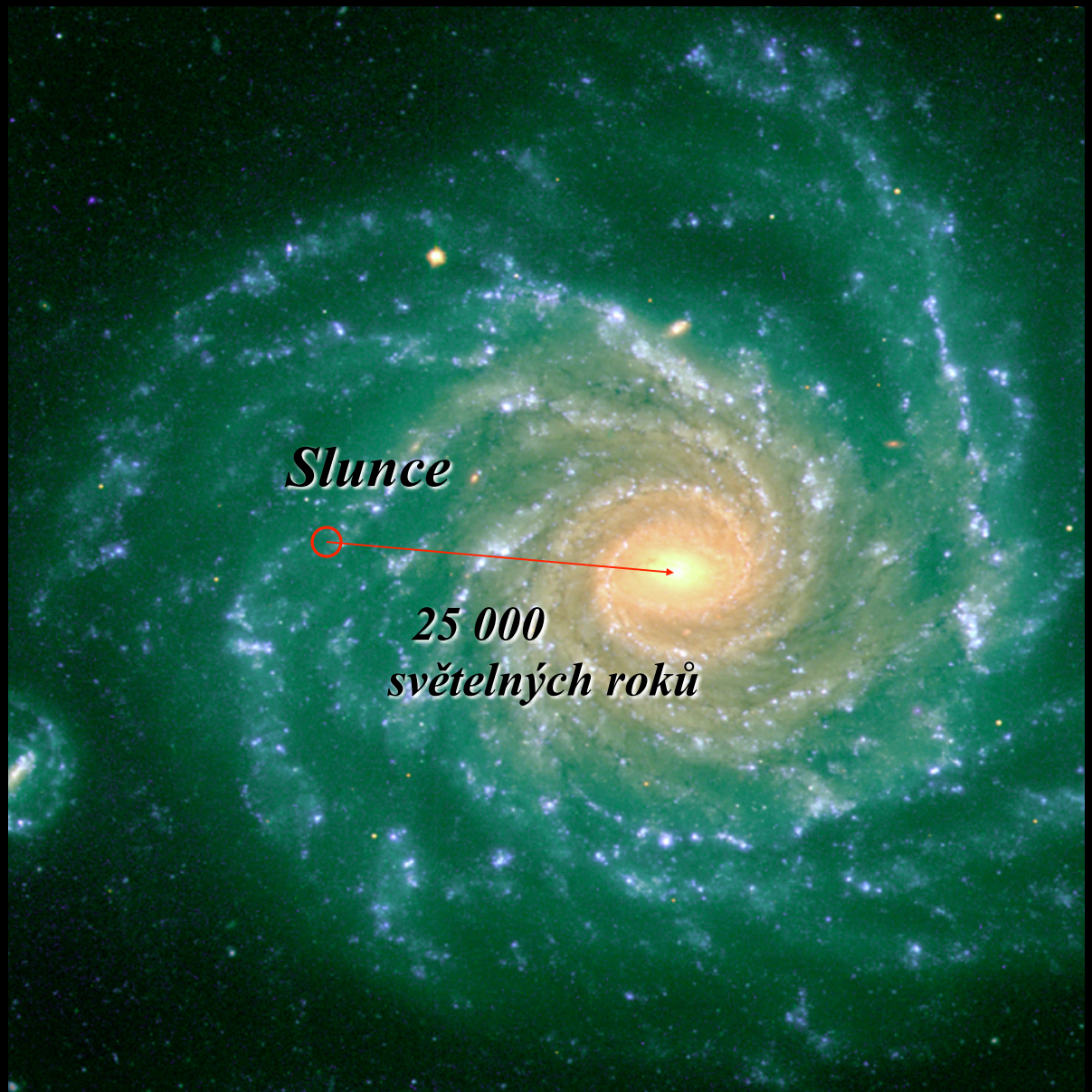
aneb

novinky z centra Galaxie

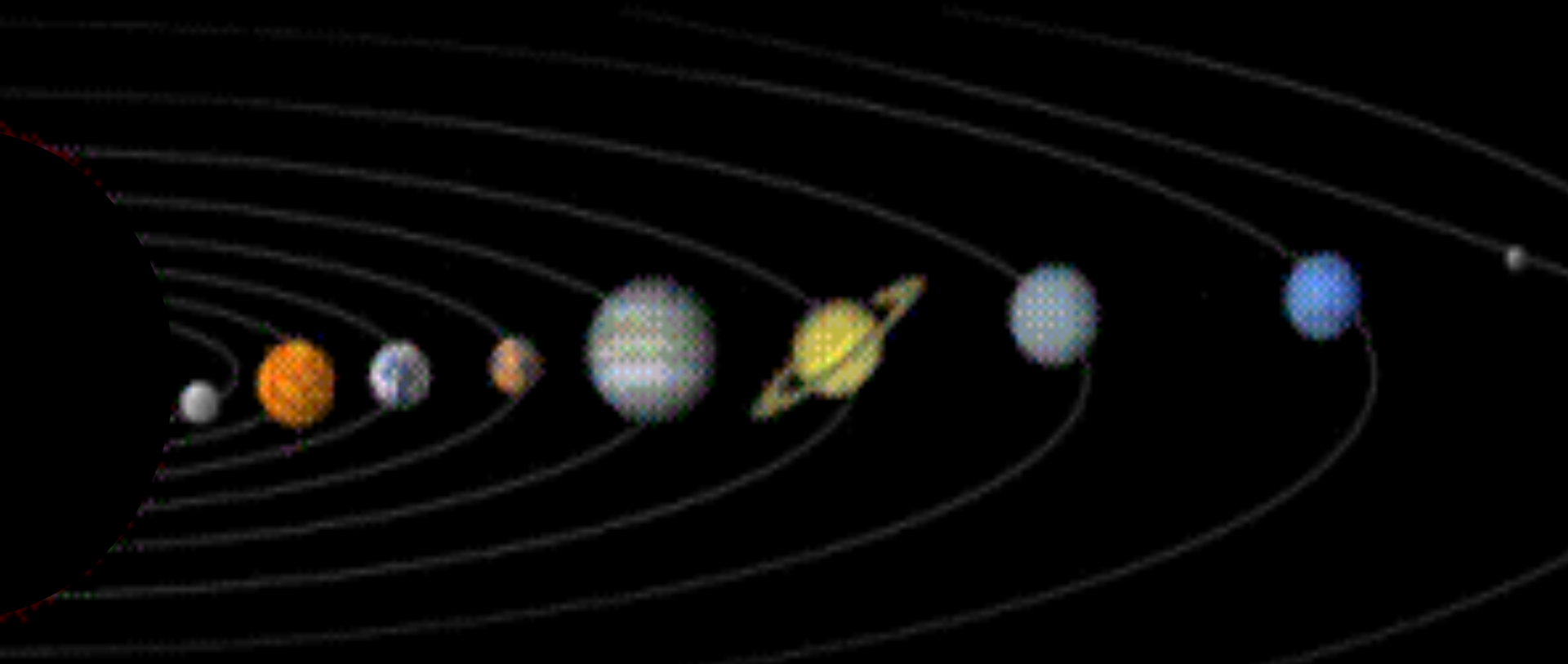
V. Karas
Astronomický ústav AV ČR

Ondřejov, 27. 9. 2019

Mléčná dráha

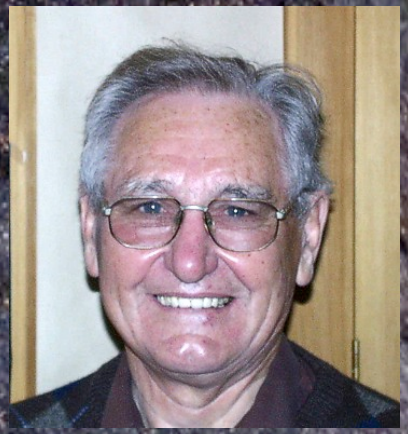


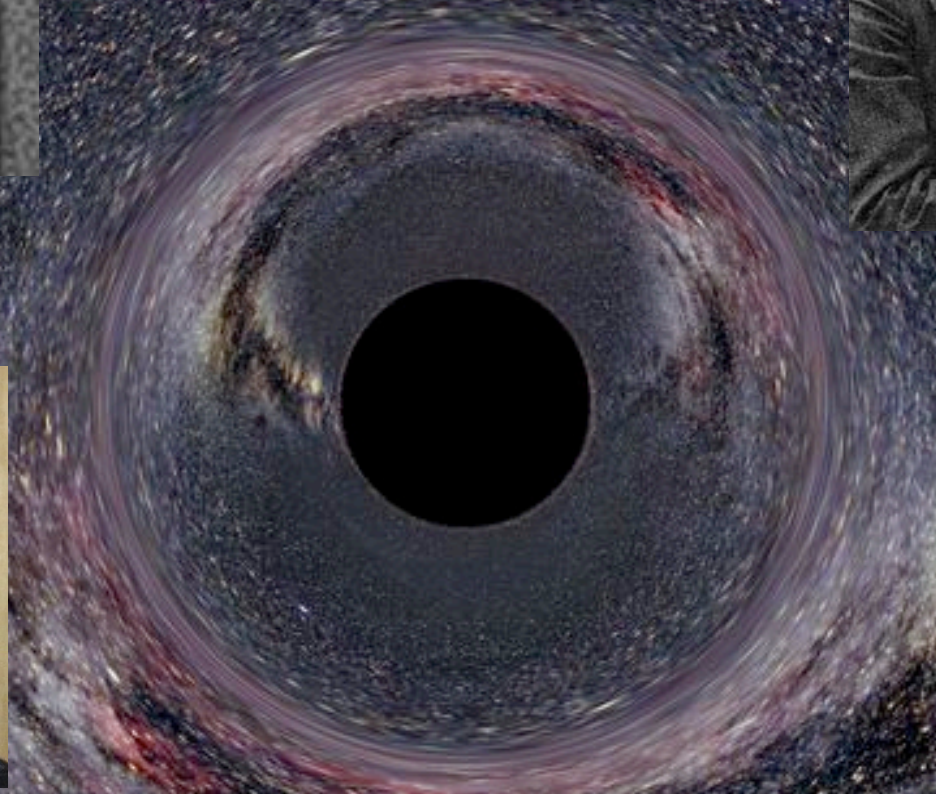
Jak se měří gravitace?



oběžná rychlost $v \sim$ vzdálenost $R^{-1/2}$
(Johannes Kepler)

Černé díry

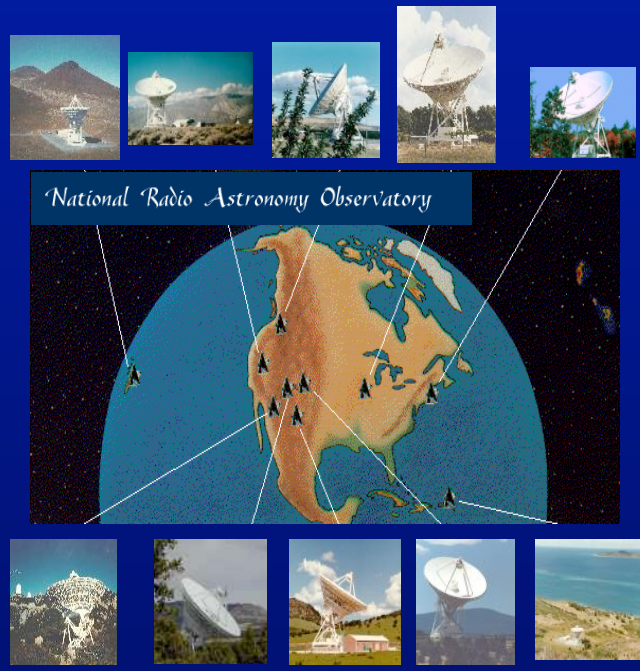


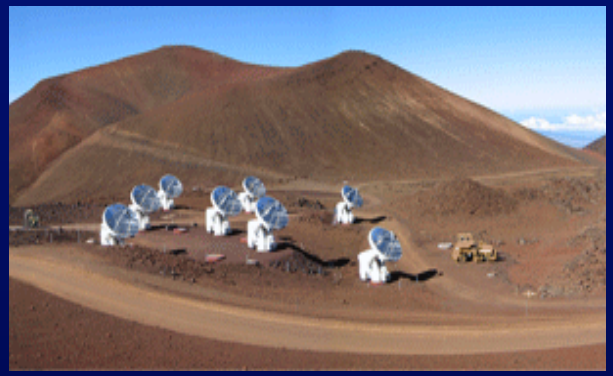


Černé díry září jasněji než jakékoli jiné kosmické těleso — pokud do nich padá hmota.

