Mengintai Si Lubang Hitam via Jendela Sinar-X

Kiki Vierdayanti

MEDHOKSAINS 4 MEI 2019

Ide Awal Tentang *LH* dan Penamaannya

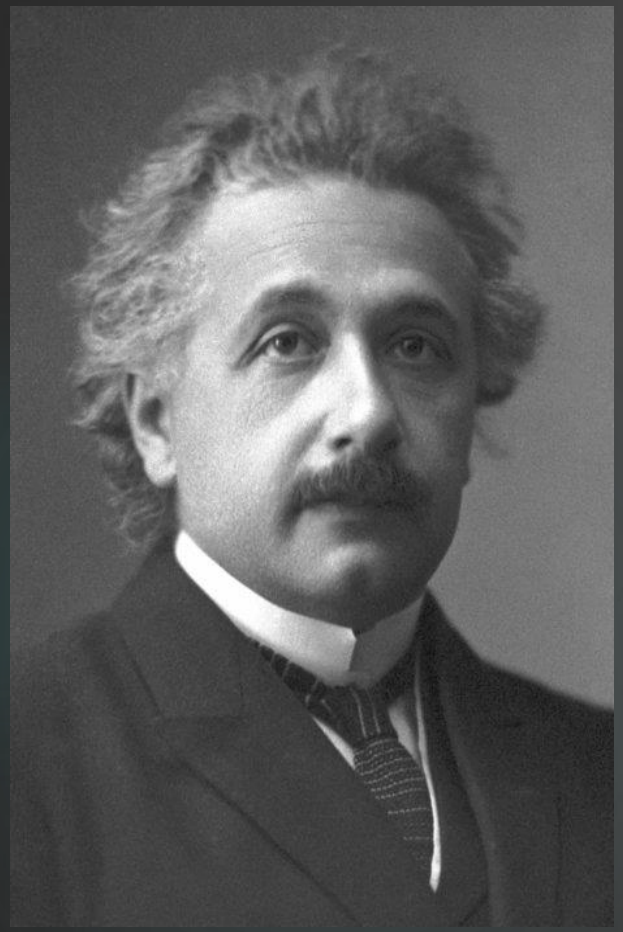
- Dari John Mitchell hingga John Wheeler

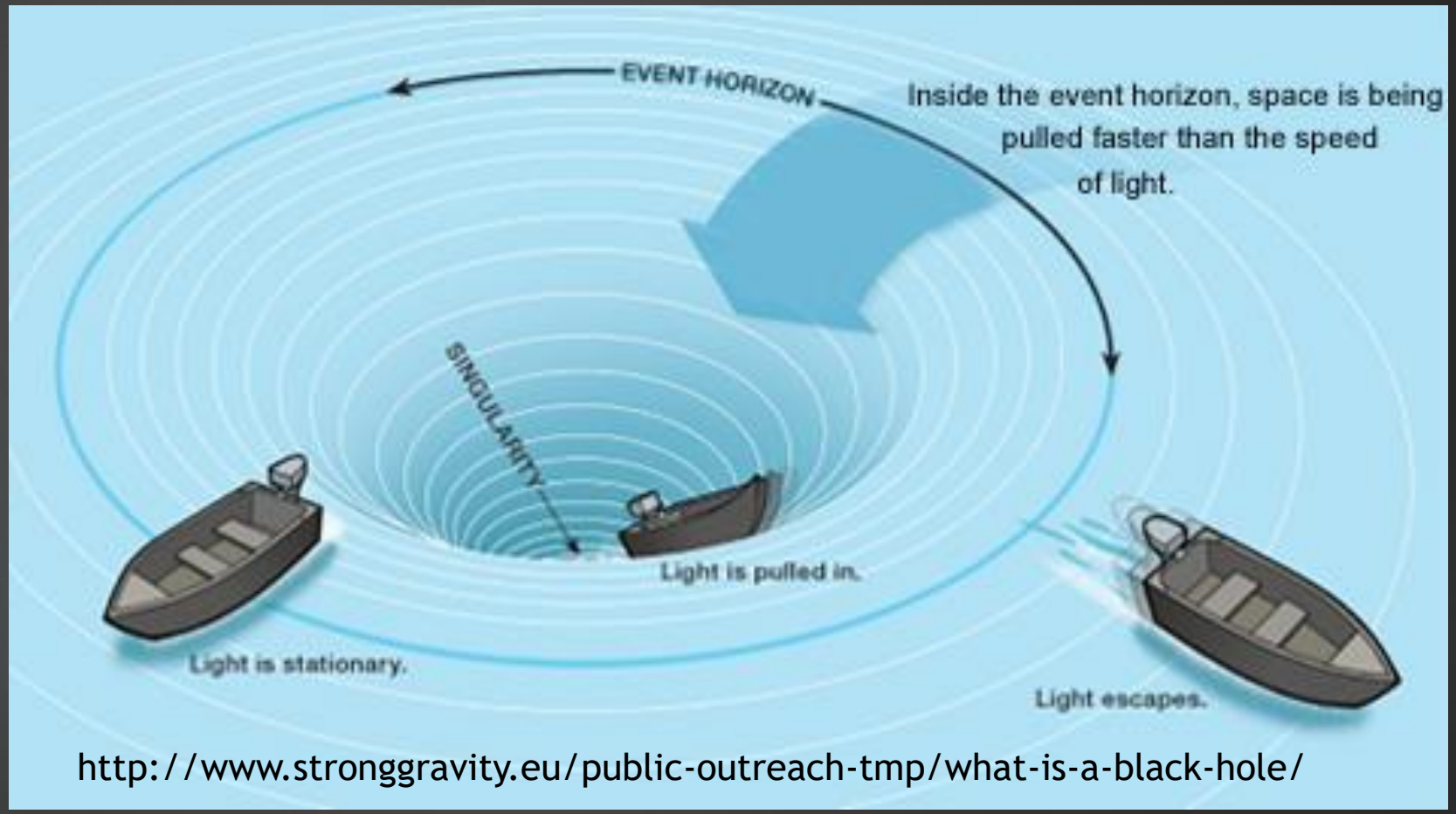
(blackholecam.org)

