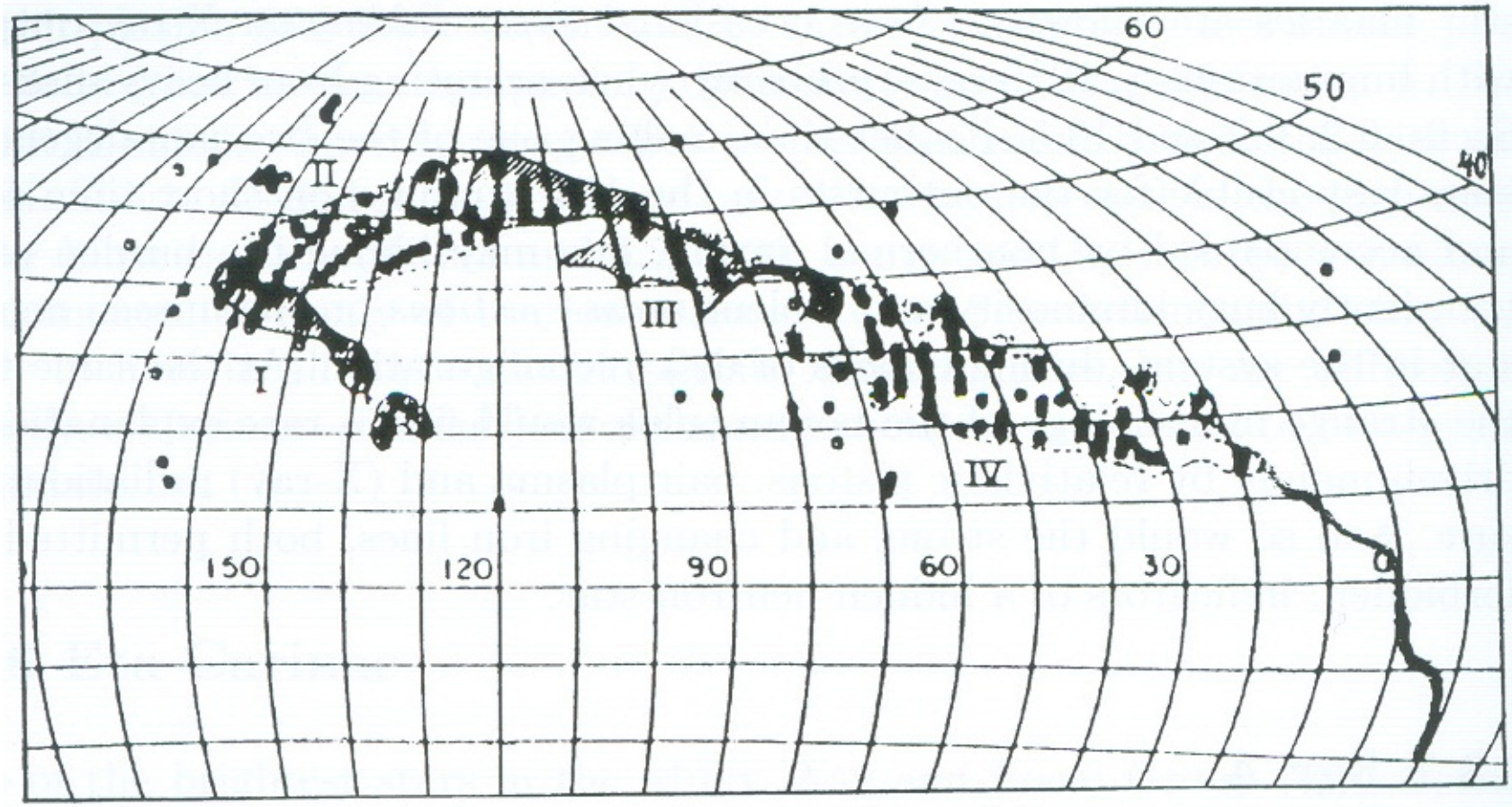
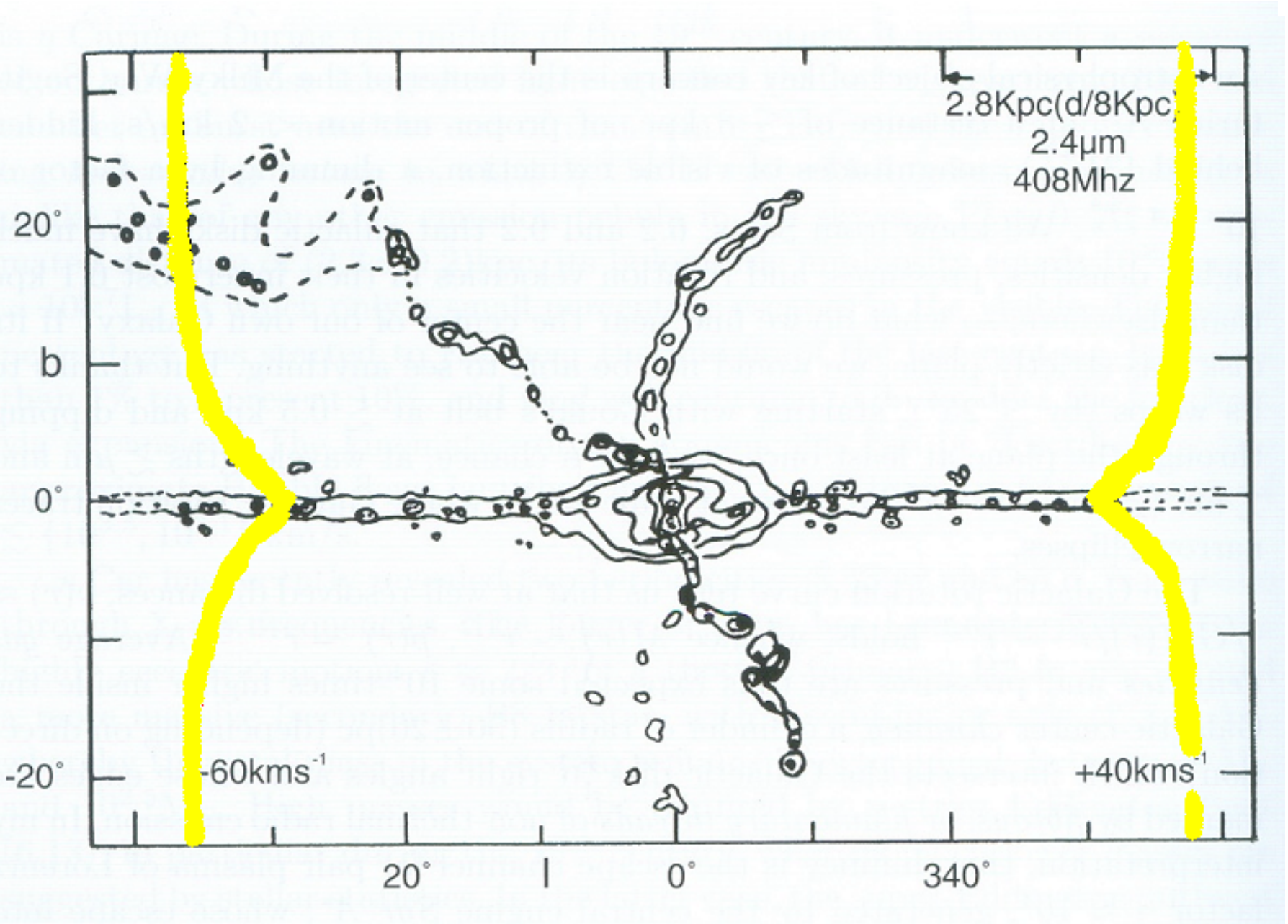
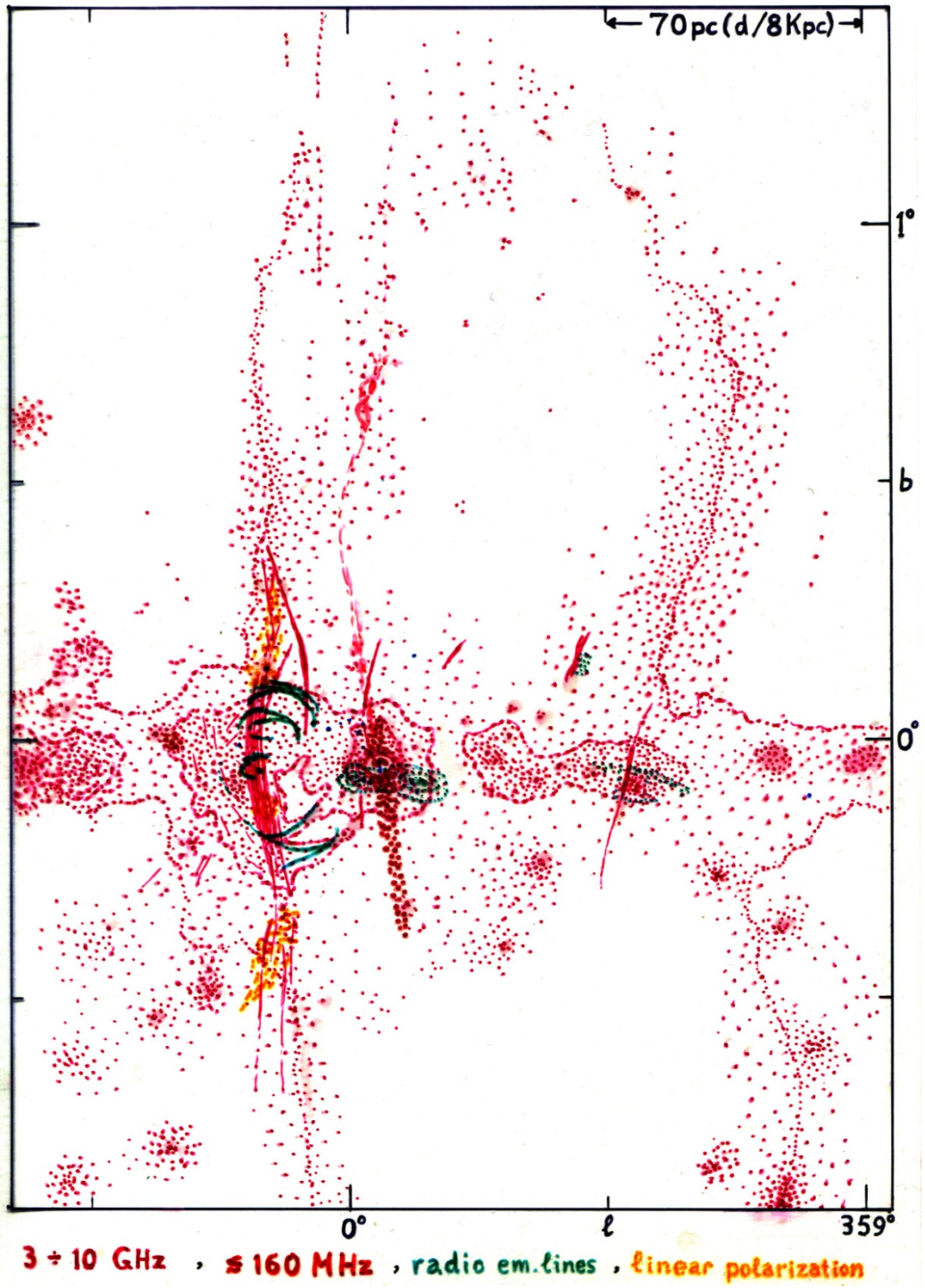
# OUR GALACTIC CENTER

