The Discovery of a Newborn Quasar Jet Triggered by a "Cosmic Dance"

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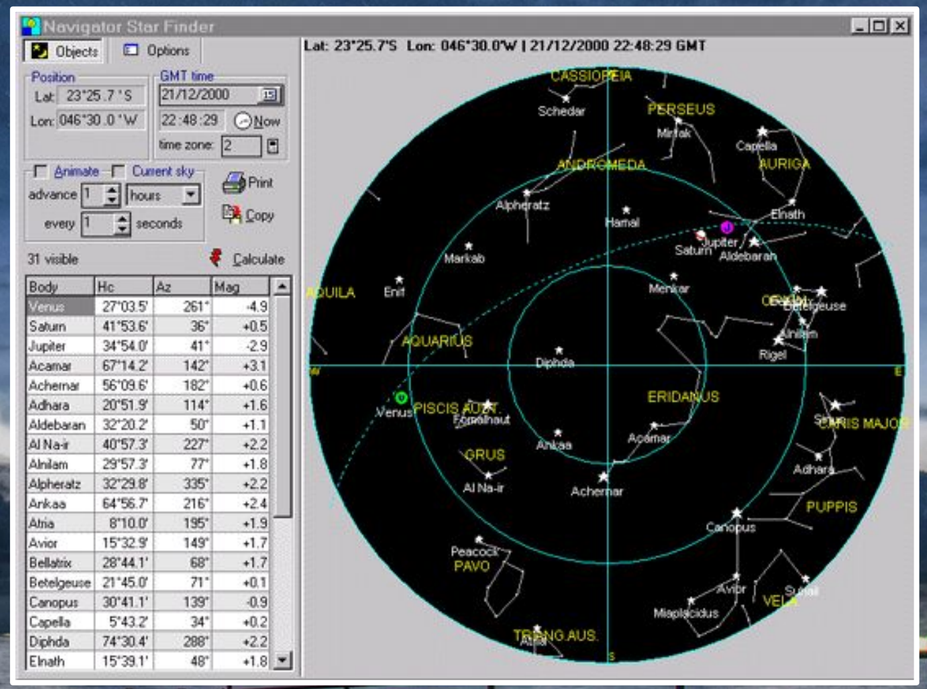
U.S. NAVAL RESEARCH LABORATORY

Celestial Navigation in the Fleet

Sextant

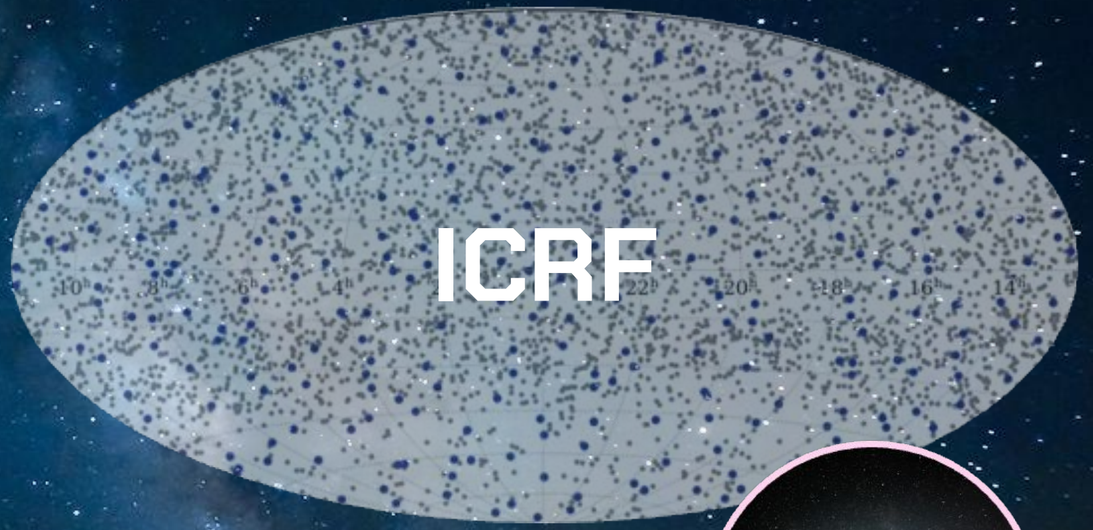
"System To Estimate Latitude and Longitude Astronomically" (STELLA)



