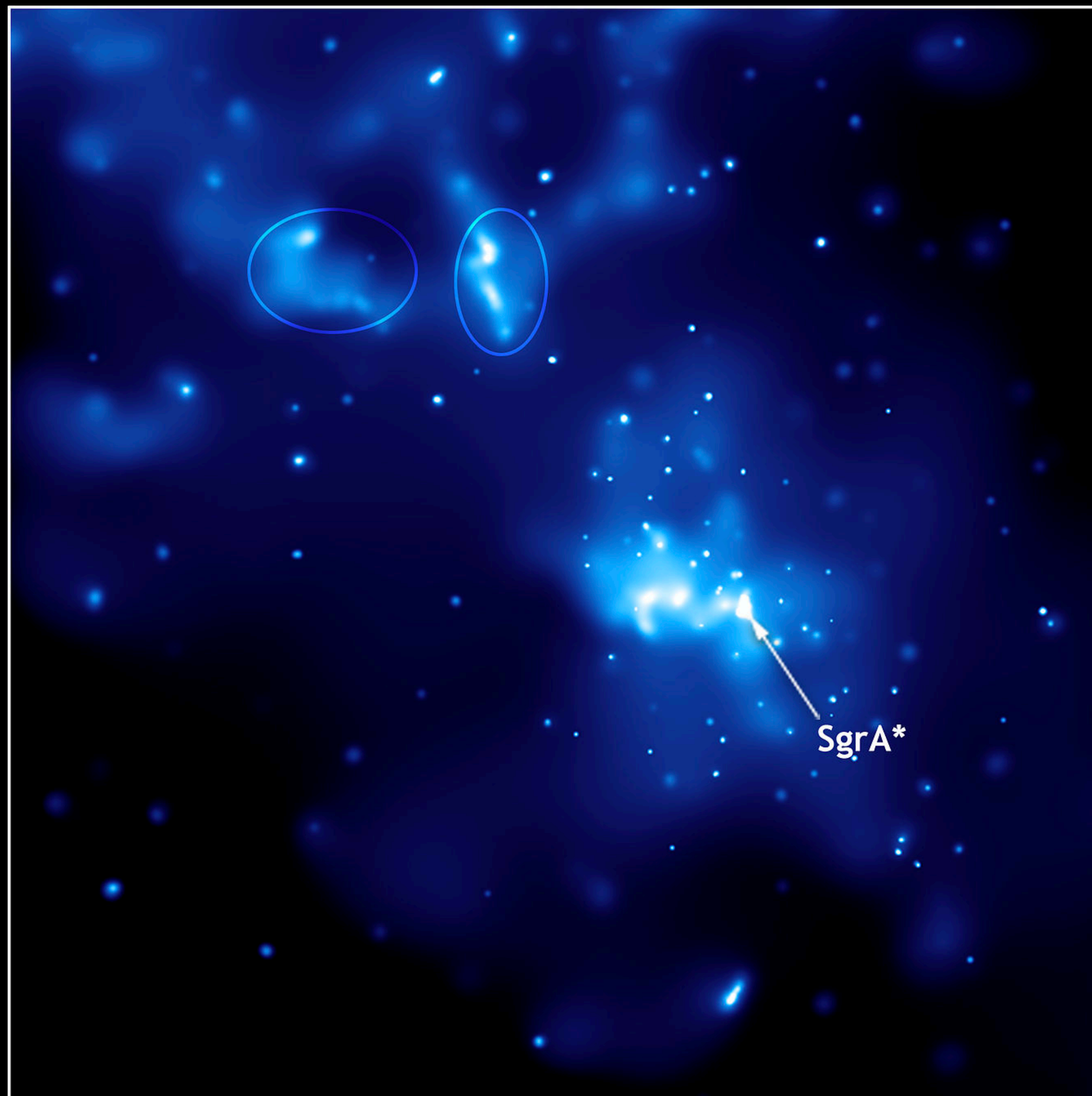
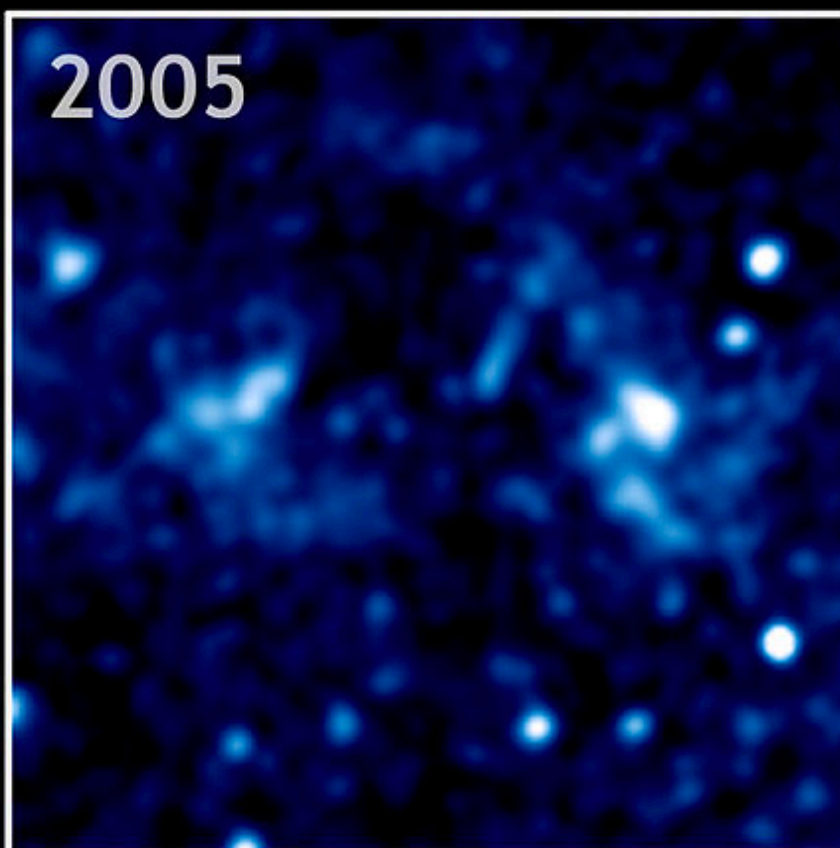
