

BLACK HOLE

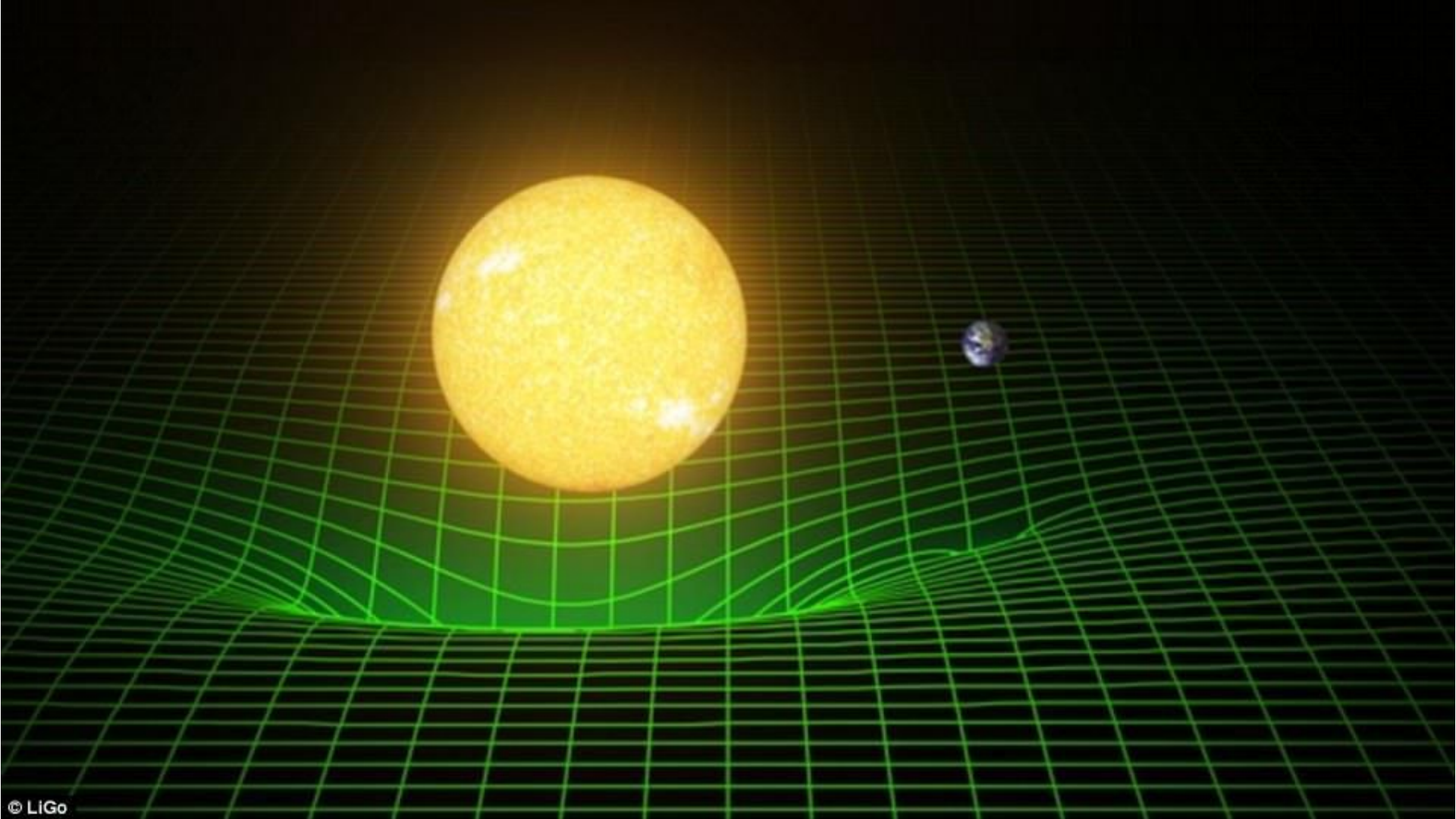
Einstein's Monster





TOPICS OF CONTENT

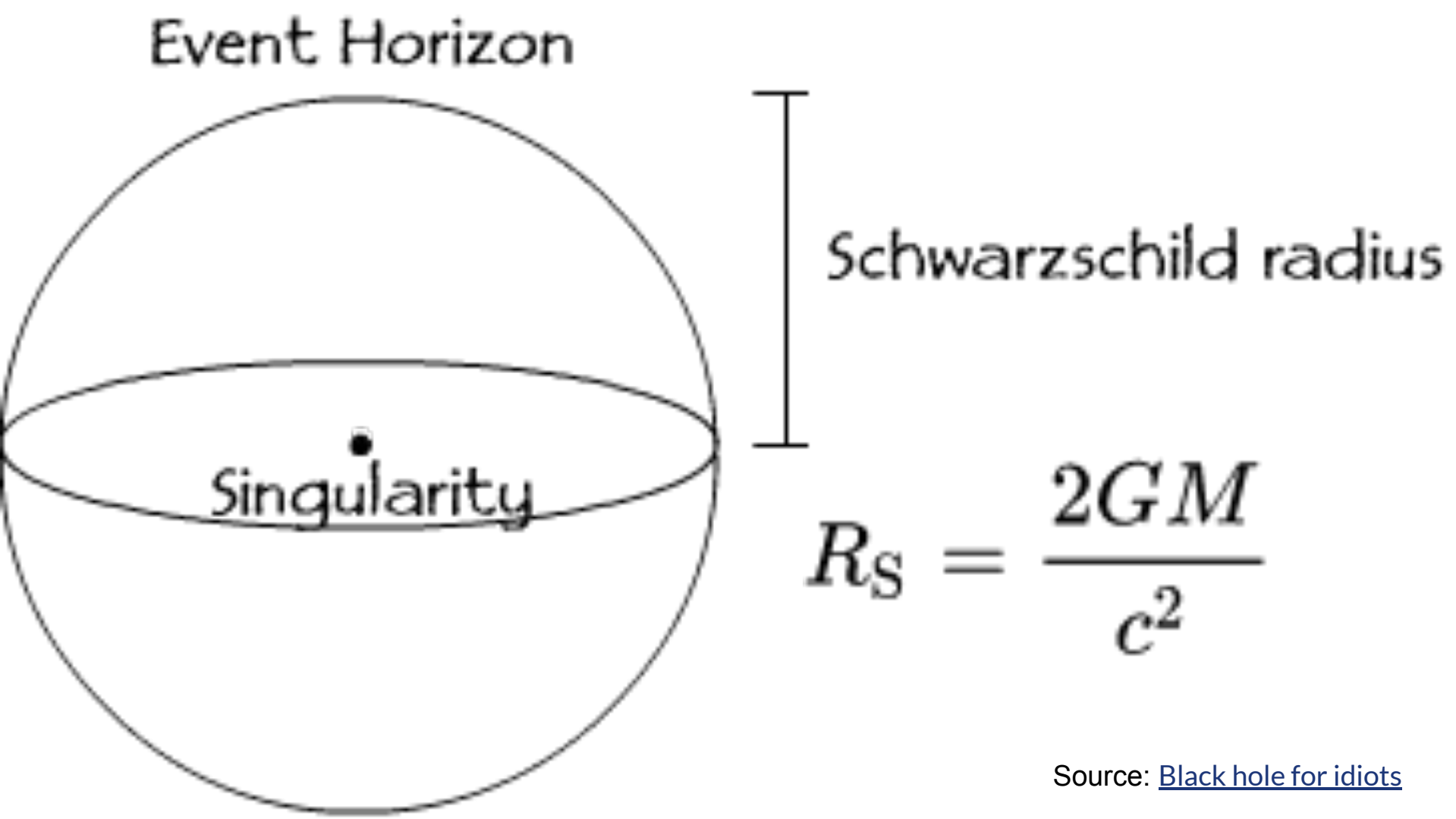
- Understanding Space and Time
- Schwarzschild's Radius
- Evidence of Black Hole
- Hawking's Radiation
- Math of Black Hole
- Information Paradox
- Our Solution



A black hole is an area of such immense gravity that nothing -- not even light -- can escape from it.

