



Evidence of a Relic Active Galactic Nucleus Eruption

Dr. Kimberly Weaver
Kimberly.A.Weaver@nasa.gov
301-452-3065 (cell)

What Are Active Galactic Nuclei (AGN)?



Galaxies with bright, variable centers

Supermassive black holes heat disks of gas and dust

Sometimes power particle jets and powerful winds

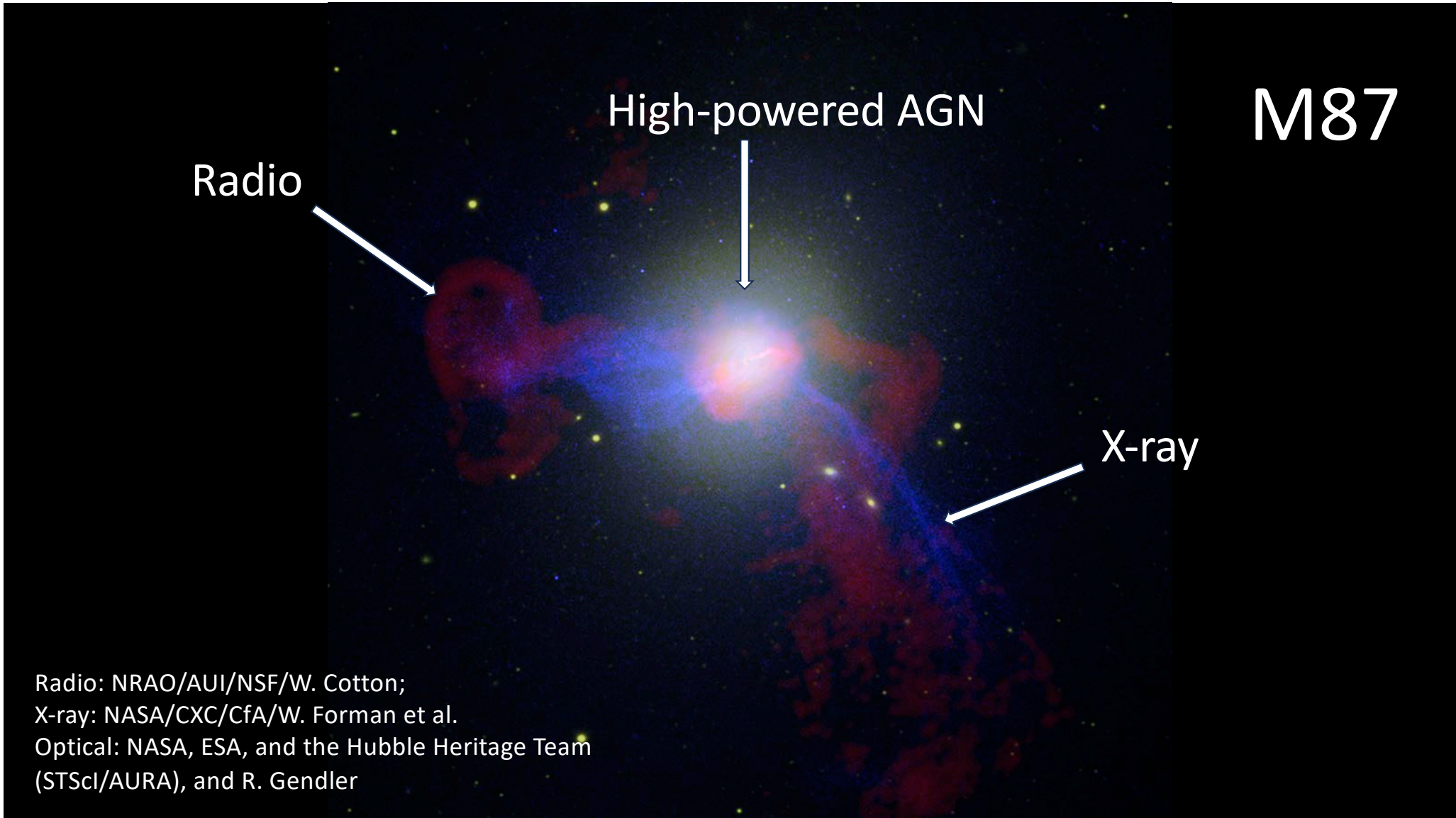
M87

High-powered AGN

Radio

X-ray

Radio: NRAO/AUI/NSF/W. Cotton;
X-ray: NASA/CXC/CfA/W. Forman et al.
Optical: NASA, ESA, and the Hubble Heritage Team
(STScI/AURA), and R. Gendler



Why Study AGN?

