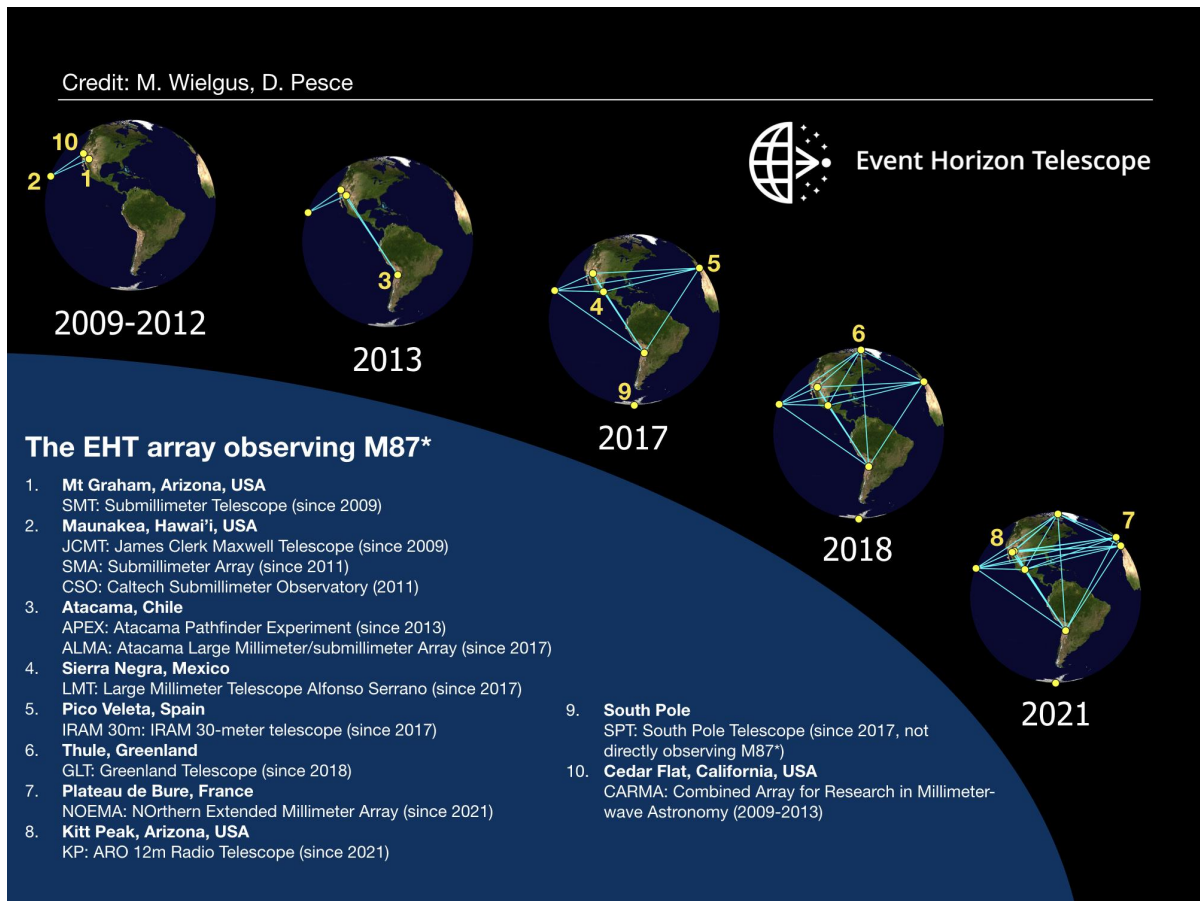


Lecture 27 : Supermassive Black Holes

The compact sources at the centre of radio galaxies have incredible luminosities. Invoking the *Eddington Luminosity Limit*, astronomers concluded that the central engine must have mass of the order of a billion solar masses. The time variability of the compact central source led one to conclude that it must be a very compact object. Thus emerged the paradigm that the central engines of Quasars and Radio Galaxies must be supermassive black holes. In April 2019, a stunning image was made of the shadow of the giant black hole at the centre of the giant elliptical galaxy M 87. This was done using the **Event Horizon Telescope** (EHT) - an intercontinental baseline radio interferometer. This Lecture describes the technical advances that were needed to make such an image, and explains how one might understand the morphology of the image.



The EHT is a global array of telescopes, performing synchronized observations using the technique of Very Long Baseline Interferometry (VLBI). Together they form a virtual Earth-sized radio dish, providing a uniquely high image resolution. In 2009-2013 M87 was observed by early-EHT prototype arrays, with telescopes located at three geographical sites in 2009-2012, and four sites in 2013. In 2017 the EHT reached maturity with telescopes located at five distinct geographical sites across the globe. Since then more telescopes have been added to make an expanded EHT array which is providing new images with much richer data sets allowing scientists to study the turbulent dynamics of the region in the vicinity of the supermassive black hole.

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Astronomy & Astrophysics : An Introductory Survey

A lecture series by Prof. G. Srinivasan

A 'Golden Jubilee Celebration' Event of the Astronomical Society of India

Lecture 27 : Supermassive Black Holes

[Supplementary Material : Dr. Sushan Konar]



Suggested Reading

1. B. M. Peterson, 1997, **An Introduction to Active Galactic Nuclei**, Cambridge University Press
2. A. K. Kembhavi & J. V. Narlikar, 1999, *Quasars and Active Galactic Nuclei: An Introduction*, Cambridge University Press
3. F. Melia, 2007, **The Galactic Supermassive Black Hole**, Princeton University Press
4. Fulvio Melia, 2009, **The Edge of Infinity : Supermassive Black Holes in the Universe**, Cambridge University Press
5. V. Beckmann & C. Shrader, 2013, **Active Galactic Nuclei**, Wiley
6. J. H. Krolik, 2021, **Active Galactic Nuclei: From the Central Black Hole to the Galactic Environment**, Princeton University Press
7. Y. Saplakoglu, Scientific American, September, 2019
Did a Supermassive Black Hole Influence the Evolution of Life on Earth?
8. A. Loeb, Scientific American, January, 2021
Zeroing in on how Supermassive Black Holes formed
9. S. Fletcher, 2018, **Einstein's Shadow: A Black Hole, a Band of Astronomers, and the Quest to See the Unseeable**, Ecco

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