238th AAS Meeting Press Conference on June 7, 2021

Serendipitous discovery of a dying Active Galactic Nucleus (AGN) in Arp 187

Kohei Ichikawa

FRIS fellow, Tohoku University, Japan

k.ichikawa@astr.tohoku.ac.jp

@IchikawaKohei

Credit: NASA/JPL Caltech

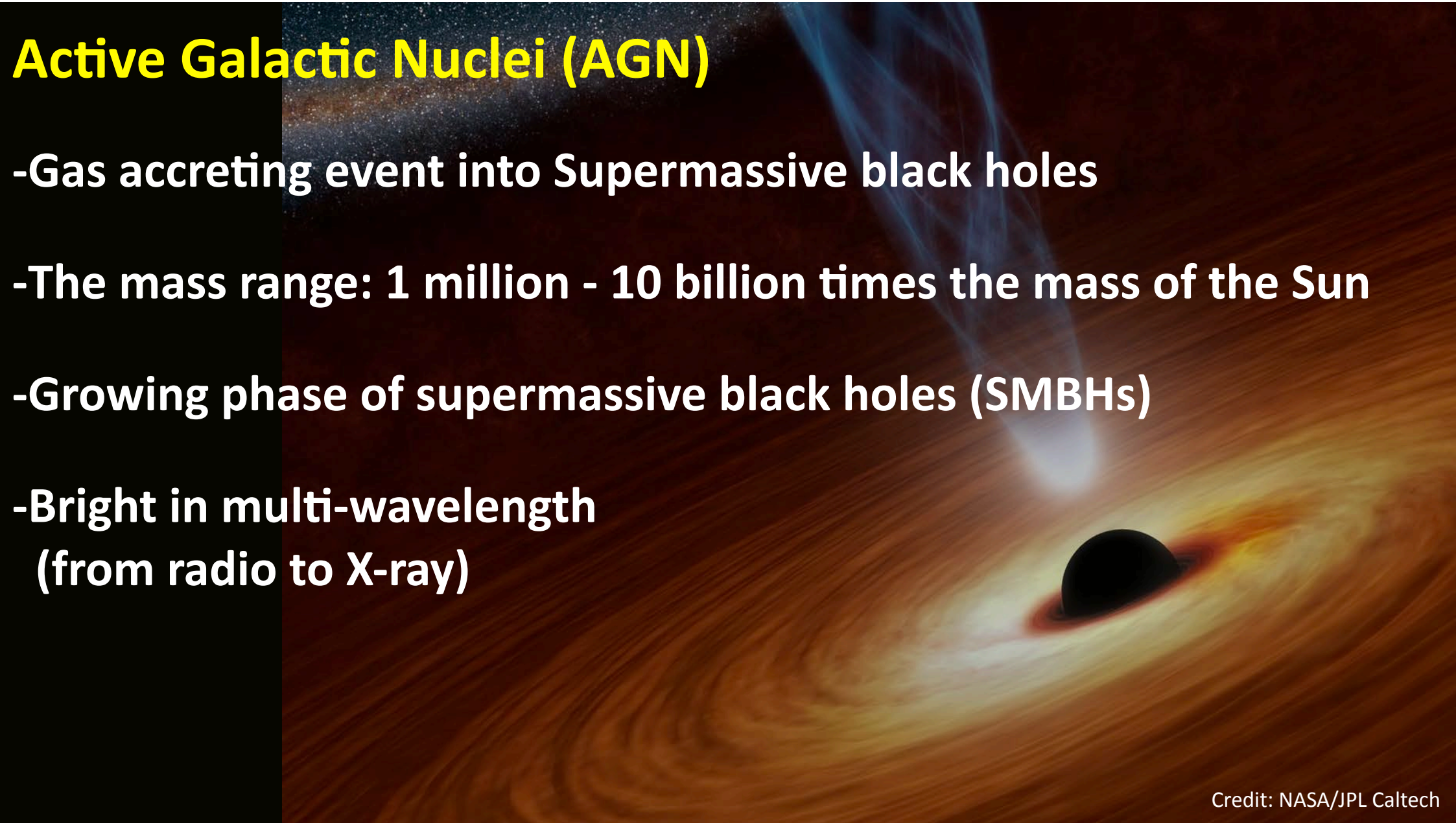
Active Galactic Nuclei (AGN)

-Gas accreting event into Supermassive black holes

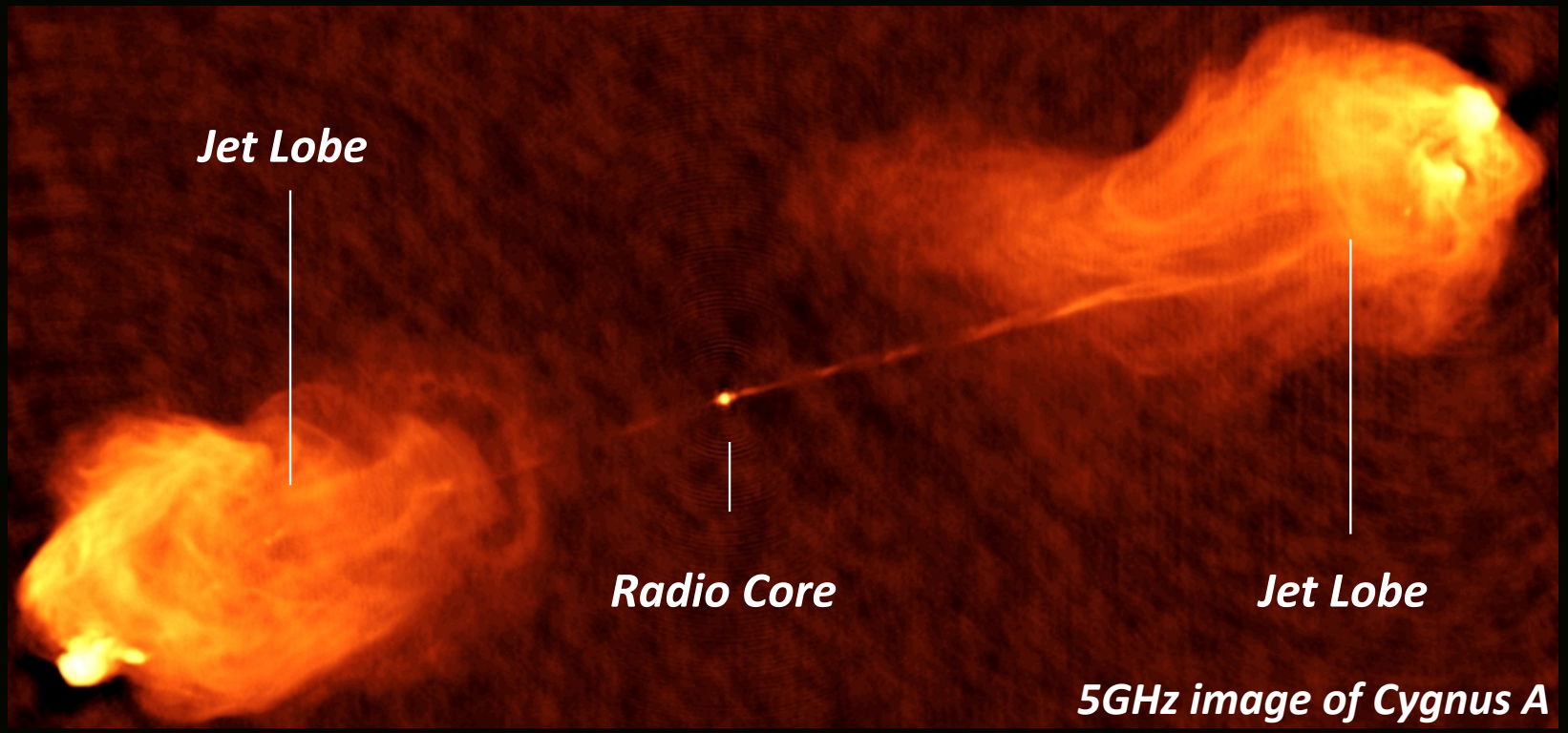
-The mass range: 1 million - 10 billion times the mass of the Sun