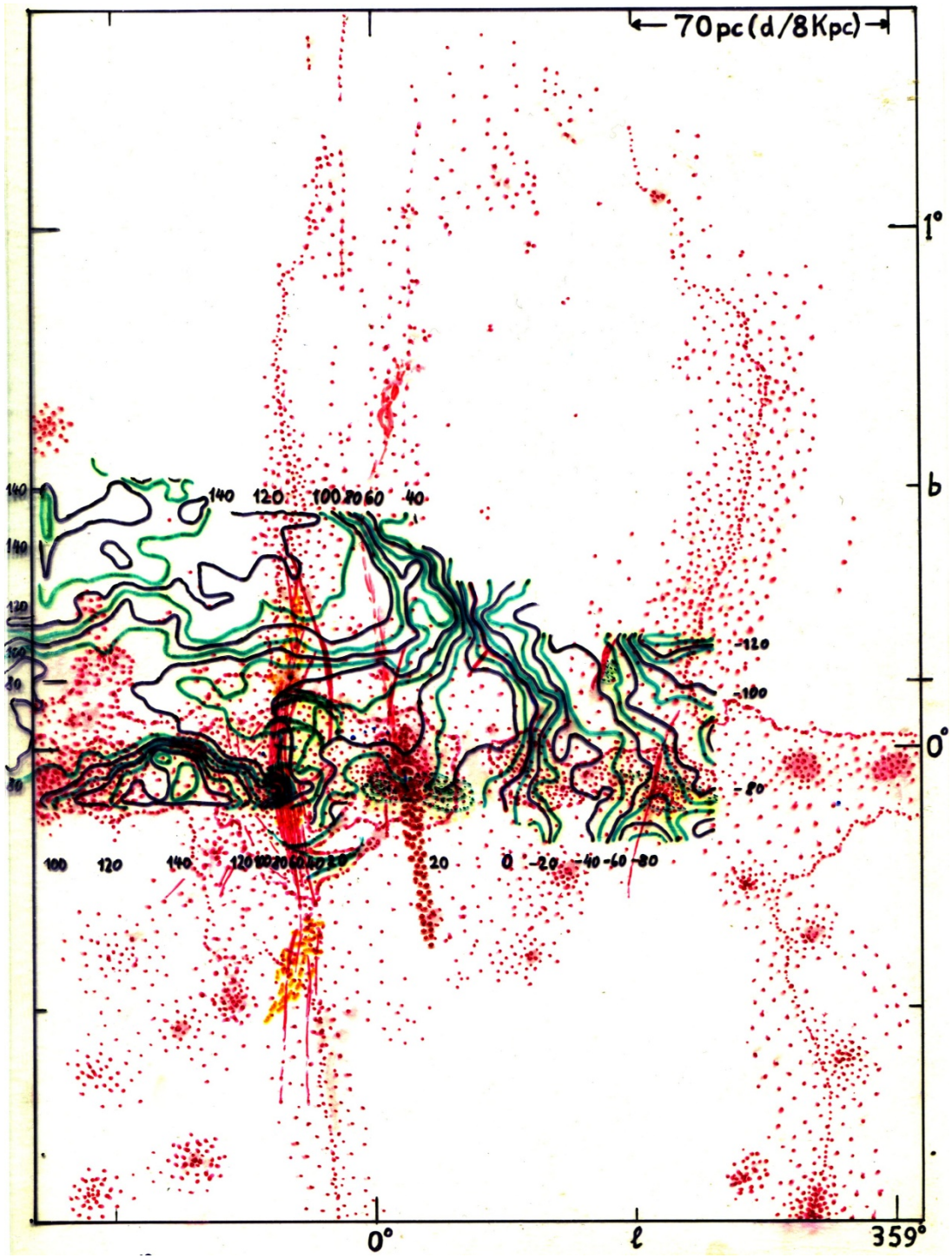
Wolfgang Kundt

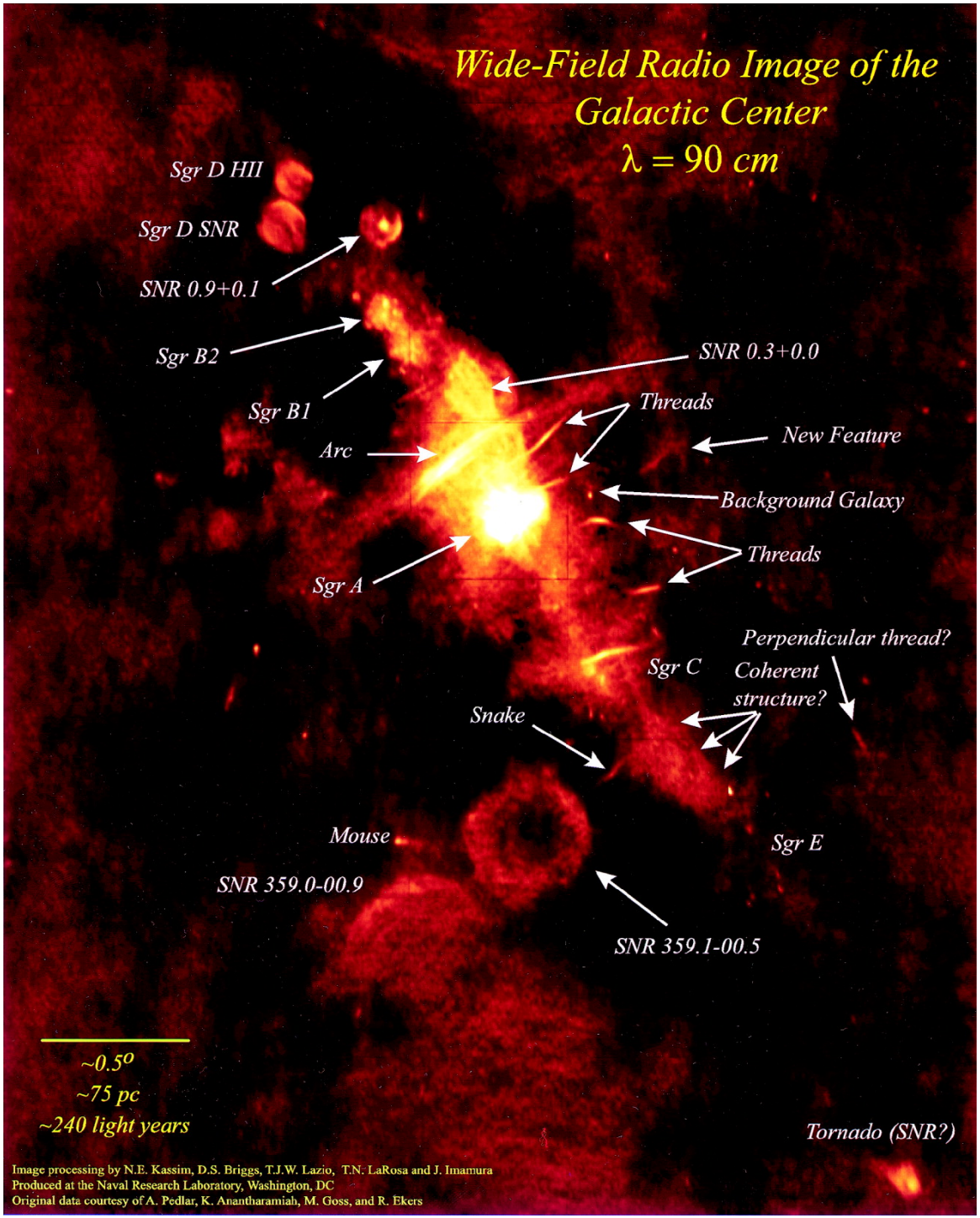
Vulcano, 28 May 2012

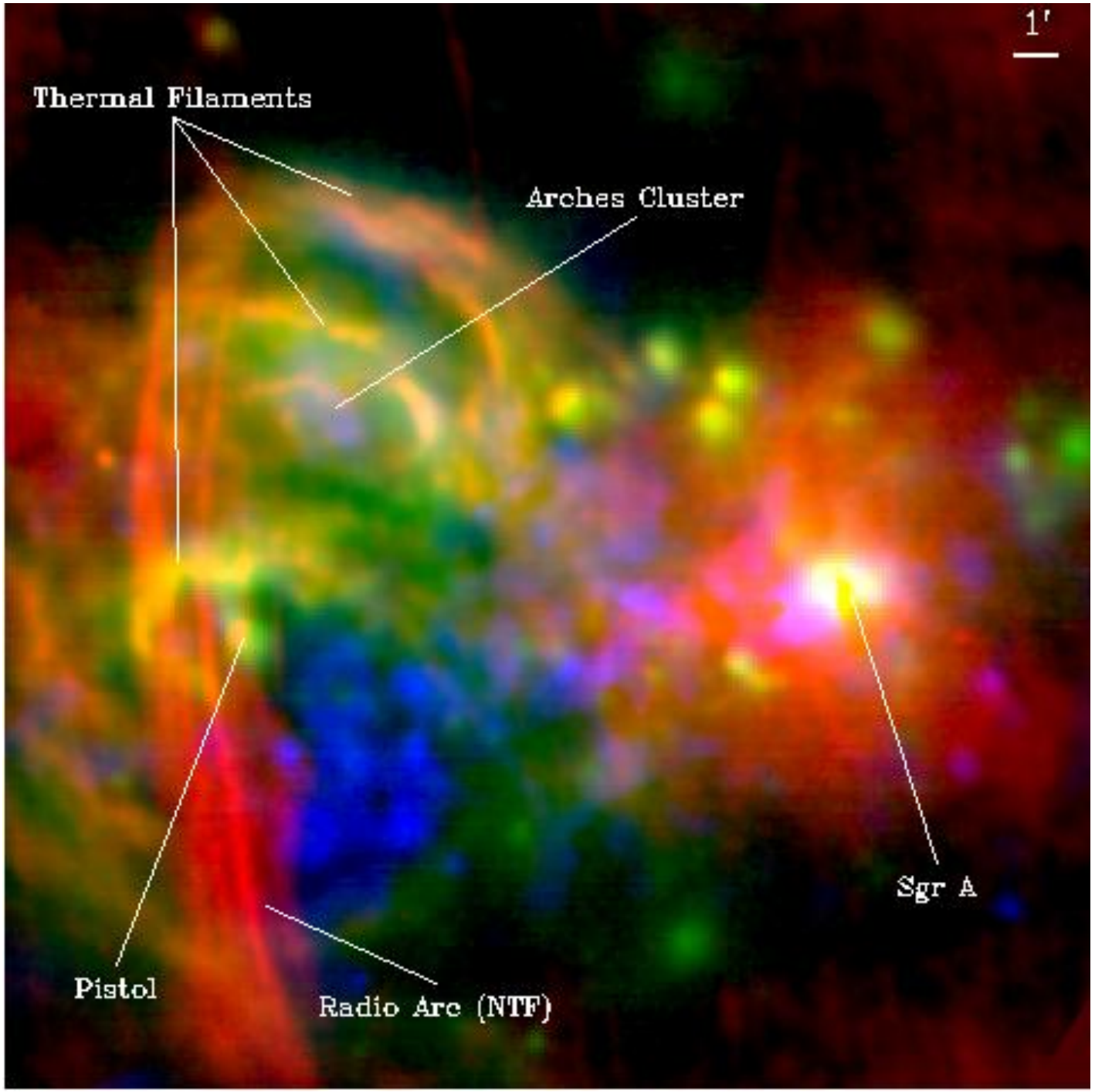

60
50
40
II
III
I
IV
150
120
90
60
30
0

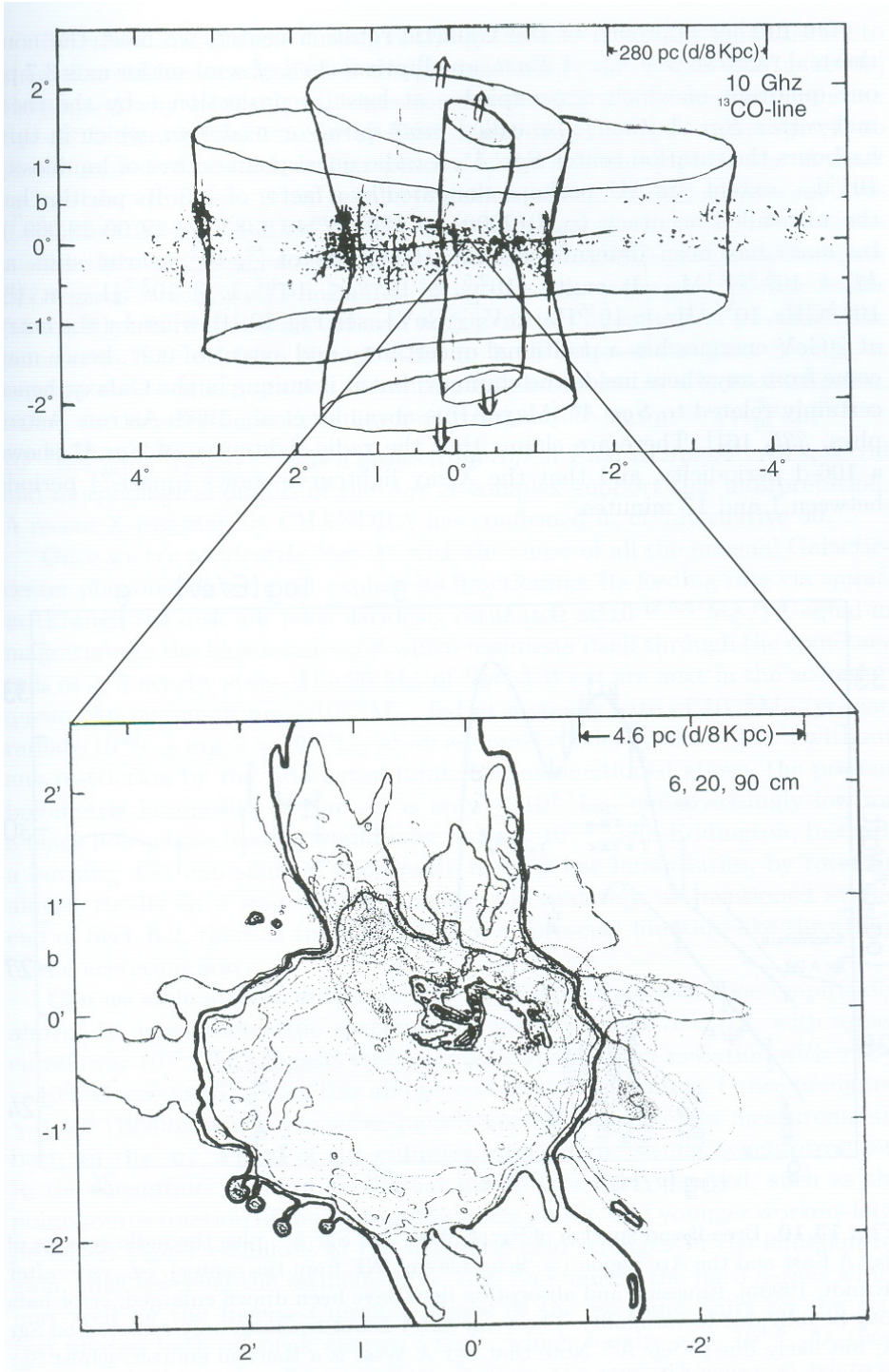

2.8Kpc(d/8Kpc)
2.4μm
408Mhz
20°
b
0°
-20°
-60kms-1
+40kms-1
20°
l
0°
340°

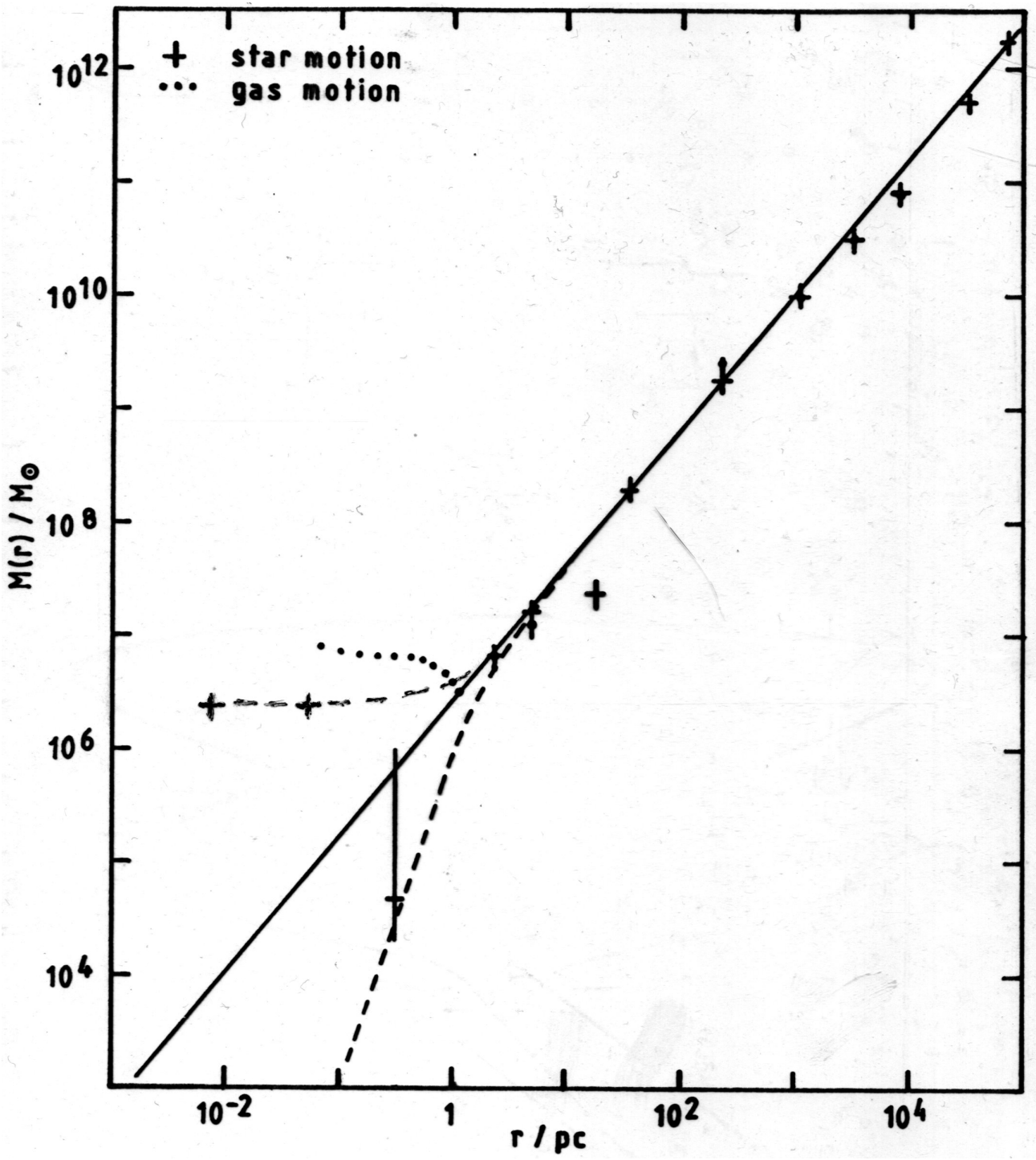

← 70 pc (d/8 Kpc) →
1°
b
0°
0°
ℓ
359°
3 ÷ 10 GHz , ≤ 160 MHz , radio em. lines , linear polarization


← 70 pc (d/8 Kpc) →
1°
b
0°
0°
ℓ
359°
140
120
100
80
60
40
20
0
-20
-40
-60
-80


Wide-Field Radio Image of the Galactic Center
λ = 90 cm
Sgr D HII
Sgr D SNR
SNR 0.9+0.1
Sgr B2
Sgr B1
Arc
SNR 0.3+0.0
Threads
New Feature
Background Galaxy
Threads
Sgr A
Perpendicular thread?
Sgr C
Coherent structure?
Snake
Mouse
SNR 359.0-00.9
Sgr E
SNR 359.1-00.5
~0.5°
~75 pc
~240 light years
Tornado (SNR?)
Image processing by N.E. Kassim, D.S. Briggs, T.J.W. Lazio, T.N. LaRosa and J. Imamura
Produced at the Naval Research Laboratory, Washington, DC
Original data courtesy of A. Pedlar, K. Anantharamiah, M. Goss, and R. Ekers