- AGN and star formation power galactic outflows.
- Should have a significant effect on galaxy evolution.
- We can trace previous nuclear activity.



NGC 4945

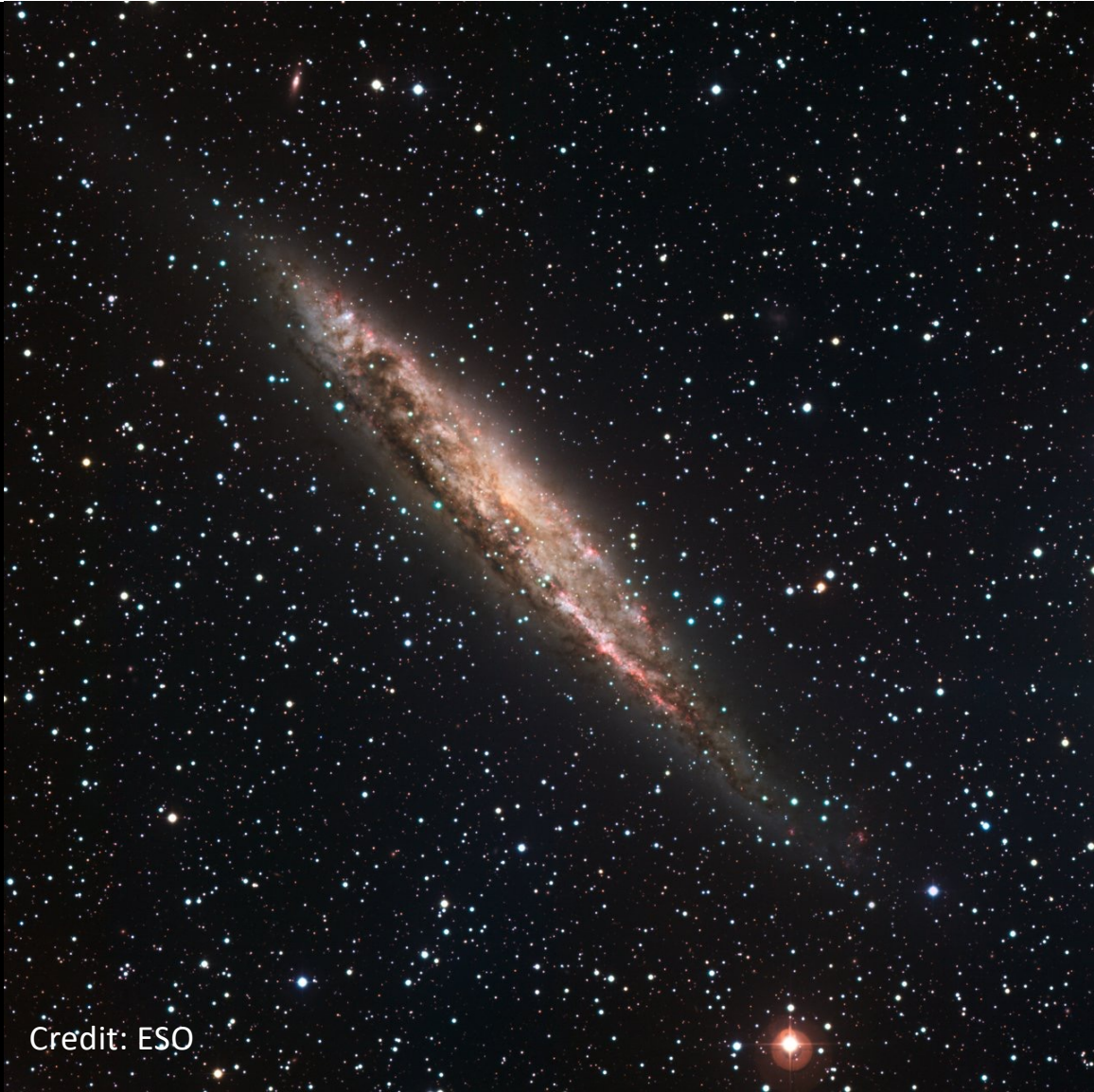