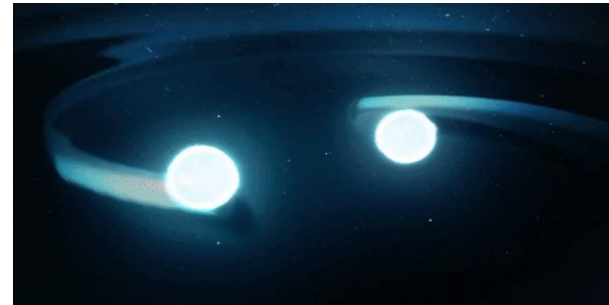


Schwarzschild Radius



Making Black Hole

- ★ Start with a fixed amount of matter and **compress it smaller and smaller** until it reaches the tipping point where it's dense enough to become a black hole.
 - Source: [Crab Supernova Explosion](#)
- ★ Keep **adding matter to an existing object** until it reaches the tipping point where it's so big it becomes a black hole.
 - Source: [Neutron Star Merger - MIT](#)





Source: [Schwarzschild radius of earth](#)



Evidence of Black Holes

S0-2 Orbit around SagA*:

Star S0-2 (also called S2) is orbit around center of the milky way in just 15.6 years, with almost 2% of speed of light.

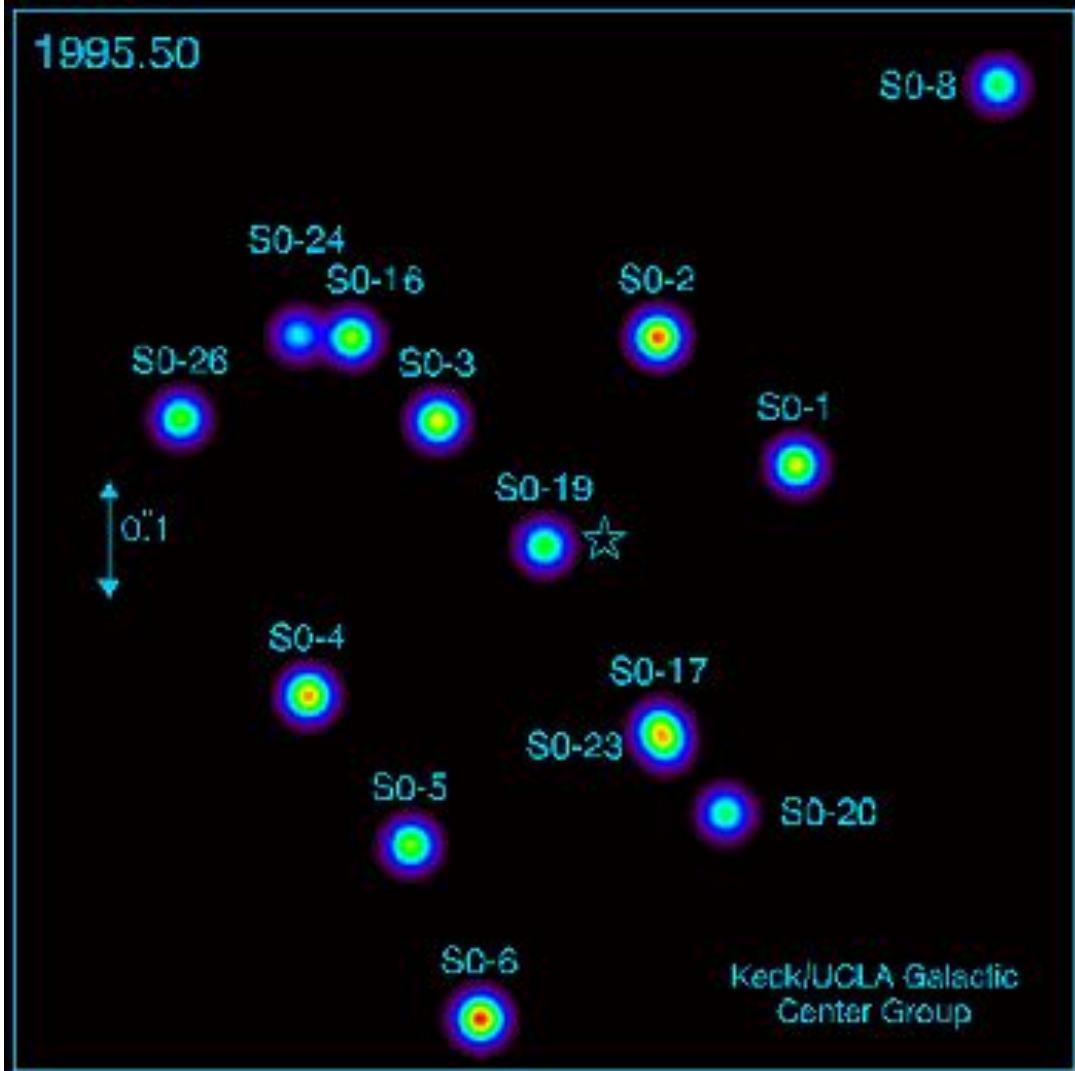
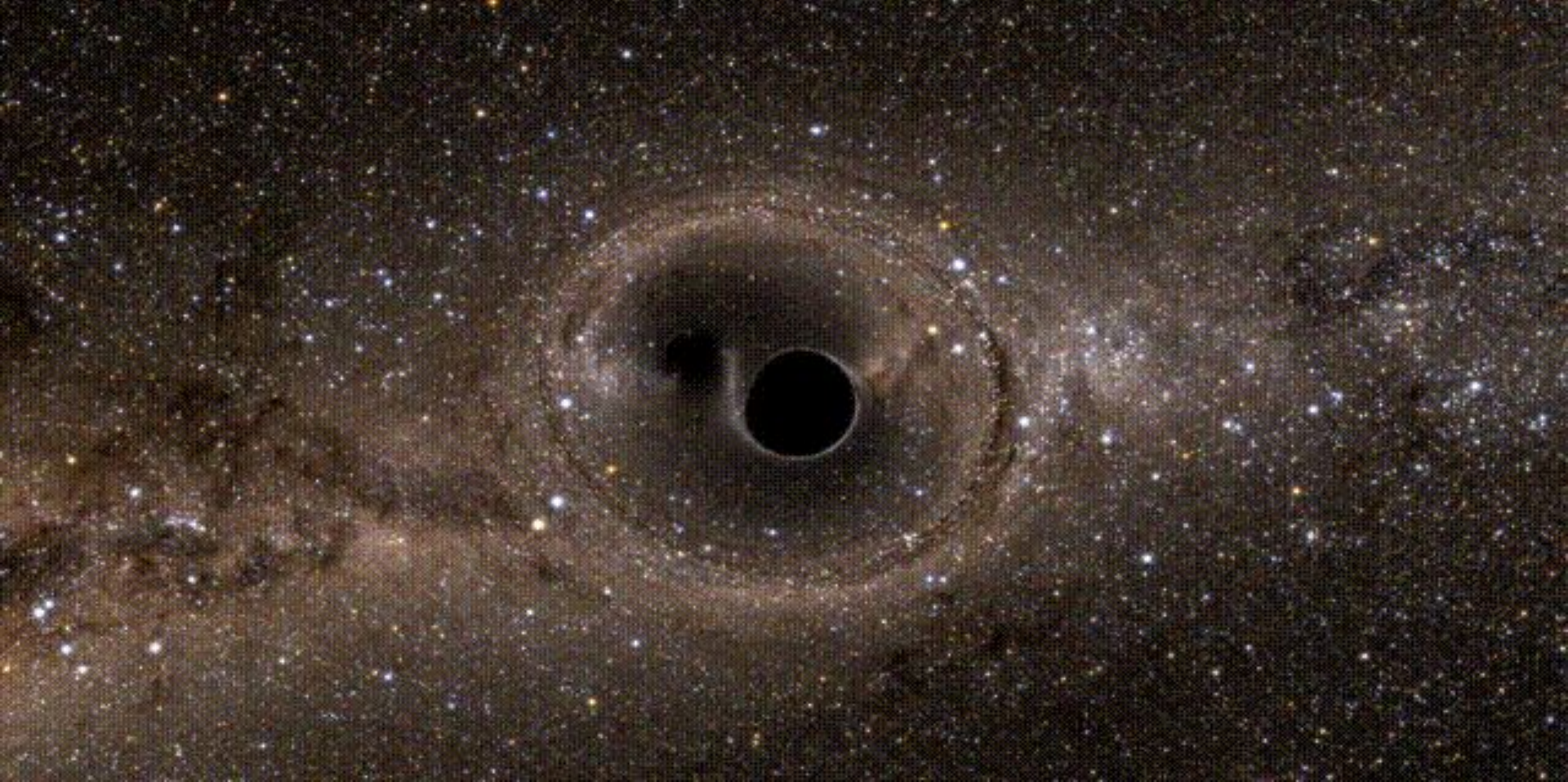