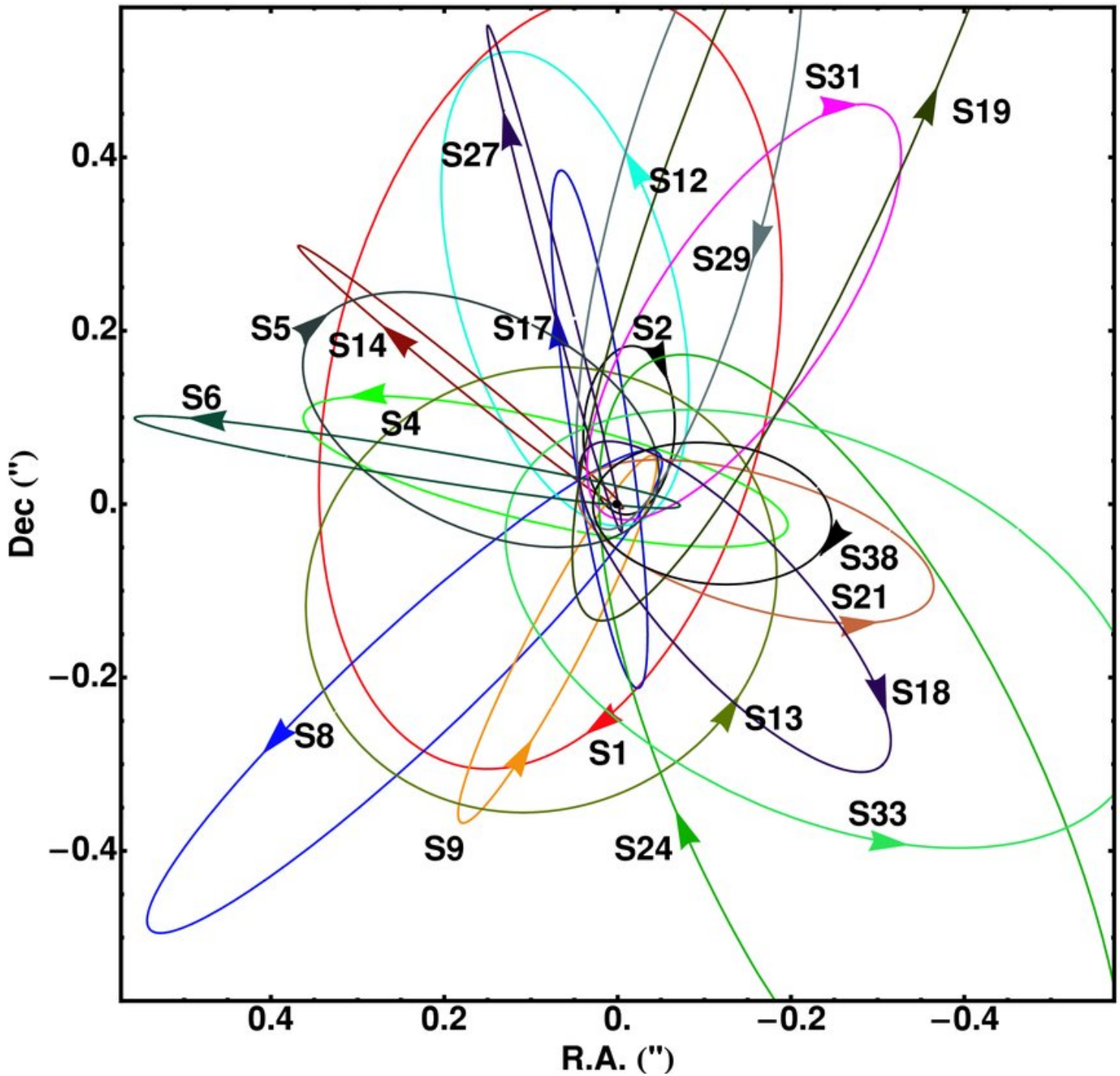

1′
Thermal Filaments
Arches Cluster
Sgr A
Pistol
Radio Arc (NTF)

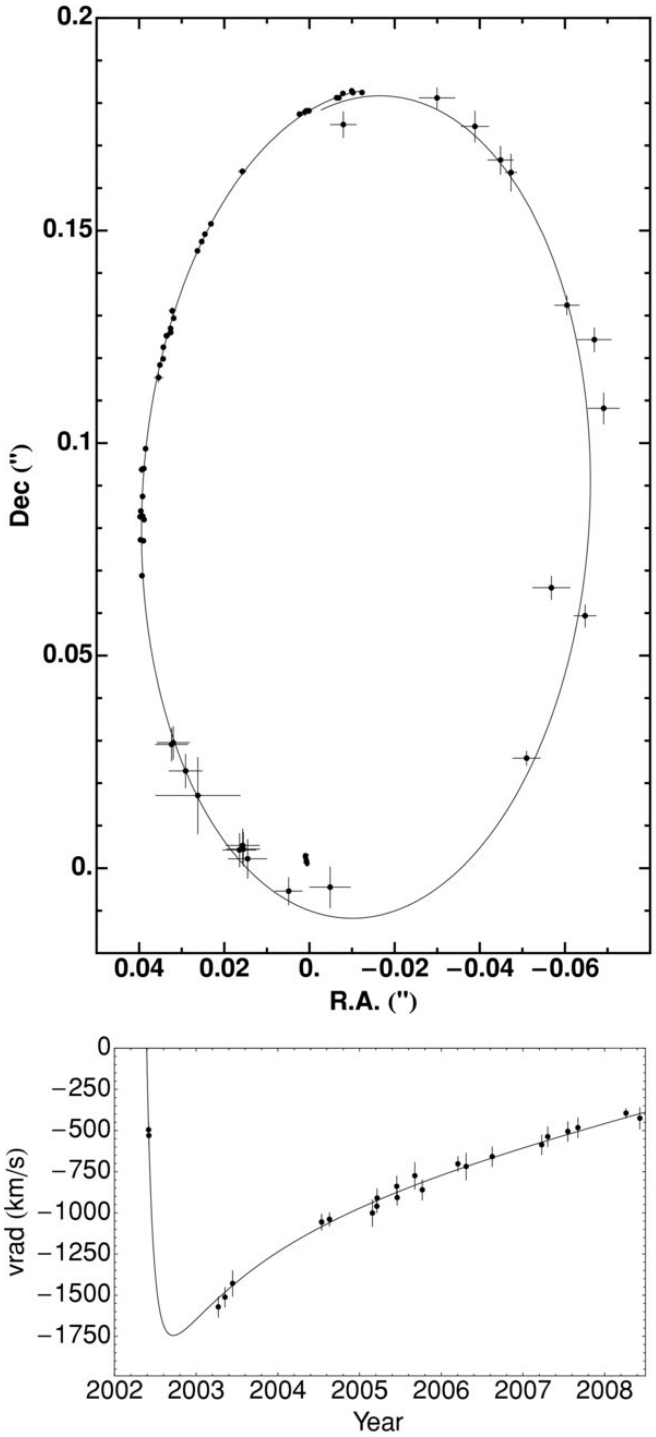

280 pc (d/8 Kpc)
10 Ghz
13CO-line
2°
1°
b
0°
-1°
-2°
4°
2°
l
0°
-2°
-4°
4.6 pc (d/8 K pc)
6, 20, 90 cm
2'
1'
b
0'
-1'
-2'
2'
l
0'
-2'


star motion
gas motion
$10^{12}$
$10^{10}$
$10^{8}$
$10^{6}$
$10^{4}$
M(r) / M⊙
$10^{-2}$
1
$10^{2}$
$10^{4}$
r / pc

# PROPERTIES, 1–3

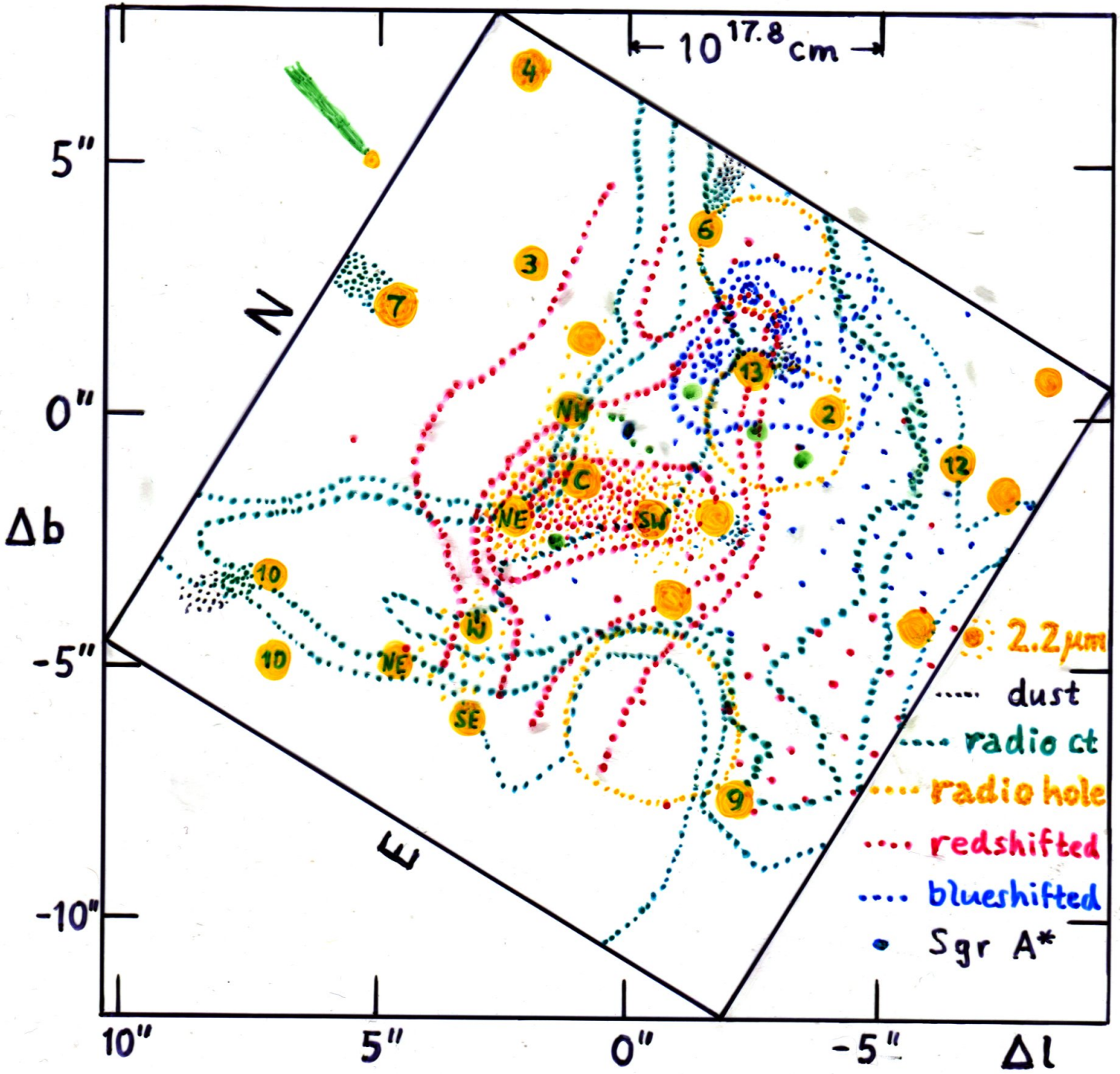
- The (attractive) mass of Sgr A* has grown monotonicly, between 2001 and 2007, from $10^{6.41}$ to $10^{6.58}$ $M_{\odot}$ with increasing approach of the stellar orbits, even to $10^{6.63}$ $M_{\odot}$ when the (improved) distance of 7.94 Kpc is used [Ann. Rev. A & A 39 (2001)].
- The distance of Sgr A* has correspondingly grown, towards 8.33 Kpc, in mild conflict with independent estimates yielding ≈ 8.1 Kpc.
- The Kepler ellipse of the star S2 around Sgr A*, with $P_{orb}$ = 16 yr, does not close, (by ≈ 3°), was stated by Frank Eisenhauer in his Bonn colloquium on 16 Nov 2007.