Low-power AGN

Spiral galaxy

Starburst galaxy

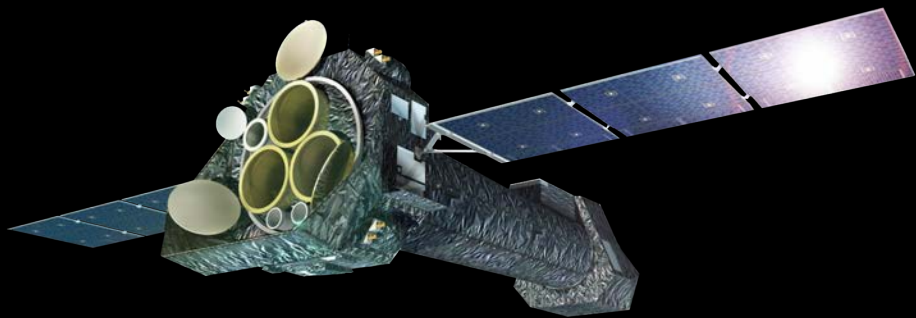
13 million light-years
away

Disk tilted ~ 80 degrees
with respect to us

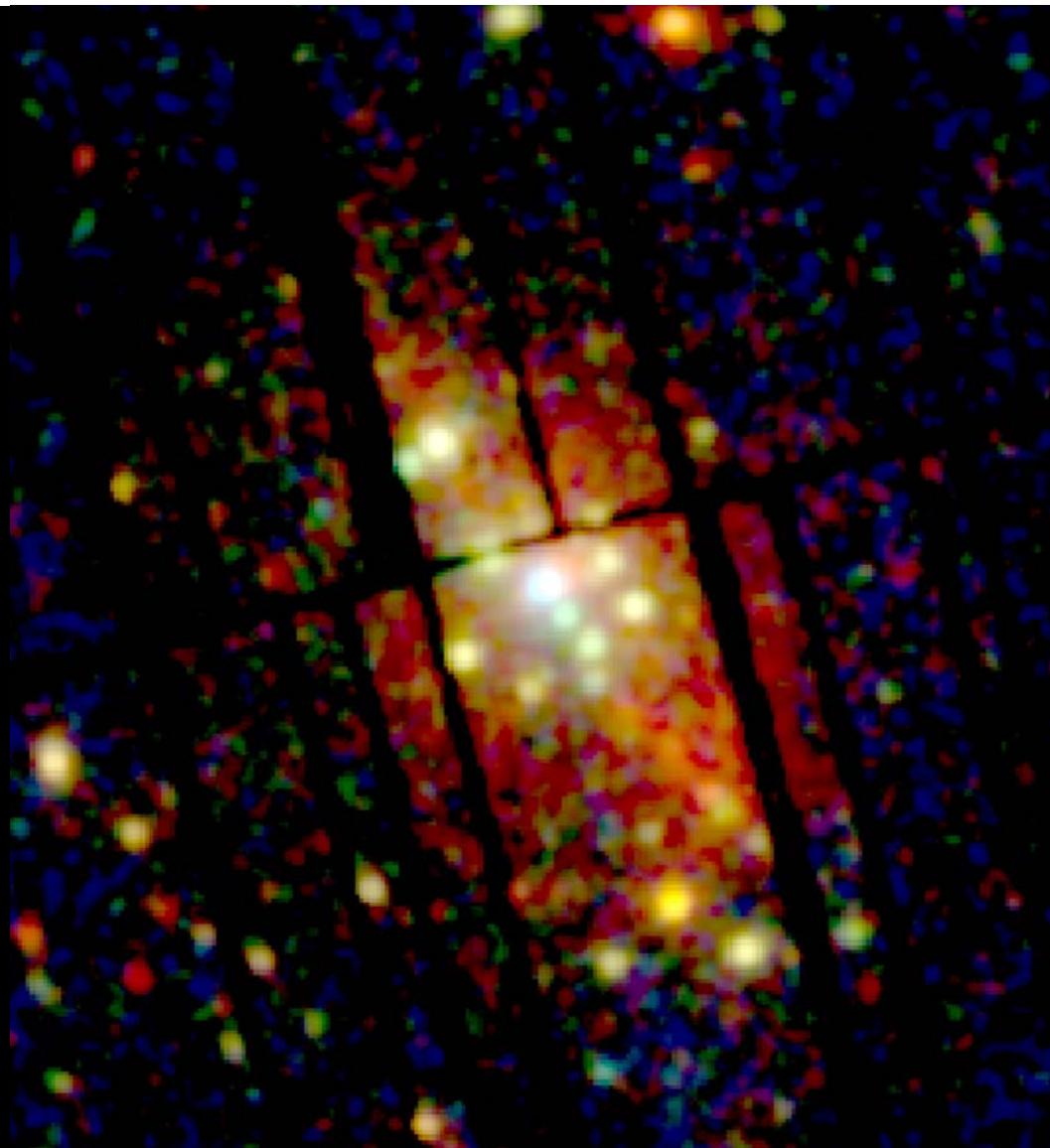


Credit: ESO

XMM-Newton View



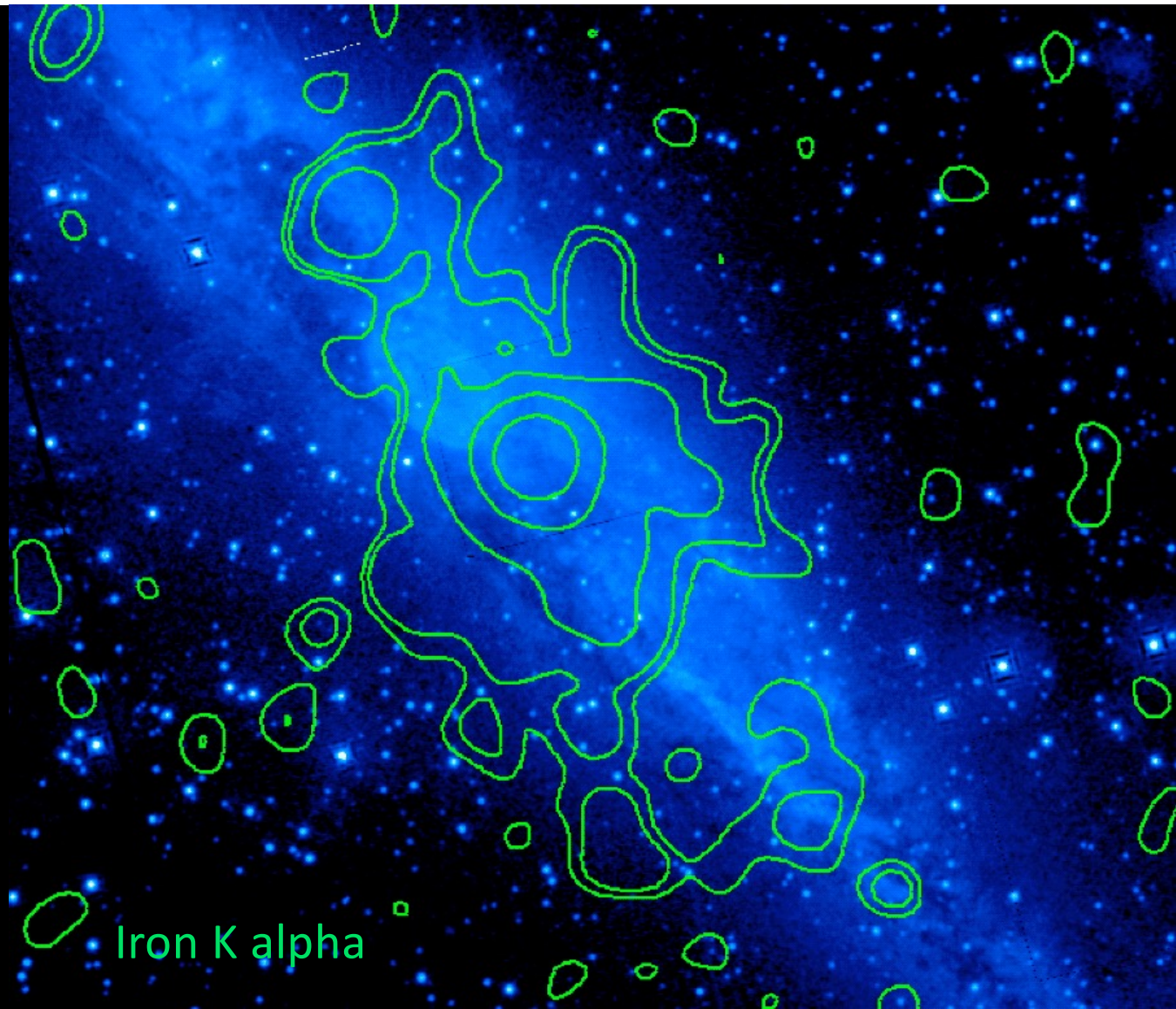
High sensitivity, wide field of view



High-energy X-rays
outlined a huge
clump of cold gas.