(1783) (1796) (1968)

- Dari istilah *Dark Star* hingga istilah *Black Hole*

LH dalam Konteks Teori Gravitasi Einstein





http://www.stronggravity.eu/public-outreach-tmp/what-is-a-black-hole/

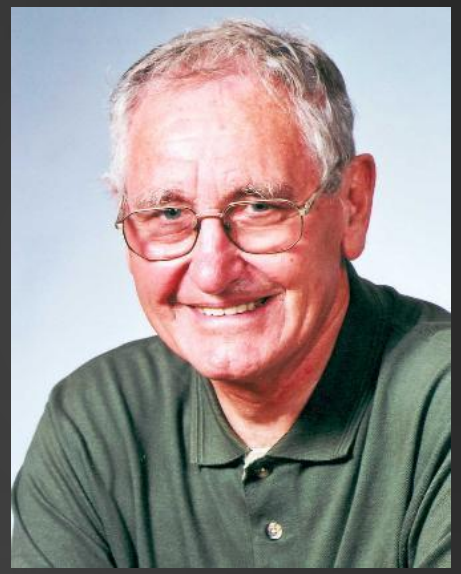
Distorsi ruang-waktu di sekitar sebuah benda bermassa

Properti *LH*

***Event Horizon*, $R_H = R_S \sim 3(M/M_\odot)$ km**

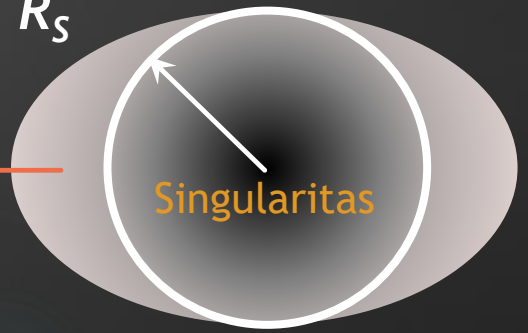
Karl Schwarzschild

Roy Kerr



***Event Horizon*, $0{,}5\ R_S < R < R_S$**

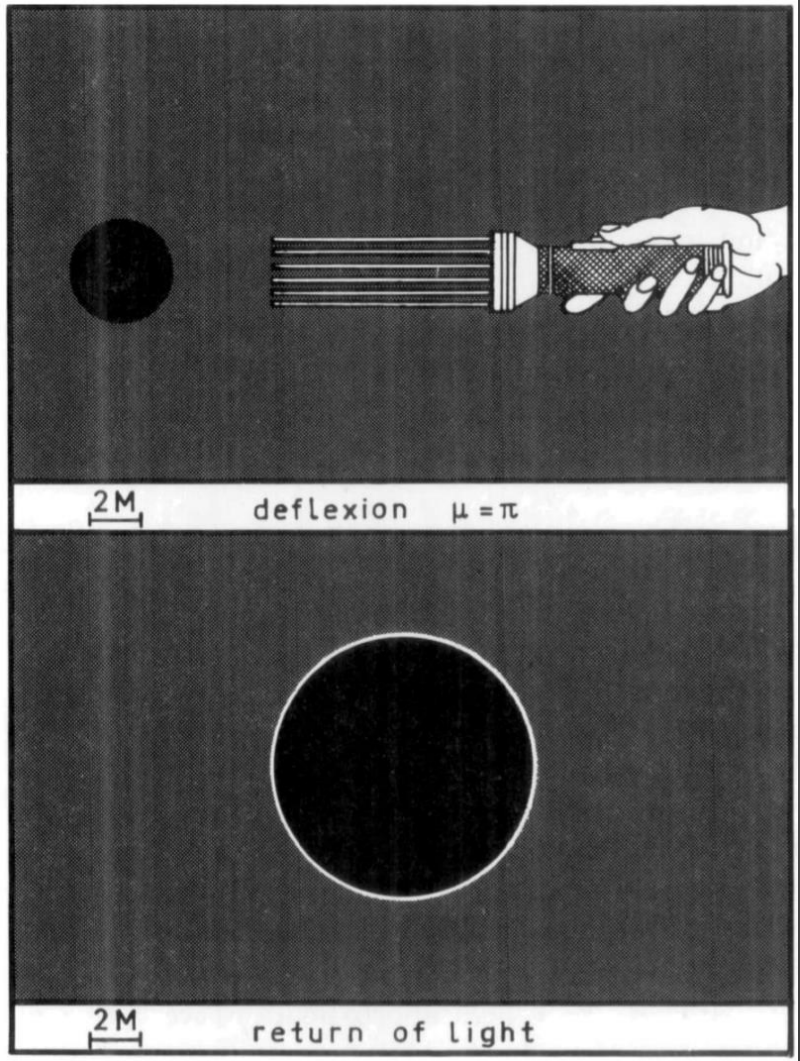
Ergosphere



Gargantua dalam Interstellar

Credit: Paramount Pictures/Warner Bros.