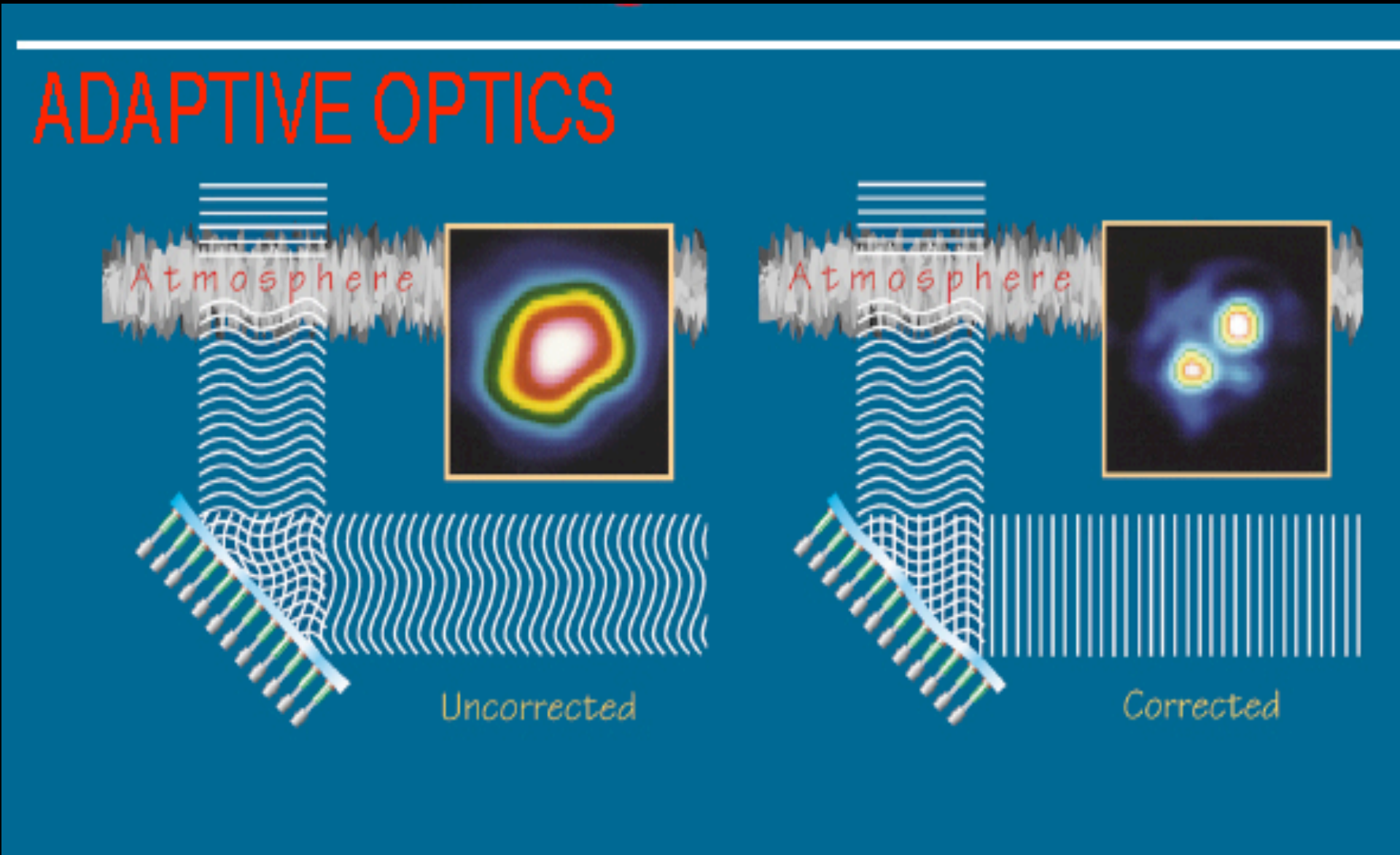
Okamžik před jejím pohlcením se gravitační energie padající hmoty přeměňuje na záření!

Současná astronomická technika



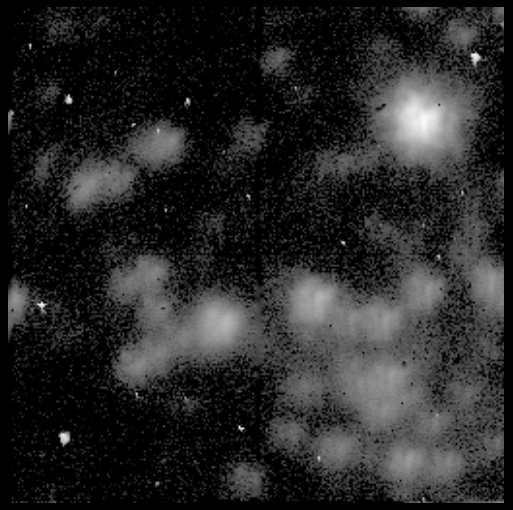


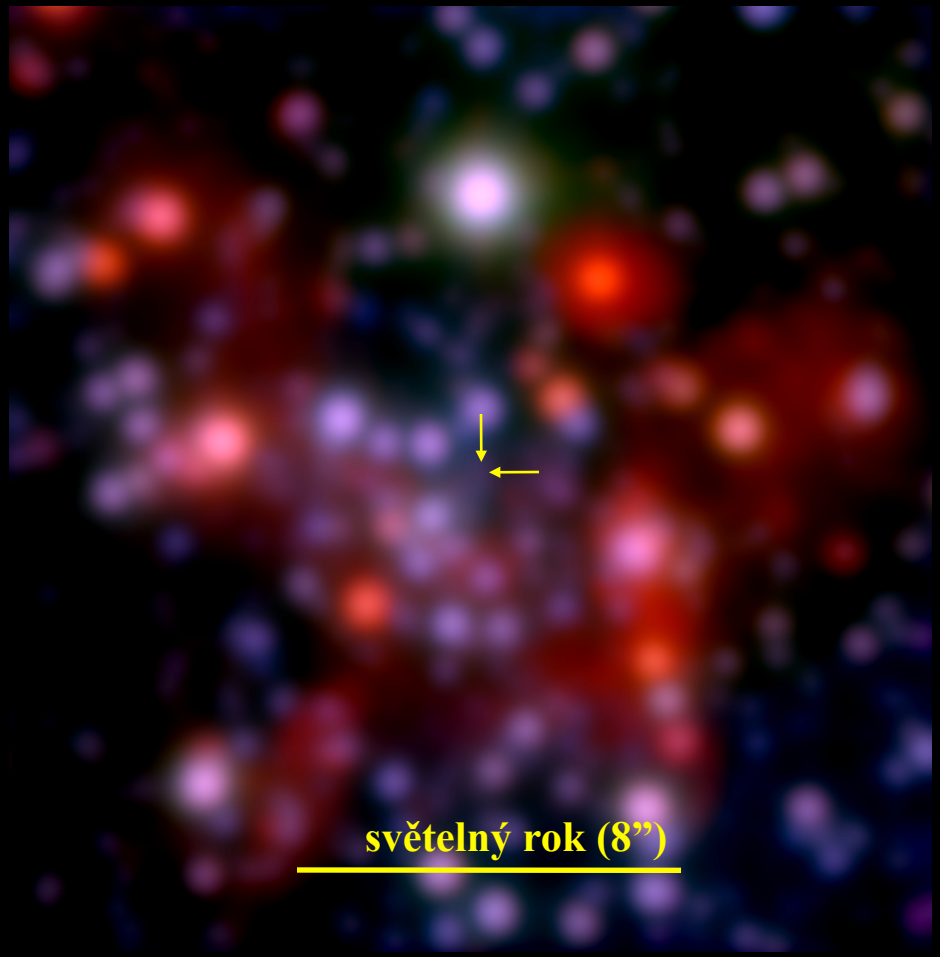
Adaptivní optika

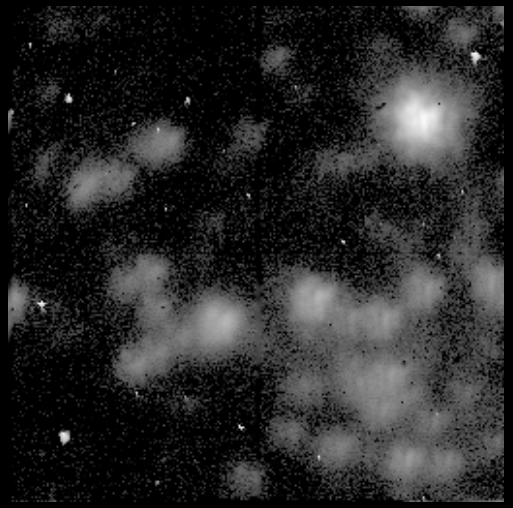


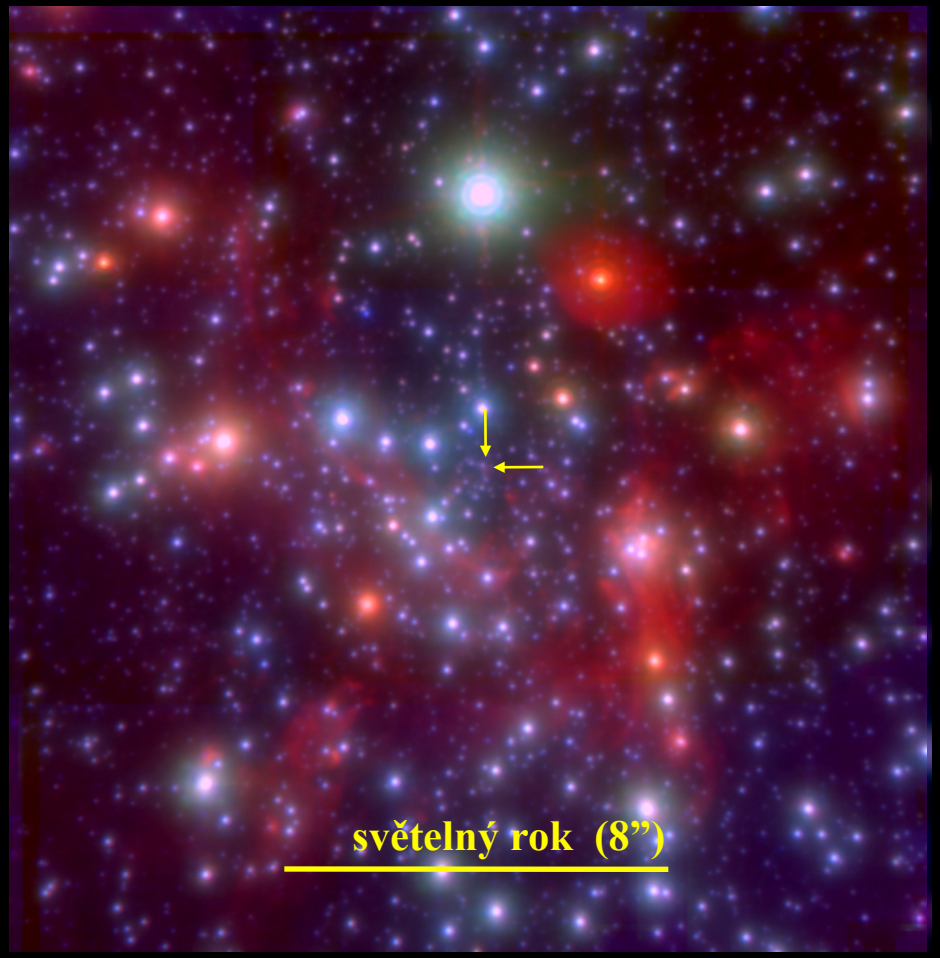
VLT, metoda laserového navádění

(ESO & MPE/MPIA, Feb 3, 2006)

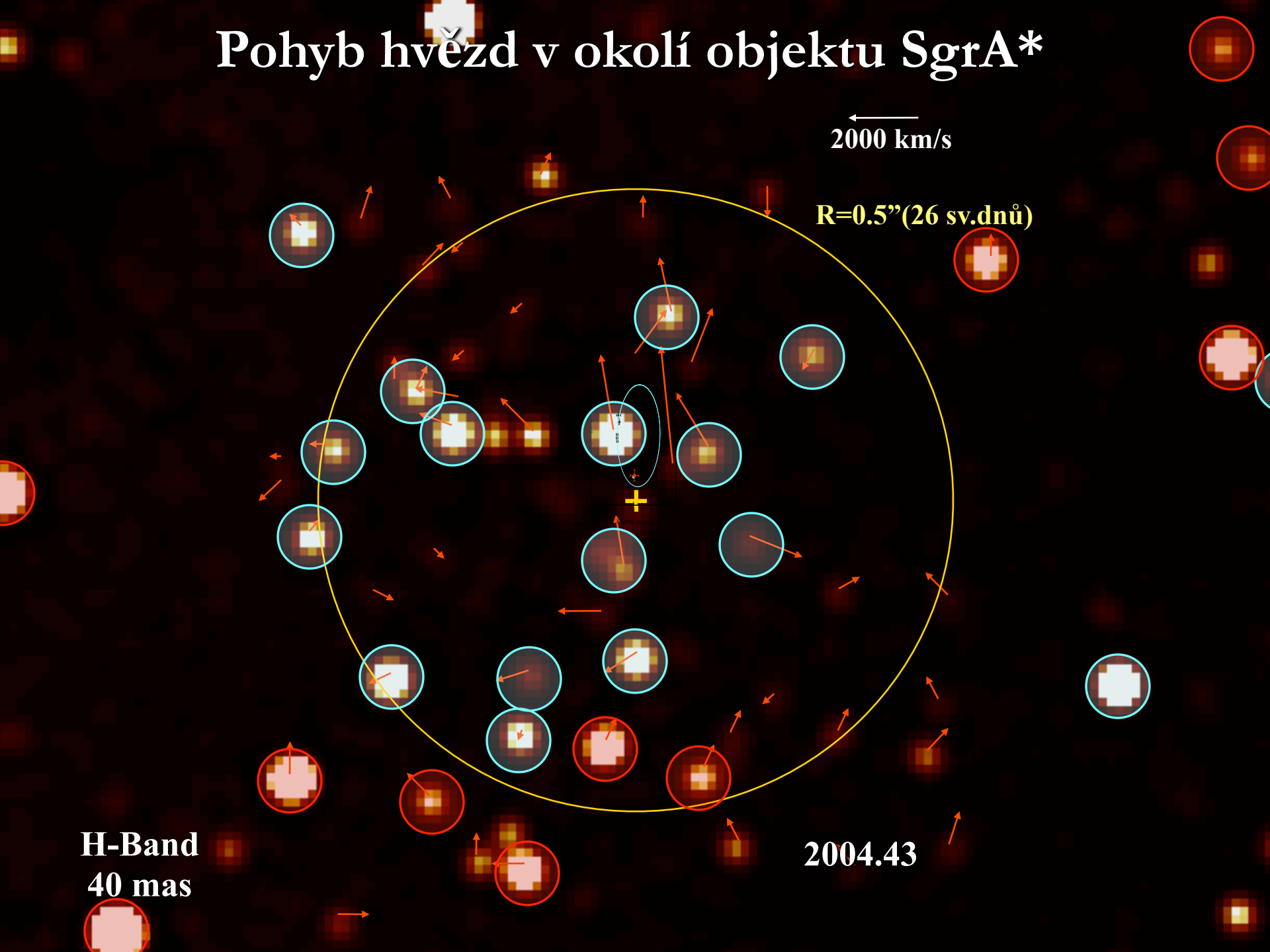



světelný rok (8”)