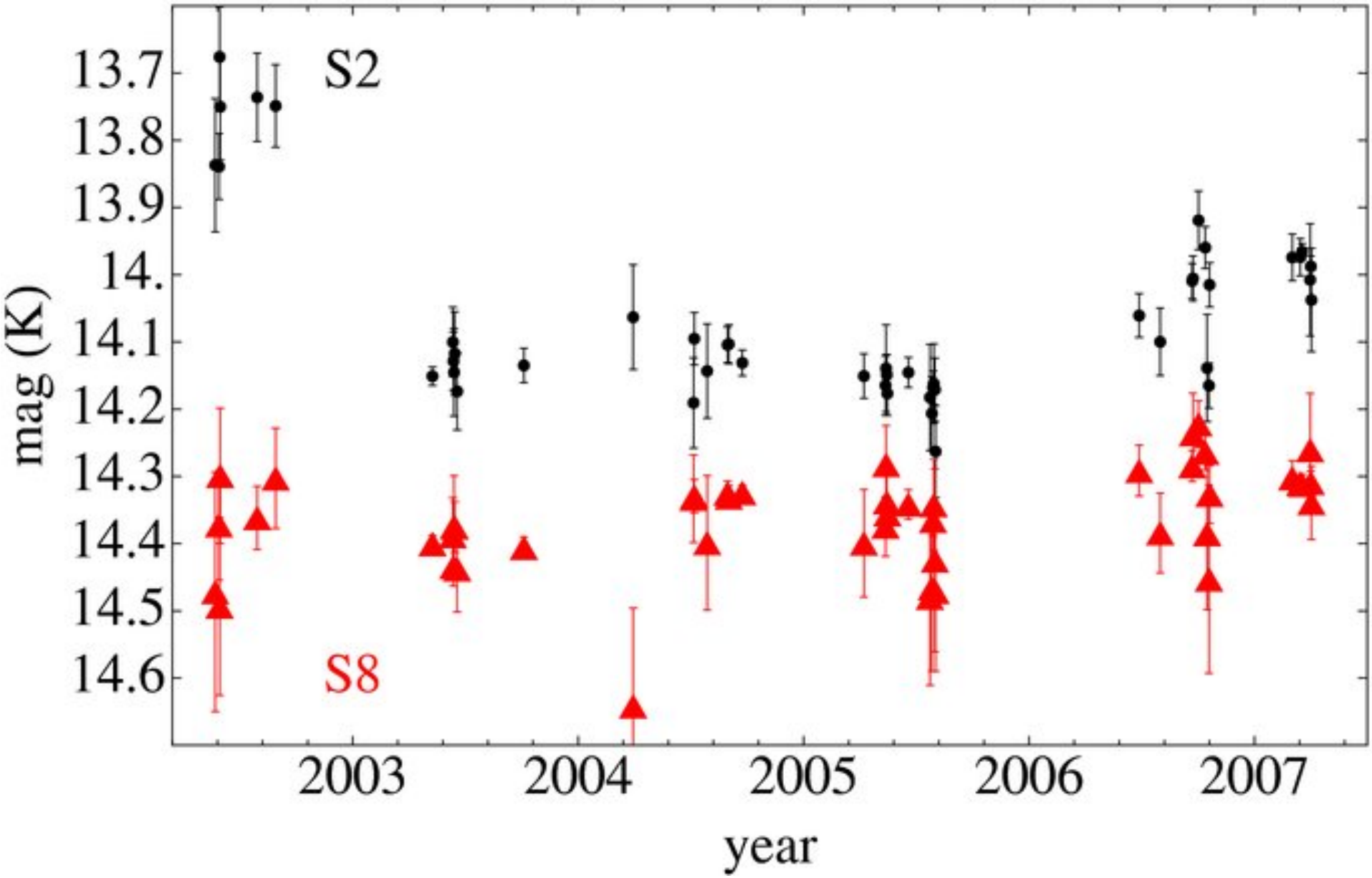

S31
S19
S27
S12
S29
S5
S14
S17
S2
S6
S4
S38
S21
S18
S13
S8
S1
S33
S9
S24
0.4
0.2
0.
−0.2
−0.4
Dec (")
0.4
0.2
0.
−0.2
−0.4
R.A. (")

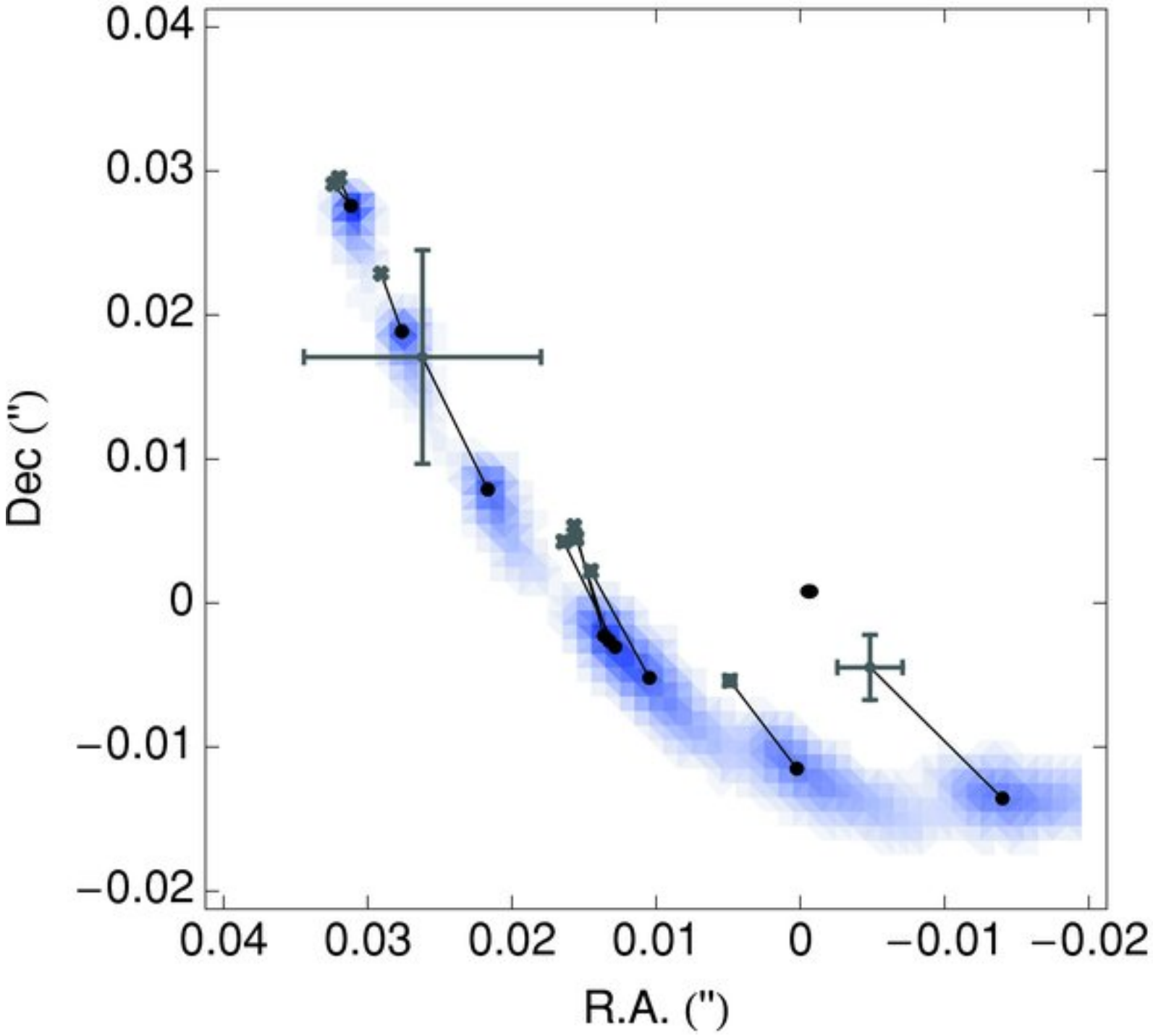

0.2
0.15
0.1
0.05
0.
Dec (")
0.04
0.02
0.
−0.02
−0.04
−0.06
R.A. (")
0
−250
−500
−750
−1000
−1250
−1500
−1750
vrad (km/s)
2002
2003
2004
2005
2006
2007
2008
Year