-Growing phase of supermassive black holes (SMBHs)

-Bright in multi-wavelength
(from radio to X-ray)



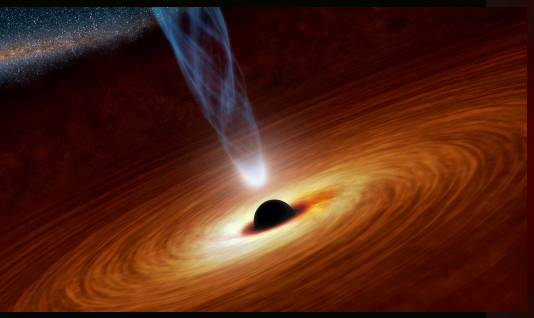
AGN in radio: jet + core



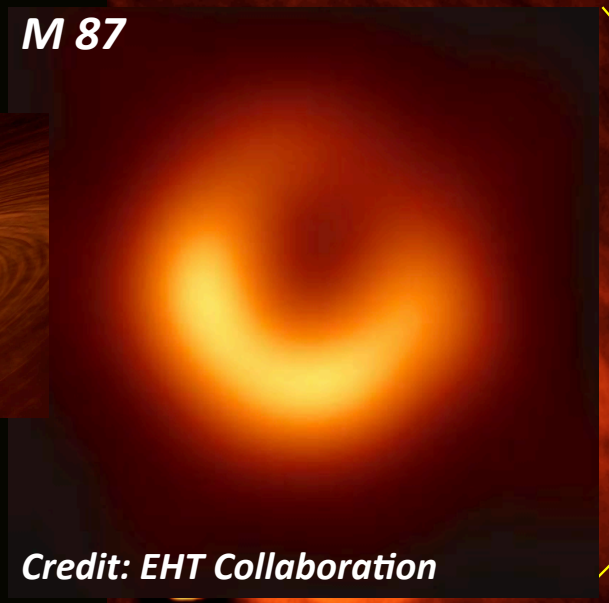
5GHz image of Cygnus A

credit: NRAO, Carilli & Barthel (1996)