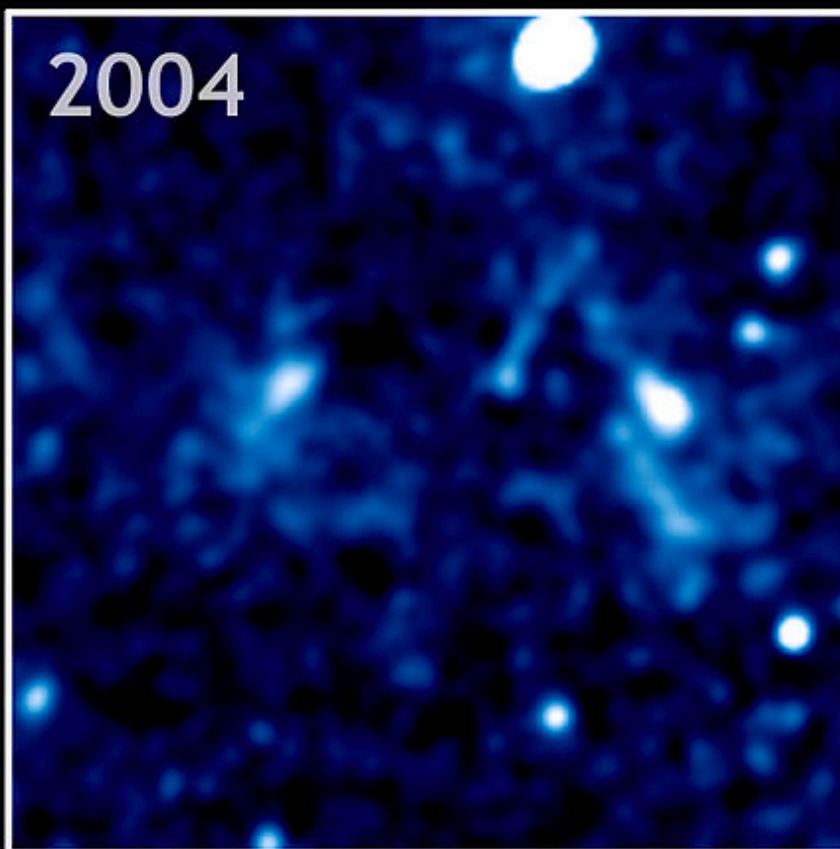
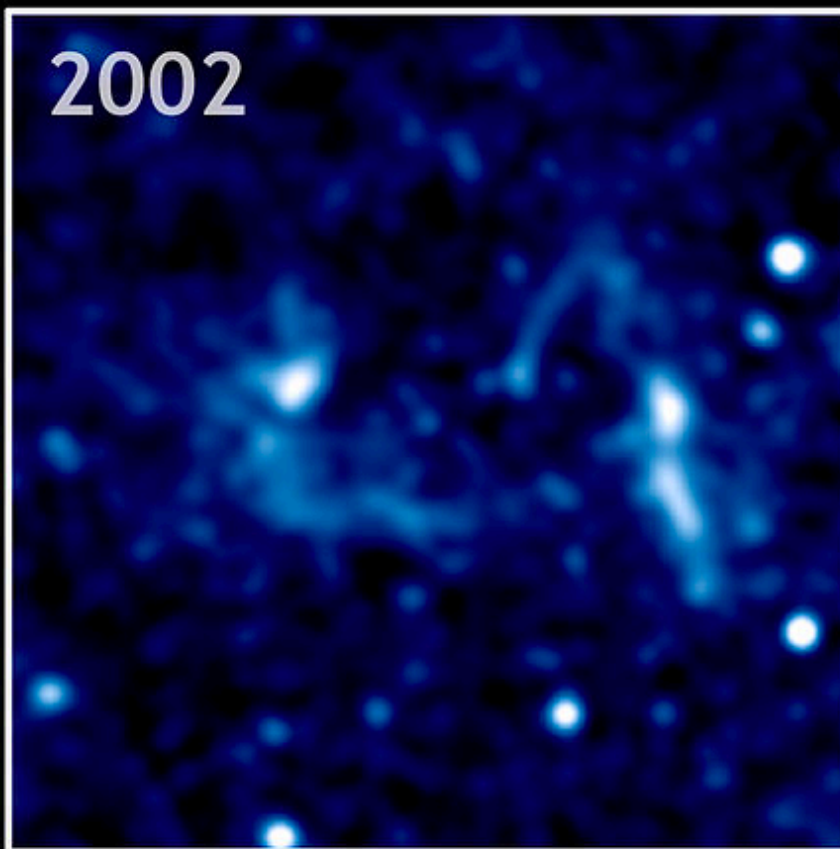