# PROPERTIES, 4 – 6

- A strong stellar-like wind from Sgr A* is indicated, both by blown-away windzones of 8 stars at d lyr, and by mapped blue- and red-shifted Br α,γ-emission: $10^{-2.5}M_{\odot}$ /yr, $10^{3}$Km/s, [Astrophys. & Sp.Sci.172, 122 (1990)].
- The star S2 flared by 0.5 mag on peri-astron approach (of Sgr A*) in 2002, probably due to an increasing plasma density.
- 6 consecutive position measurements of S2 near peri-astron were offset by 10 mas towards NE, reminiscent of an IR fata morgana by a discal medium, of density $\approx 10^{12}$ cm$^{-3}$.

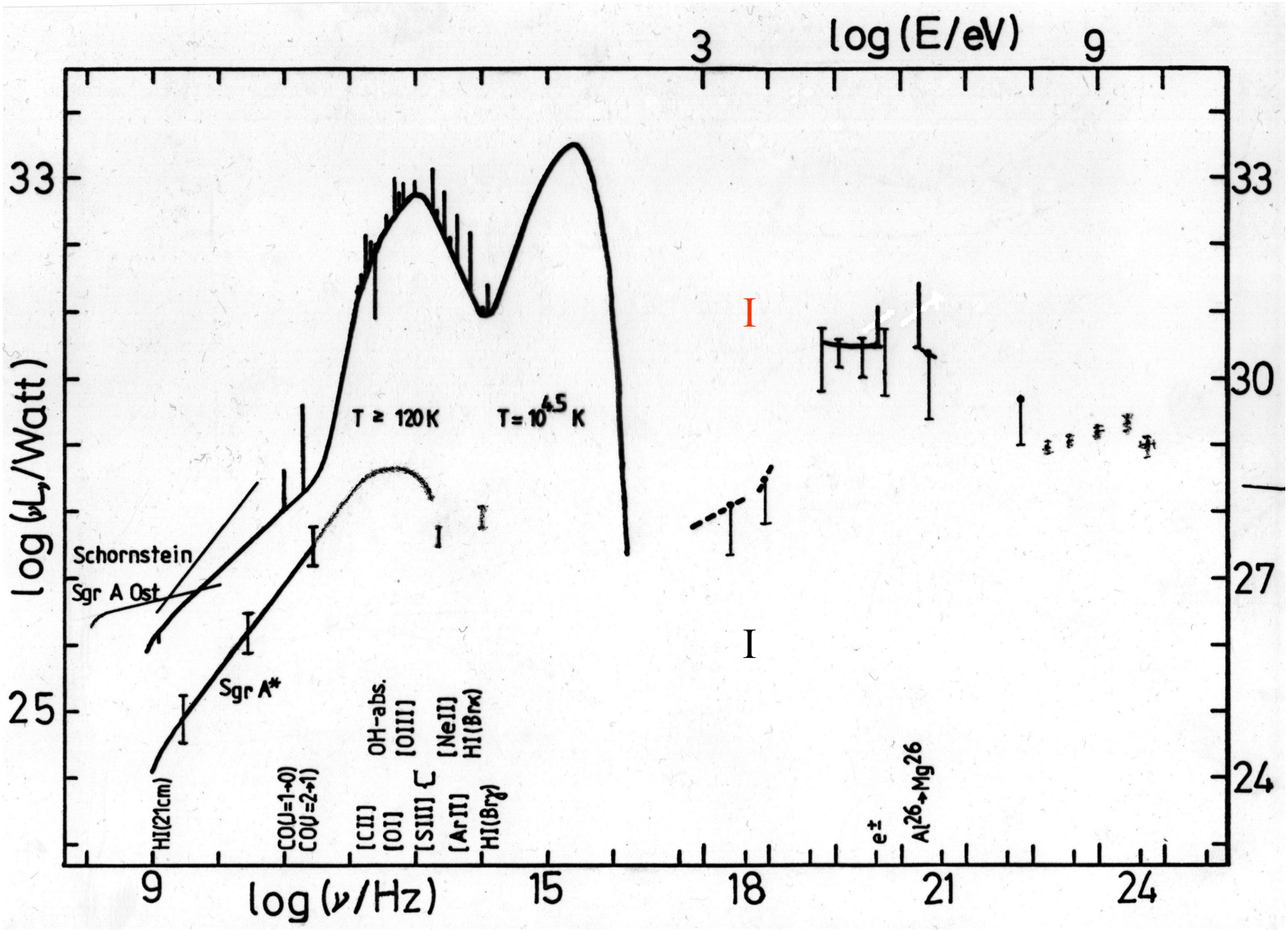

$10^{17.8}$ cm
5"
0"
-5"
-10"
Δb
10"
5"
0"
-5"
Δl
N
E
4
3
6
7
13
2
12
NW
C
NE
SW
10
10
NE
W
SE
9
2.2μm
dust
radio ct
radio hole
redshifted
blueshifted
Sgr A*


S2
S8
13.7
13.8
13.9
14.
14.1
14.2
14.3
14.4
14.5
14.6
mag (K)
2003
2004
2005
2006
2007
year


0.04
0.03
0.02
0.01
0
−0.01
−0.02
Dec (")
0.04
0.03
0.02
0.01
0
−0.01
−0.02
R.A. (")