AGN in radio: jet + core

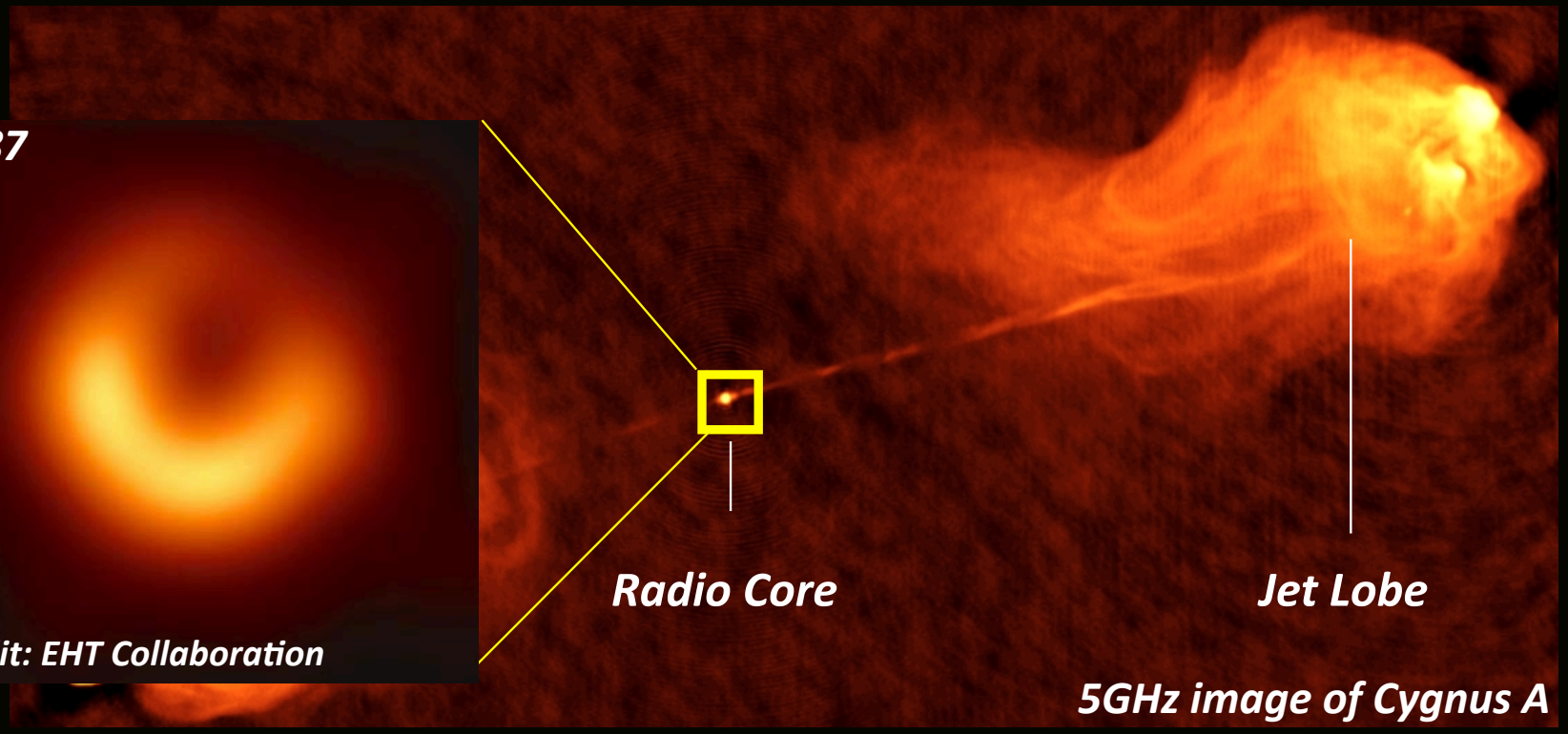


Credit: NASA/JPL Caltech



M 87

Credit: EHT Collaboration



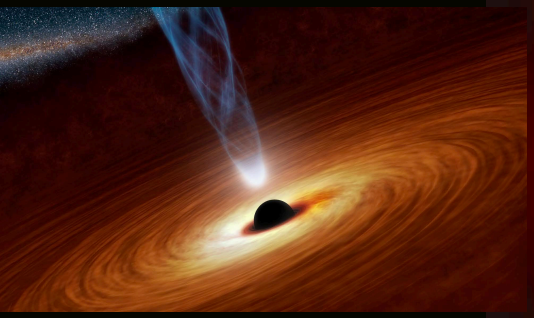
Radio Core

Jet Lobe

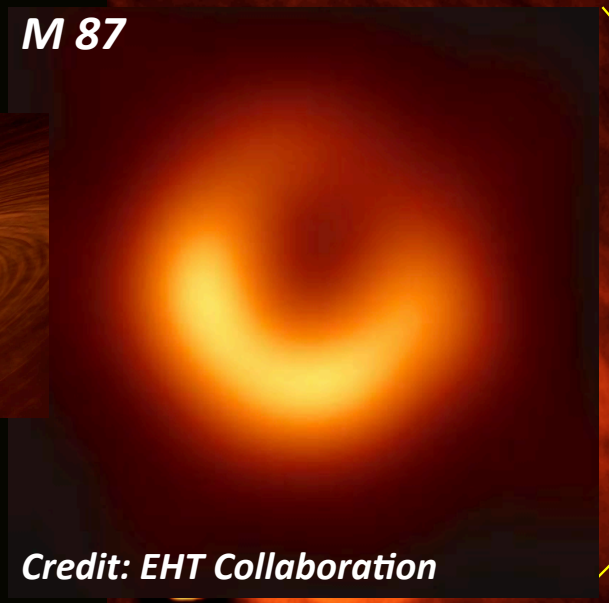
5GHz image of Cygnus A

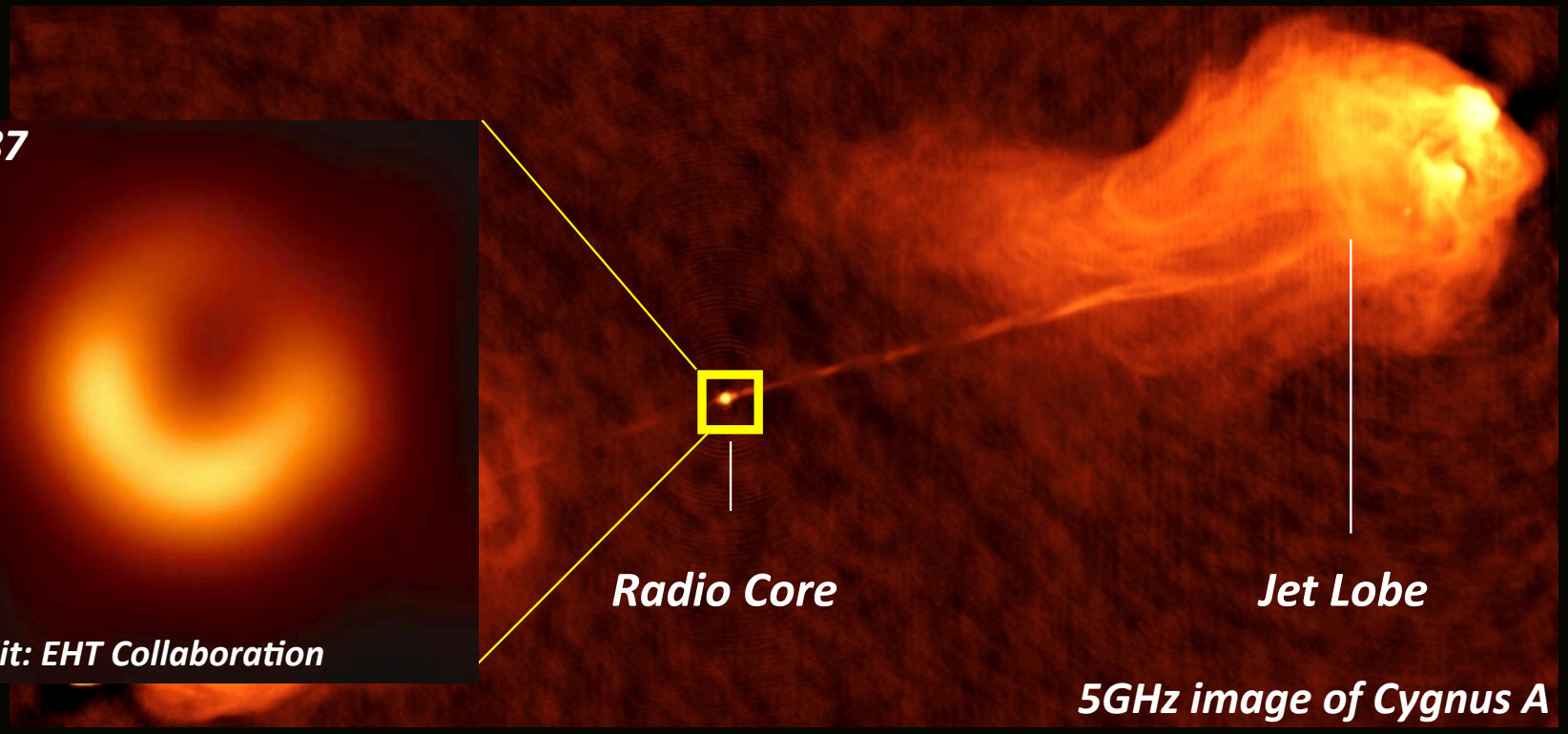
credit: NRAO, Carilli & Barthel (1996)

AGN in radio: jet + core



Credit: NASA/JPL Caltech





credit: NRAO, Carilli & Barthel (1996)

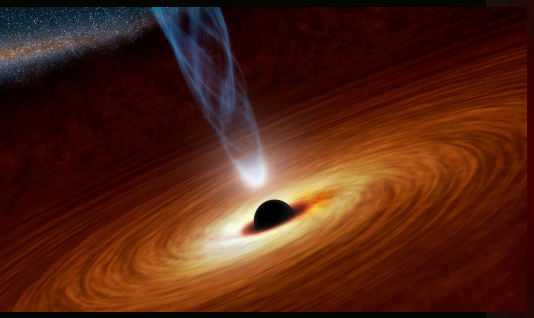
One big question: **Is there an ending (=dying) of this "AGN" phase?**

"Everything that has a beginning has an ending."

