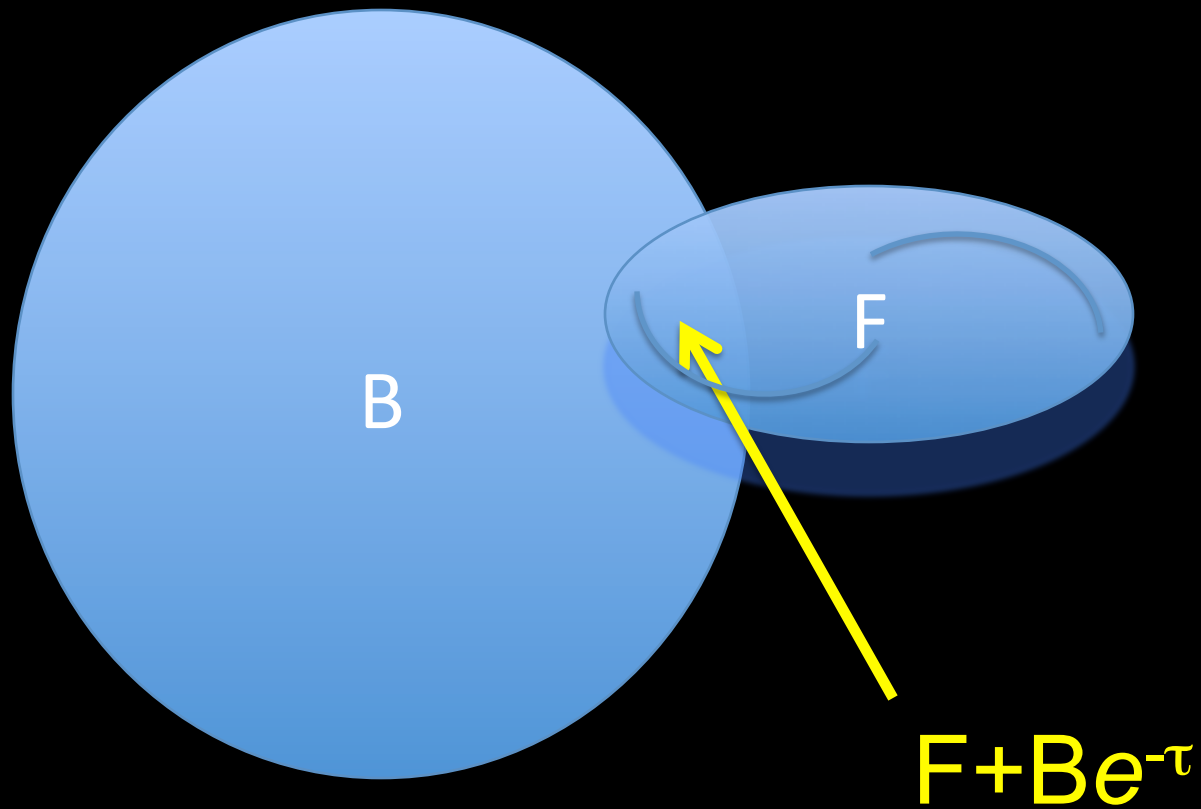


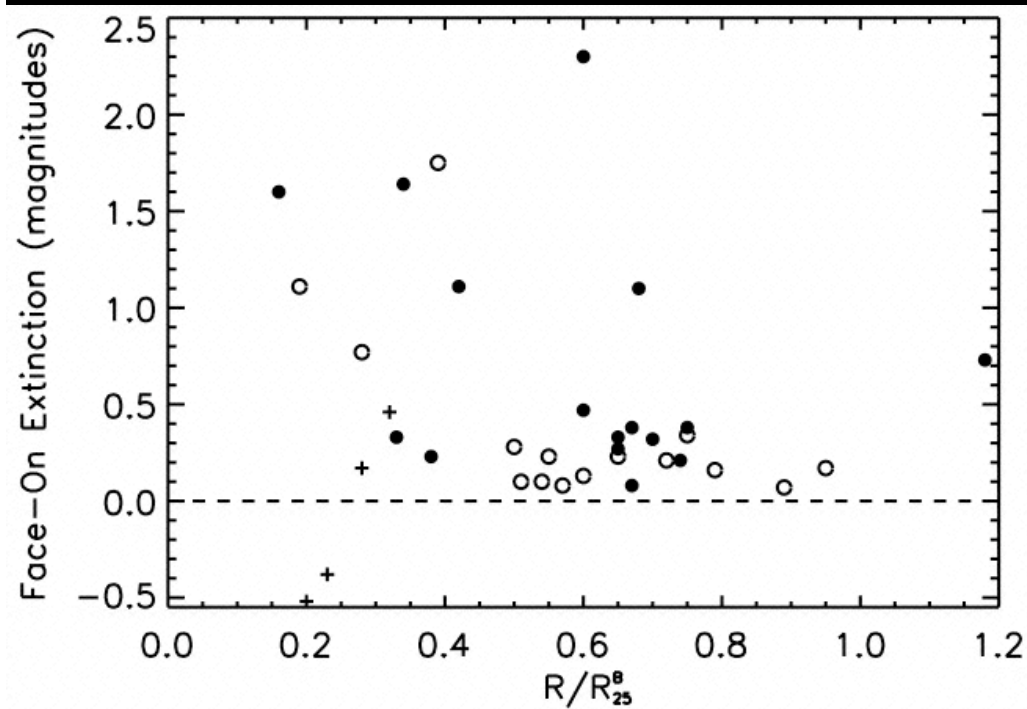
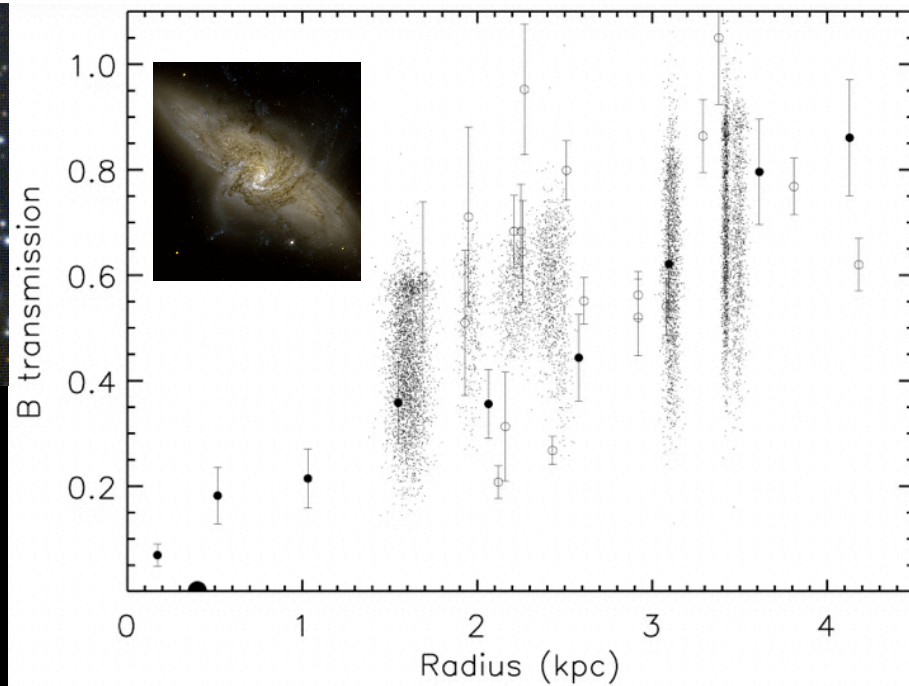