Dapatkah Kita Melihat *LH*?



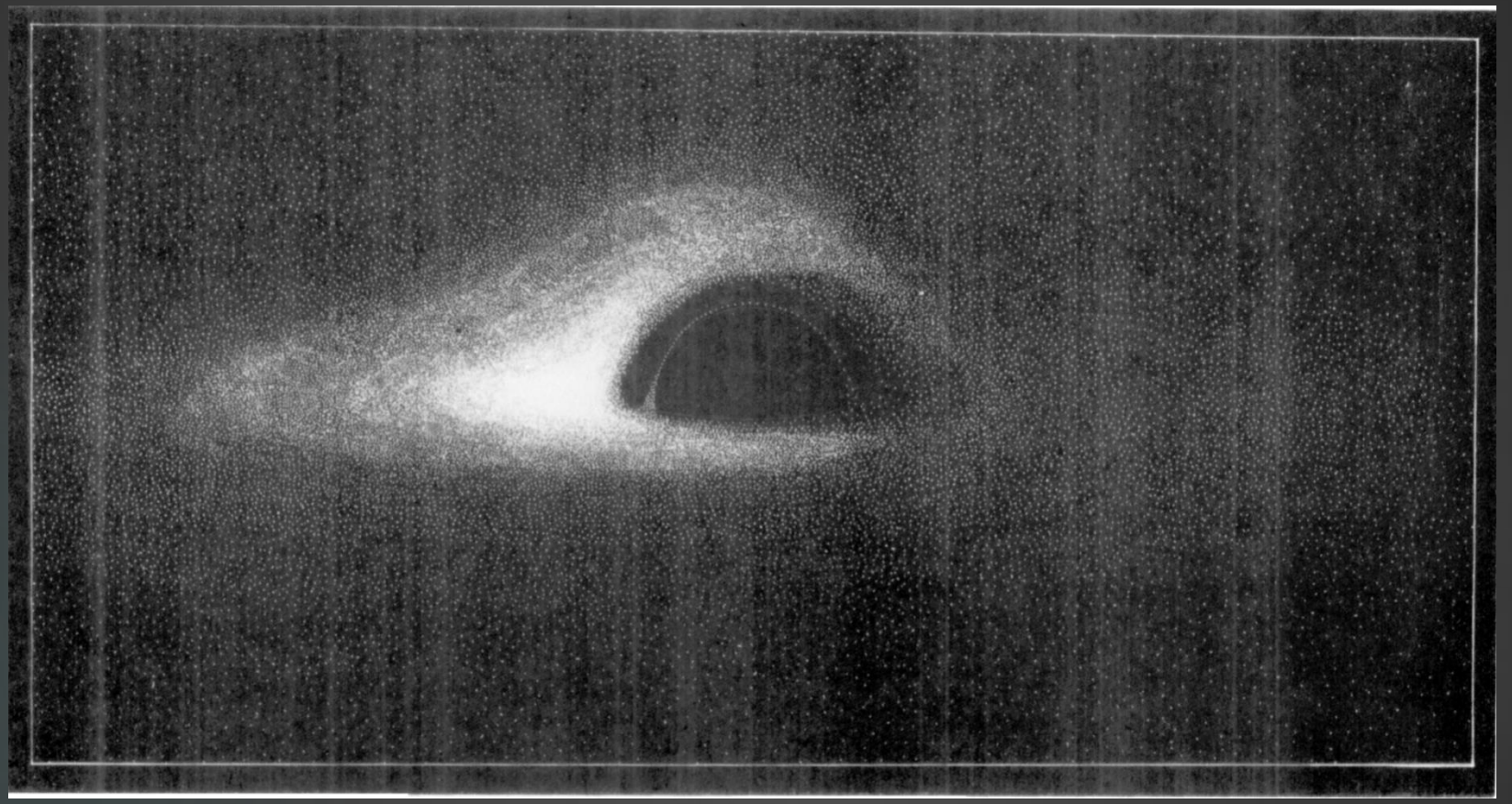
(J. P. Luminet 1978)