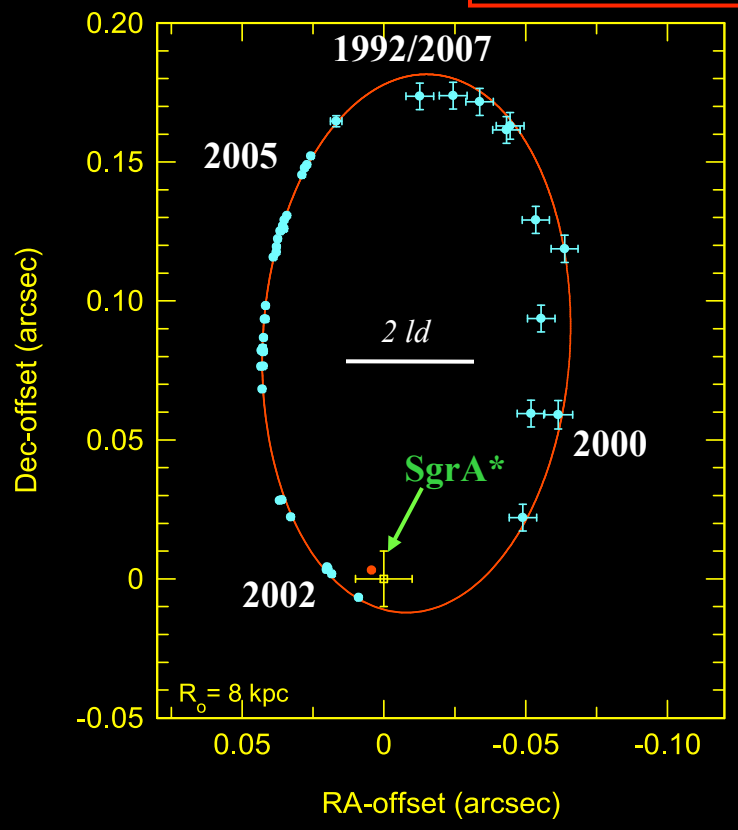

světelný rok (8”)

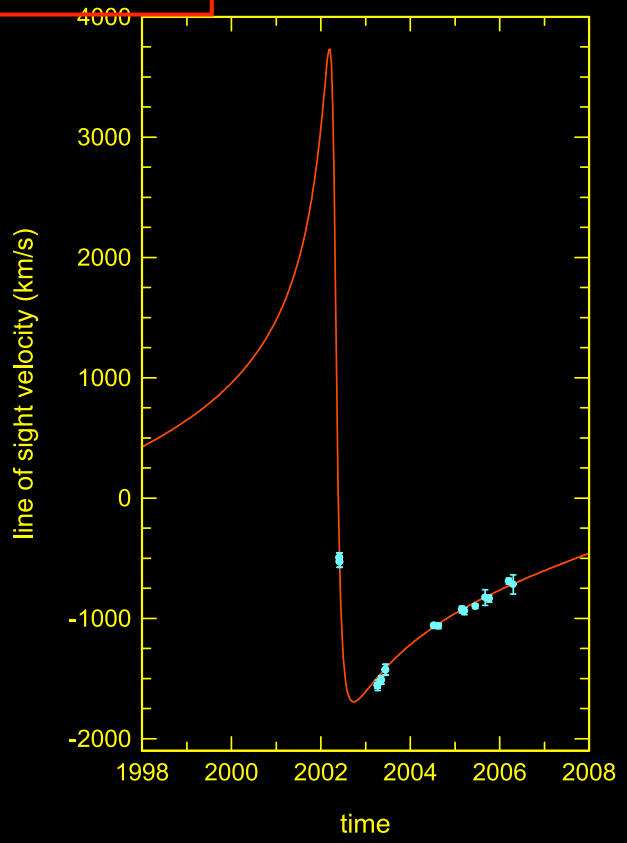
Pohyb hvězd v okolí objektu SgrA*



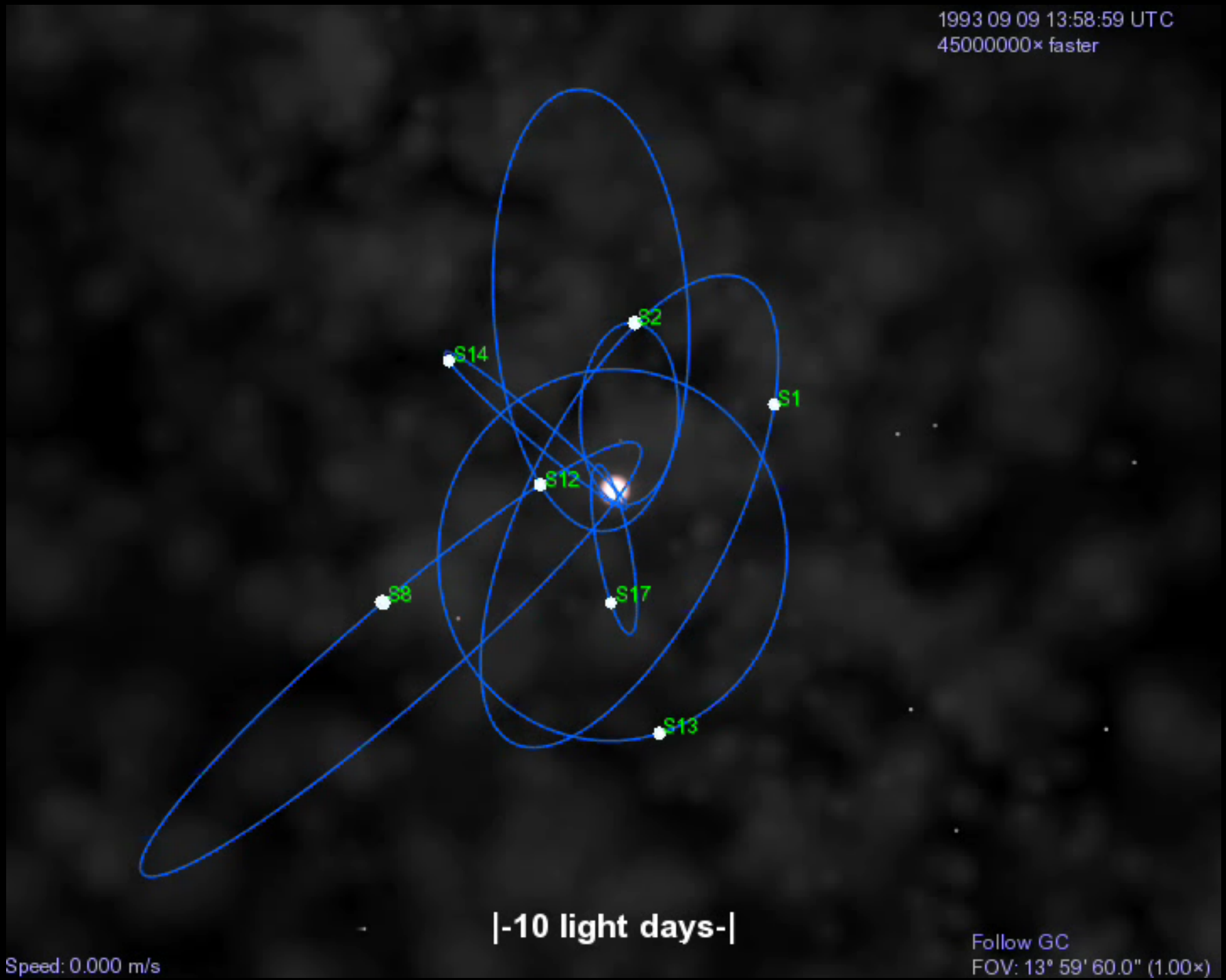
Přesné měření hvězdných drah

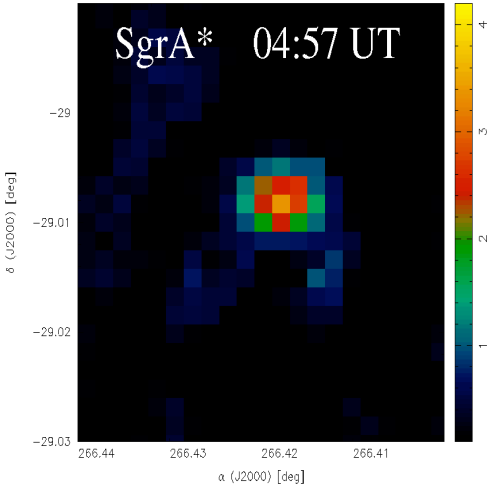
R_o (sv.r.) 25400±1300
M_o ($M_\odot$) 3.6±0.3x10^6