Fading AGN and backlit galaxies -
finding the rare and unexpected
with Galaxy Zoo

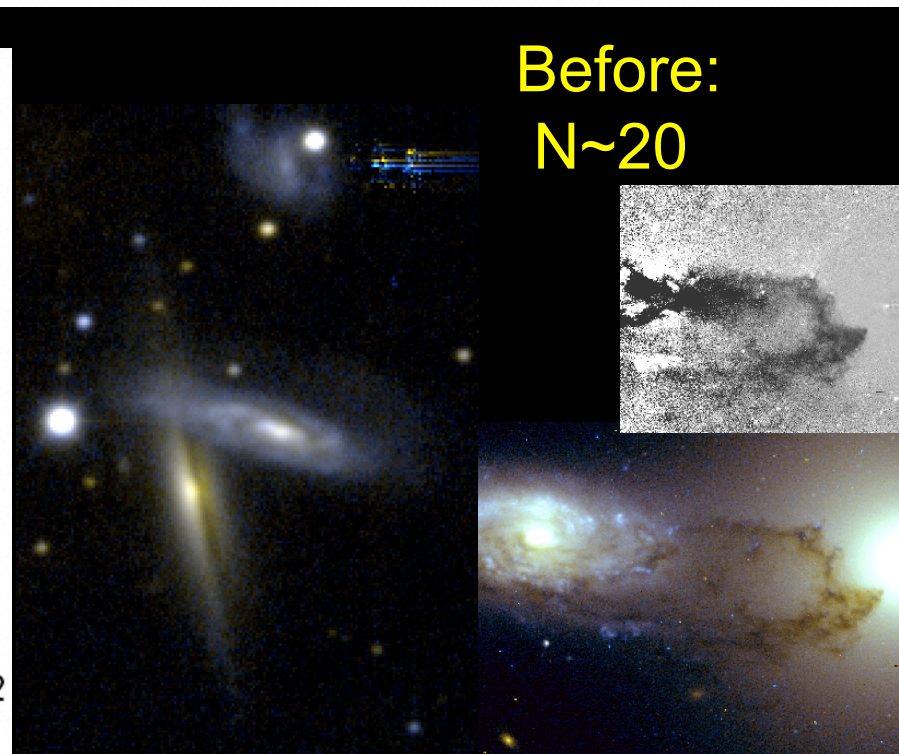
Extinction in overlapping-galaxy pairs: The ideal