Bayangkan sebuah *LH* disinari cahaya dari suatu jarak tertentu

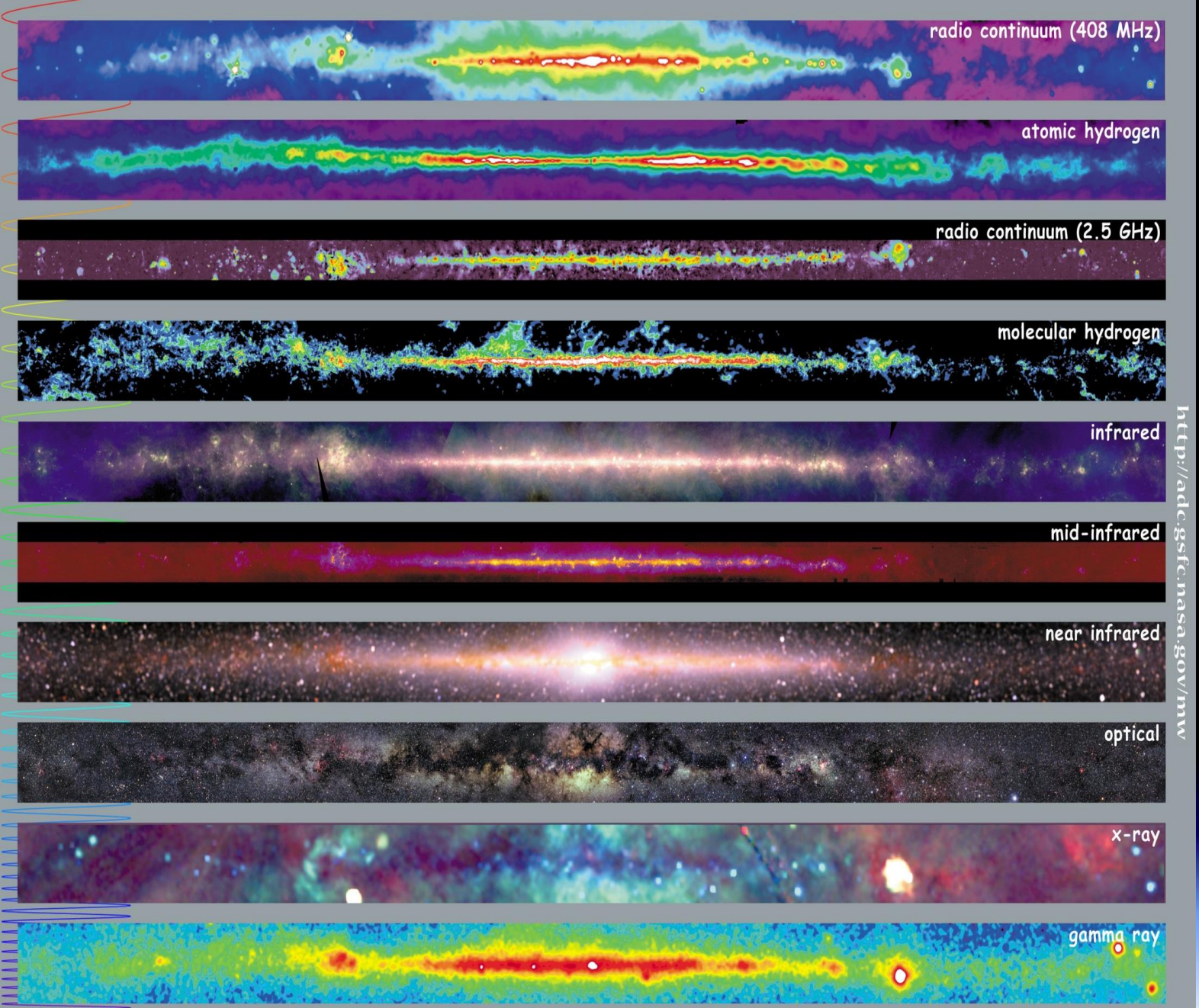
Pada dasarnya akan dapat diamati cahaya di sekeliling *LH* tersebut akibat adanya cahaya yang kembali

Persoalan:
Apakah sumber cahayanya?
Apakah sumber cahaya tersebut cukup kuat untuk dapat teramati?

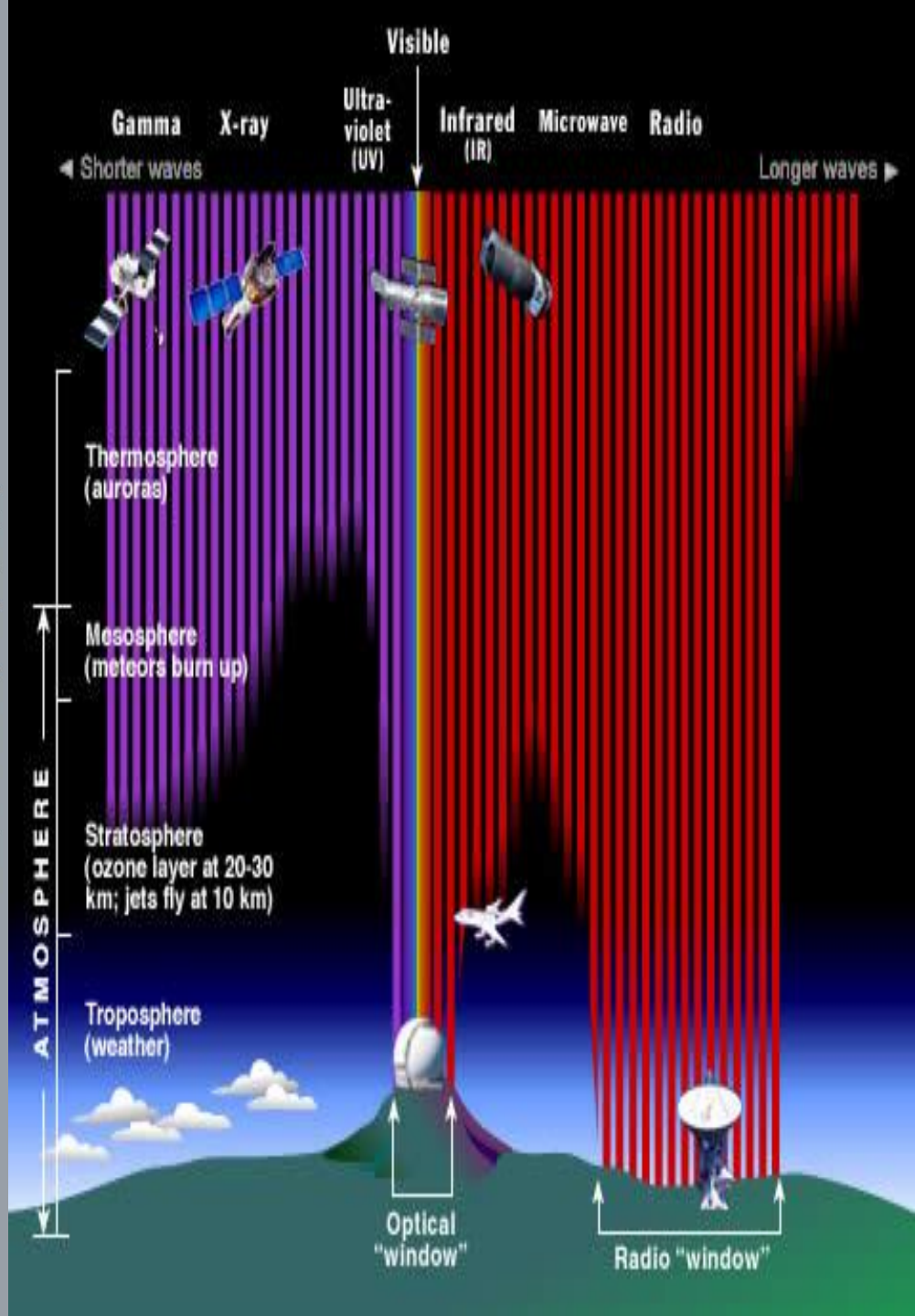
LH dengan gas yang dapat berpijar di sekelilingnya