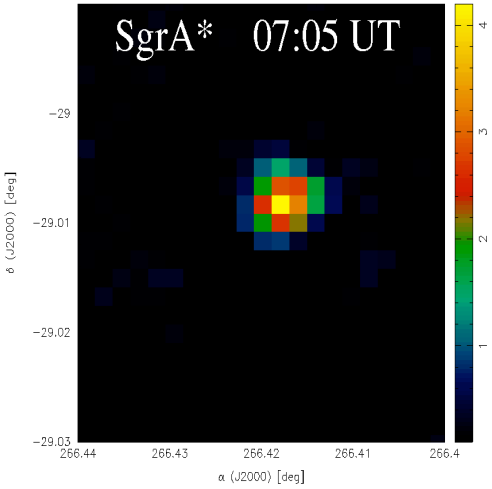


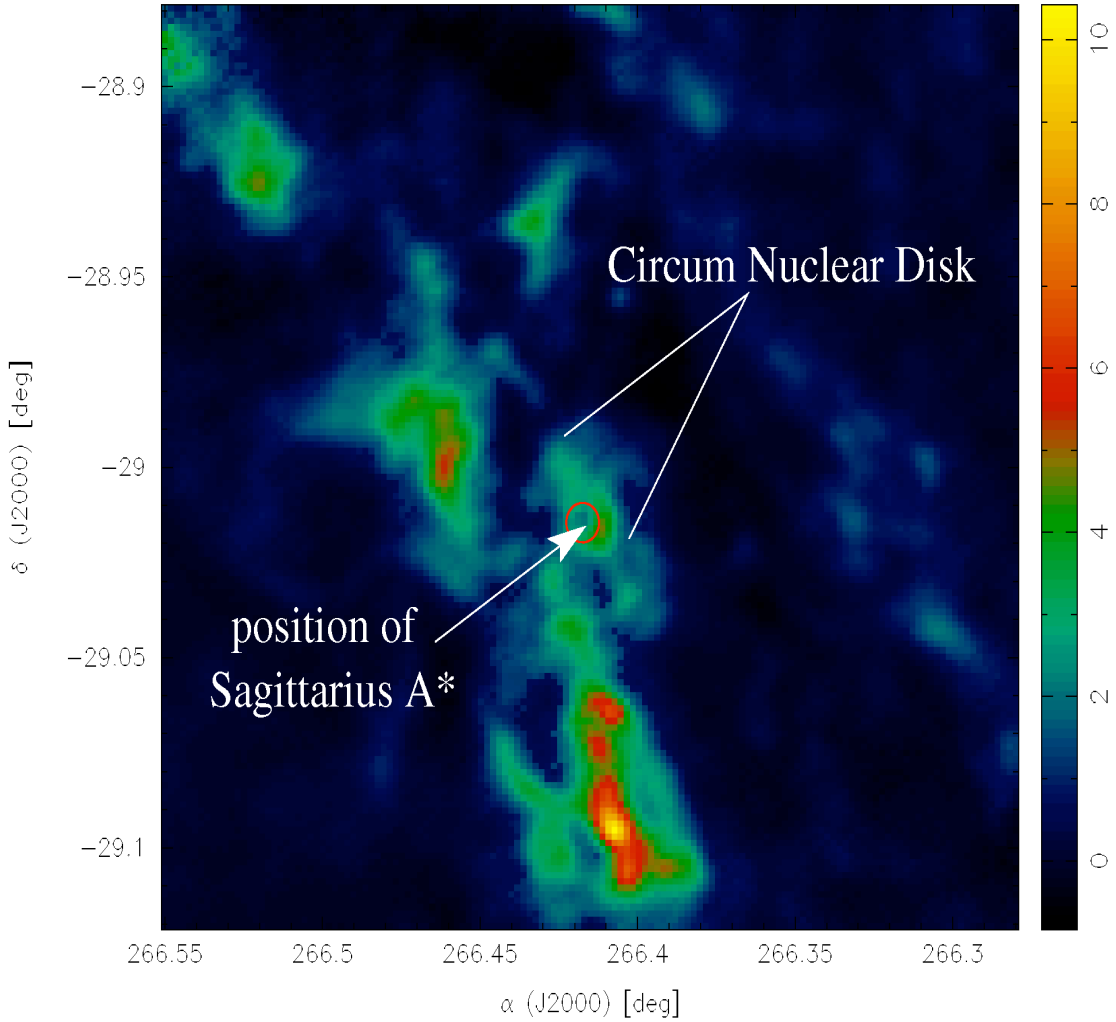


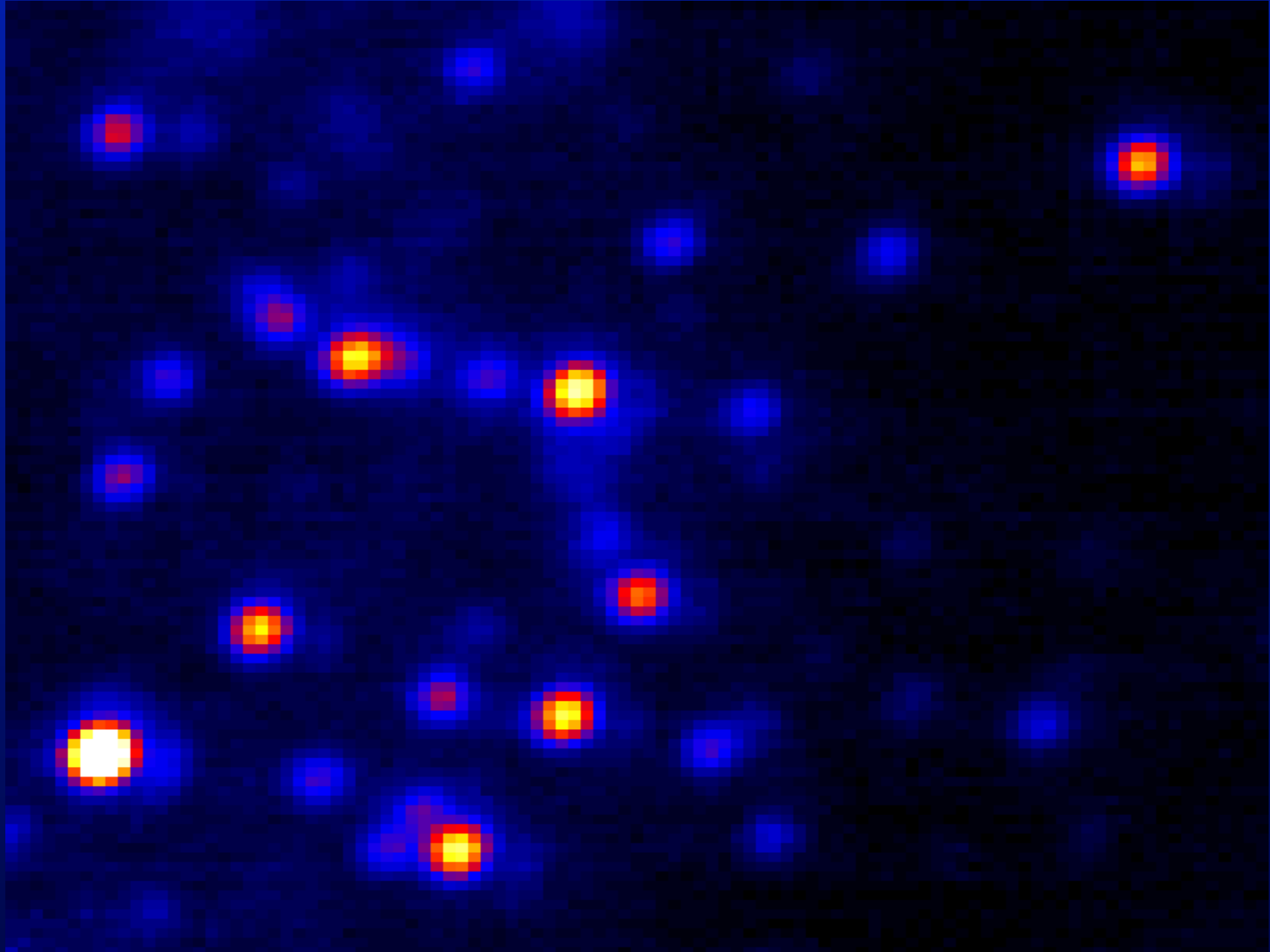
Rozprostřené hmoty je méně než několik % kompaktní hmoty uprostřed (<10^5 $M_\odot$).
Projevy speciální i obecné teorie relativity budou měřitelné během několika příštích roků.

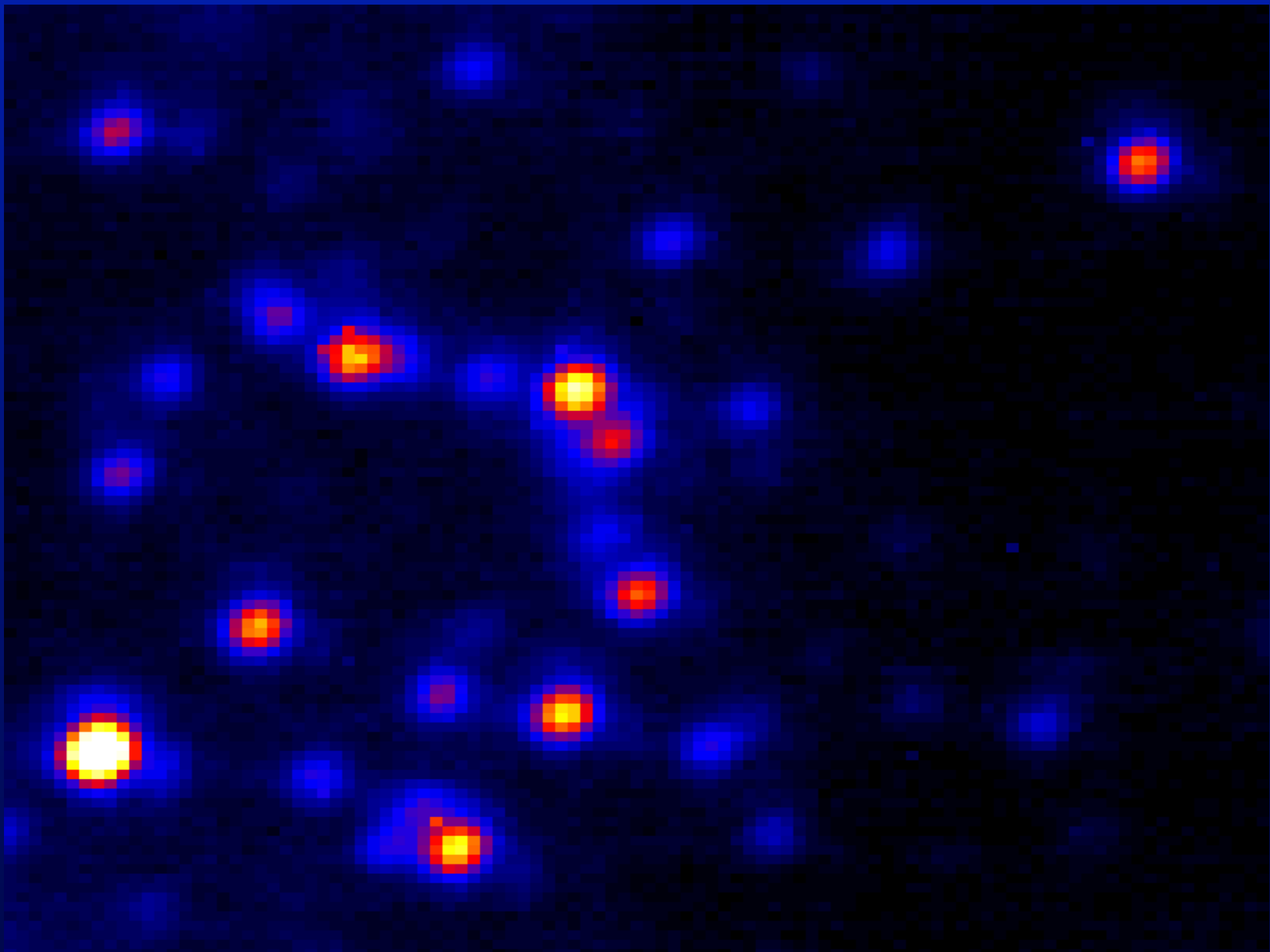

1993 09 09 13:58:59 UTC
45000000× faster
S2
S14
S1
S12
S8
S17
S13
|-10 light days-|
Speed: 0.000 m/s
Follow GC
FOV: 13° 59' 60.0" (1.00×)

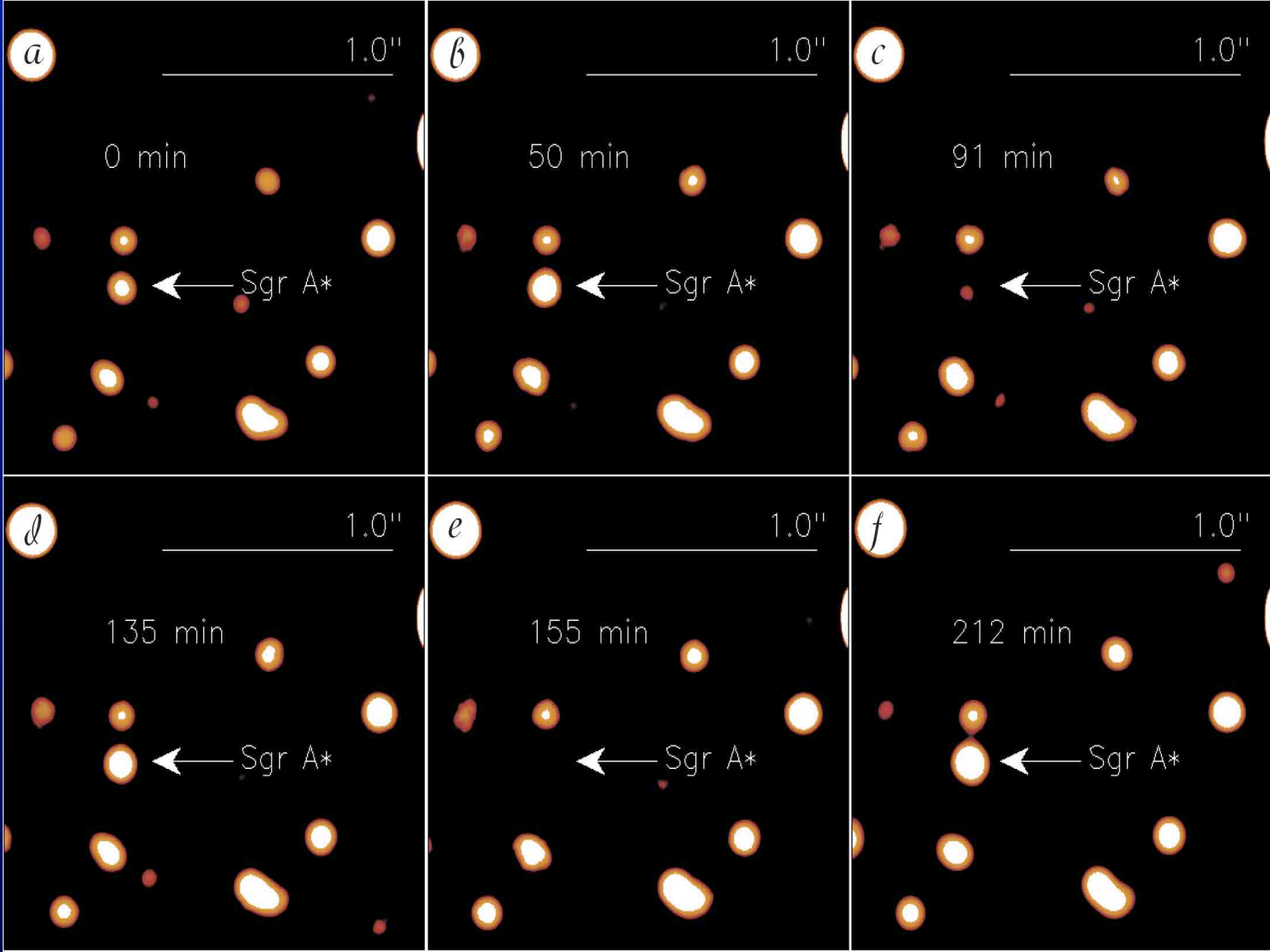

SgrA* 04:57 UT
δ (J2000) [deg]
α (J2000) [deg]