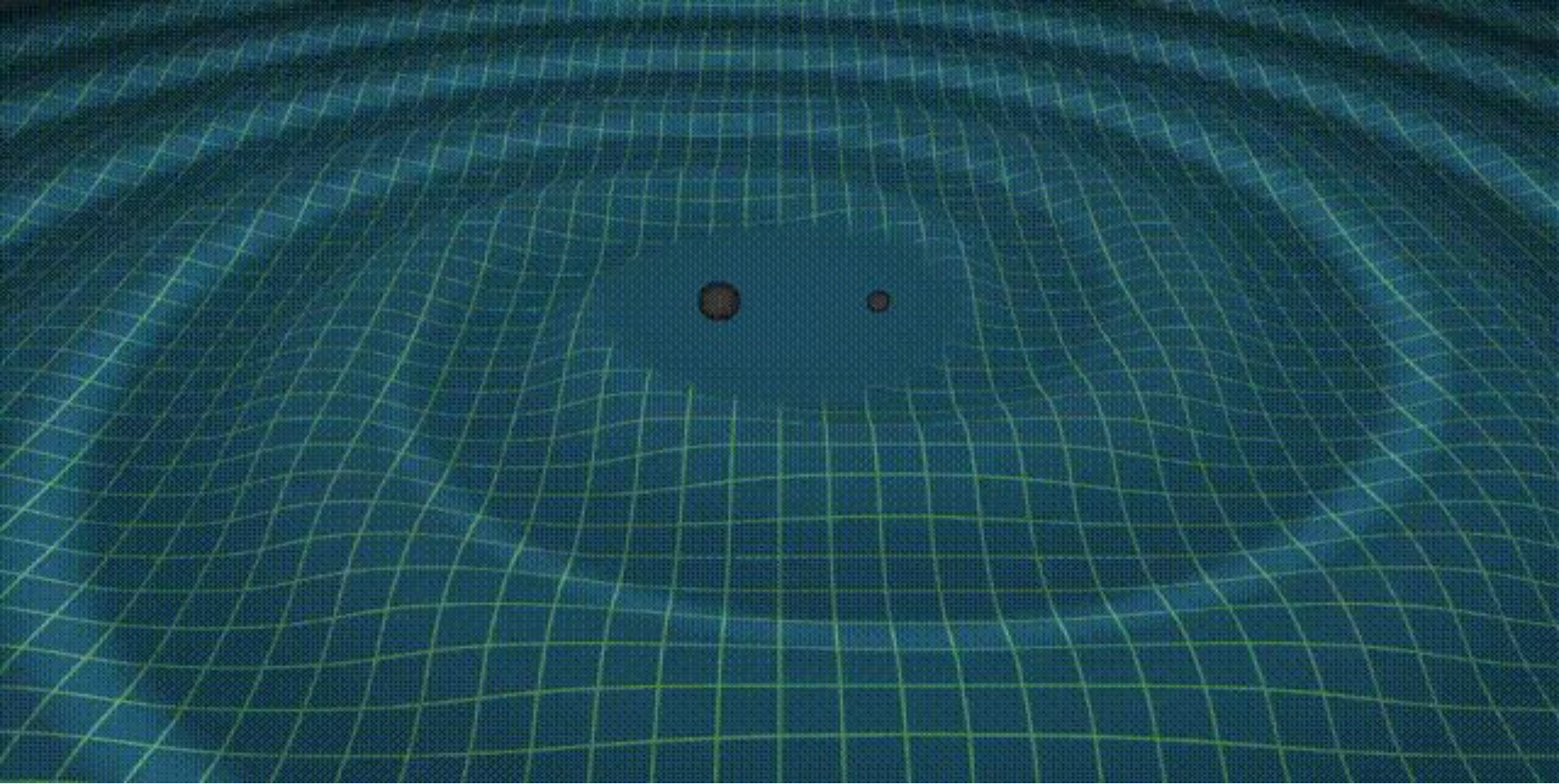
Fig. Orbiting stars reveal location of black hole
Credit: [My Hero - Andrea Mia Ghez](#)