Core curriculum for future officers at the United States Naval Academy

International Celestial Reference Frame

Radio-frequency measurements of thousands of distant active supermassive black holes (*quasars*) form the foundation of modern day navigation



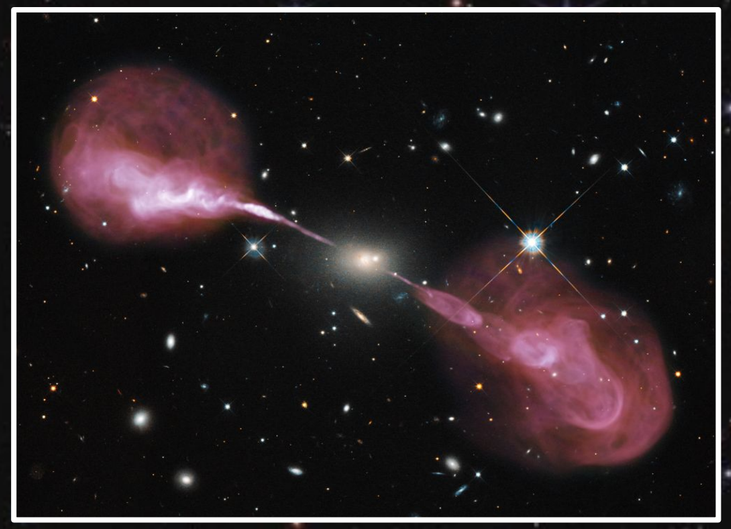
Radio Telescope →

Charlot et al. 2020

The Unknowns of Quasar Jet Physics

Out of all the quasars in the Universe, only about 1-10% have **jets**.

Why do only some quasars have radio jets?



How are quasar jets **triggered**?

Introducing J0742+2704

- Previously known quasar at z = 0.6264 discovered to have recently launched newborn radio jets
- Discovery was made by comparing new and old radio survey images