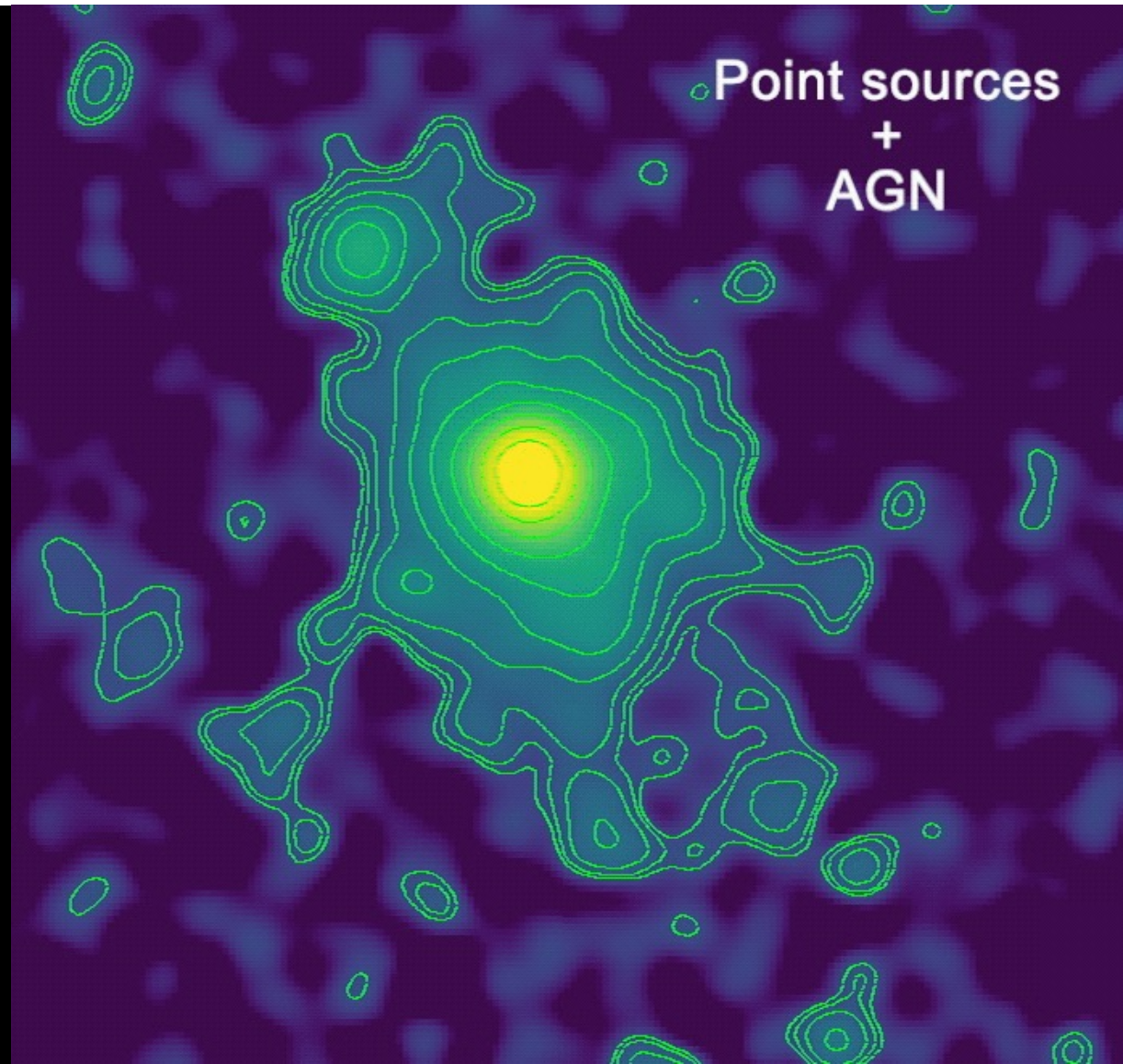
32,000 light-years
along galactic plane

16,000 light-years
into intergalactic
space



Removed point sources
using NASA's Chandra