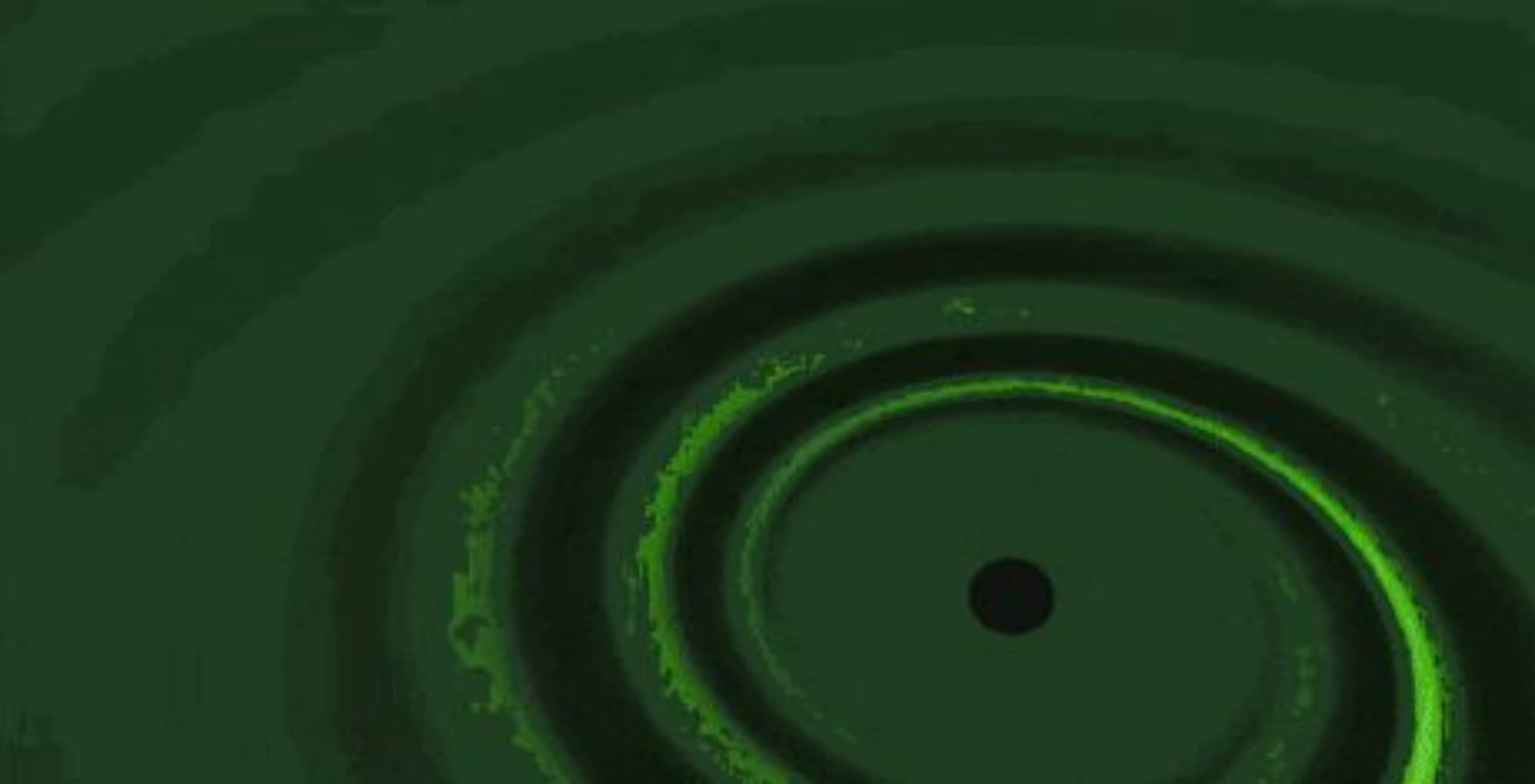
Merging black holes: Top view Credit: [SXS Collaboration](#)



Merging black holes (Side view) Credit: [SXS Collaboration](#)