Nyland et al. 2020

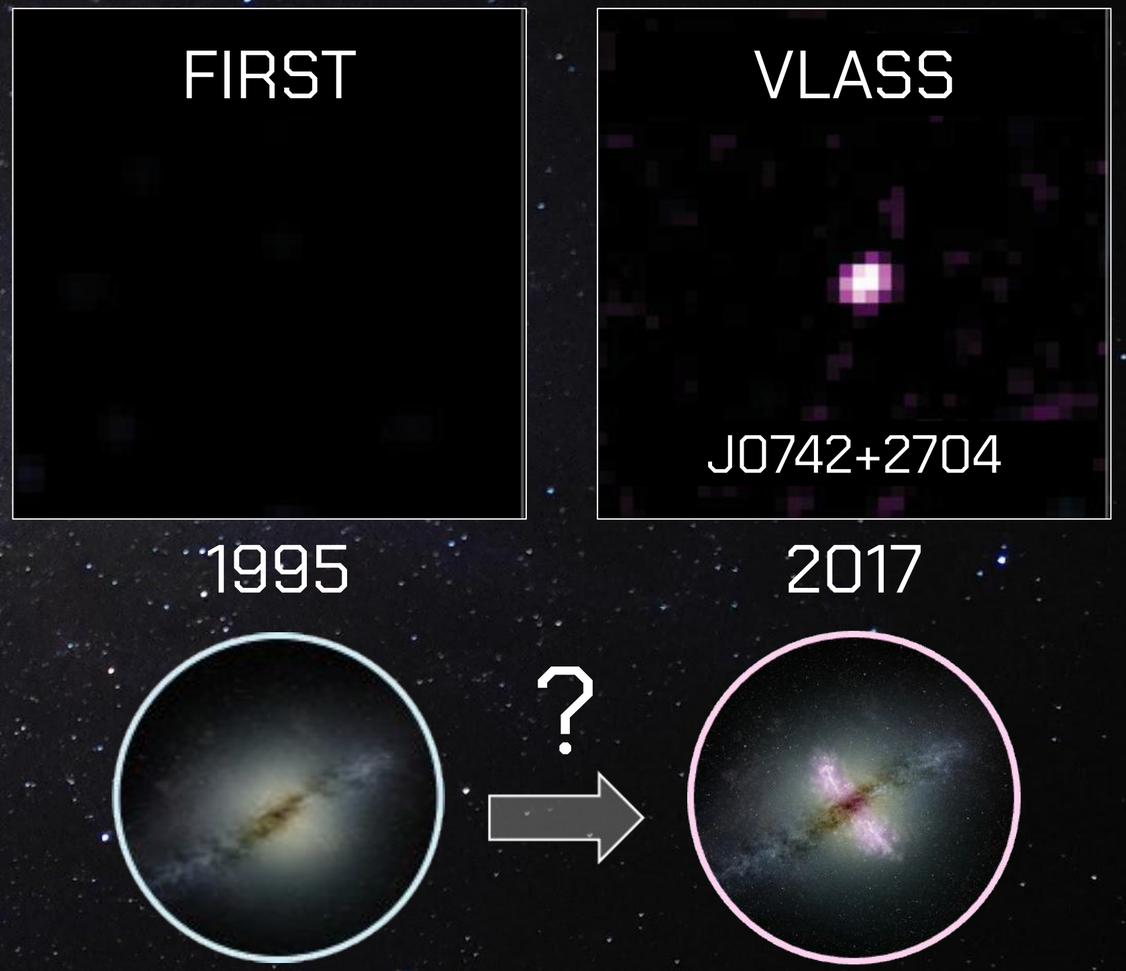