Black-holes

L. Vacher -





$$\frac{1}{2}mv^2 = \frac{GMm}{r}$$

$$v = \sqrt{\frac{2GM}{r}}$$

Location	Relative to	V_e (km/s) ^[12]	Location	Relative to	V_e (km/s) ^[12]	System escape, V_{te} (km/s)
On the Sun	The Sun's gravity	617.5				
On Mercury	Mercury's gravity	4.25	At Mercury	The Sun's gravity	~ 67.7	~ 20.3
On Venus	Venus's gravity	10.36	At Venus	The Sun's gravity	49.5	17.8
On Earth	Earth's gravity	11.186	At Earth	The Sun's gravity	42.1	16.6
On the Moon	The Moon's gravity	2.38	At the Moon	The Earth's gravity	1.4	2.42
On Mars	Mars' gravity	5.03	At Mars	The Sun's gravity	34.1	11.2
On Ceres	Ceres's gravity	0.51	At Ceres	The Sun's gravity	25.3	7.4
On Jupiter	Jupiter's gravity	60.20	At Jupiter	The Sun's gravity	18.5	60.4
On Io	Io's gravity	2.558	At Io	Jupiter's gravity	24.5	7.6
On Europa	Europa's gravity	2.025	At Europa	Jupiter's gravity	19.4	6.0
On Ganymede	Ganymede's gravity	2.741	At Ganymede	Jupiter's gravity	15.4	5.3
On Callisto	Callisto's gravity	2.440	At Callisto	Jupiter's gravity	11.6	4.2
On Saturn	Saturn's gravity	36.09	At Saturn	The Sun's gravity	13.6	36.3
On Titan	Titan's gravity	2.639	At Titan	Saturn's gravity	7.8	3.5
On Uranus	Uranus' gravity	21.38	At Uranus	The Sun's gravity	9.6	21.5
On Neptune	Neptune's gravity	23.56	At Neptune	The Sun's gravity	7.7	23.7
On Triton	Triton's gravity	1.455	At Triton	Neptune's gravity	6.2	2.33
On Pluto	Pluto's gravity	1.23	At Pluto	The Sun's gravity	~ 6.6	~ 2.3
At Solar System galactic radius	The Milky Way 's gravity	492–594 ^{[13][14]}				
On the event horizon	A black hole 's gravity	299,792.458 (speed of light)				