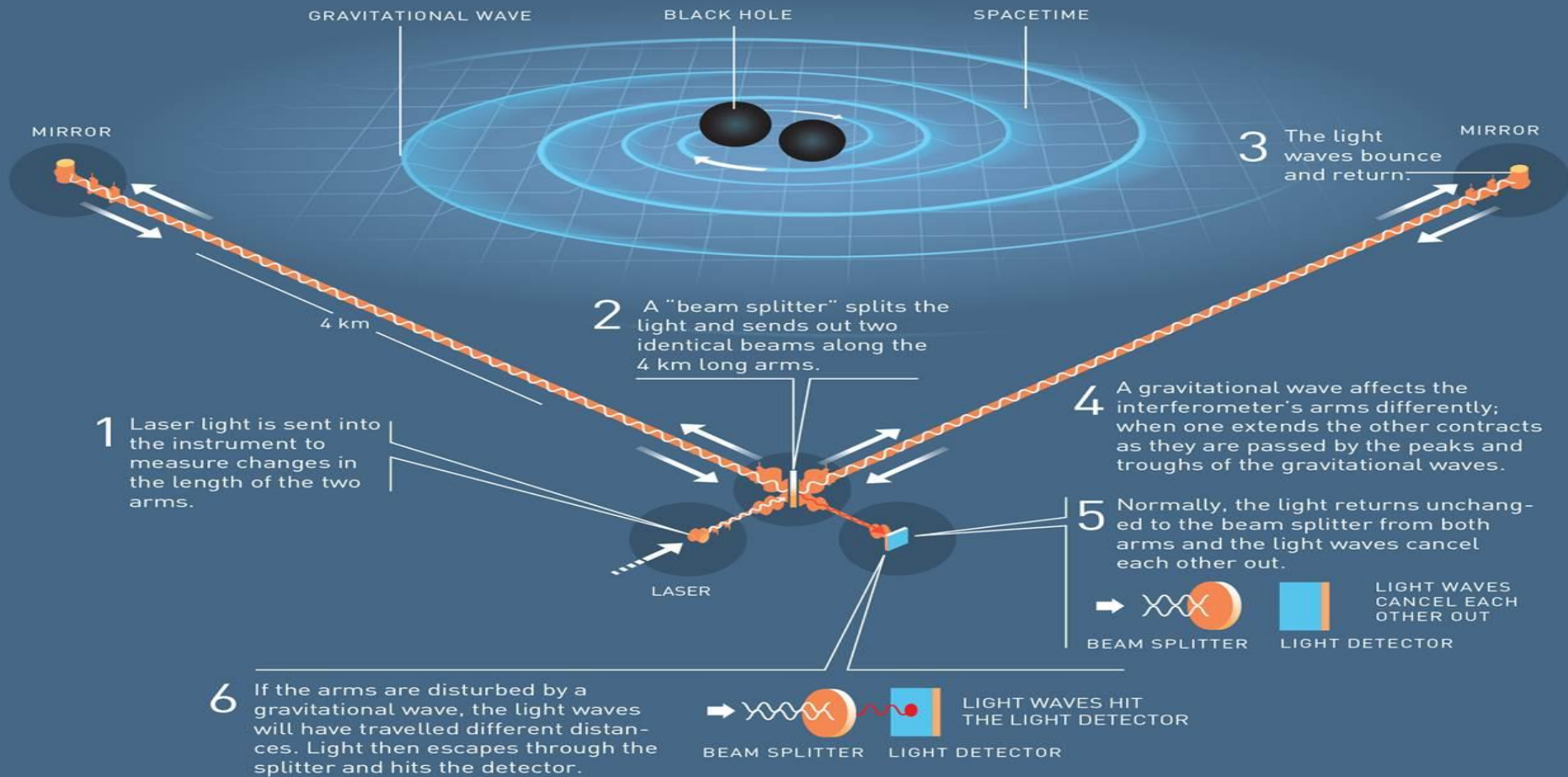


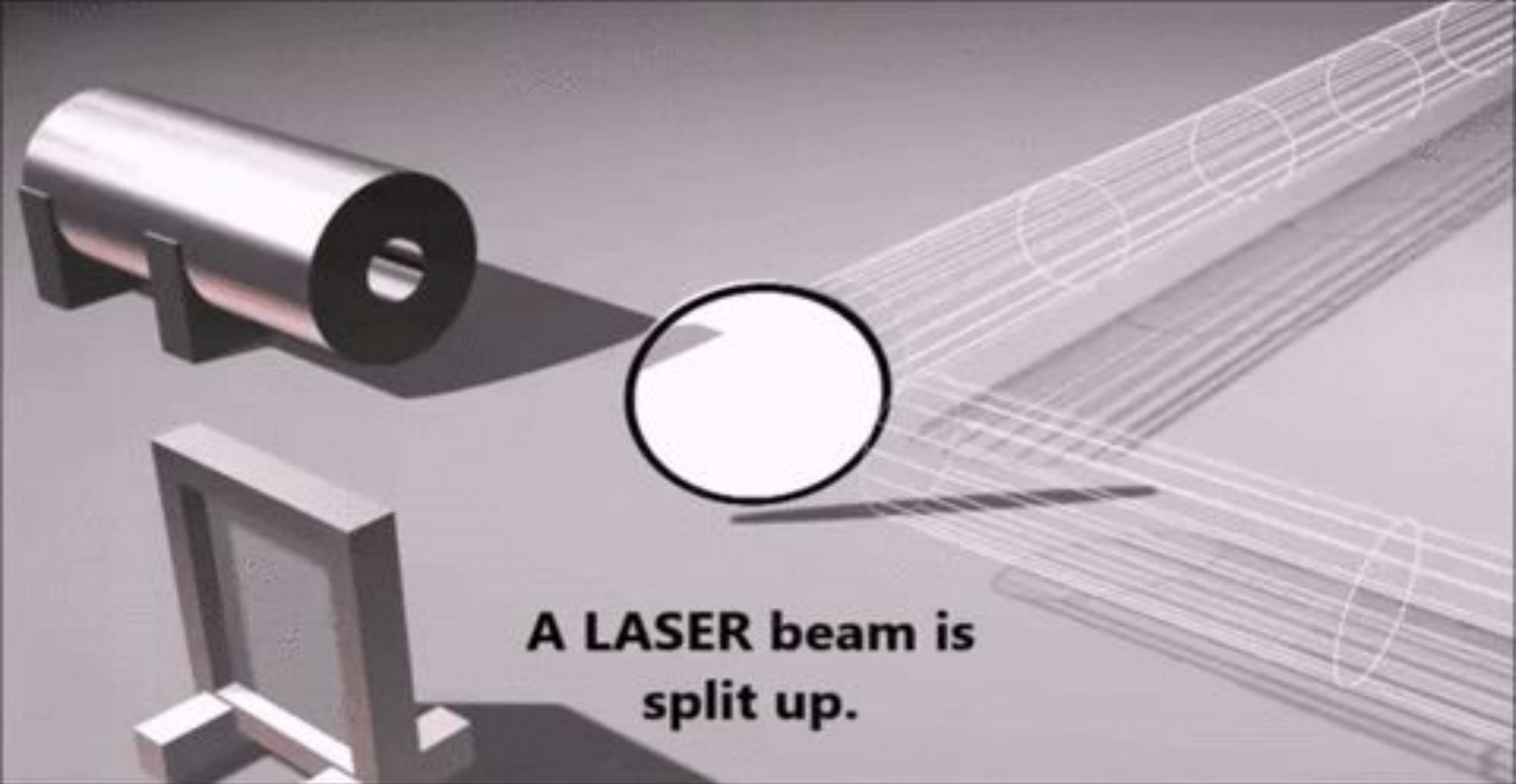
Spacetime ripples Credit: [NOLA.com](https://nola.com)



Source: [Gravitational waves](#)

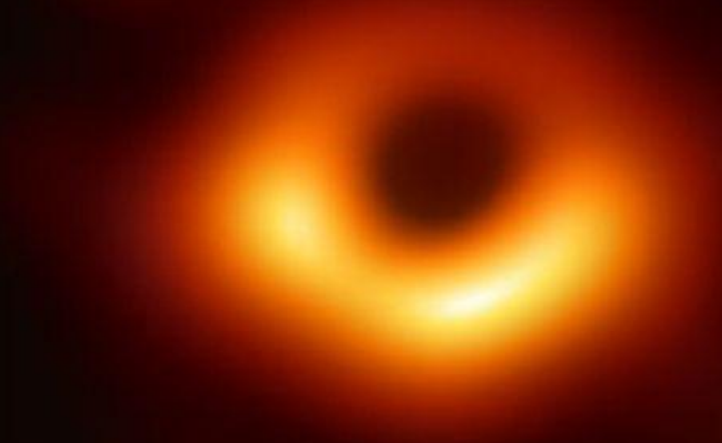
LIGO – A GIGANTIC INTERFEROMETER





**A LASER beam is
split up.**

Source: [How LIGO detects gravitational waves](#)