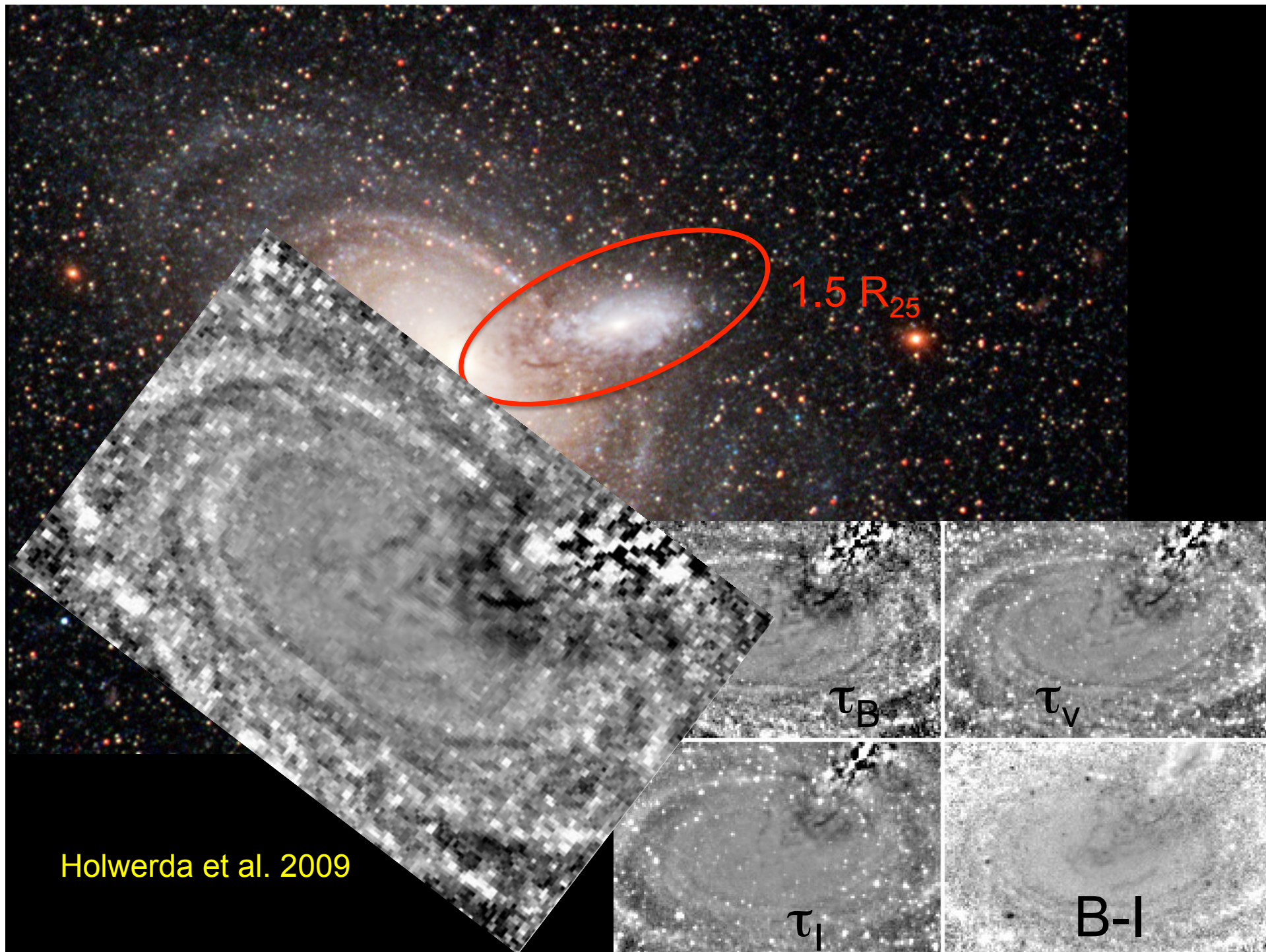


The real:



Before:
N~20

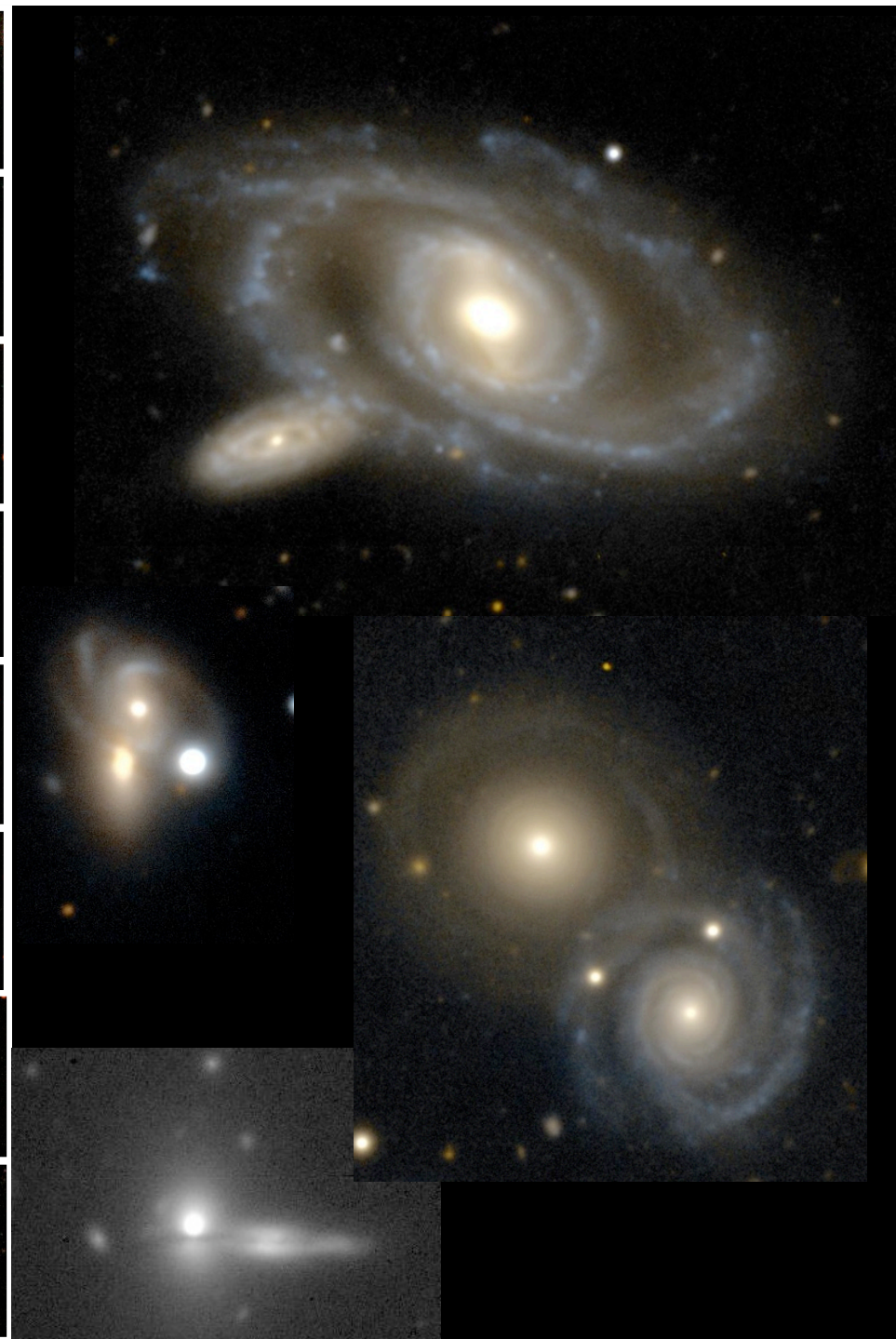
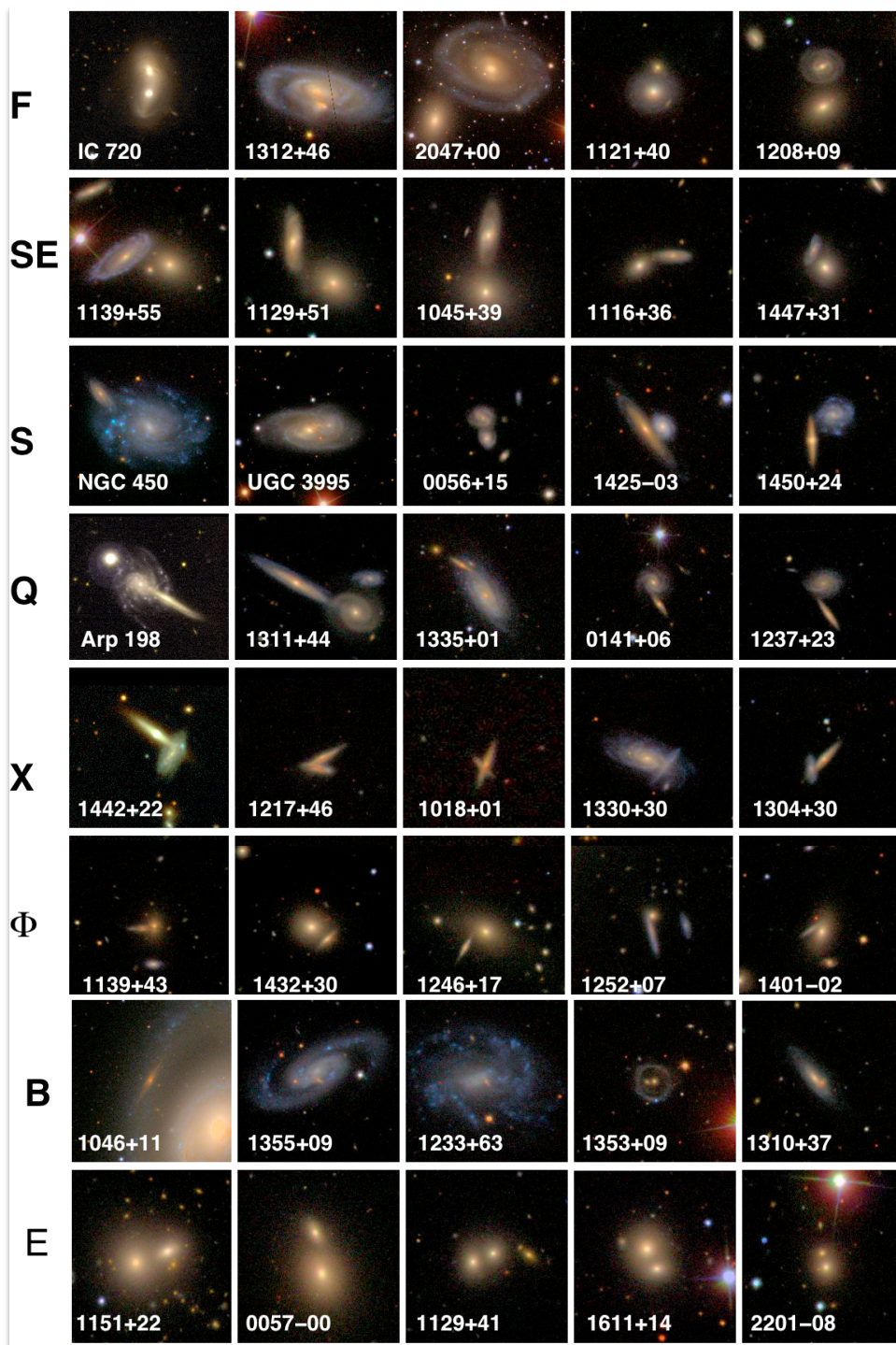