$$v = \sqrt{\frac{2GM}{r}} = c$$

$$R_s = \frac{2GM}{c^2}$$

Object	Mass M	Schwarzschild radius $\frac{2GM}{c^2}$	Actual radius r	Schwarzschild density $\frac{3c^6}{32\pi G^3 M^2}$ or $\frac{3c^2}{8\pi G r^2}$
Observable universe	8.8×10^{52} kg	1.3×10^{26} m (13.7 billion ly)	4.4×10^{26} m (46.5 billion ly)	9.5×10^{-27} kg/m ³
Milky Way	1.6×10^{42} kg	2.4×10^{15} m (0.25 ly)	5×10^{20} m (52.9 thousand ly)	0.000029 kg/m ³
TON 618 (largest known black hole)	1.3×10^{41} kg	1.9×10^{14} m (~1300 AU)		0.0045 kg/m ³
SMBH in NGC 4889	4.2×10^{40} kg	6.2×10^{13} m (~410 AU)		0.042 kg/m ³
SMBH in Messier 87 ^[9]	1.3×10^{40} kg	1.9×10^{13} m (~130 AU)		0.44 kg/m ³
SMBH in Andromeda Galaxy ^[10]	3.4×10^{38} kg	5.0×10^{11} m (3.3 AU)		640 kg/m ³
Sagittarius A* (SMBH in Milky Way) ^[11]	8.2×10^{36} kg	1.2×10^{10} m (0.08 AU)		1.1×10^6 kg/m ³
Sun	1.99×10^{30} kg	2.95×10^3 m	7.0×10^8 m	1.84×10^{19} kg/m ³
Jupiter	1.90×10^{27} kg	2.82 m	7.0×10^7 m	2.02×10^{25} kg/m ³
Earth	5.97×10^{24} kg	8.87×10^{-3} m	6.37×10^6 m	2.04×10^{30} kg/m ³
Moon	7.35×10^{22} kg	1.09×10^{-4} m	1.74×10^6 m	1.35×10^{34} kg/m ³
Saturn	5.683×10^{26} kg	8.42×10^{-1} m	6.03×10^7 m	2.27×10^{26} kg/m ³
Uranus	8.681×10^{25} kg	1.29×10^{-1} m	2.56×10^7 m	9.68×10^{27} kg/m ³
Neptune	1.024×10^{26} kg	1.52×10^{-1} m	2.47×10^7 m	6.97×10^{27} kg/m ³
Mercury	3.285×10^{23} kg	4.87×10^{-4} m	2.44×10^6 m	6.79×10^{32} kg/m ³
Venus	4.867×10^{24} kg	7.21×10^{-3} m	6.05×10^6 m	3.10×10^{30} kg/m ³
Mars	6.39×10^{23} kg	9.47×10^{-4} m	3.39×10^6 m	1.80×10^{32} kg/m ³
Human	70 kg	1.04×10^{-25} m	$\sim 5 \times 10^{-1}$ m	1.49×10^{76} kg/m ³
Planck mass	2.18×10^{-8} kg	3.23×10^{-35} m	(twice the Planck length)	1.54×10^{95} kg/m ³