Still see a huge amount
of cold gas in the iron K-
alpha line

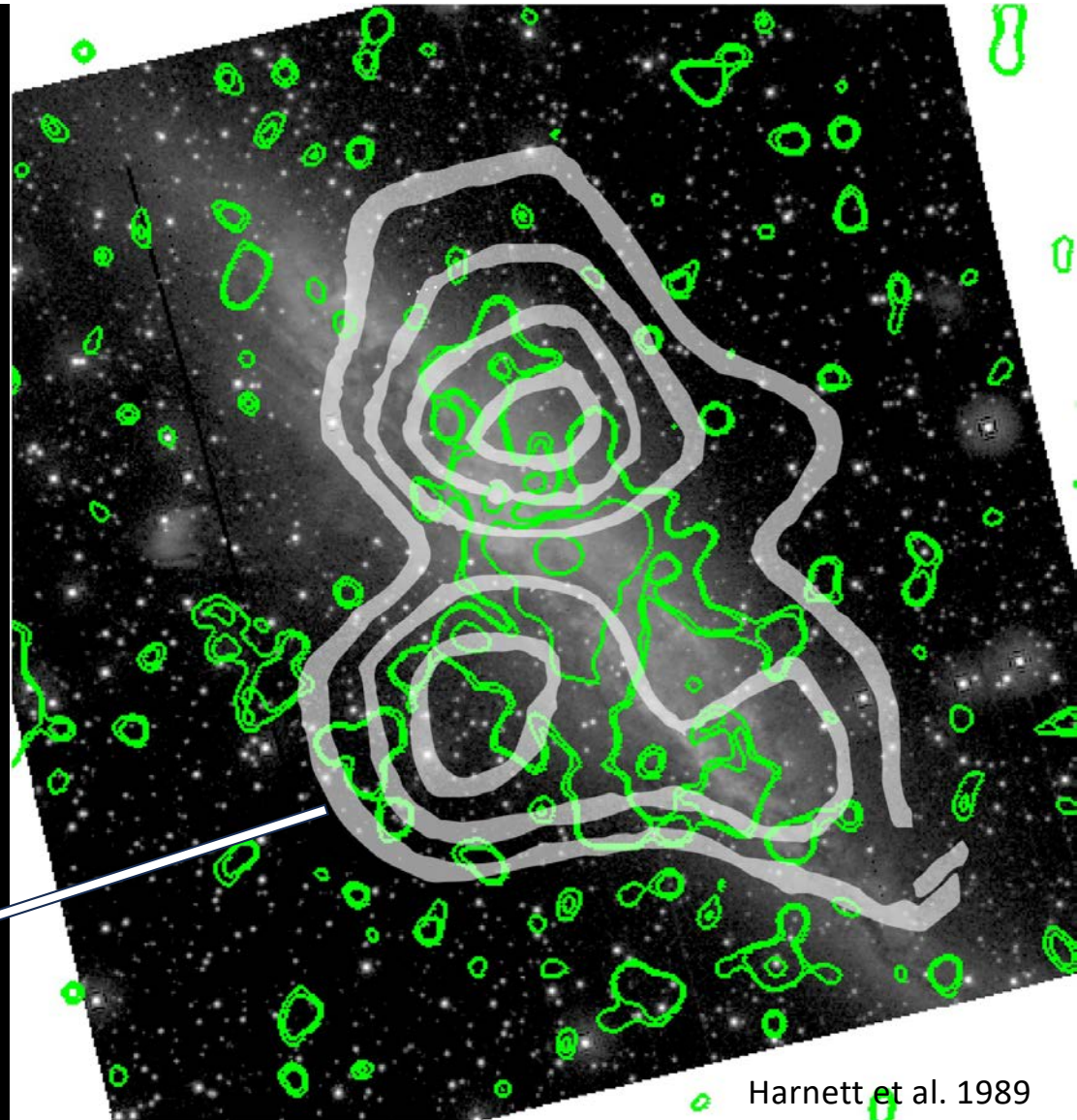


Lines up with known radio
polarization

Strong, ordered magnetic