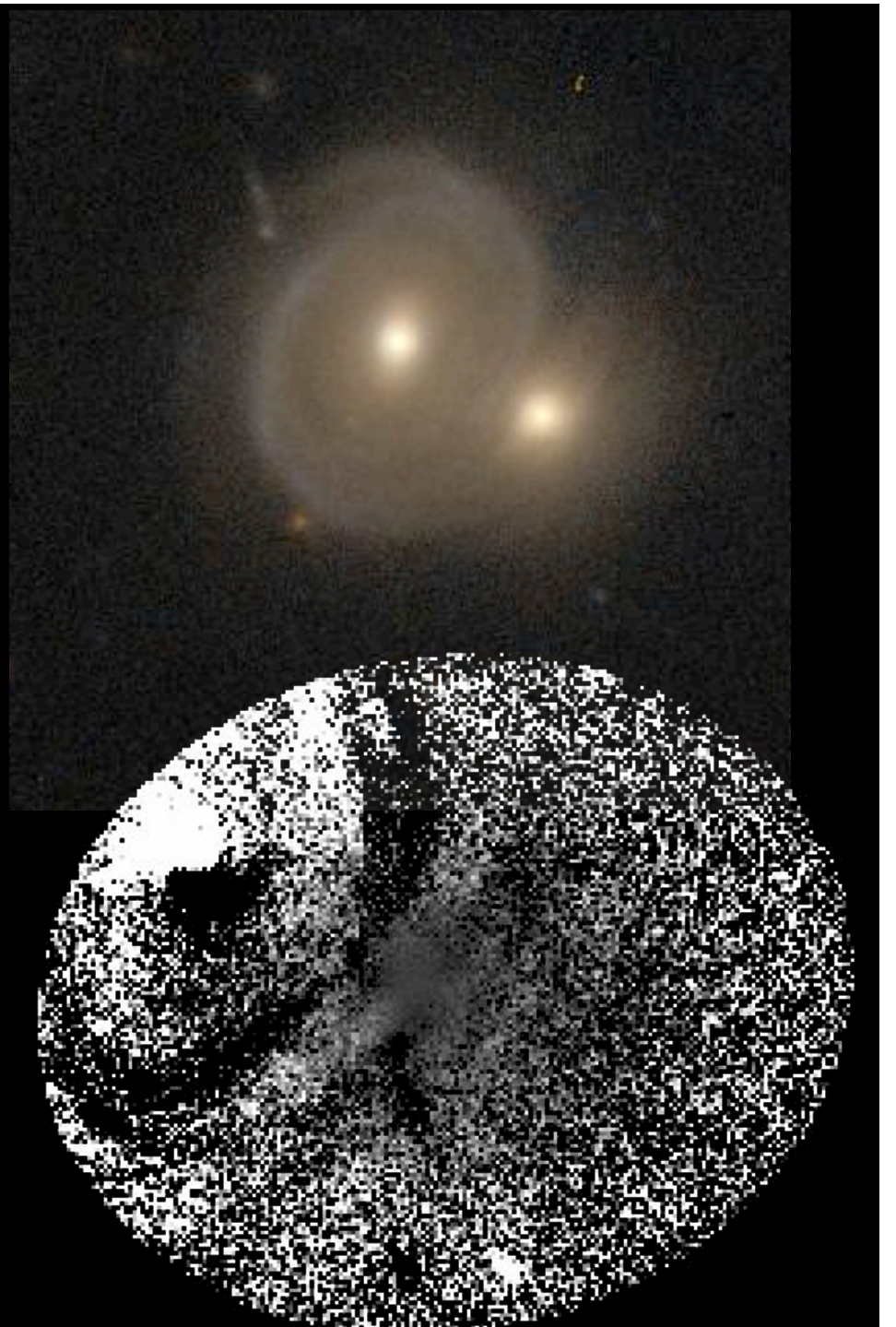
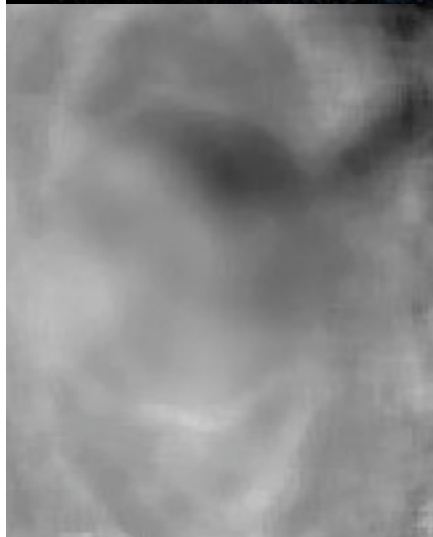