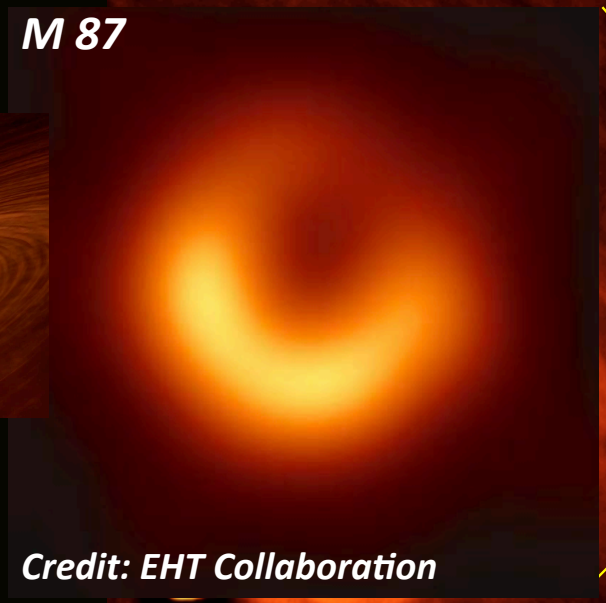
Currently no clear observational findings of such "dying" AGN

Why? since AGN phase is very long with >10^5 yr (thus catching dying phase is very hard)

AGN in radio: jet + core

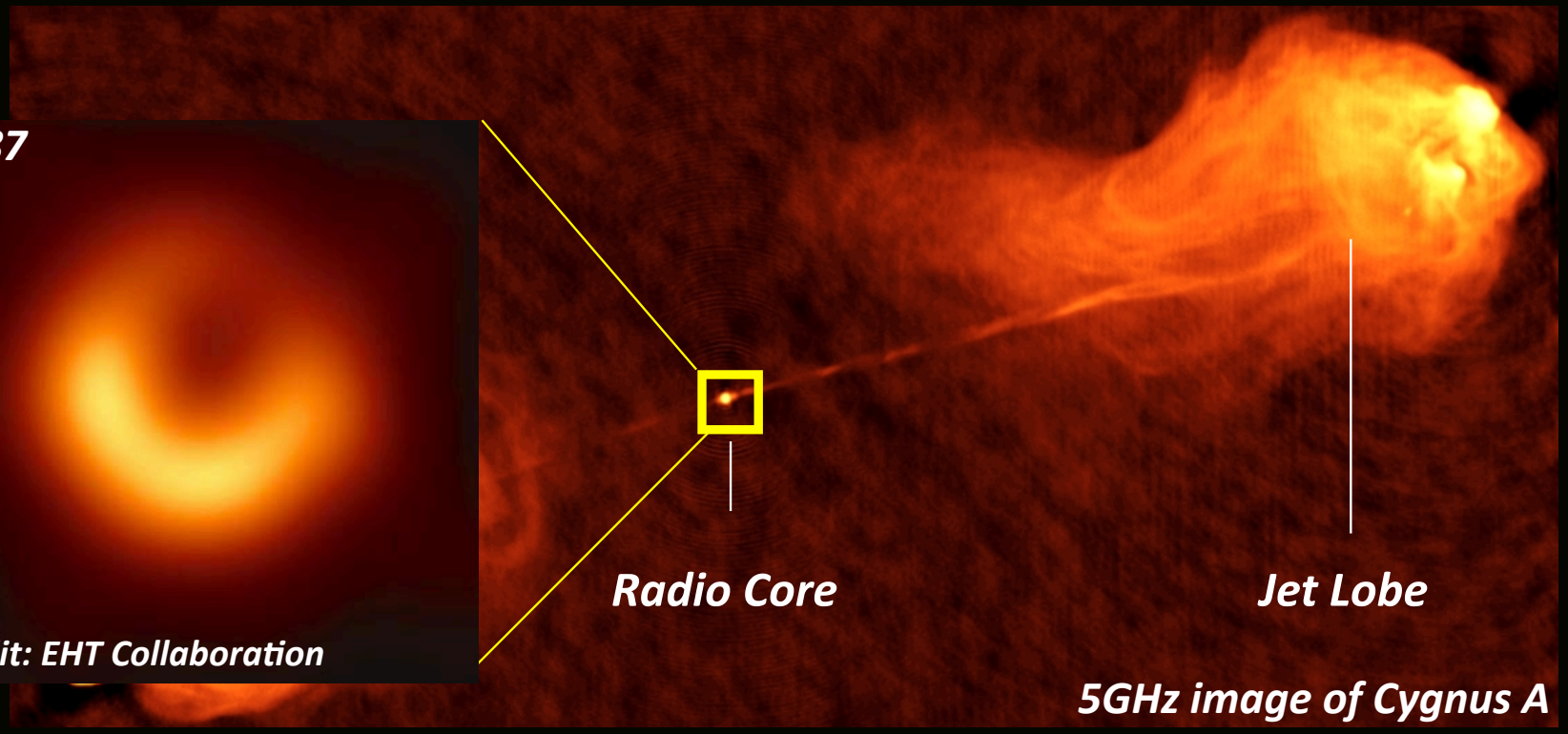


Credit: NASA/JPL Caltech



M 87

Credit: EHT Collaboration



Radio Core

Jet Lobe

5GHz image of Cygnus A

credit: NRAO, Carilli & Barthel (1996)

One big question: **Is there an ending (=dying) of this "AGN" phase?**

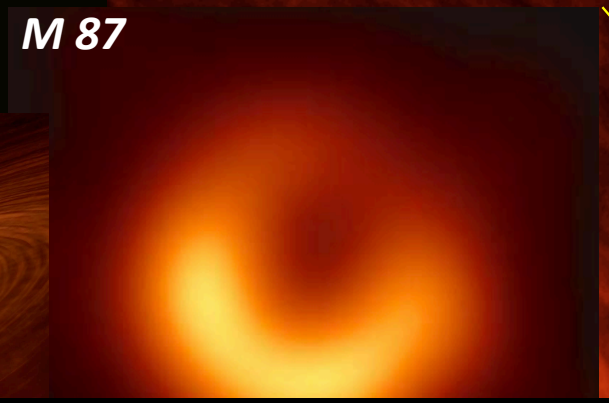
"Everything that has a beginning has an ending."

But… Finding of such "dying" AGN is very difficult

Why? **Since AGN phase is very long with >10^5 yr (thus catching dying phase is very hard)**

AGN in radio: jet + core

Credit: NASA/JPI



credit: NRAO, Carilli & Barthel (1996)

We report our serendipitous discovery of one "dying" AGN

One big question: **Is there an ending (=dying) of this "AGN" phase?**

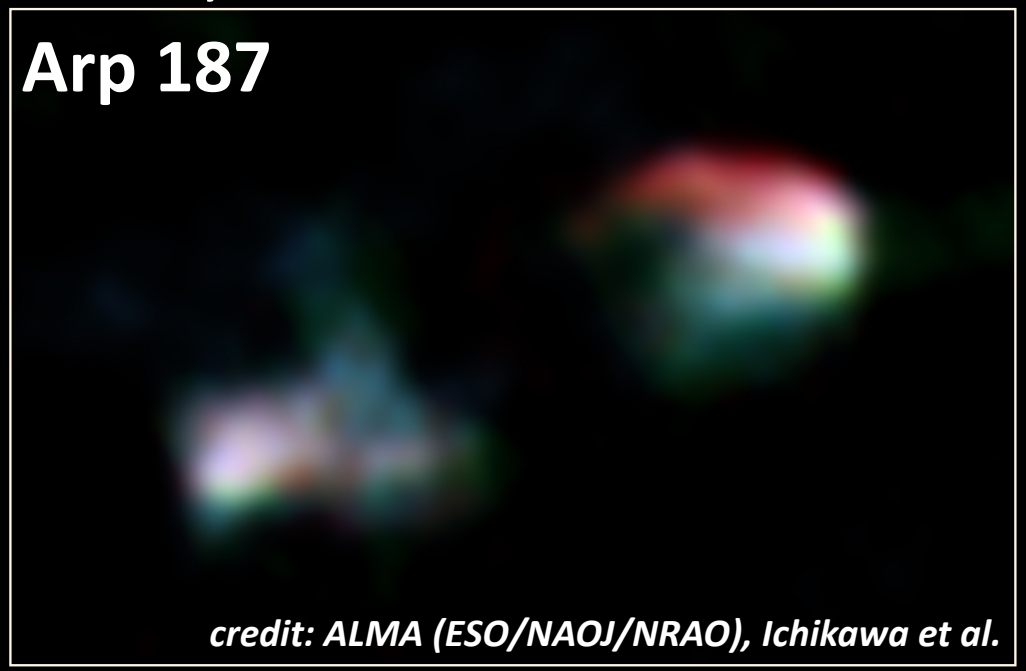
"Everything that has a beginning has an ending."