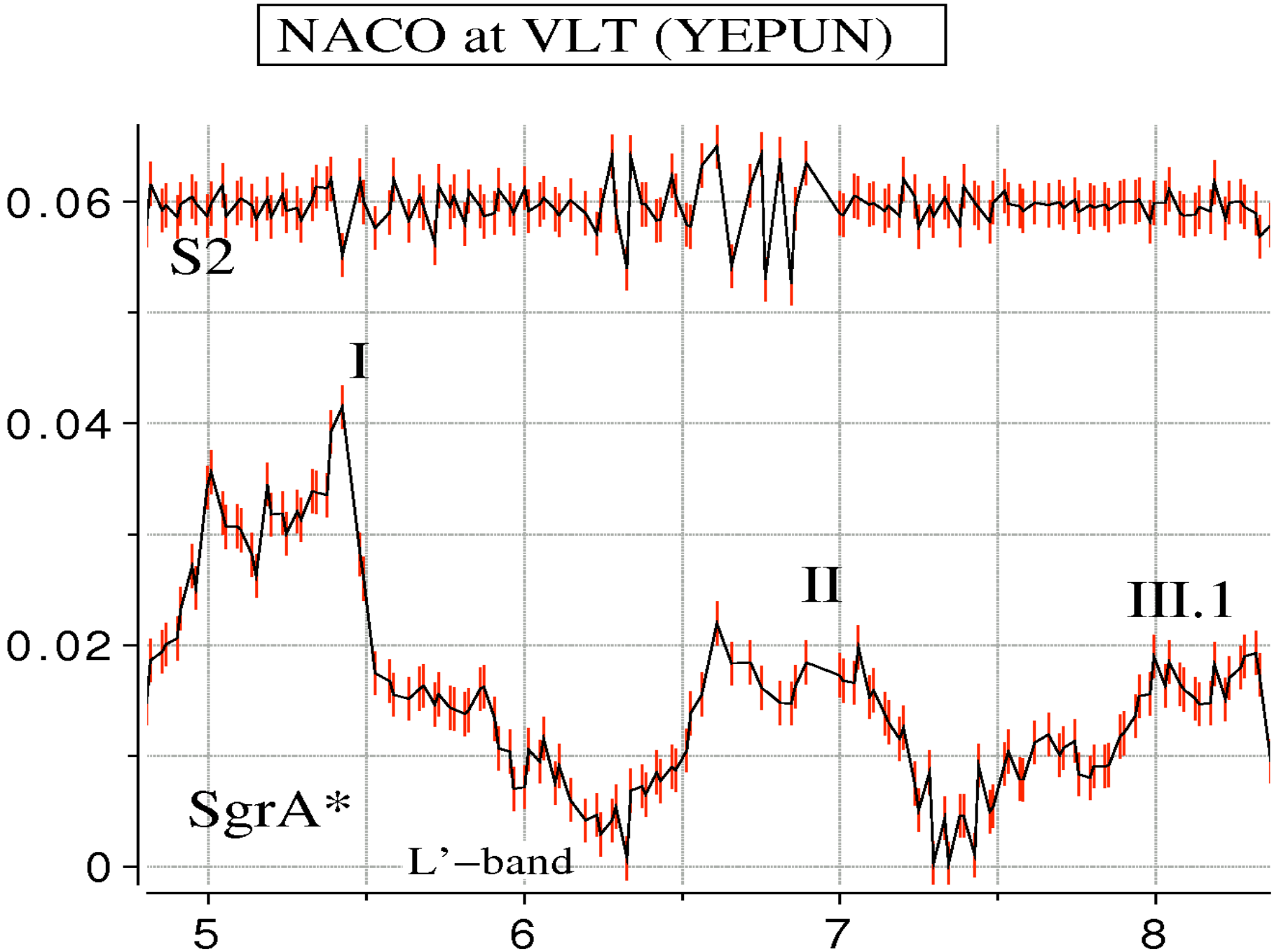

SgrA* 07:05 UT
δ (J2000) [deg]
α (J2000) [deg]

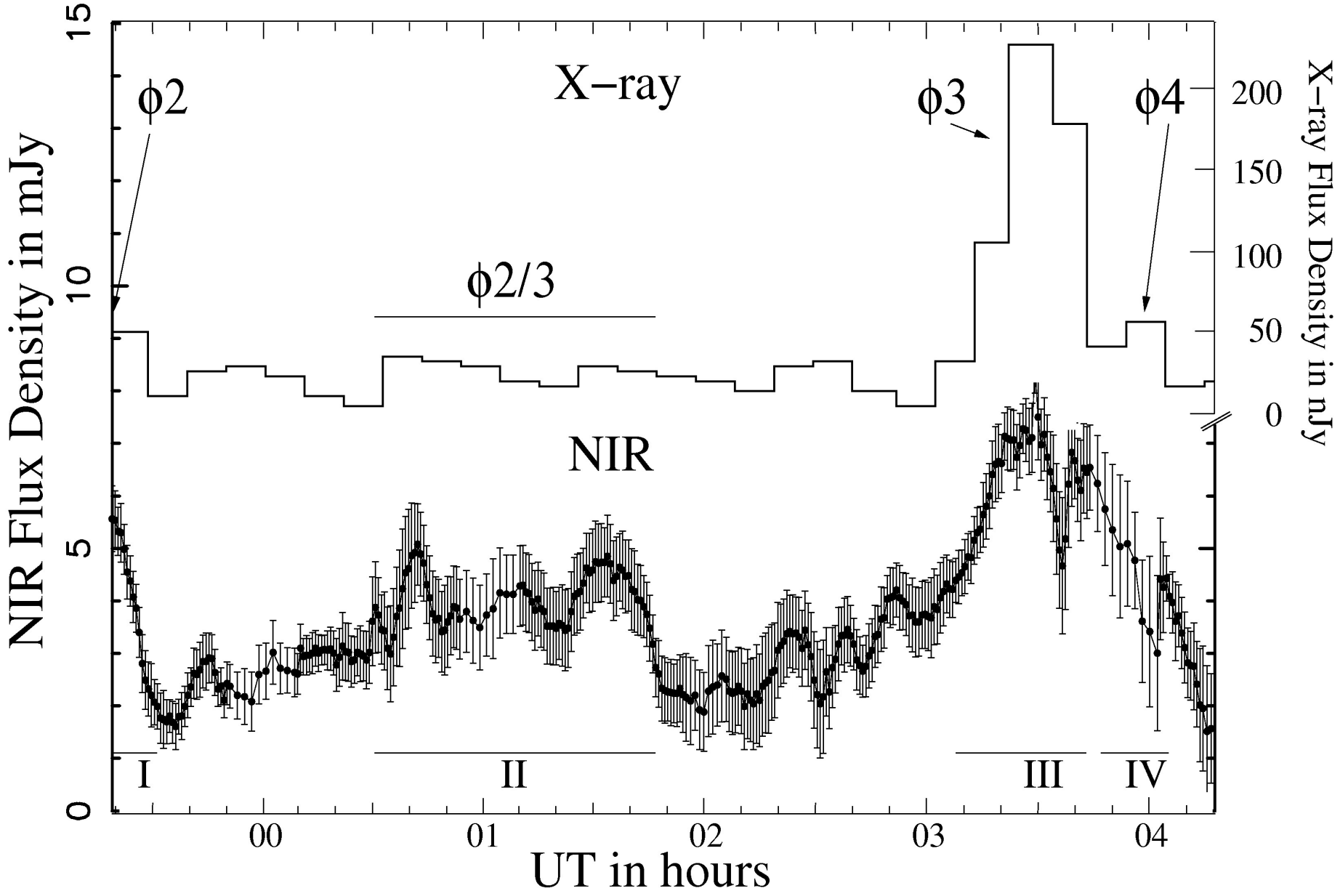

Circum Nuclear Disk
position of
Sagittarius A*
δ (J2000) [deg]
α (J2000) [deg]