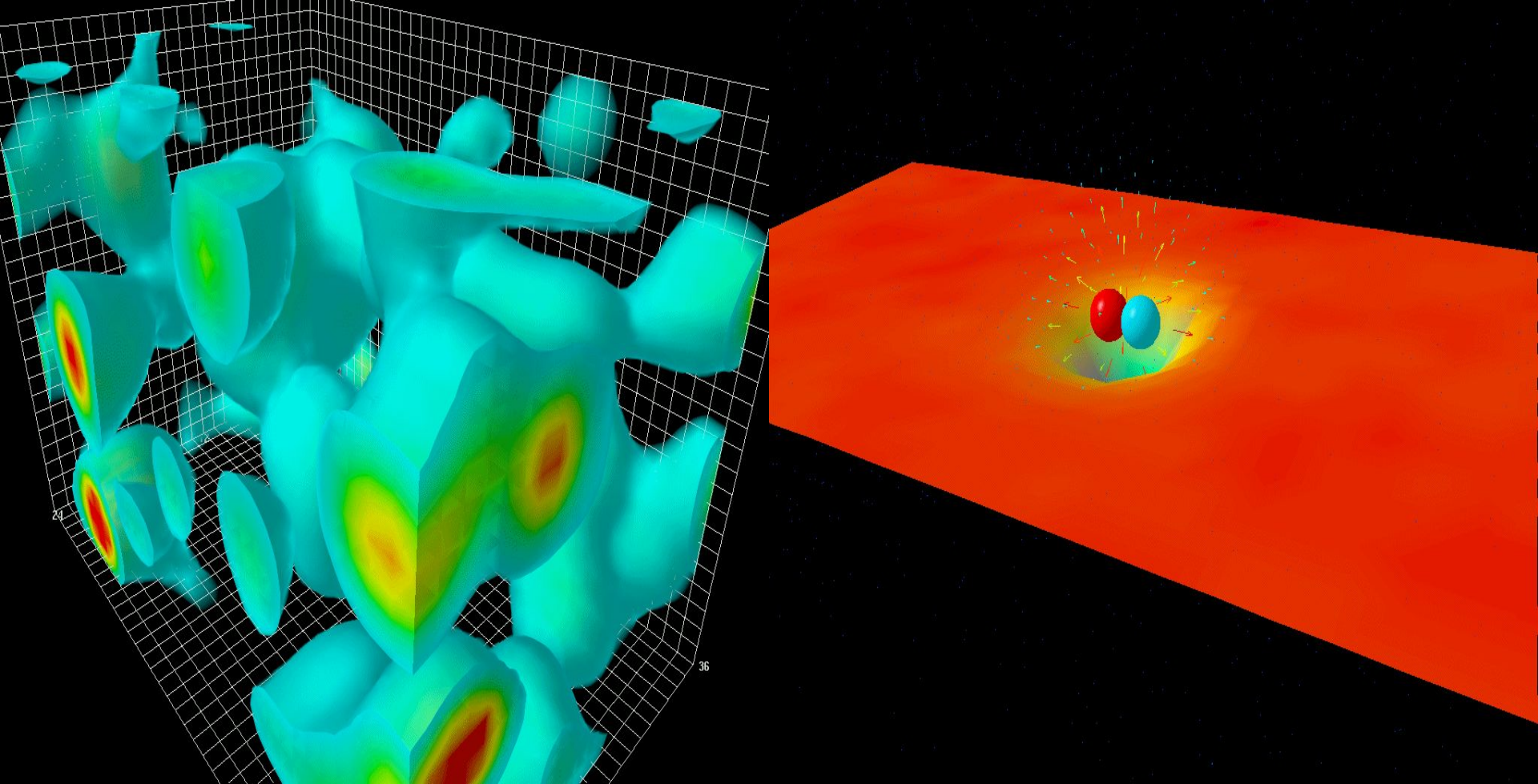


First Ever Image of **Accretion Disk** of Black Hole

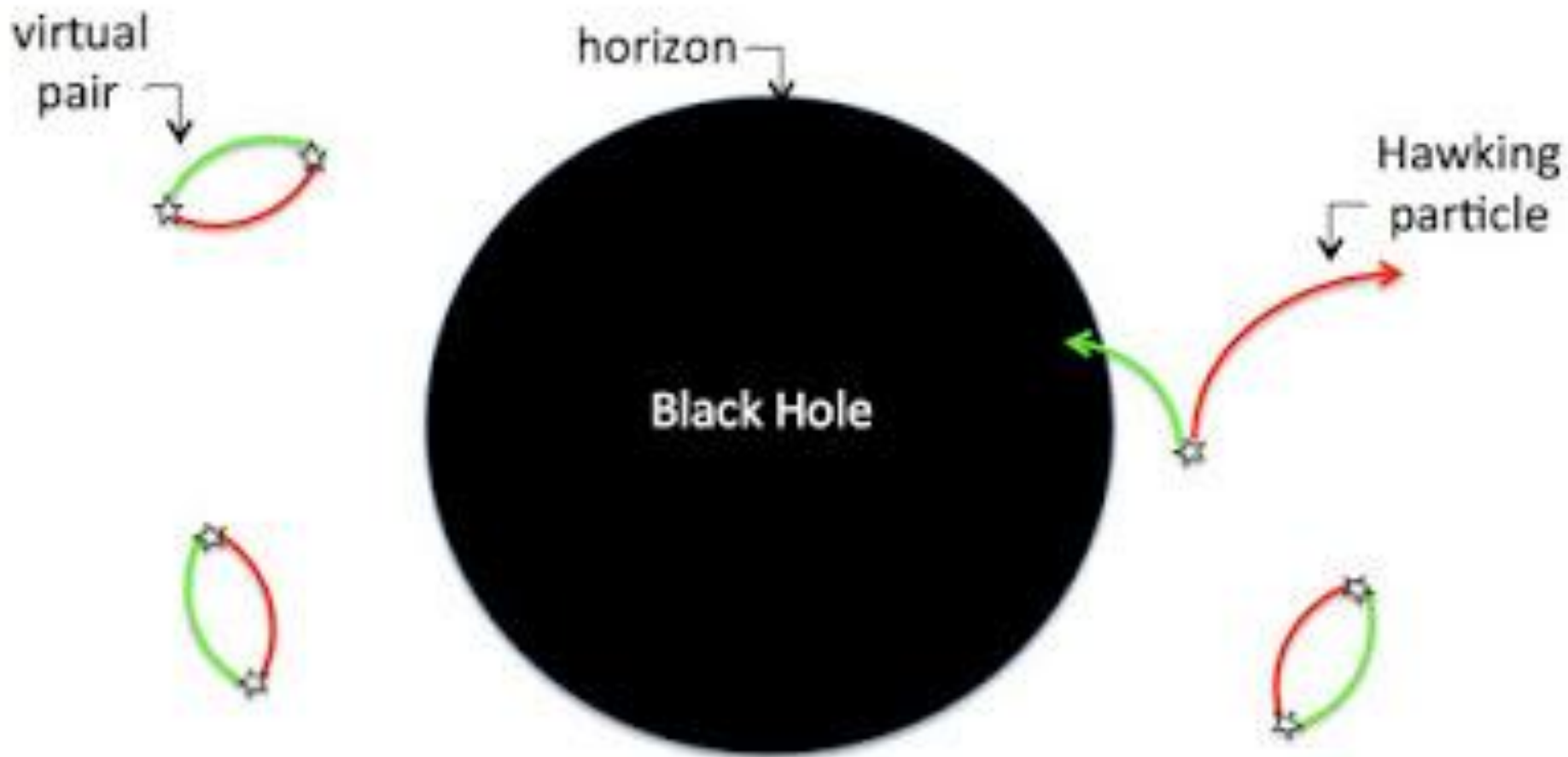


Hawking Radiation

Black holes should emit electromagnetic radiation with a black body spectrum; this process is also called black hole evaporation.



Visualizations of Quantum Chromodynamics Credit: ([Derek Leinweber](#))



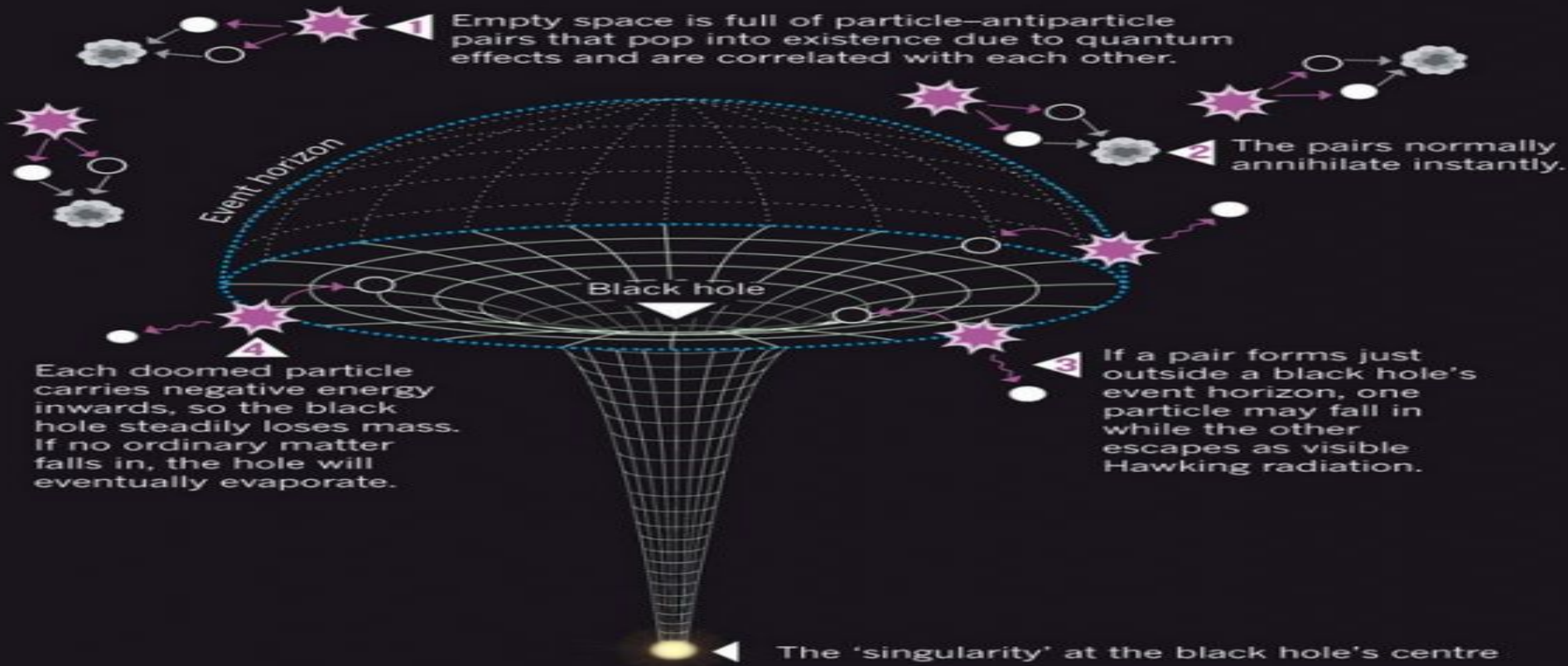
Source: [Hawking Radiation](#)