But… Finding of such "dying" AGN is very difficult

Why? **Since AGN phase is very long with >10^5 yr (thus catching dying phase is very hard)**

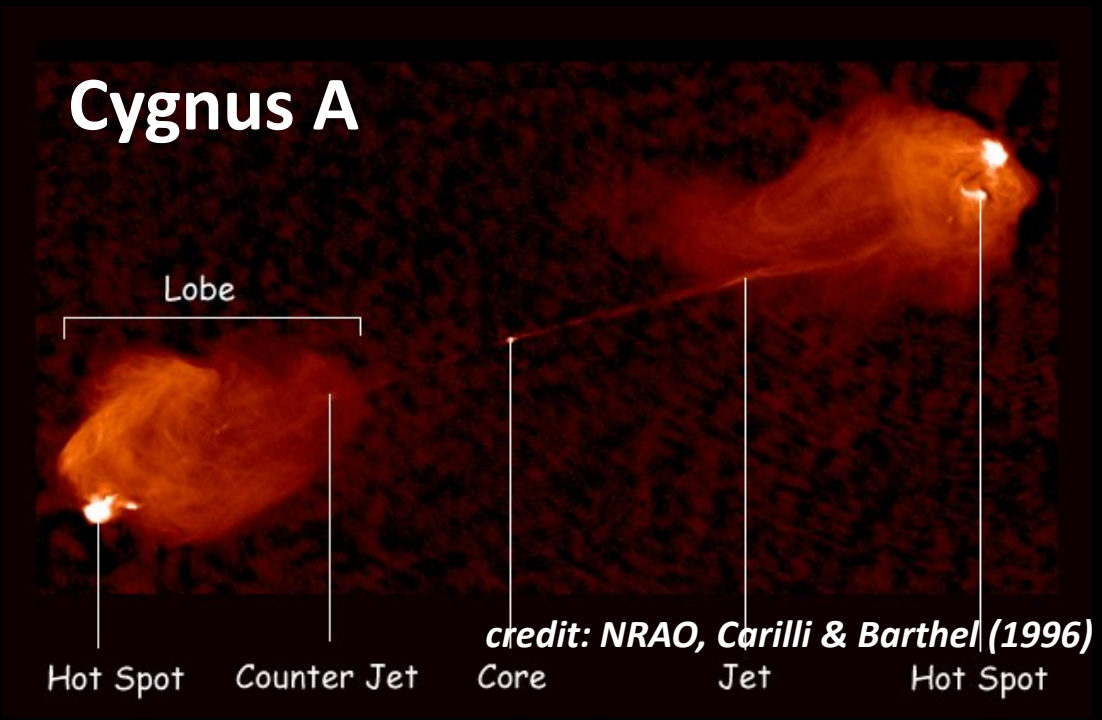
Arp 187 has Bright Jets

VLA 5, 8.5 GHz + ALMA 133 GHz



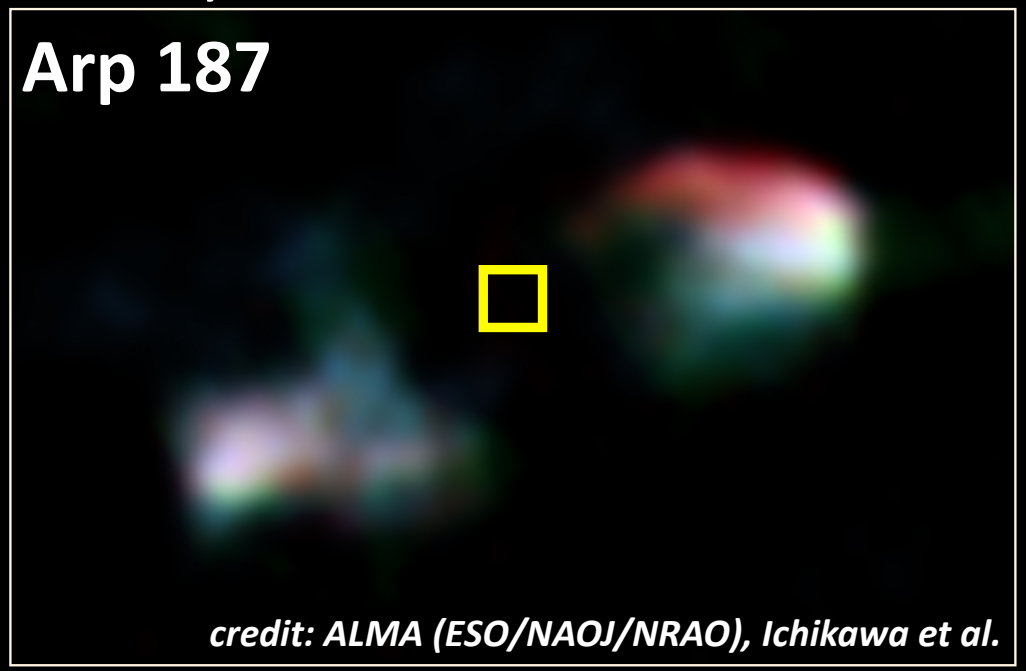
Arp 187 has Bright Jets = Arp 187 has AGN