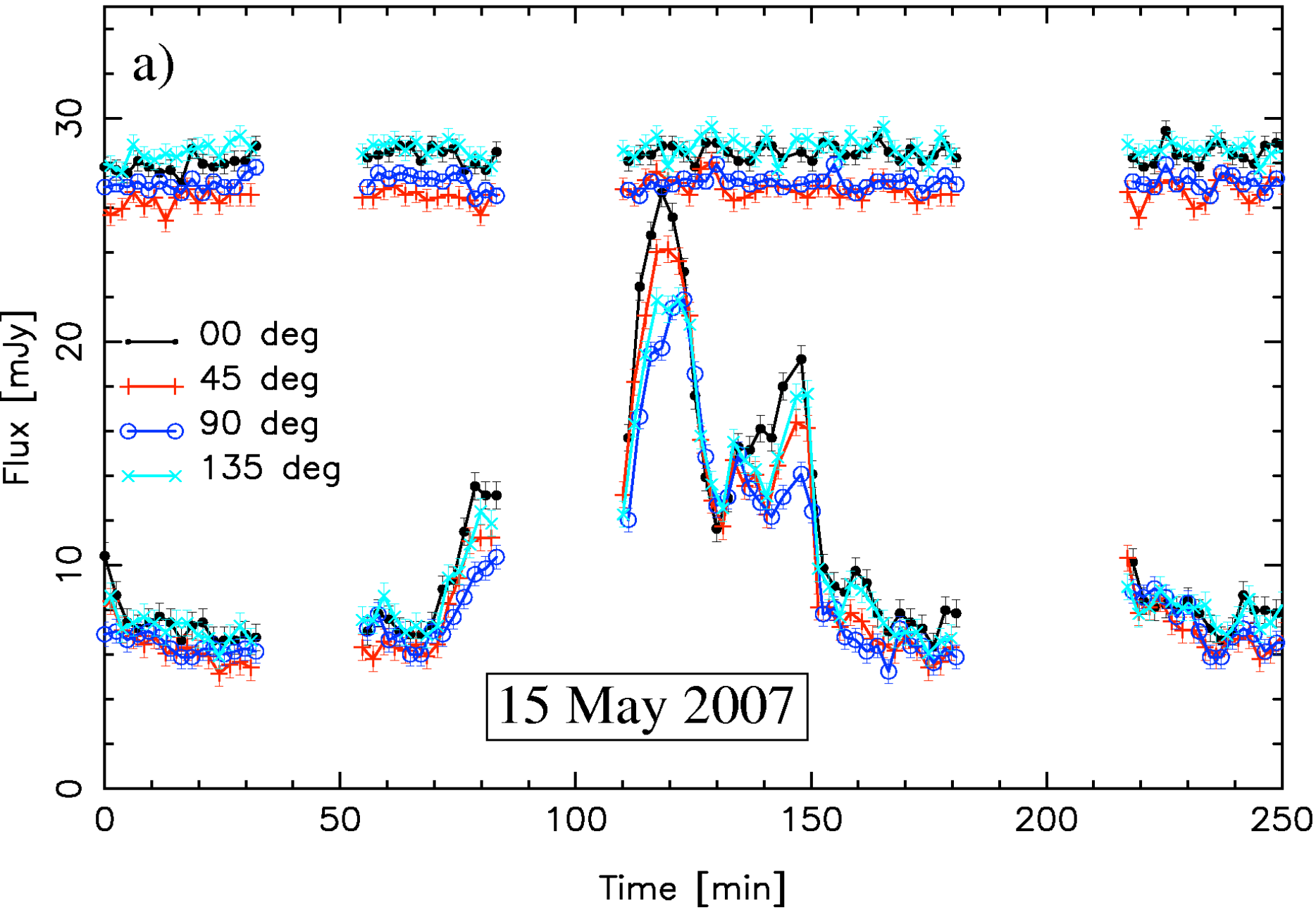


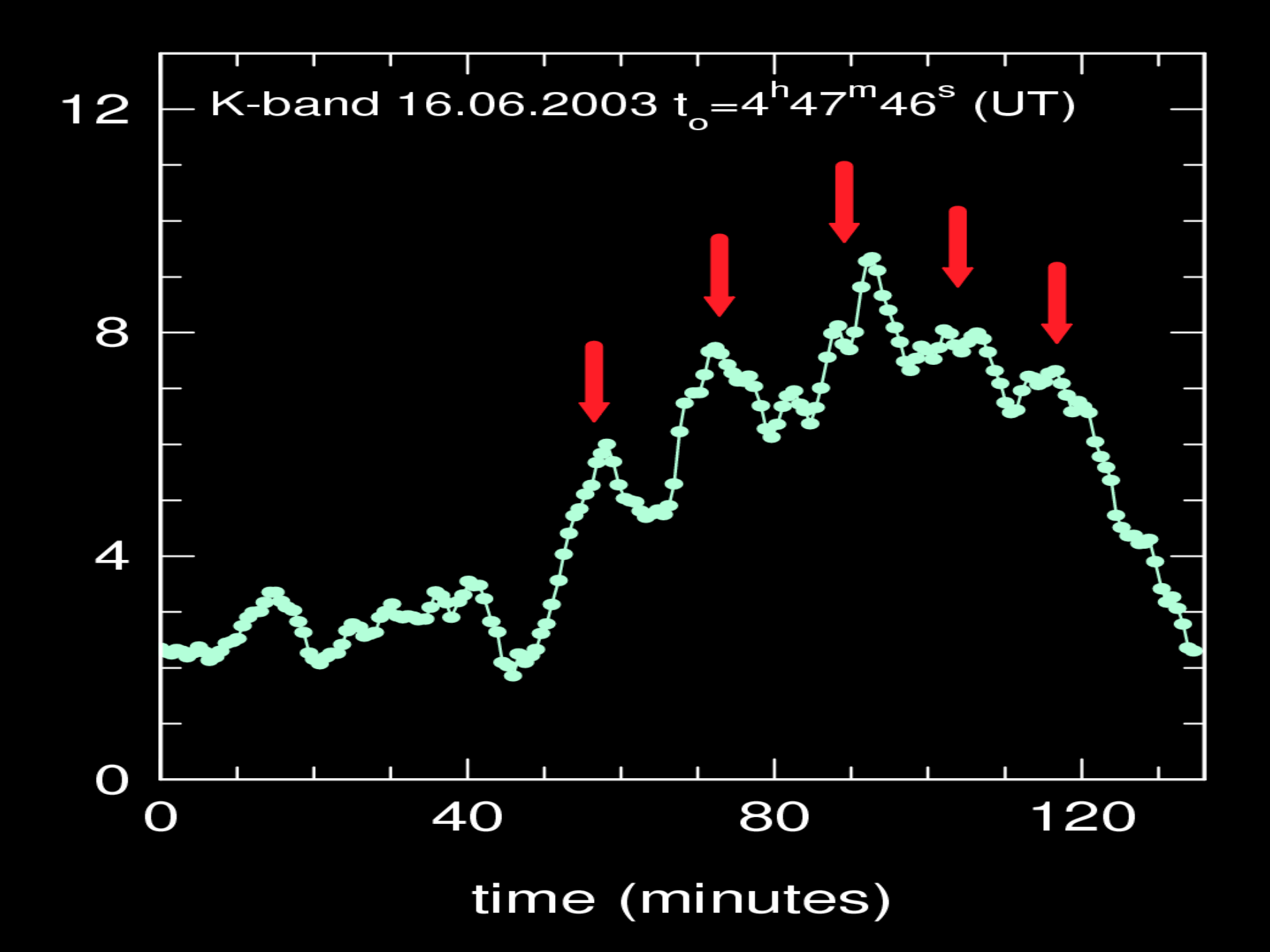


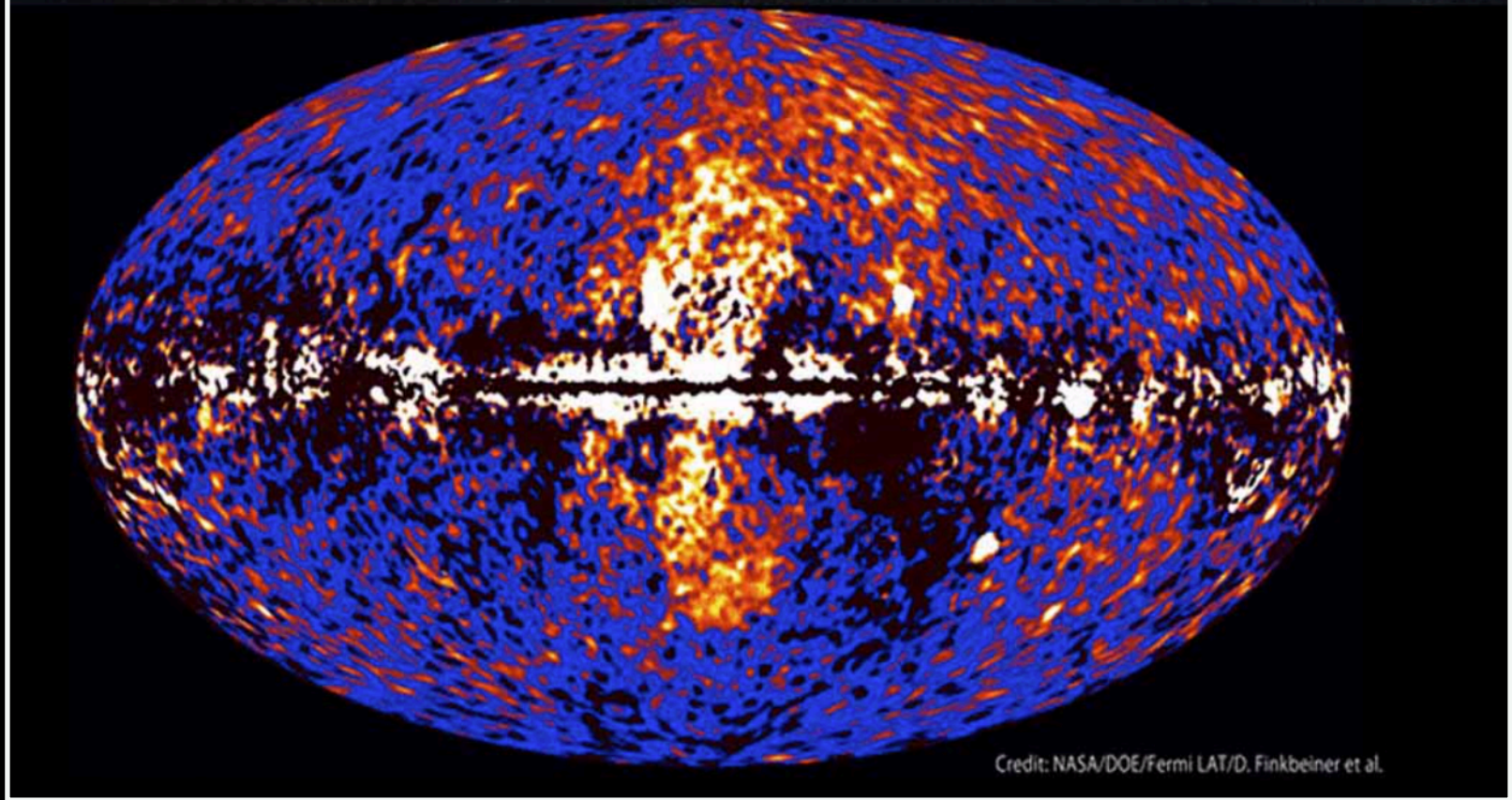

a
1.0''
0 min
Sgr A*
b
1.0''
50 min
Sgr A*
c
1.0''
91 min
Sgr A*
d
1.0''
135 min
Sgr A*
e
1.0''
155 min
Sgr A*
f
1.0''
212 min
Sgr A*