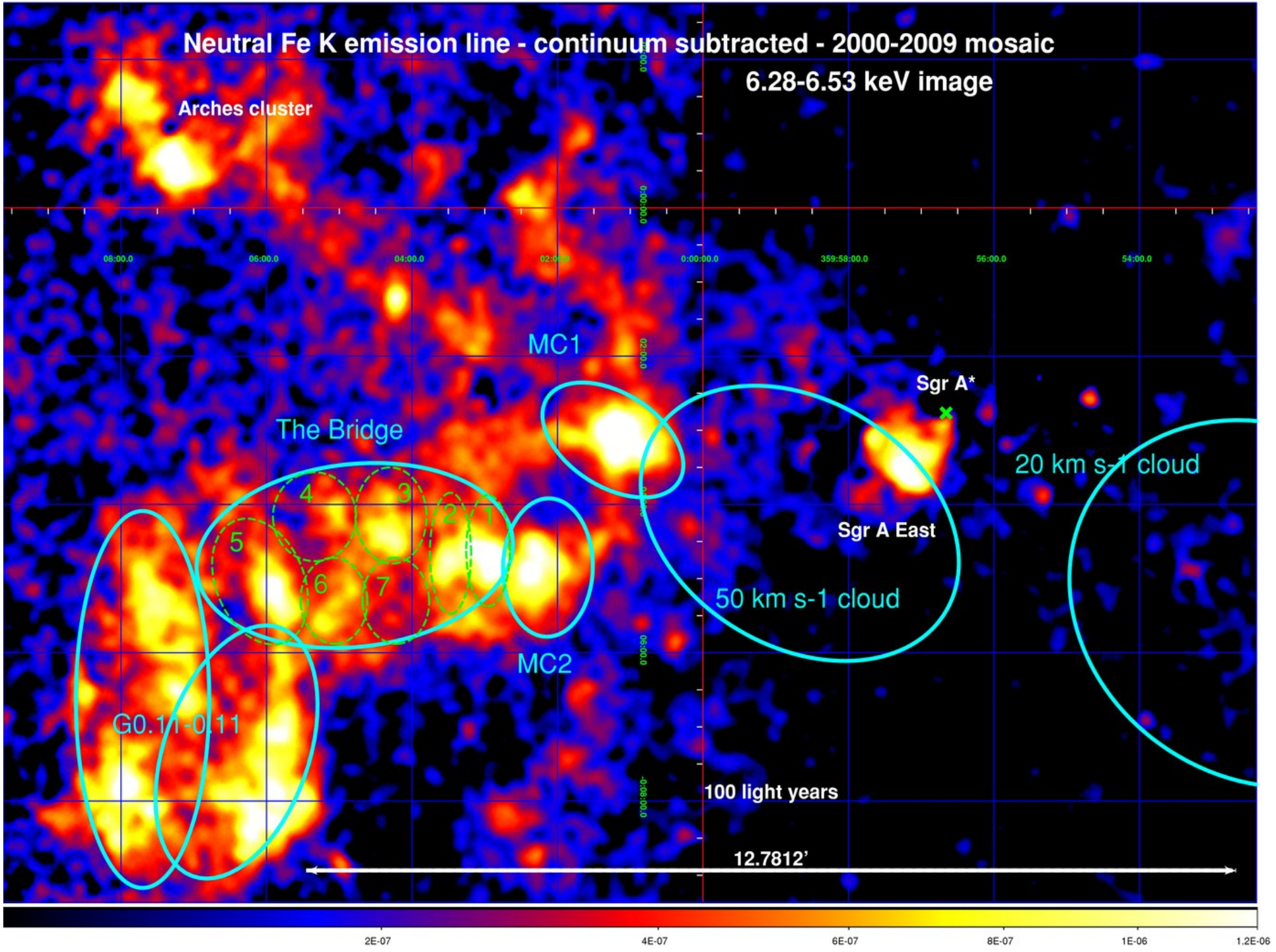
# PROPERTIES, 7 – 9

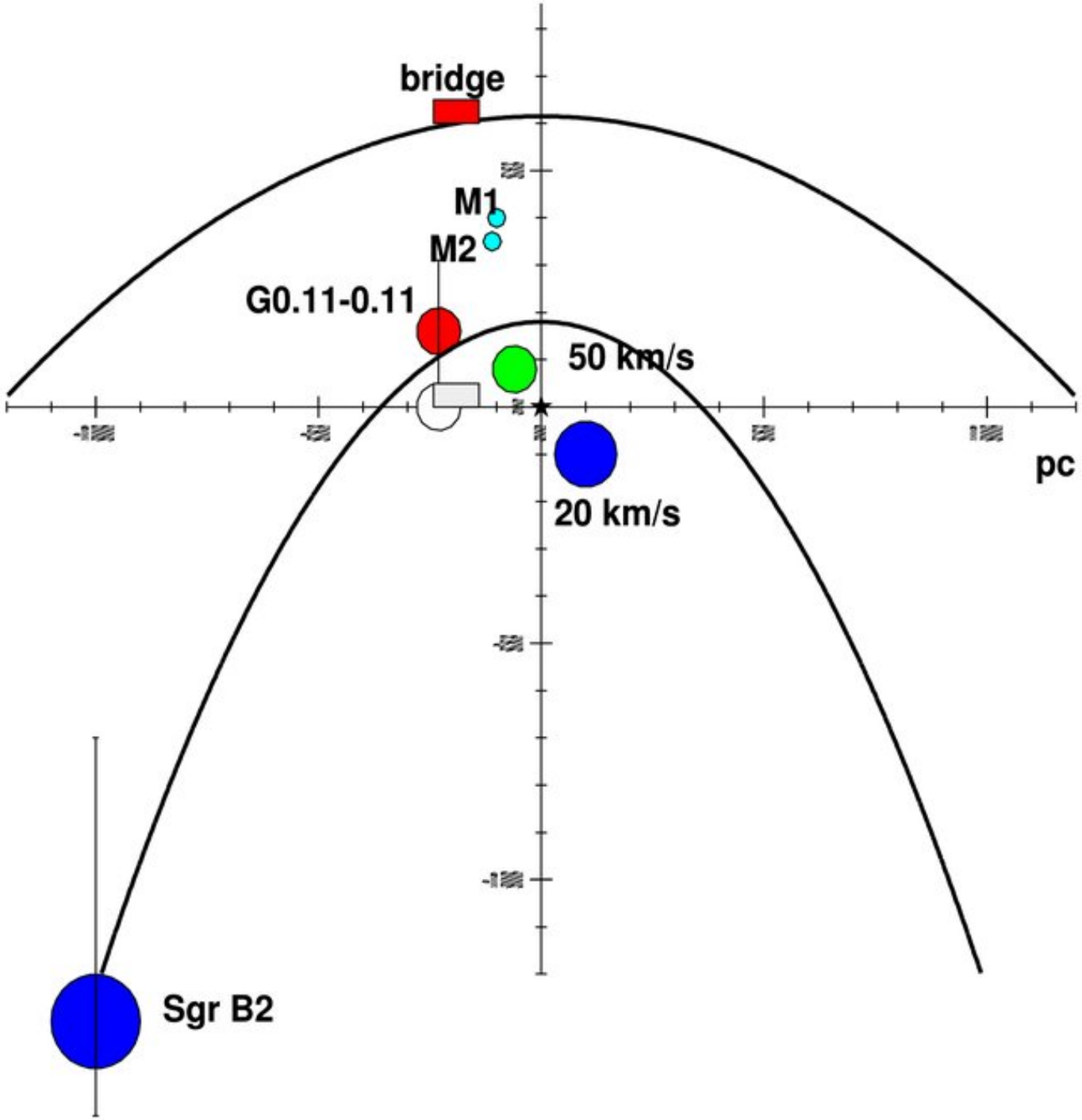
- An observed emission by Sgr A* at TeV energies, by Aharonian et al [A & A **425**, L13-17 (2004)], is in conflict with the BH-emission upper T limit of $\hbar$ KeV$(M_{\hbar}/M_{BH})^{1/4} = 25$ eV, controlled by its Eddington limit.
- A seen structure of Sgr A* at 1.3 cm, on the horizon scale of 4 $R_S = 10^{12.6}$cm, conflicts with a BH interpretation [Nature 4. 9. 2008].
- Tidal forces exerted by a central BH would conflict with the observed recent star formation in its vicinity $\{10^{-2}, 0.5\}$pc [Hagai Perets & Alessia Gualandris, Ap. J. **719**, 220-228 (2010)].


log (E/eV)
3
9
log (νL,/Watt)
33
30
27
25
24
T ≥ 120K
T=10^4.5 K
Schornstein
Sgr A Ost
Sgr A*
HI(21cm)
CO(J=1→0)
CO(J=2→1)
[CII]
[OI]
OH-abs.
[OIII]
[SIII]
[ArII]
[NeII]
HI(Brγ)
HI(Brα)
e±
Al^26→Mg^26
log (ν/Hz)
9
15
18
21
24

# PROPERTIES, 10–12

- A twin-jet from SgrA*, mapped within ±{1,100} pc at ~ 160 MHz, X-rays, and 24~m respectively, reveals its present activity [Yusef-Zadeh et al, Kassim et al, Baganoff et al, Morris et al].
- SgrA* flared at hard X-rays, $\times 10^5$, ~ $10^2$yr ago, evidenced by a superluminal light echo [Terrier et al, Ap. J. **719**,143-150 (2010)].
- Iron has been violently ejected by SgrA*, recently, mapped at K~,~ absorption, an evidence of extreme nuclear burning at the GC [Predehl et al, Astron. Nachr. **324**, 73-76 (2003)].


Neutral Fe K emission line - continuum subtracted - 2000-2009 mosaic
6.28-6.53 keV image
Arches cluster
MC1
Sgr A*
The Bridge
20 km s-1 cloud
Sgr A East
50 km s-1 cloud
MC2
G0.11-0.11
100 light years
12.7812'
2E-07
4E-07
6E-07
8E-07
1E-06
1.2E-06


bridge
M1
M2
G0.11-0.11
50 km/s
20 km/s
pc
Sgr B2

# PROPERTIES, 13 – 15

- Sgr A East = transient storage bubble for relativistic pair plasma, (differs from a SNR).
- The powerful, broad, and highly variable spectrum of SgrÀ*, between 60 MHz and TeV, even PeV energies, with flares down to ≈17 min, cannot be emitted by a BH.
- Two Galactic bipolar hypershells, or plasma bubbles, centered on the GC, of angular radius ≈$60^0$, from radio through X-rays to 10GeV energies [Y.Sofue:Ap.J.**540**, 224-235 (2000) , FERMI 2010].

# REFERENCES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