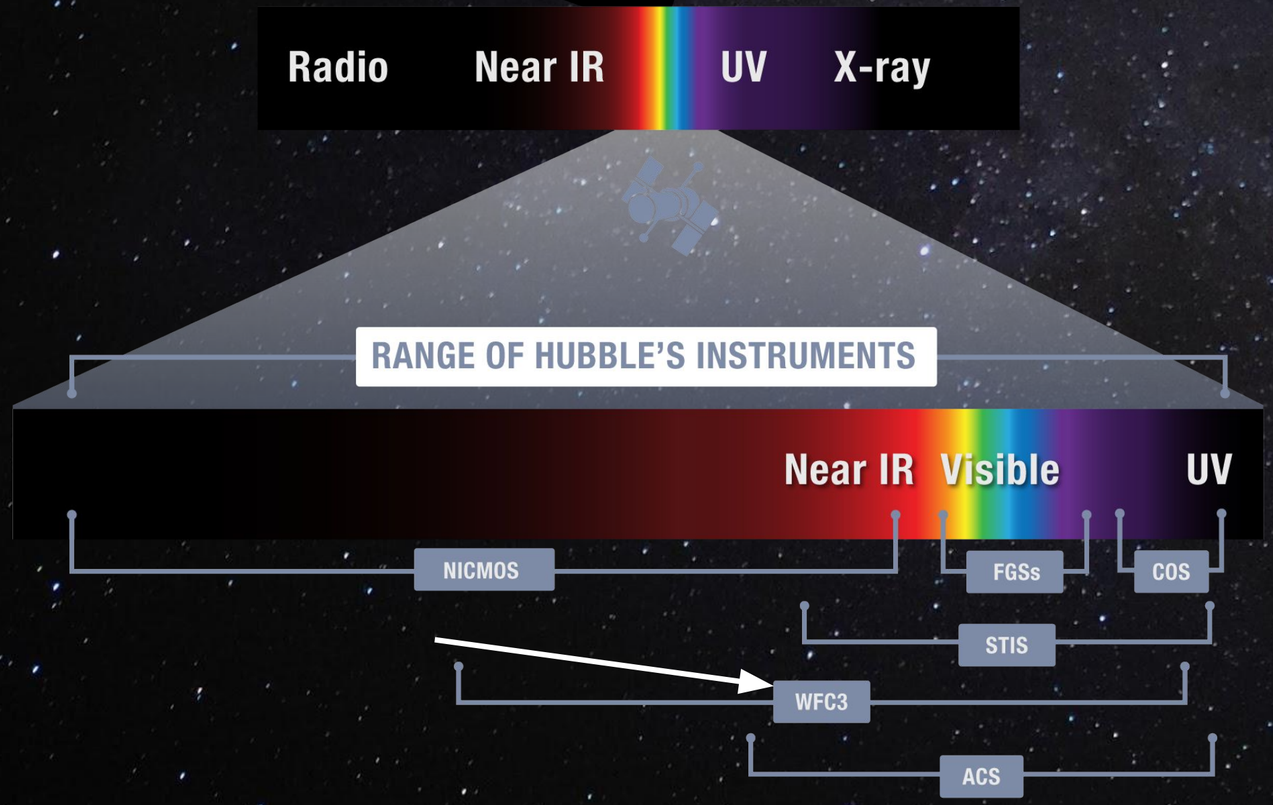
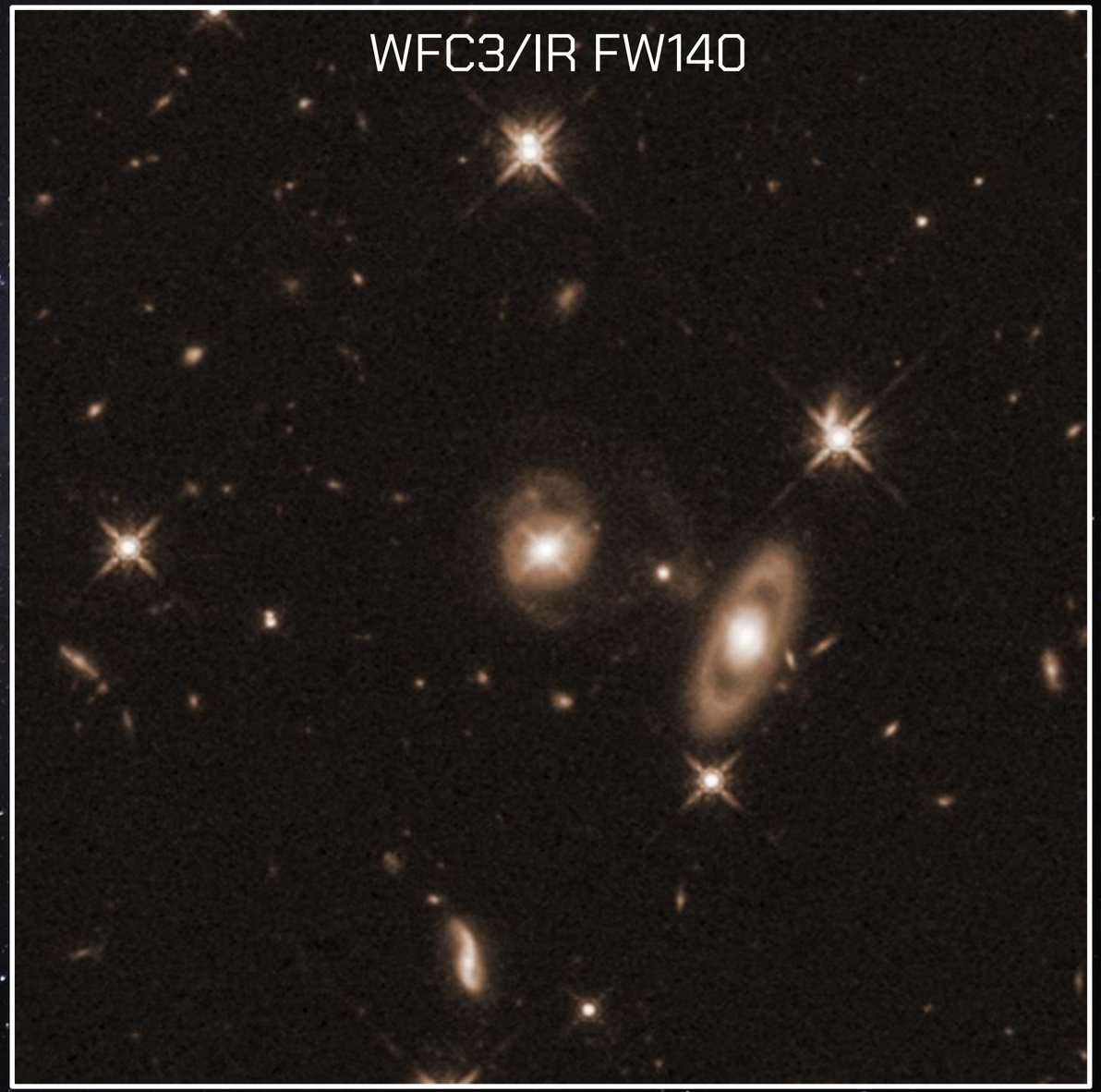