Information Paradox

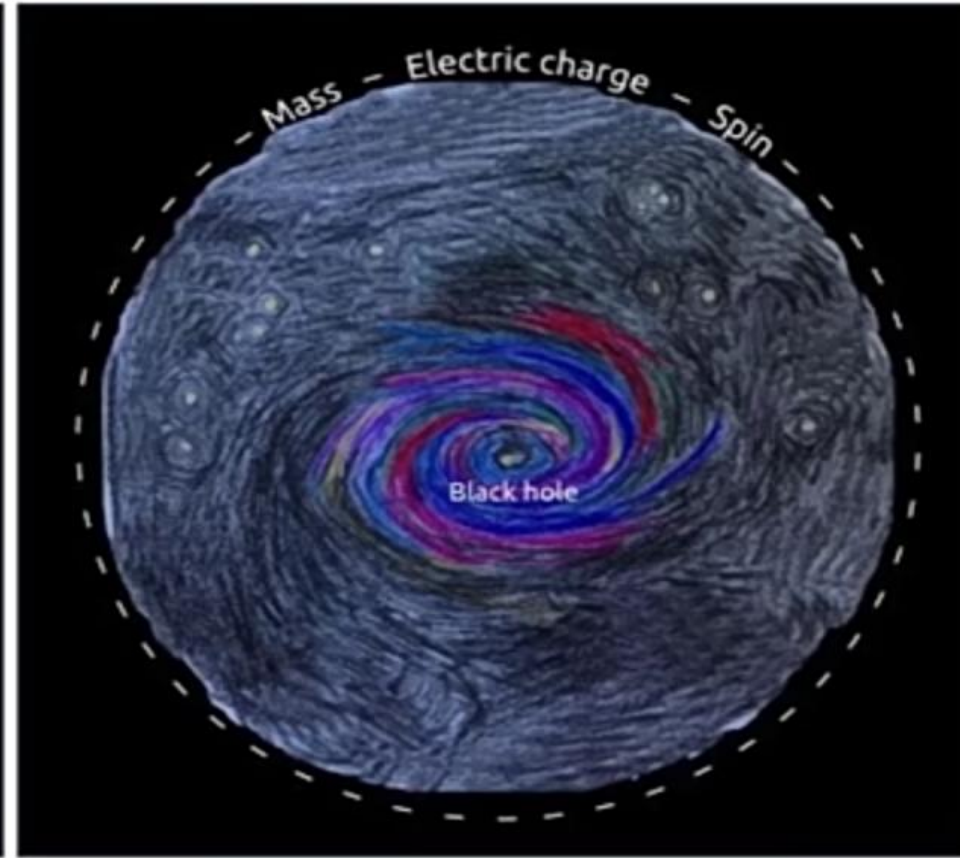
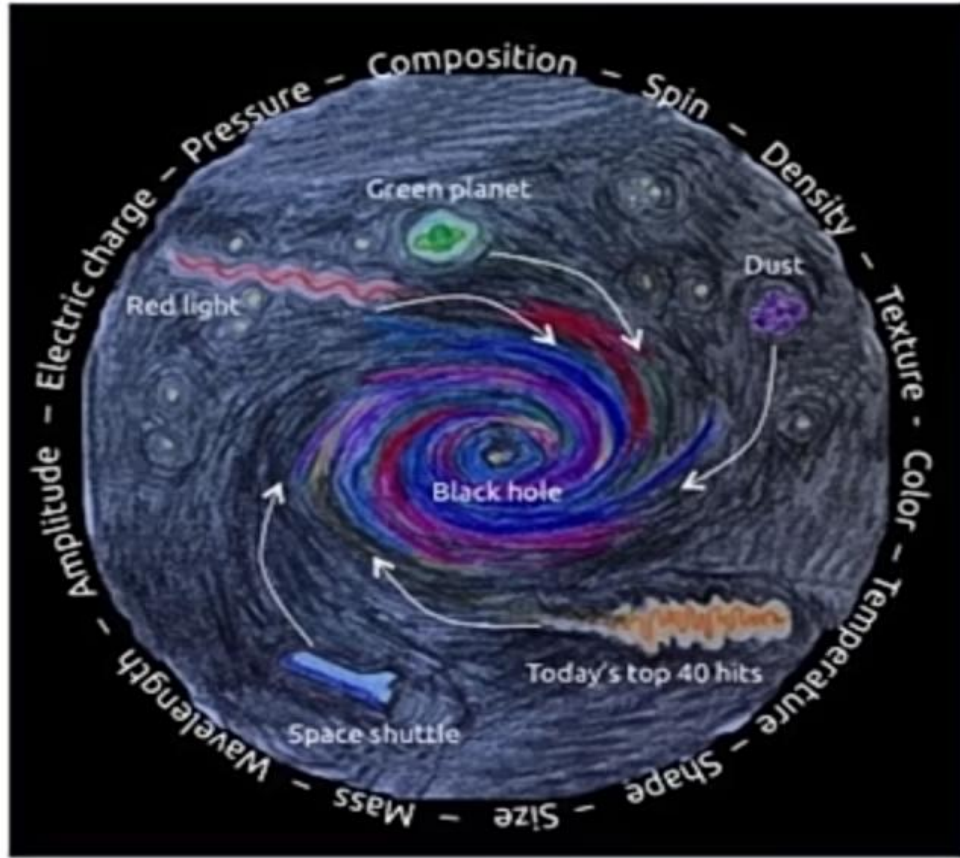
DISAPPEARANCE

When the hole evaporates, all the information disappears with it.