fields

Suggest collimated
outflow

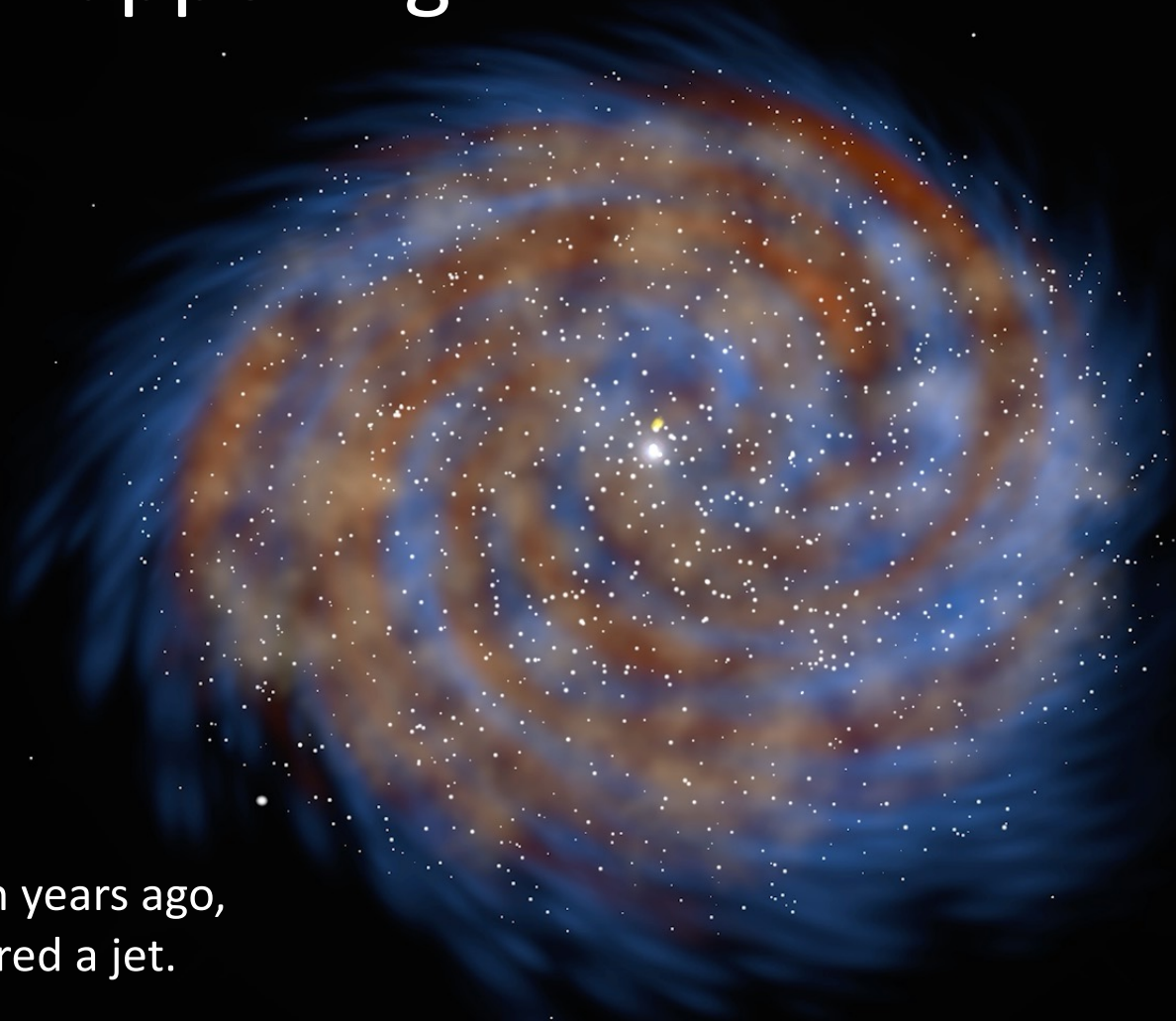
Radio



Harnett et al. 1989

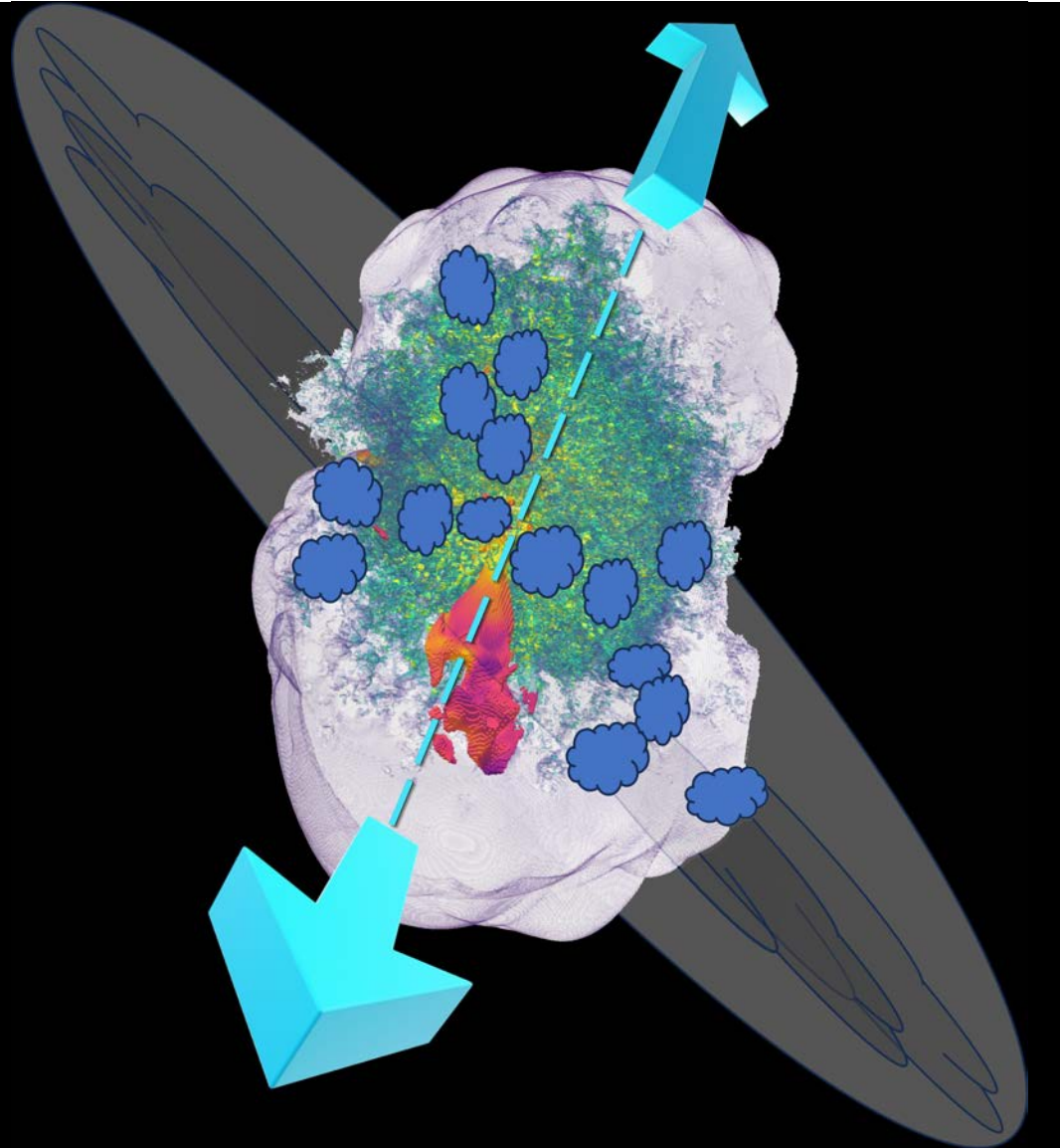
What's Happening?