Holwerda et al. 2009

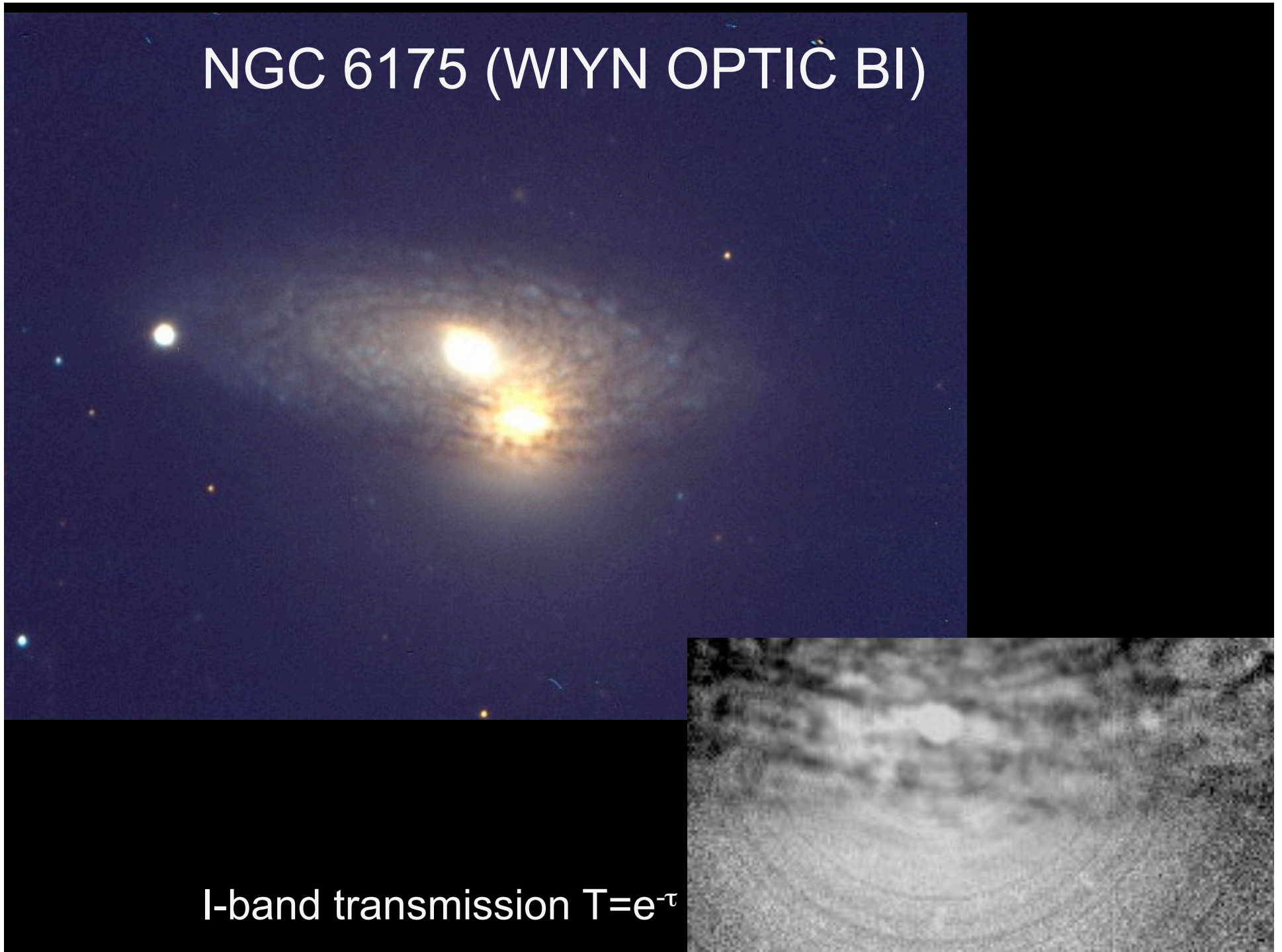


After: $N=1990$

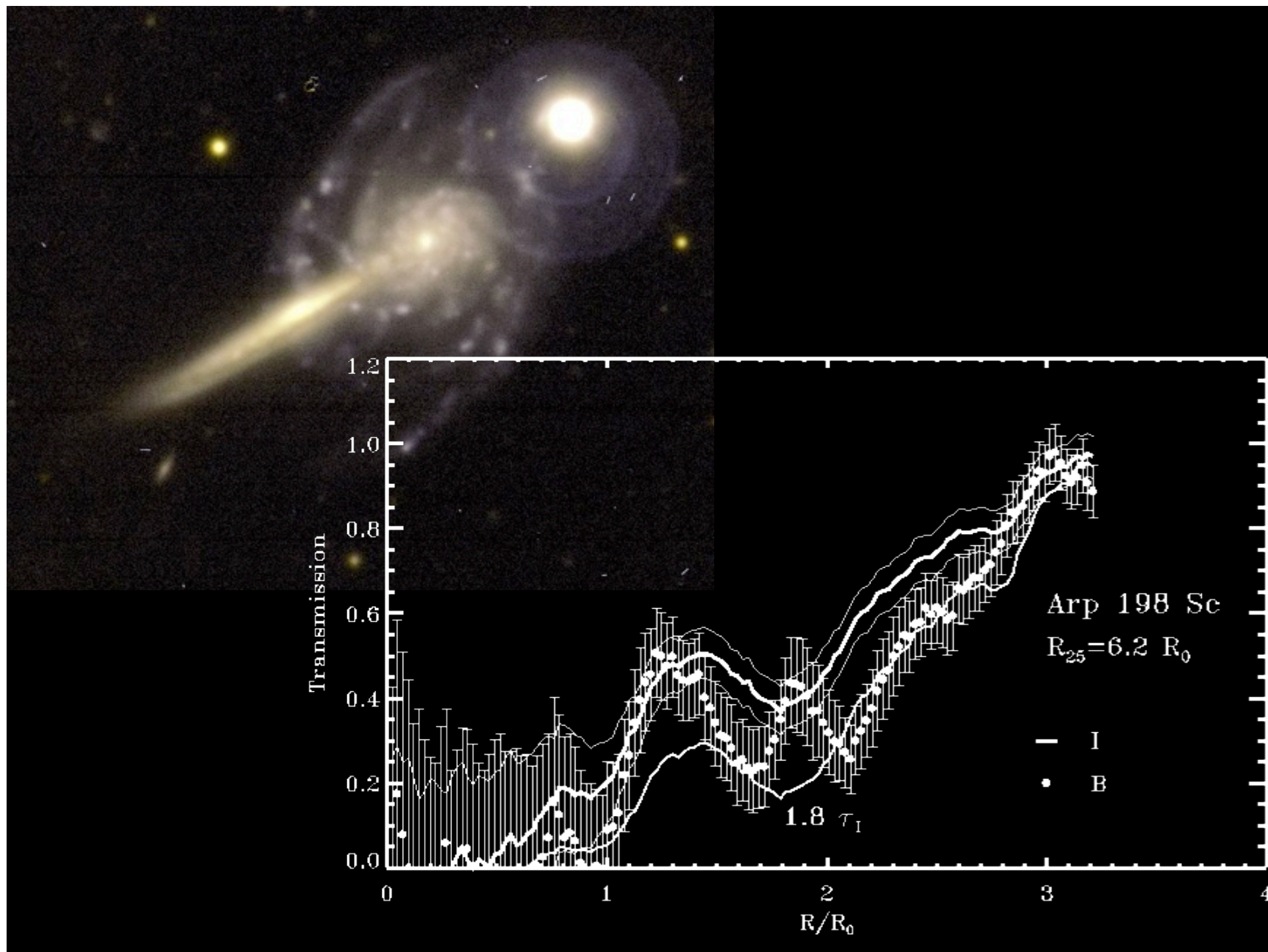




NGC 6175 (WIYN OPTIC BI)