When Stephen Hawking proposed the concept of [Hawking radiation](#) in 1974, he opened up another topic for debate: The [black hole information paradox](#). Credit: Futurism - Information Paradox

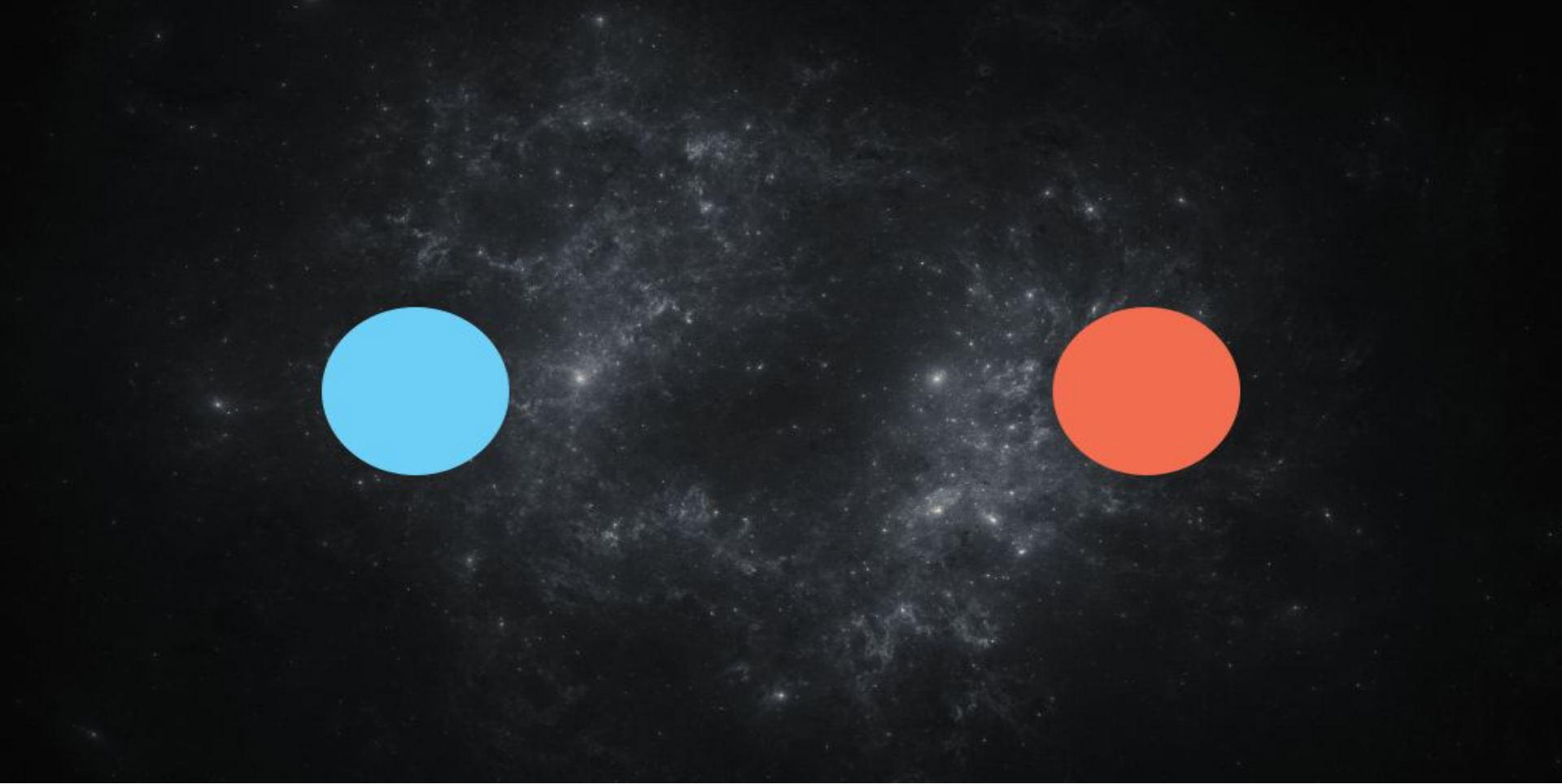
The Information Paradox



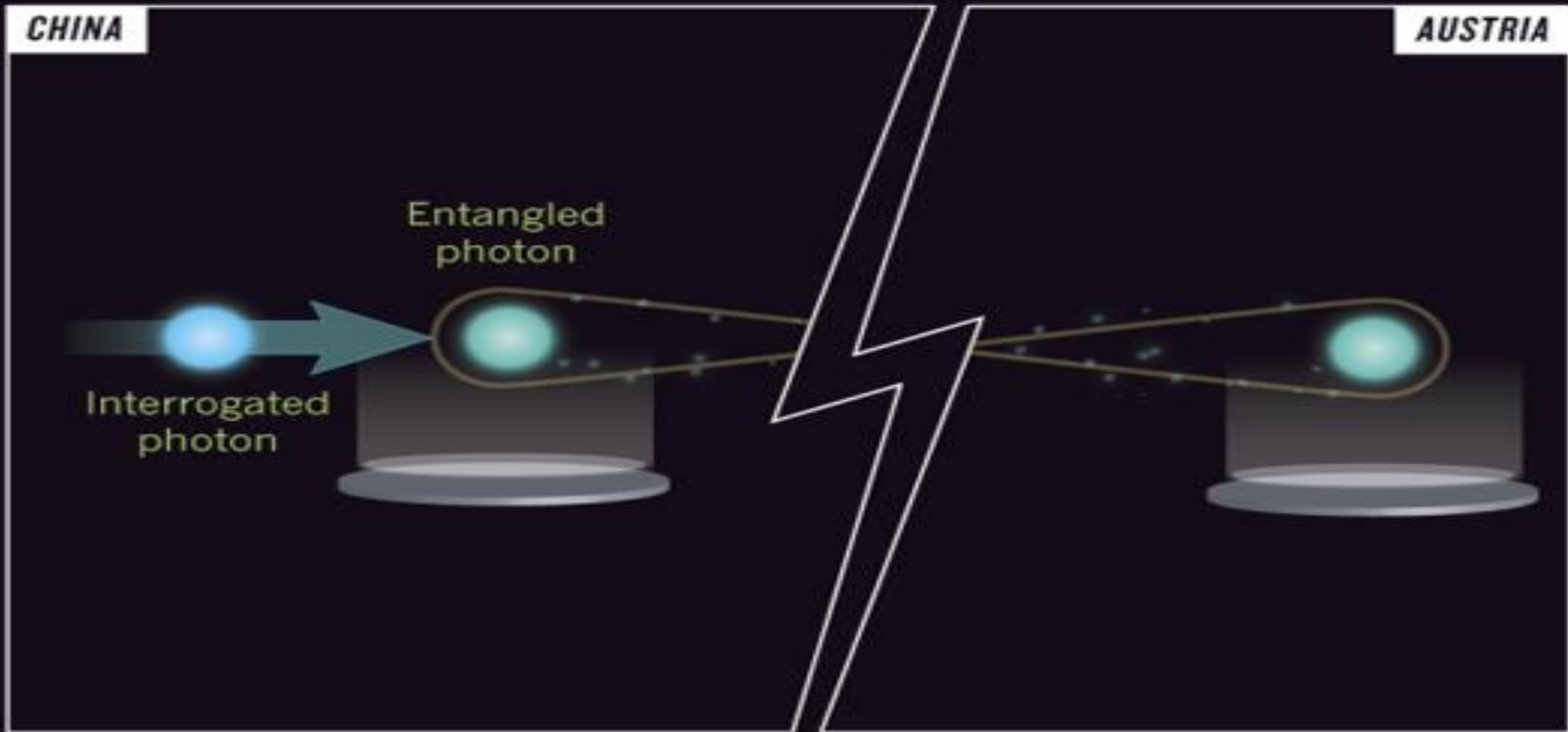
Credit: [Harvard University - Black Hole soft hairs](#)



Our Solution



Credit: [Quantum Magazine - Experiment Reaffirms Quantum Weirdness](#)



The stay-at-home photon is used to pick up information from another photon. The traveling photon is instantly affected by the comparison in China, and acquires information about the interrogated photon. (Credit: Nature doi:10.1038/492022a)

BYE BYE!