Penampakan *LH* dengan piringan akresi di sekelilingnya
(J. P. Luminet 1978)



Multiwavelength Milky Way



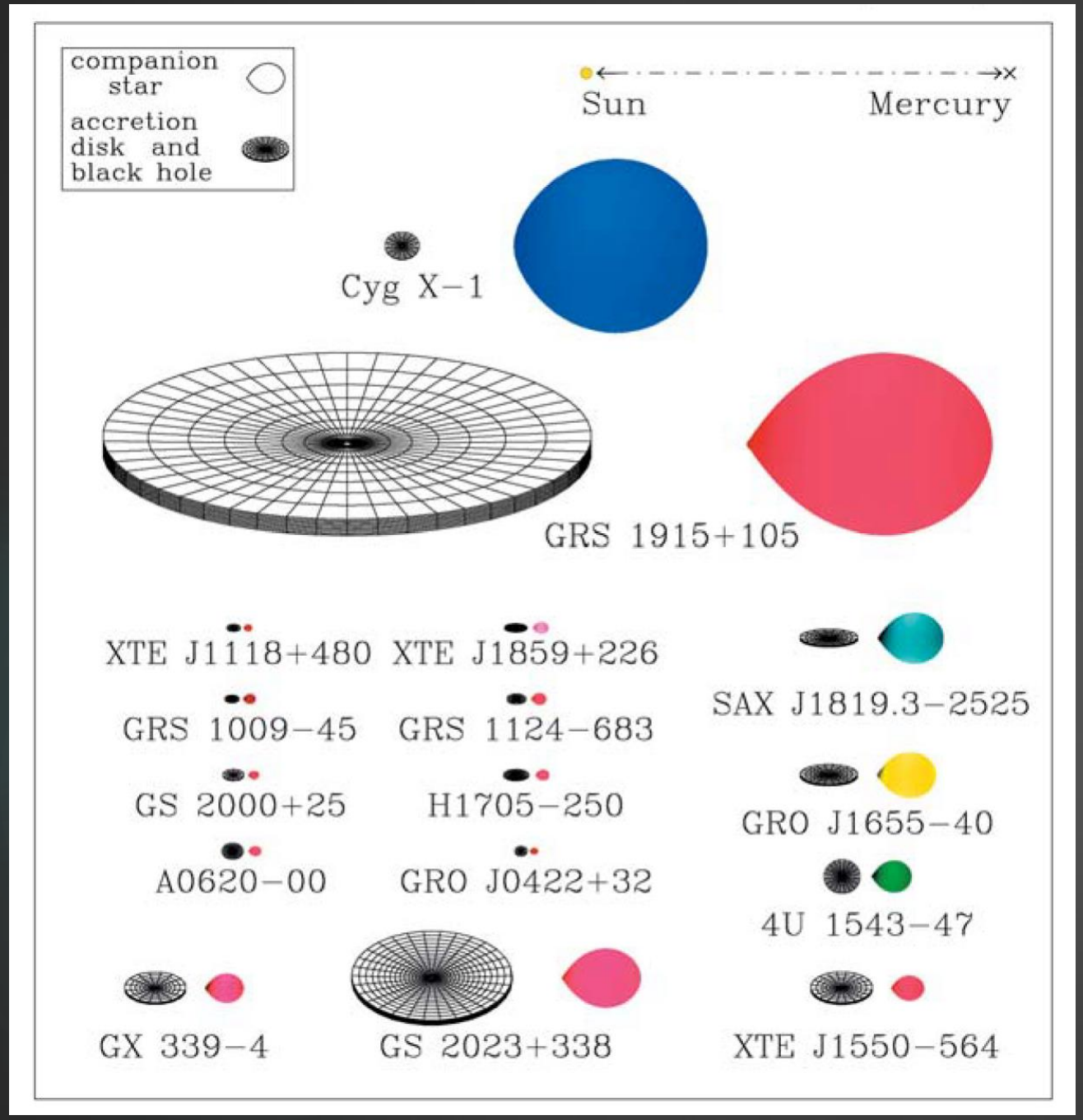
Astronomi Sinar-X

Riccardo Giacconi
(1931 – 2018)
Bapak Atronomi Sinar-X

The Nobel Prize in Physics 2002 was divided, one half jointly to Raymond Davis Jr. and Masatoshi Koshiba "for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos" **and the other half to Riccardo Giacconi "for pioneering contributions to astrophysics, which have led to the discovery of cosmic X-ray sources."**