I-band transmission $T=e^{-\tau}$



Searching for Dust in Occulting Galaxies

Anna Manning¹, Bill Keel¹, Benne Holwerda², Chris Lintott³

¹University of Alabama, ²University of Cape Town, South Africa, ³University of Oxford, United Kingdom



Arp198



SDSS0856



SDSS1314



NGC3861



SDSS1442



SDSS1012

Collecting Data

The images used in this project were collected at the WIYN (Wisconsin, Indiana, Yale, and National Optical Astronomy Observatory) at Kitt Peak National Observatory near Tucson, Arizona. The telescope run was completed over 5 nights in April 2008 and each galaxy pair was recorded in the B and I filters for 30 minutes each.

The WIYN observatory lit by the moon in November 2008 taken by Bill Keel.



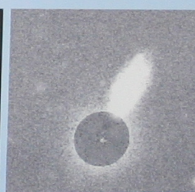
Why Dust?

The clumpy dust within spiral galaxies maps locations of active star formation and of star collapse. This project seeks to learn more about the structure of spiral galaxies and to do that, we need to analyze the components that make up spirals.

Galaxy Zoo Project

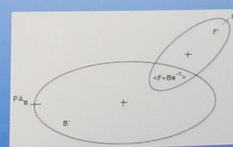
The project launched in July 2007 and allows "citizen scientists" to classify the million astronomical objects catalogued by the Sloan Digital Sky Survey (SDSS). Since its conception, the project has progressed from simply determining whether each galaxy is either spiral or elliptical to include more specific types of galaxy classifications. To take part as a citizen scientist visit www.galaxyzoo.org.

Figure 1 (a) SDSS1032B combined image of the B and I filters with 30 minutes total exposure time (second from left) and the same galaxy pair in the B filter with the elliptical model subtracted from the original image (second from right). (b) At far right, the dust lane from the spiral galaxy of the pair shows in red.

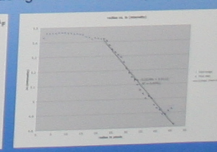


Results

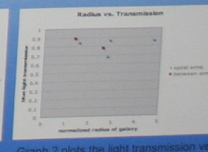
The results for this specific galaxy give that the pixel radius for the disk should be 41.8 pixels. It is calculated from the slope of the disk component on Graph 1. This number acts as a normalization of the intensity so that the results of different galaxies can be compared. Graph 2 illustrates this normalization for the spiral arm that crosses the elliptical galaxy and for areas that overlap and are between spiral arms. This sample of galaxies did not show the distinction in the blue light between the spiral arms and dust lane that we expected.



The diagram shows the mathematical representation of method used, but with flux measurements. The slope of the disk component on Graph 1 corresponds to e^{-1} in the equation of the overlap region.



Graph 1 shows the bulge component in light blue and the disk component in dark blue. The slope of the disk component is used to calculate the normalization factor of pixel intensity.