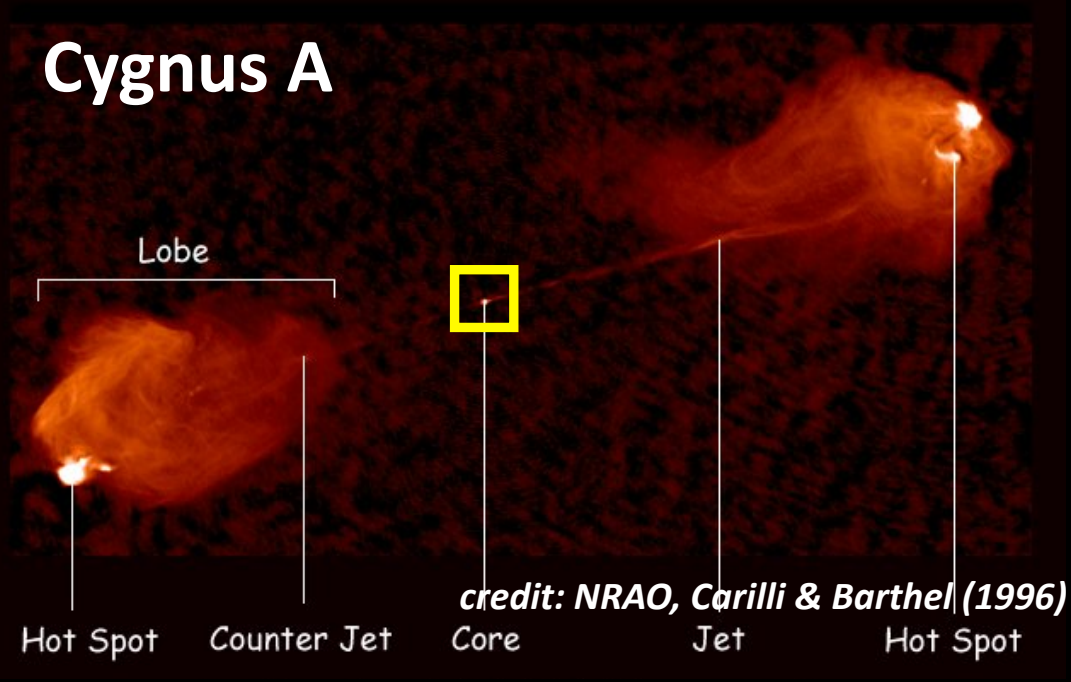
VLA 5, 8.5 GHz + ALMA 133 GHz



Arp 187 has Bright Jets but No Radio Core

VLA 5, 8.5 GHz + ALMA 133 GHz





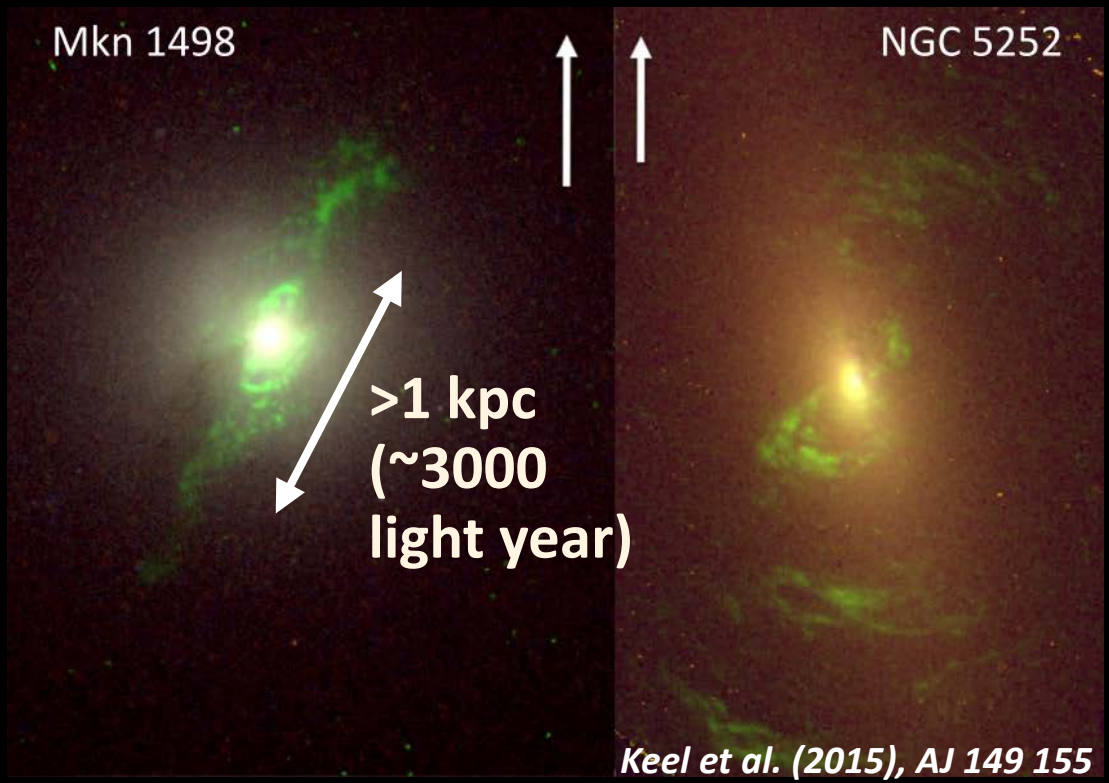
Radio core seems absent => current AGN activity is silent?

Let's check multi-wavelength data of Arp 187

AGN is bright in multi-wavelength and each traces *different physical scale*

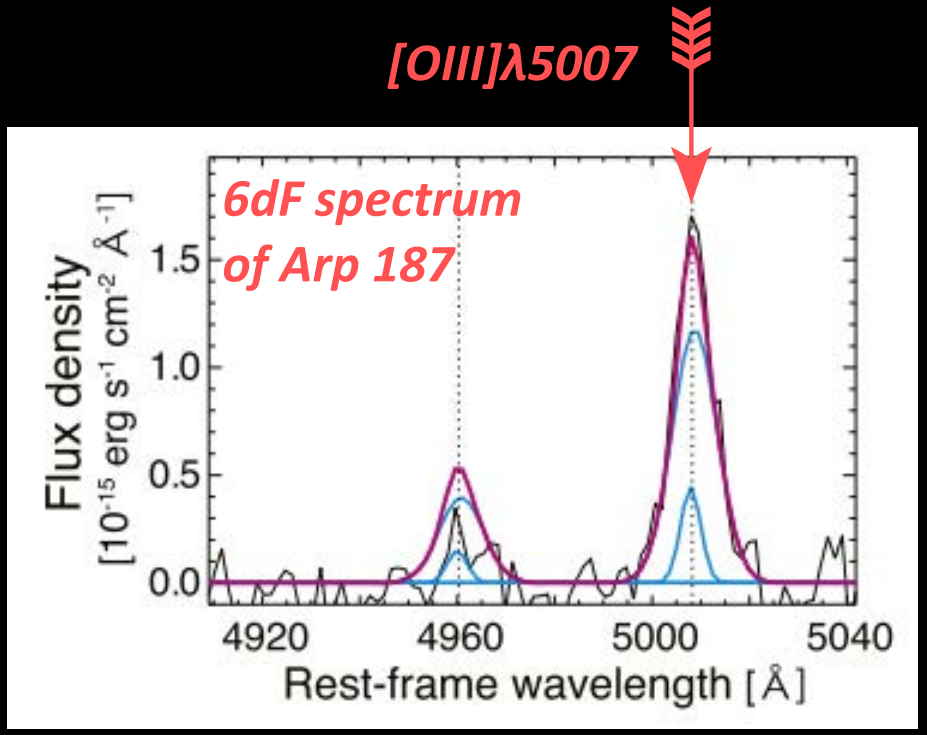
Optical spectra: tracing extended ionized gas region