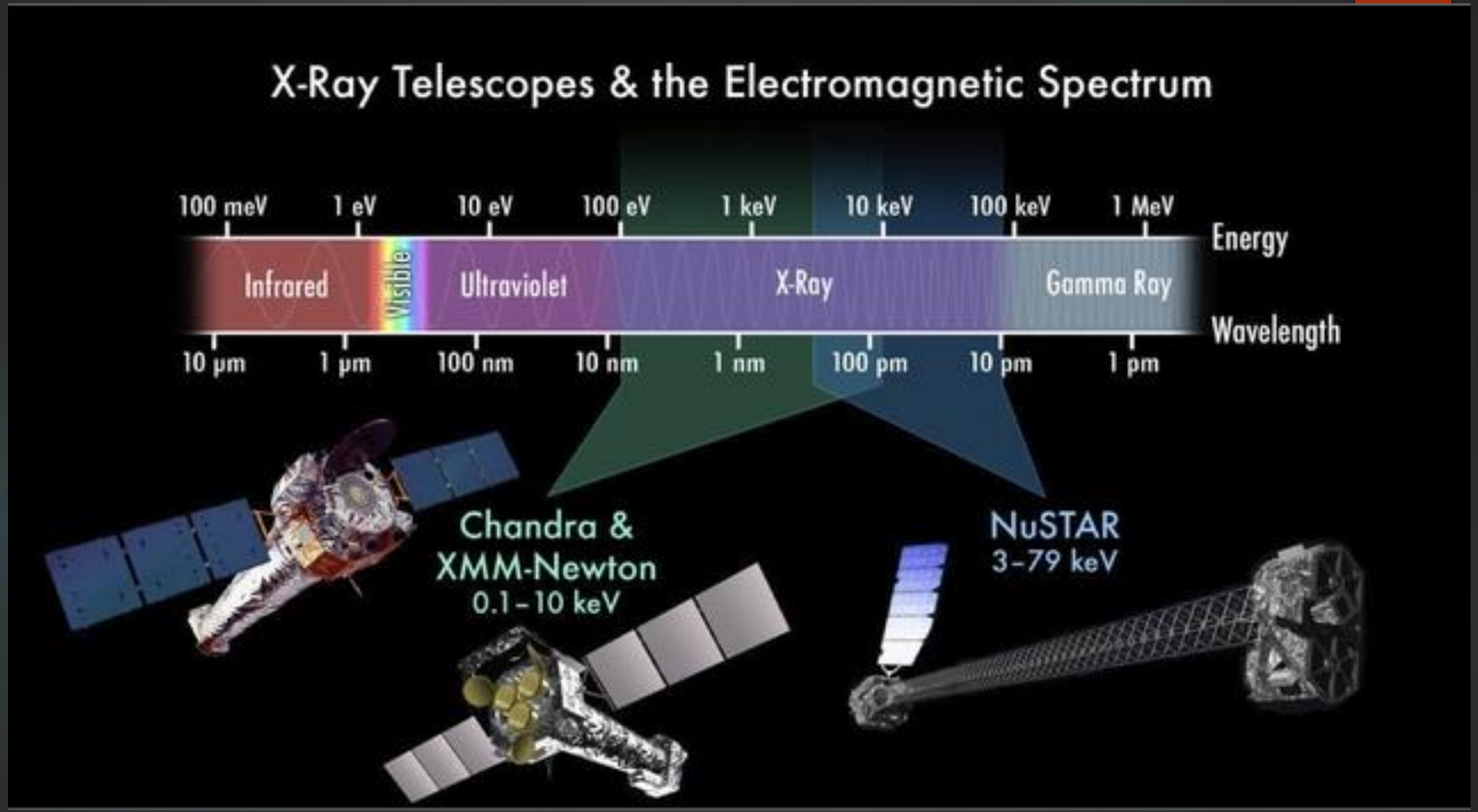
Stellar-Mass Black Hole

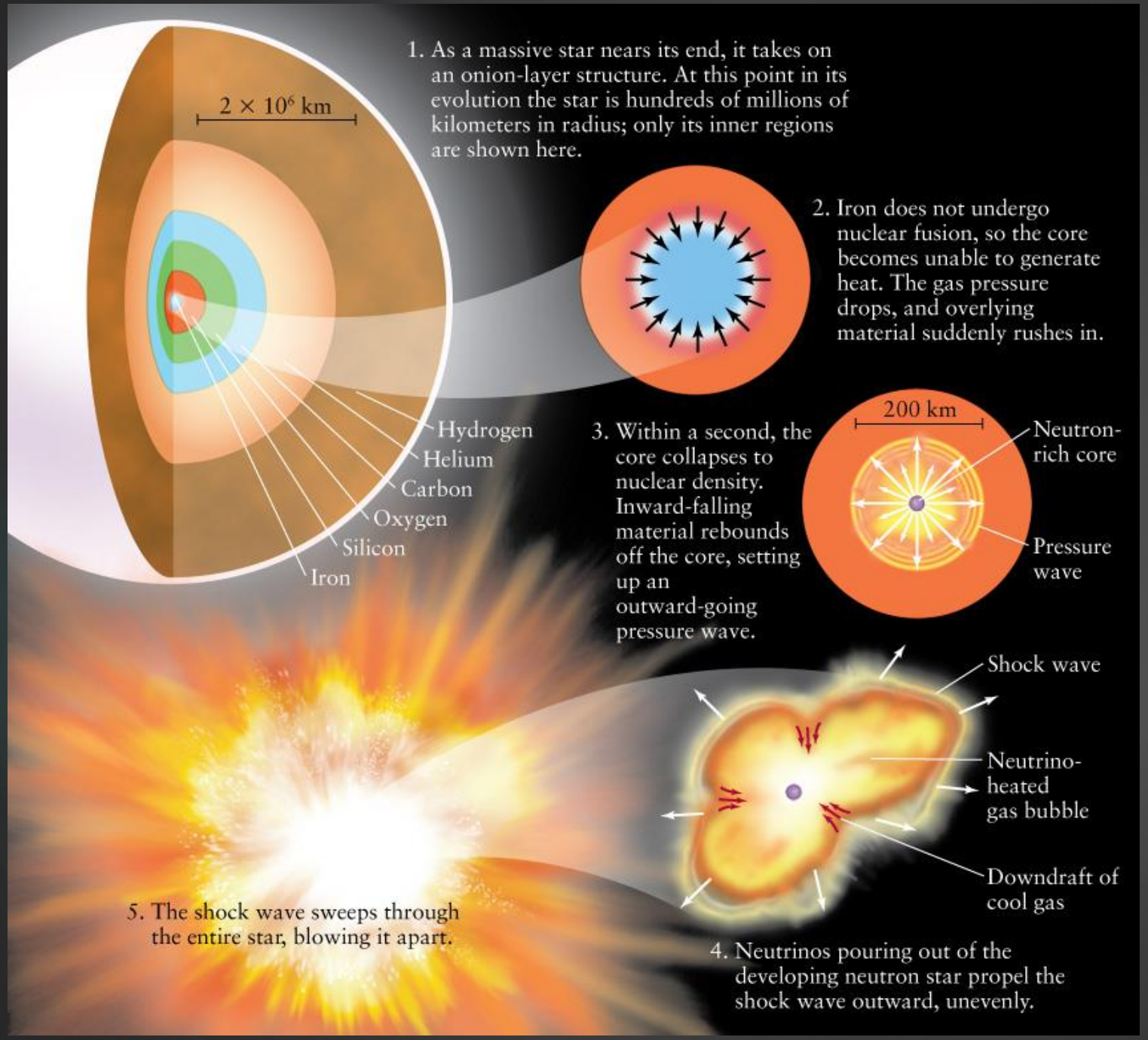
http://chandra.harvard.edu/photo/2011/cygx1/animations.html



Stellar-mass Black Hole di Galaksi Kita

Ditemukan pada sistem bintang ganda pemancar sinar-X


X-Ray Telescopes & the Electromagnetic Spectrum
100 meV
1 eV
10 eV
100 eV
1 keV
10 keV
100 keV
1 MeV
Energy
Infrared
Visible
Ultraviolet
X-Ray
Gamma Ray
Wavelength
10 μm
1 μm
100 nm
10 nm
1 nm
100 pm
10 pm
1 pm
Chandra &
XMM-Newton
0.1 – 10 keV
NuSTAR
3 – 79 keV