Illustration credit: Sophia Dagnello, NRAO/AUI/NSF

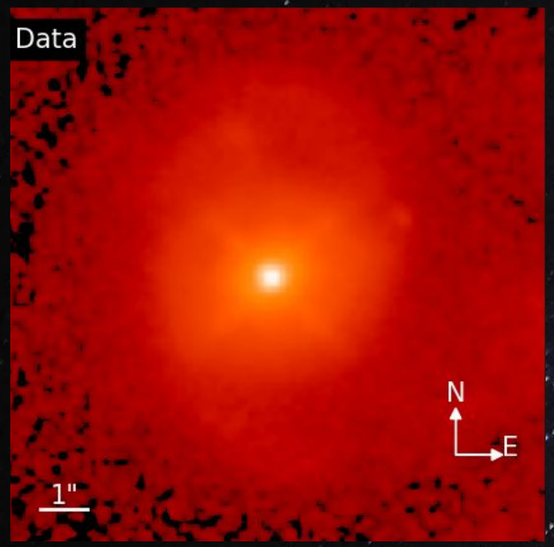
Hubble Space Telescope Observations





Quasar Host Decomposition

Image



HST image showing the quasar superimposed on the host galaxy

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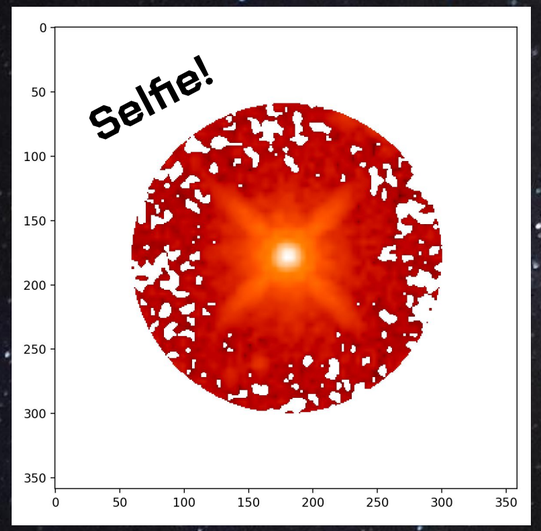
PSF



PSF model for removing the quasar's light based on a nearby star

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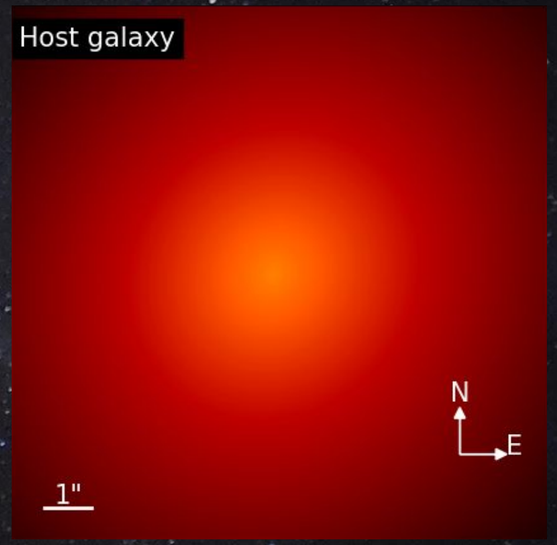
Model