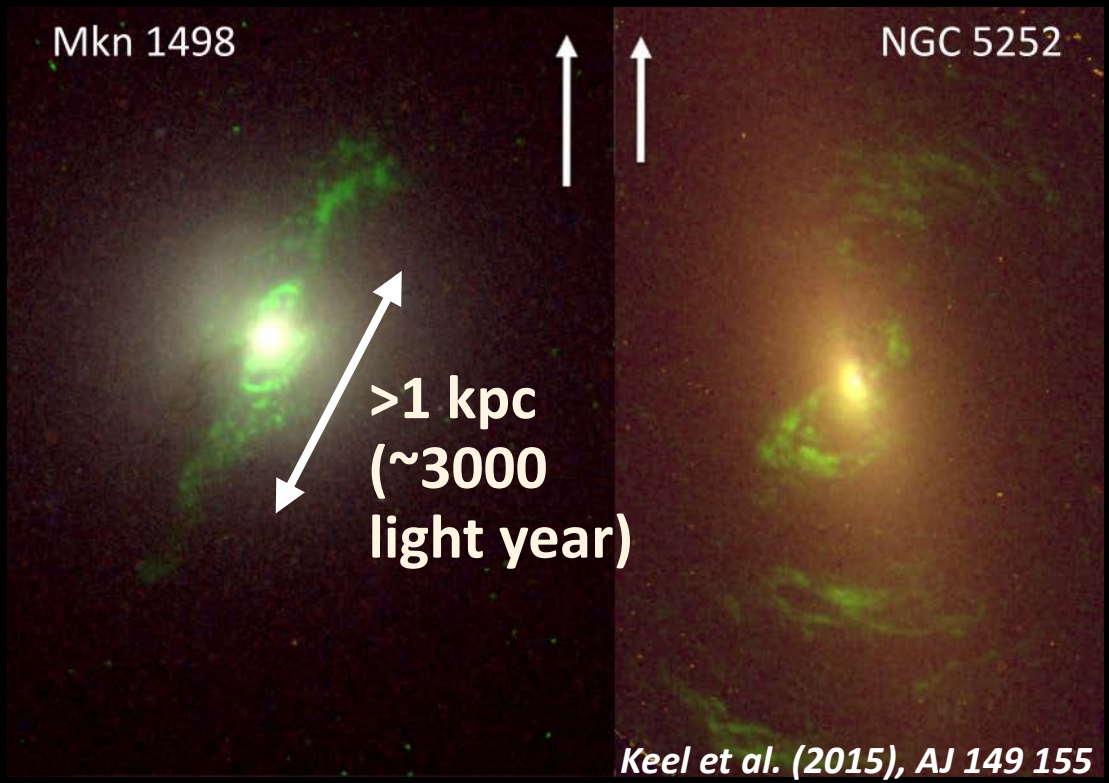
Ionized Oxygen ([OIII]λ5007Å): tracer of extended AGN ionized region



Arp 187: extended (>1 kpc) Ionized gas ([OIII]) exists

Ionized Oxygen ([OIII]λ5007Å): tracer of extended AGN ionized region





Keel et al. (2015), AJ 149 155

AGN luminosity (estimated from Oxygen emission line)

L_{AGN} = 2x10^{46} erg/s = 4x10^{12} L_{Sun} (L_{Sun}: solar luminosity)

X-ray: tracing AGN nuclear emission (<0.1 light year)

hard X-rays

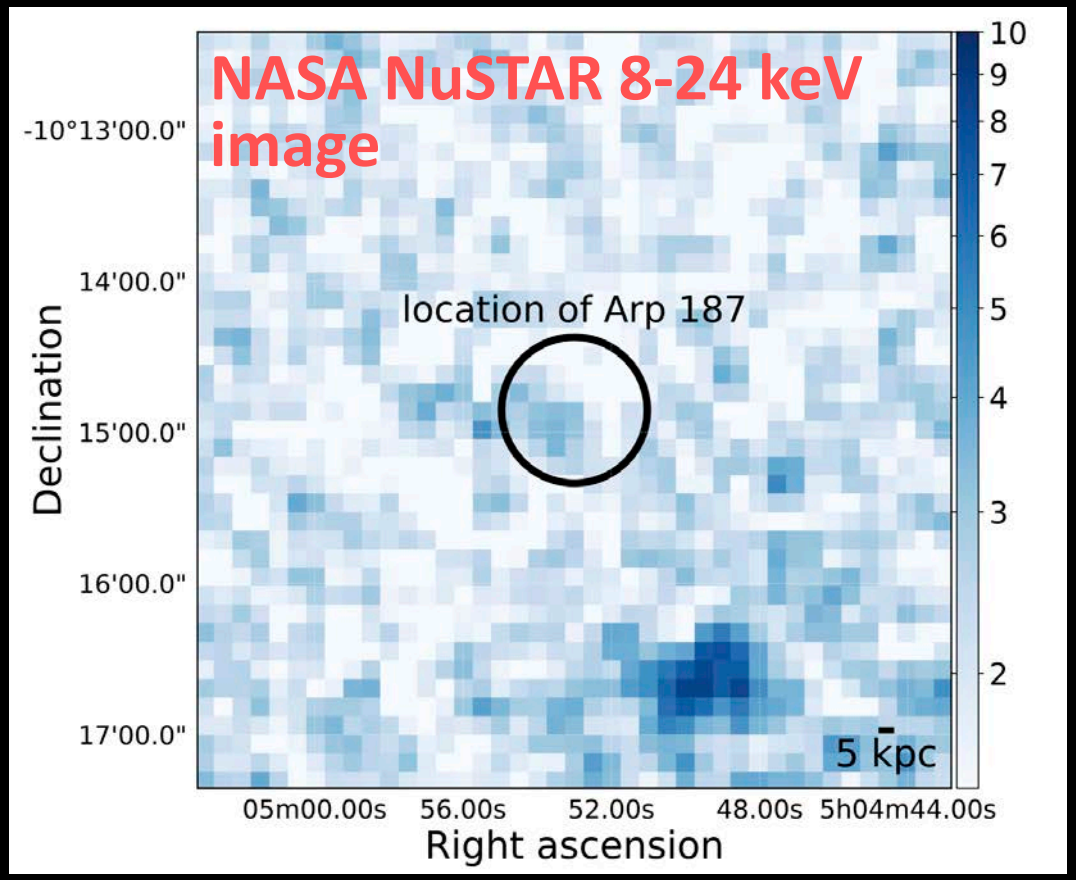
> 10 keV

Hickox & Alexander (2018)