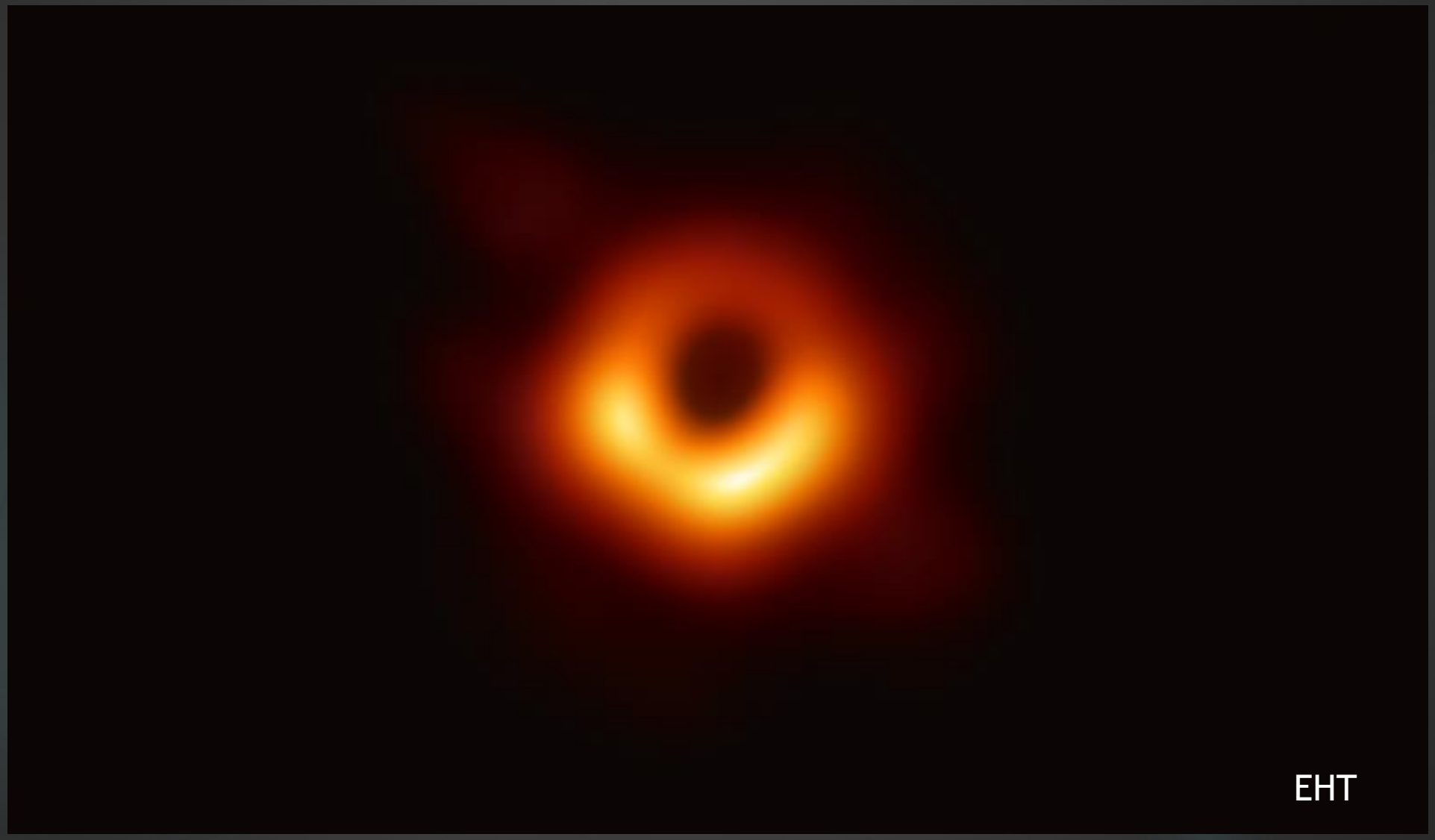


Evolusi Bintang Bermassa Besar

- *LH* merupakan salah satu produk akhir
- Semua materi runtuh ke titik singularitas
- *Event horizon* merupakan permukaan virtual

public.asu.edu

Event Horizon Telescope



How do you image an object that doesn't emit light? By looking at the bright material around it.

Matter swirling around a black hole can be heated to incredibly high temperatures, turning it into a glowing plasma like in this simulation. At the centre, a bright ring of photons outlines the black "shadow" of inside the event horizon.

Observing shape of the shadow may help test Einstein's theory of general relativity.

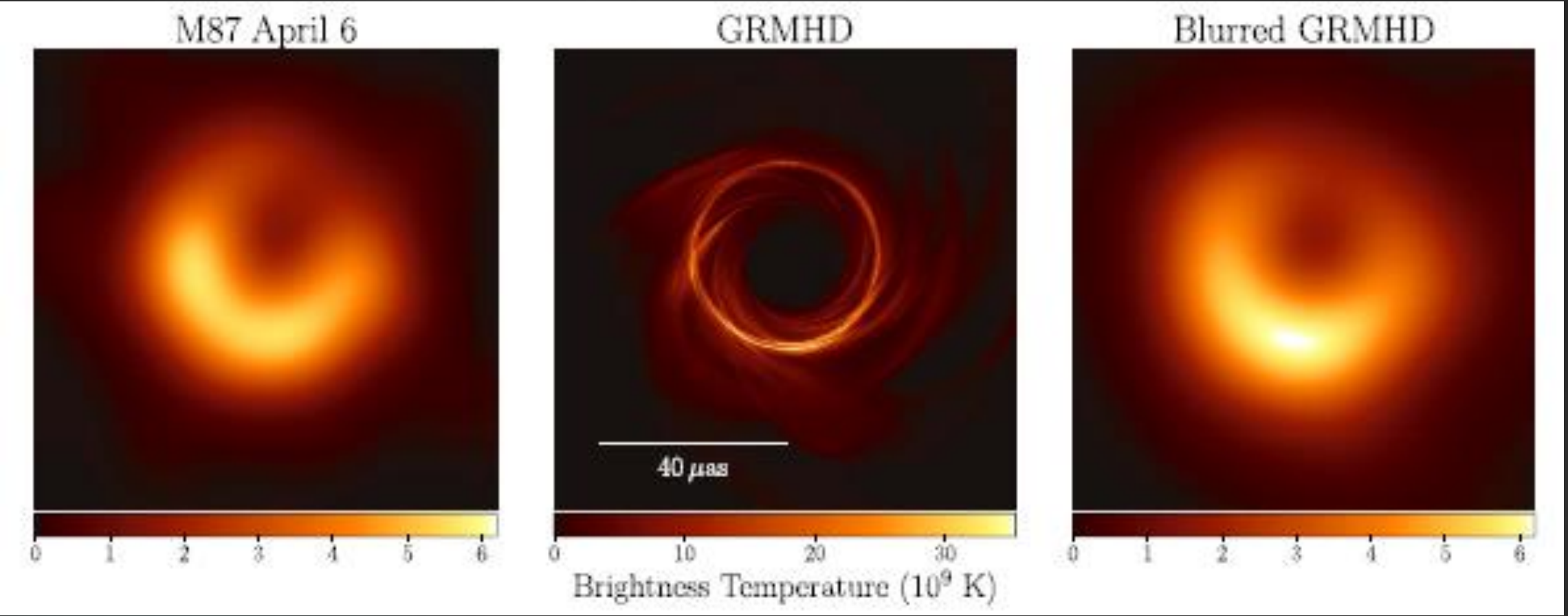
General relativity predicts a circular shadow.

But the shadow could also be "squashed" along the vertical axis (prolate)...

or the horizontal axis (oblate). Imaging the event horizon will test whether our ideas about space and time are correct.

EHT

Event Horizon Telescope



The EHT Collaboration et al. 2019