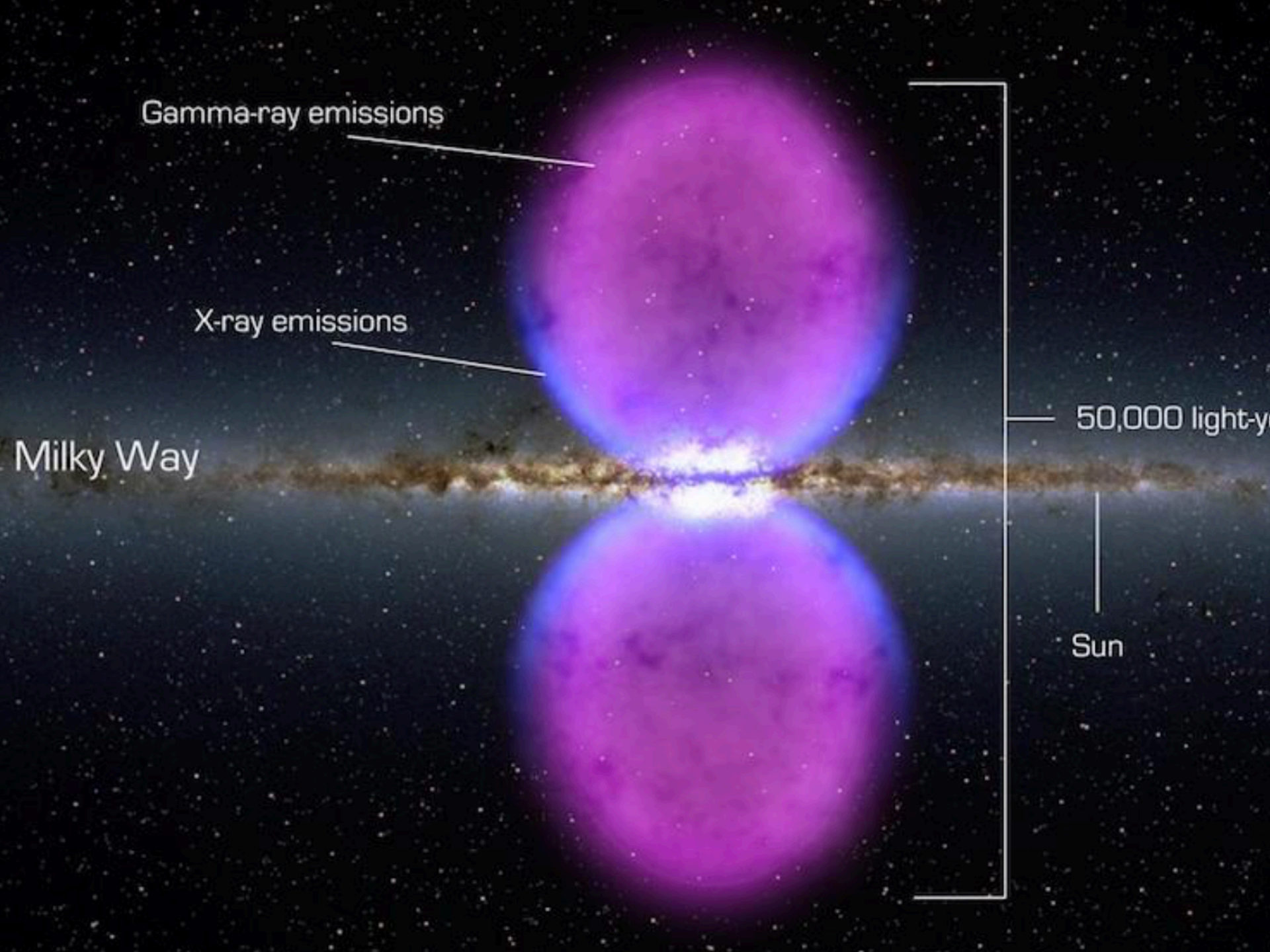

NACO at VLT (YEPUN)
0.06
0.04
0.02
0
S2
I
II
III.1
SgrA*
L'–band
5
6
7
8

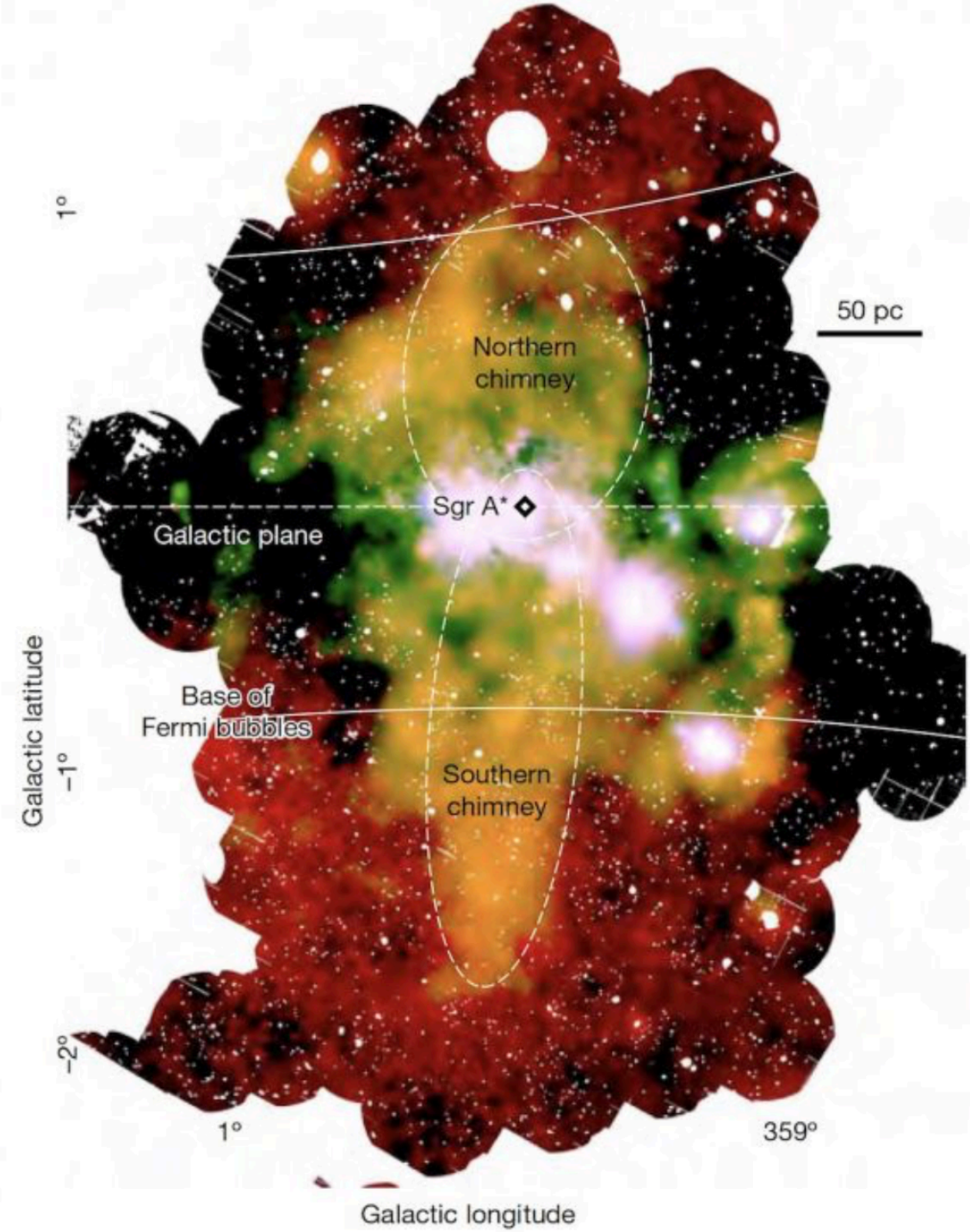

X−ray
NIR
ϕ2
ϕ2/3
ϕ3
ϕ4
I
II
III
IV
NIR Flux Density in mJy
X−ray Flux Density in nJy
UT in hours
0
5
10
15
0
50
100
150
200
00
01
02
03
04

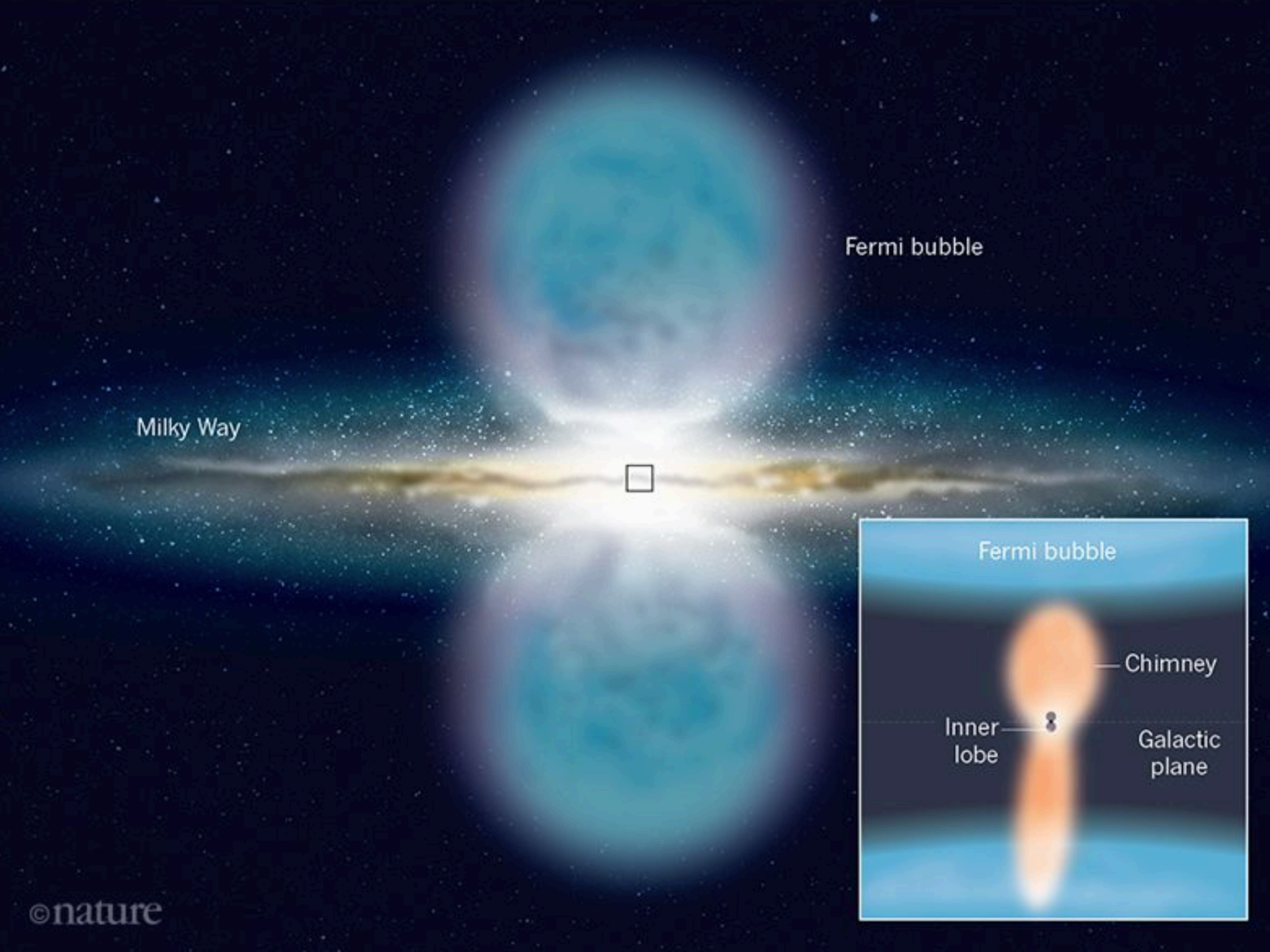

a)
00 deg
45 deg
90 deg
135 deg
15 May 2007
Flux [mJy]
Time [min]
0
10
20
30
0
50
100
150
200
250


K-band 16.06.2003 $t_o=4^h47^m46^s$ (UT)
12
8
4
0
0
40
80
120
time (minutes)

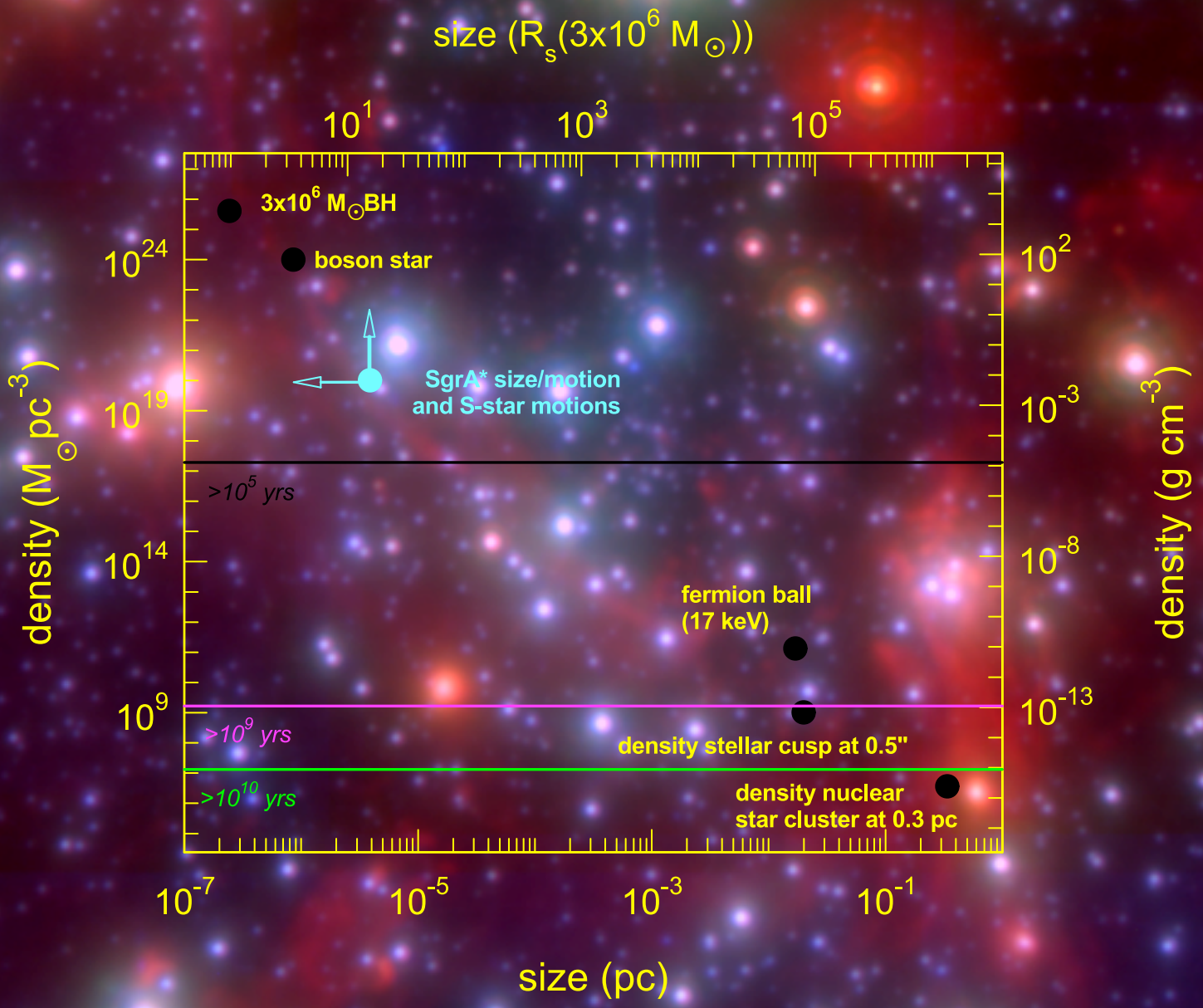

Credit: NASA/DOE/Fermi LAT/D. Finkbeiner et al.


Gamma-ray emissions
X-ray emissions
Milky Way
50,000 light-y
Sun

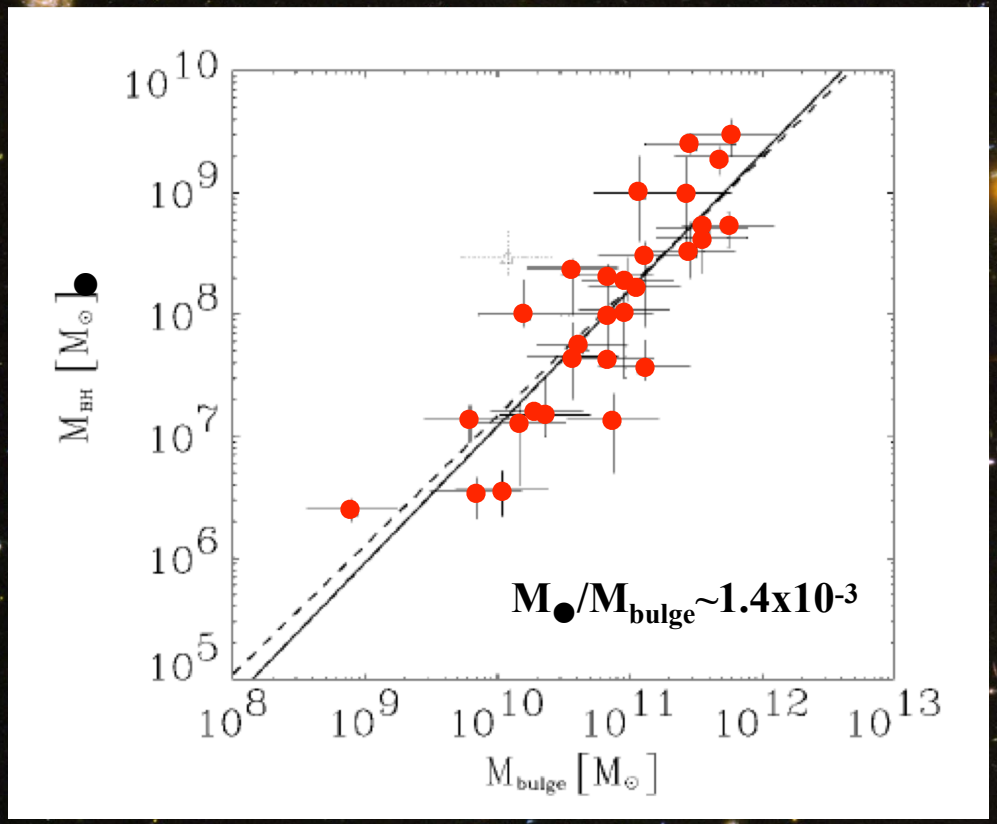

1°
50 pc
Northern
chimney
Sgr A*
Galactic plane
Galactic latitude
Base of
Fermi bubbles
−1°
Southern
chimney
−2°
1°
359°
Galactic longitude