X-ray: tracing AGN nuclear emission (<0.1 light year)

hard X-rays

> 10 keV



Credit: NASA/JPL Caltech

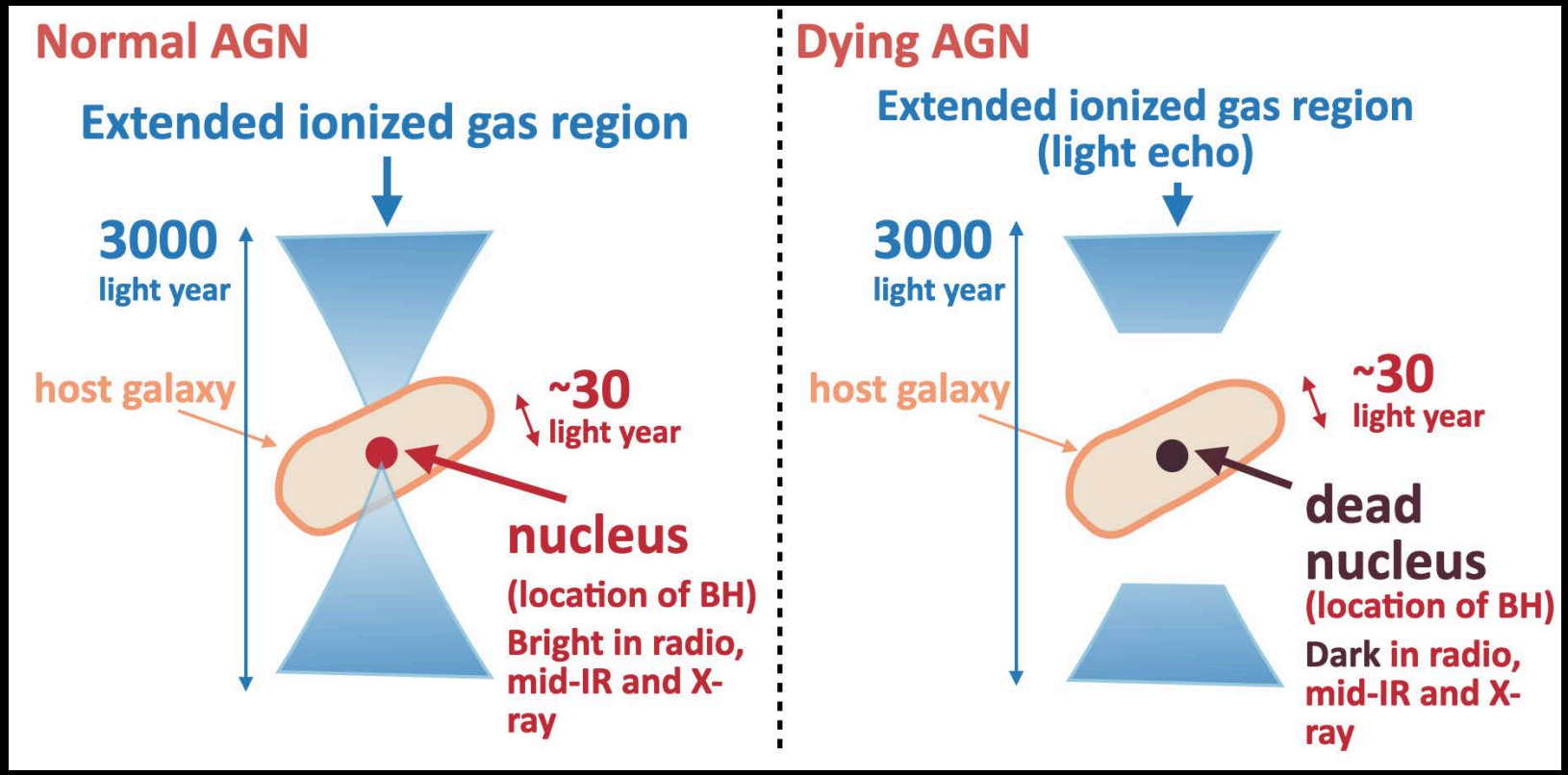
AGN luminosity (estimated from X-ray by NuSTAR)

L_{AGN} < 3x10^{42} erg/s: ~5000 times fainter than the value from [OIII]

What is happening in Arp 187?

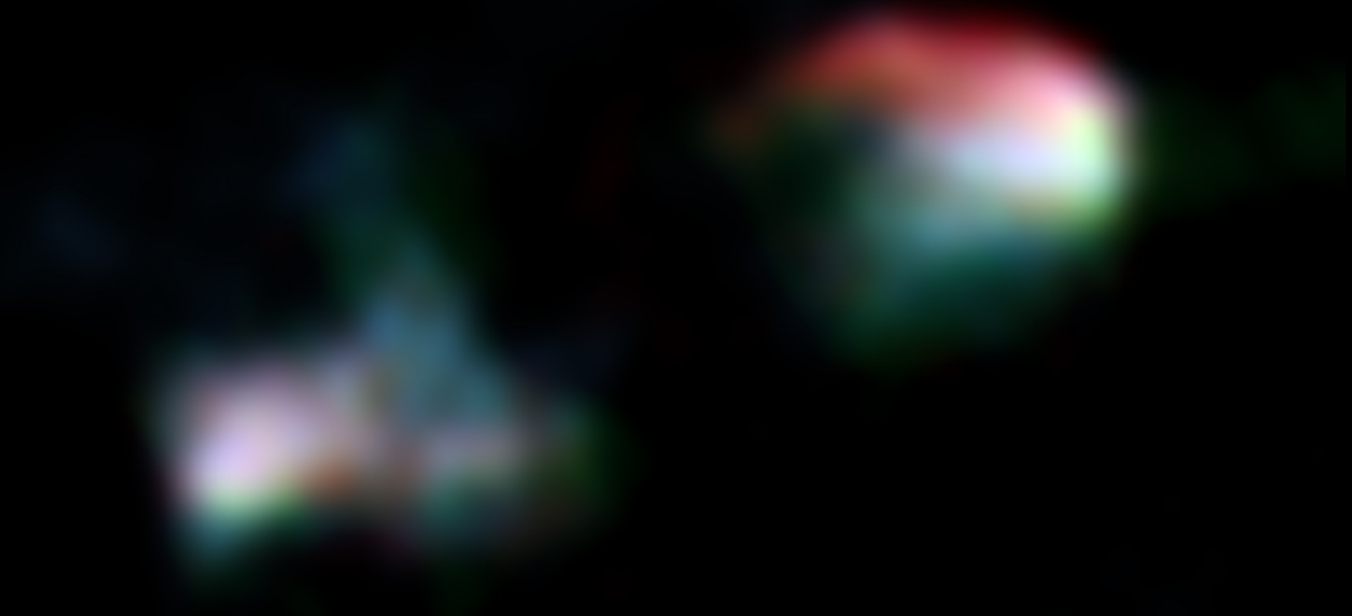
☑ Existence of **ionized gas region**, **jet lobe** (> 1000 light year scale)

☑ Absence of **radio core, and X-ray core** (<10 light year scale)



☑ **AGN "recently" shut-down within <~10^3 years => "dying" AGN**

Conclusion: nucleus of Arp 187 is dead, but we can see large scale “AGN remnant” => “dying” AGN



credit: ALMA (ESO/NAOJ/NRAO), Ichikawa et al.

See Ichikawa et al. (2019a), ApJ, 870, 65
and Ichikawa et al. (2019b), ApJL, 883, L13
My AAS talk: [209.02.] on June 8

Contact:
Kohei Ichikawa
k.ichikawa@astr.tohoku.ac.jp
@IchikawaKohei

- ☑ We found a “dying” AGN in Arp 187, whose current AGN activity is already silent, but large scale (=past) AGN activity (radio jet and ionized gas region) is still observable.
- ☑ luminosity drop in Arp 187: fainter by a factor of >~5000 within $10^{3\text{-}4}$ yrs