About 5 million years ago,
the AGN powered a jet.

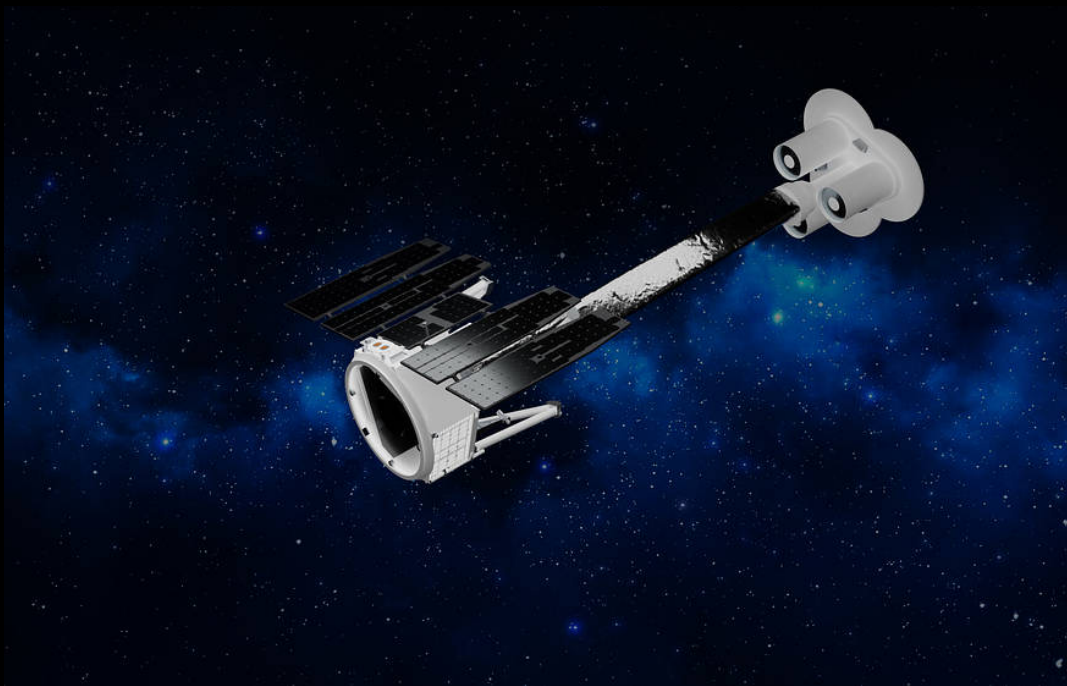


Relic Signature

- Jet drove into the galaxy disk.
- Cold gas (clouds) is a fossil of that activity.
- We detect the relic signature because the high-energy X-rays travel through the disk.
- Eruption coincides with age of starburst (~5M years).




Next Steps:



NASA's IXPE
(X-ray polarization)



NASA's XRISM
(high-energy X-rays)



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