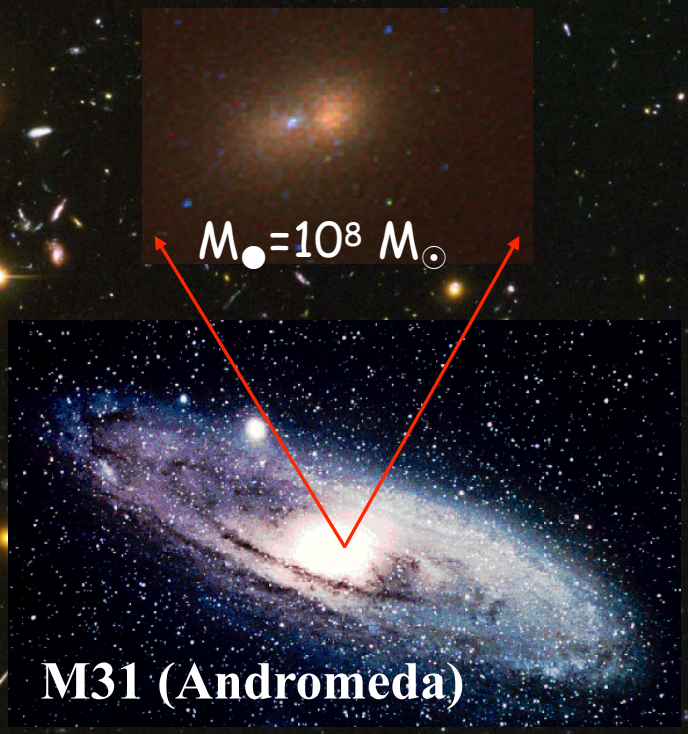

Fermi bubble
Milky Way
Fermi bubble
Chimney
Inner lobe
Galactic plane
©nature

Je objekt SgrA opravdu černou dírou ?*

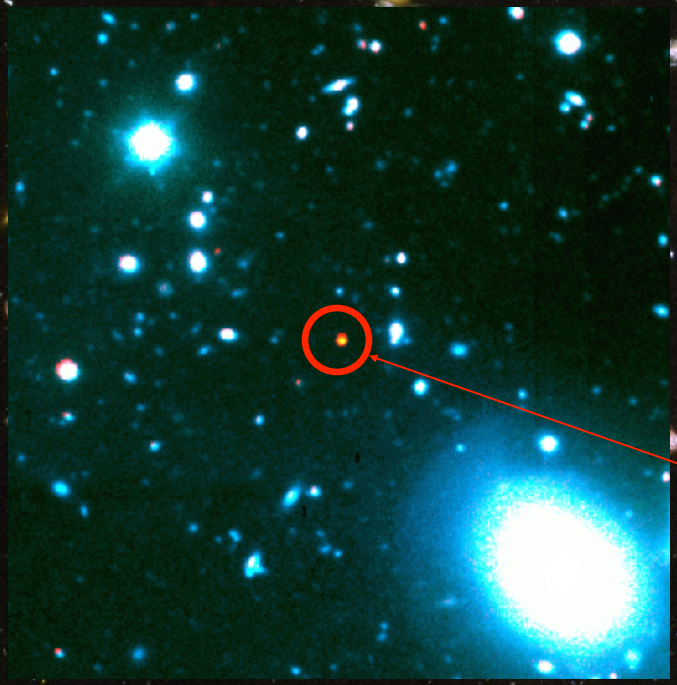


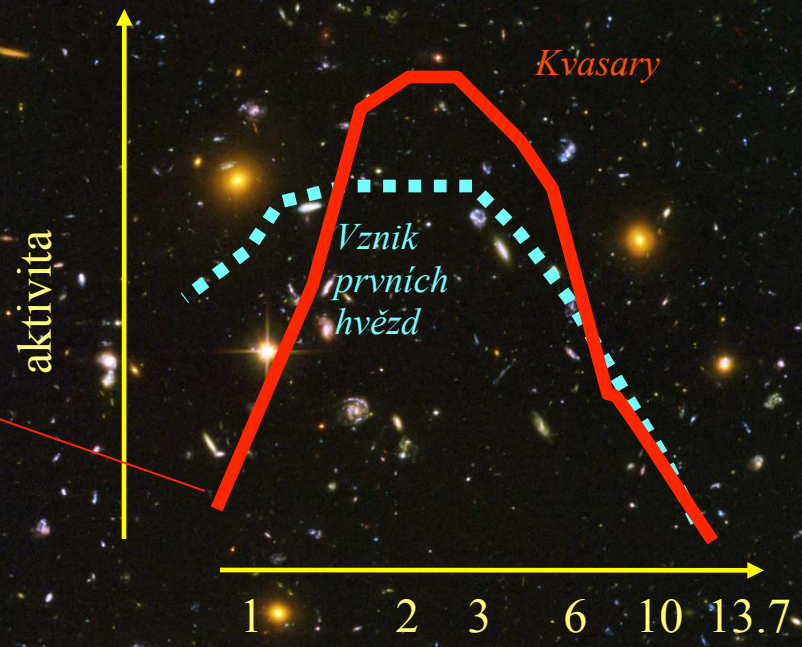
Velmi hmotné černé díry v ostatních galaxiích



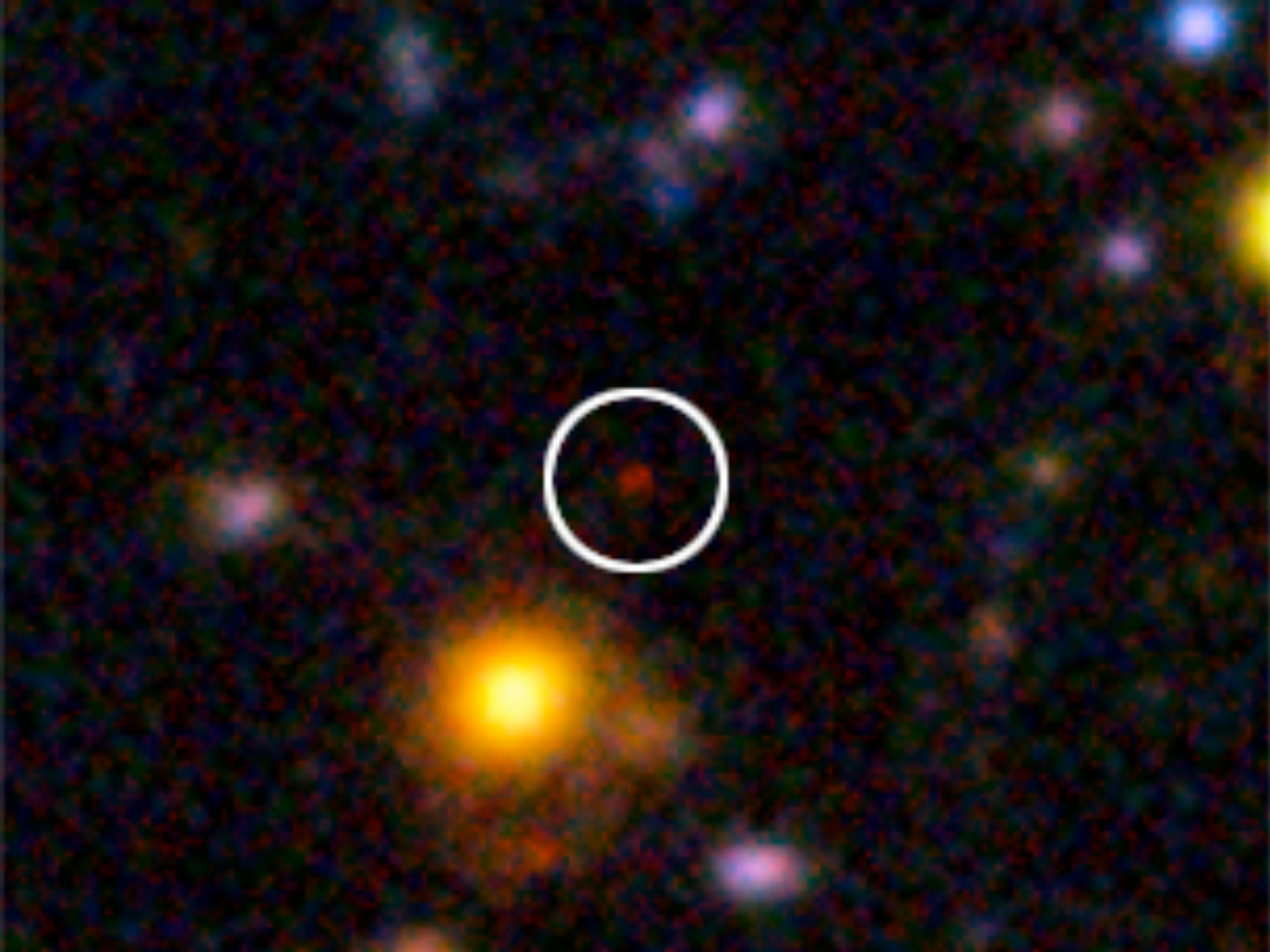


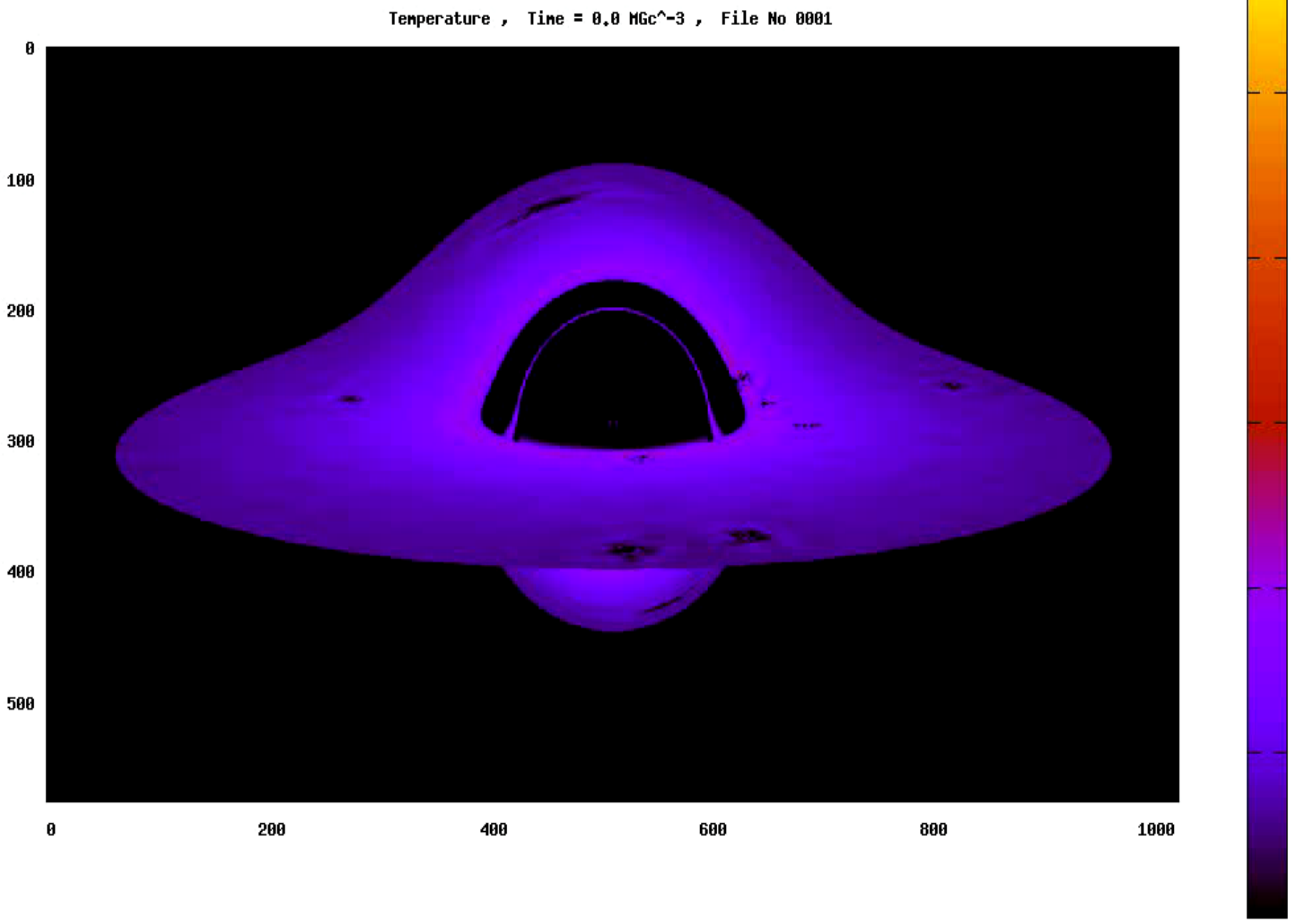
Galaxie a hmotné černé díry v raném vesmíru





800 milionů let po velkém třesku se formuje černá díra o hmotnosti 3 milardy sluncí!




Temperature , Time = 0.0 MGc^-3 , File No 0001
0
100
200
300
400
500
0
200
400
600
800
1000