Simple disk model

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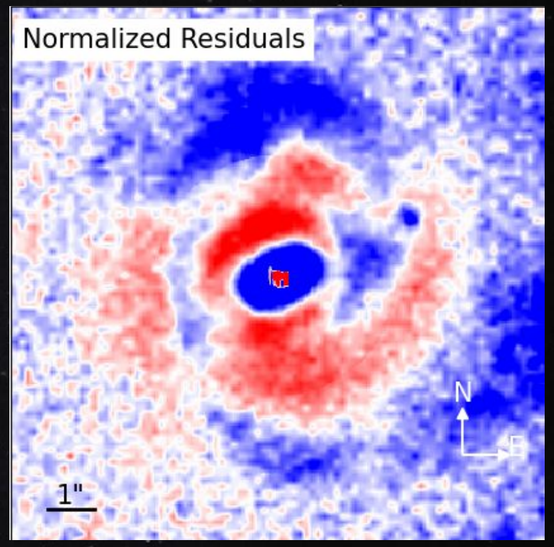
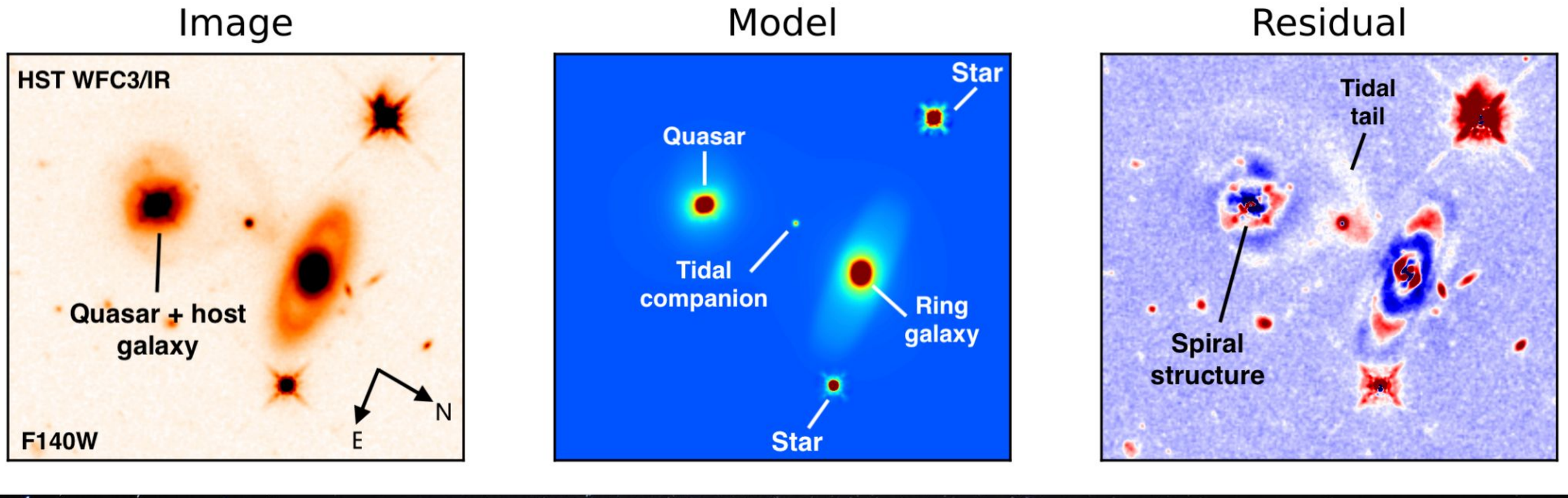
Residual



Residual showing spiral structure

Software package: Lenstronomy (Birrer 2018)

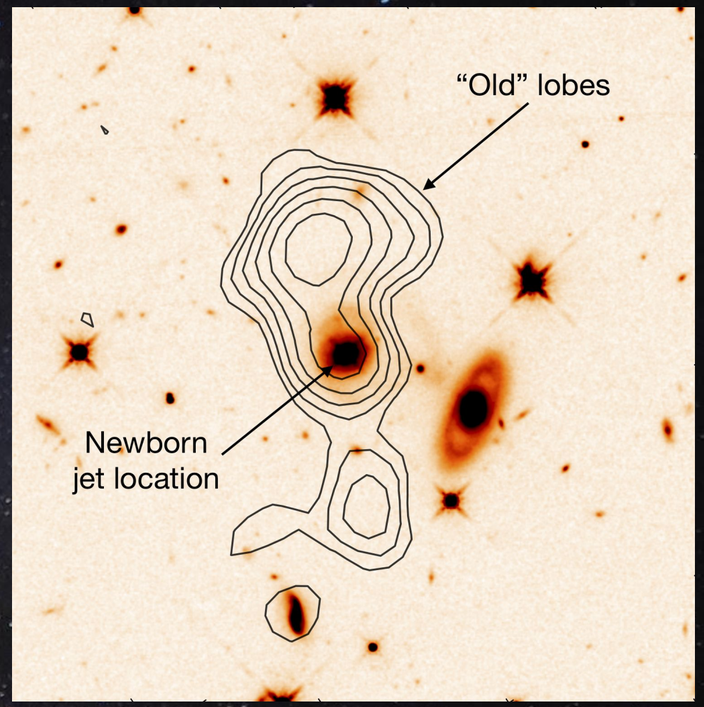
Discovering An Interacting System



Nyland, Achenbach et al., in prep.

Plot Twist: Ancient Radio Lobes

J0742+2704 is a re-started radio quasar!



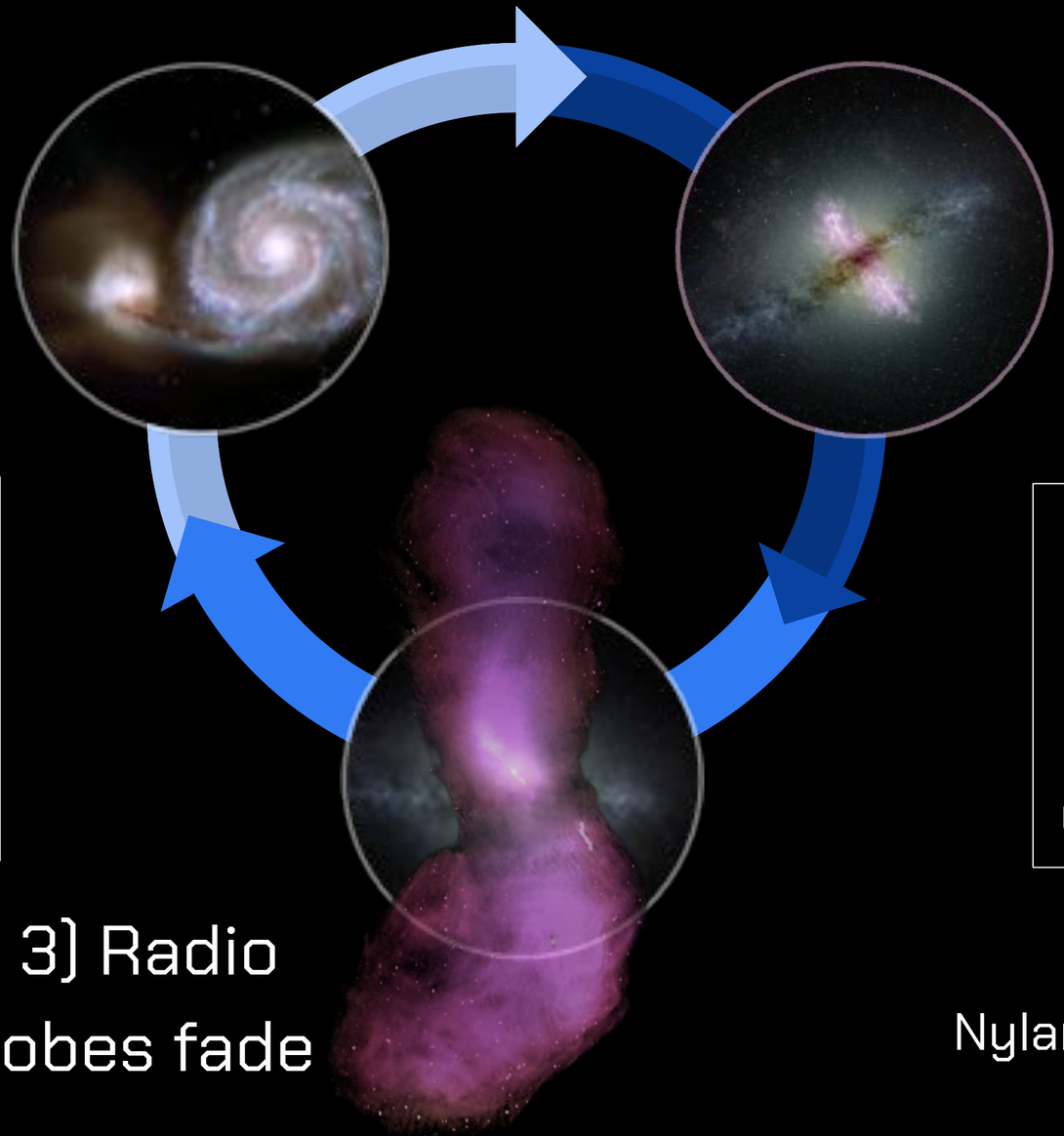
Low-frequency radio telescopes trace old, fading quasar lobes

Large-scale (240 kpc) radio lobes from a previous jet outburst

Nyland, Achenbach et al., in prep.

Working Model: The “Cosmic Dance”

1) Galaxy interaction



2) Radio jet forms

3) Radio lobes fade

The “cosmic dance” of galaxy mergers and interactions reignites quasar jets

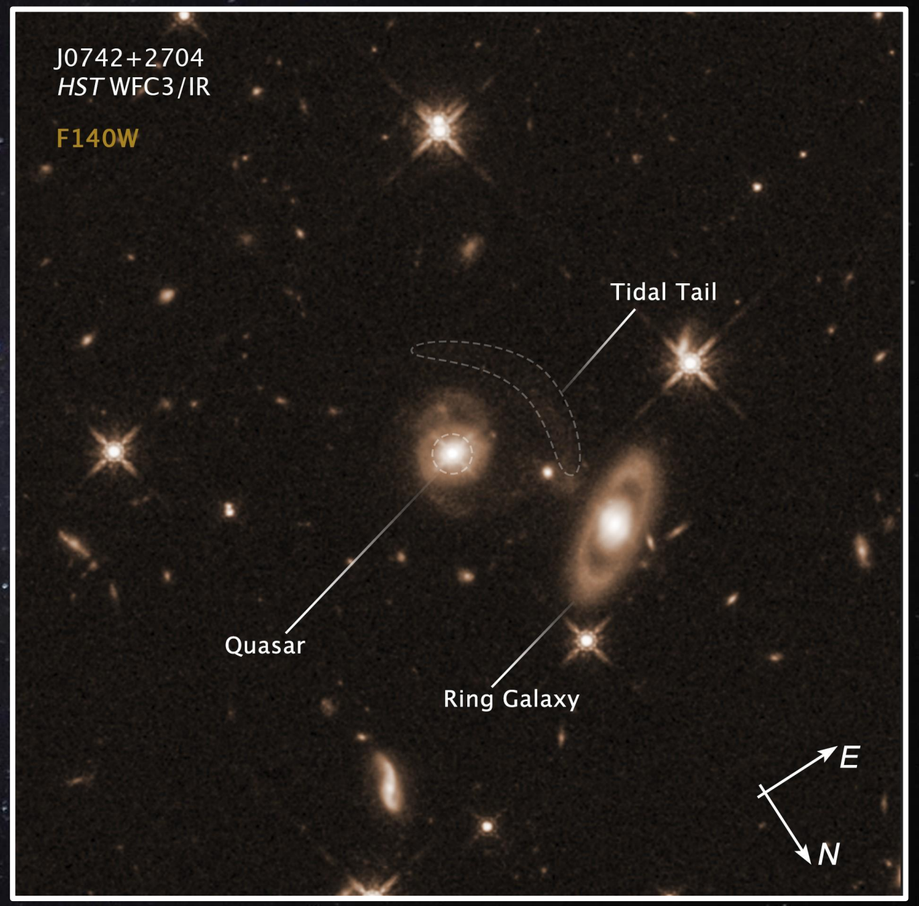
Timing between phases still being explored (10’s-100’s of millions of years)

Nyland, Achenbach et al., in prep.

Summary

- Ground-based **radio** sky surveys + ***HST*** imaging reveal the physics of jet **triggering**

- Powerful quasar jets may be **(re-)triggered** by galaxy **interactions** in a “cosmic dance”



Credits: STScI/NASA

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For more info: see iposter by Achenbach and ApJ paper by Nyland, Achenbach et al. (in prep.)