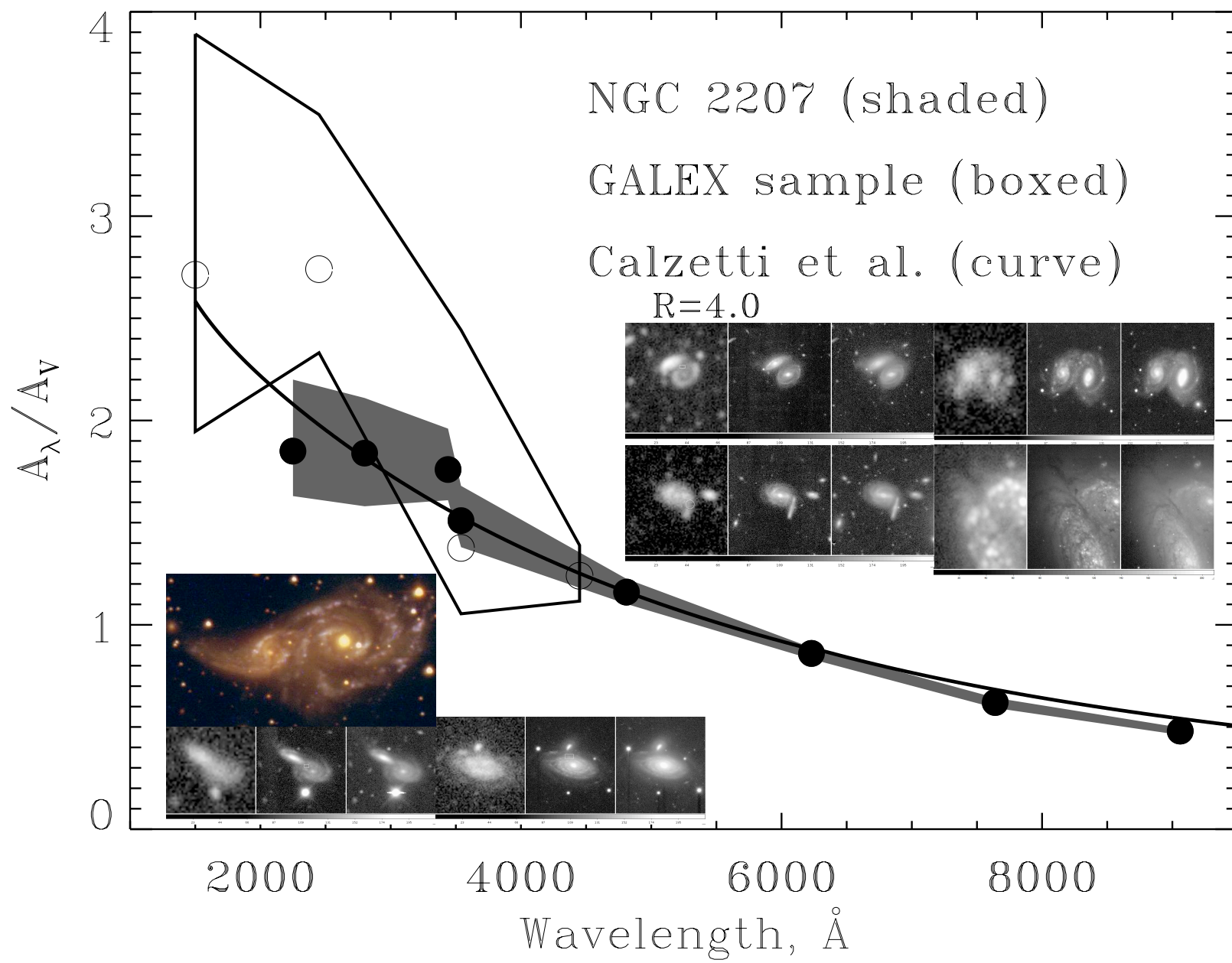


Graph 2 plots the light transmission versus the radius of the galaxies in blue for a point in the spiral arms and in red for a point between spiral arms. There are only two red points because while every galaxy has a spiral arm that overlaps the elliptical, only two had a corresponding section between spiral arms.

References

Holwerda, Keel, et al. 2009
Keel, White, et al. 2000
Lintott, et al. 2008

Galaxy Zoo 2



Techniques:

Automated: simple symmetric subtraction/division

Better: model each galaxy (ellipse or symmetry)

Arm tracing: use opposite arm as interpolation aid

Error estimates may be tailored to the geometry

Gains from larger sample:

“Gold” subset with large Δz (no interaction or scattering)

Distinct geometric classes of overlaps

Dependences on galaxy properties

Rare (deep) overlaps

Dusty dwarfs, as ANGST system behind NGC 253?

Dusty sequence of galaxies (can be LSB for 2 reasons)

Extended dust features/disks

HST sample, dust evolution via single technique

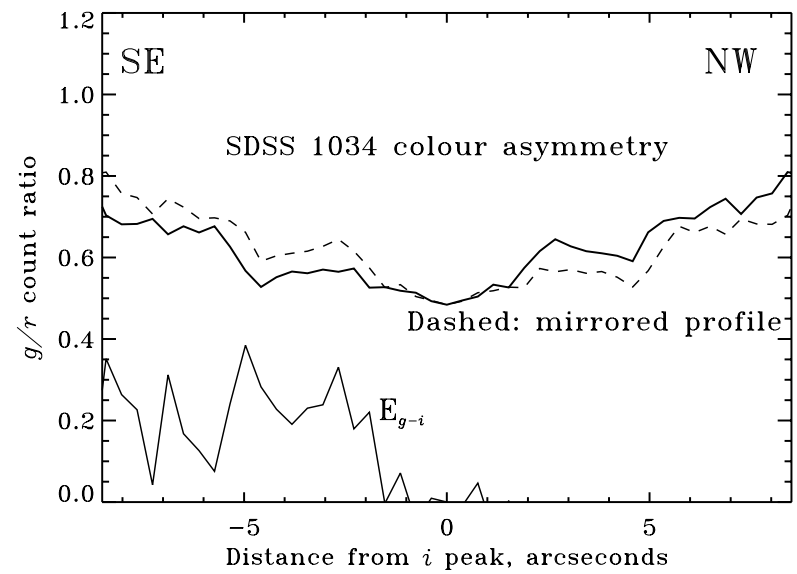


Deep



UGC 4008

BI composite



SDSS 1034+10

Hello **NGC3314**

March 26, 2008, 03:38:14 AM



Show unread posts since last visit.
Show new replies to your posts.
Total time logged in: 8 days, 19 hours and 59 minutes.

News: New Galaxy Zoo Forum Is launched! (Note: this requires a separate registration)



Search

[HOME](#) [HELP](#) [SEARCH](#) [PROFILE](#) [MY MESSAGES](#) [MEMBERS](#) [LOGOUT](#)

[Galaxy Zoo Forum](#) > [The objects](#) > [Weird and wonderful](#) (Moderators: Alice, Edd, StuartA, bamford) > [The Hanny's Voorwerp.](#)

« [previous](#) [next](#) »

Pages: [1] 2 3 ... 19

[REPLY](#) | [NOTIFY](#) | [MARK UNREAD](#) | [SEND THIS TOPIC](#) | [PRINT](#)



Author

Topic: The Hanny's Voorwerp. (Read 6426 times)

Hanny

Hero Member



Posts: 7205



"Voorwerp kid"



The Hanny's Voorwerp.

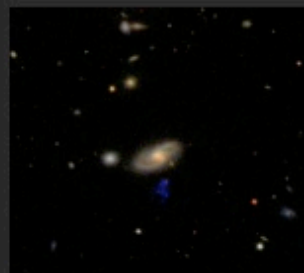
« on: August 13, 2007, 06:16:40 AM »

Quote

What's the blue stuff below?

Anyone?

<http://cas.sdss.org/astro/en/tools/chart/chart.asp?ra=145.2671505&dec=34.73290502>



[O III] 4959,5007

H β

He II 4686

[O III] 4363

H γ

H δ

H ϵ + [Ne III] 3968

H ζ

[Ne III] 3869

[O II] 3726,3729

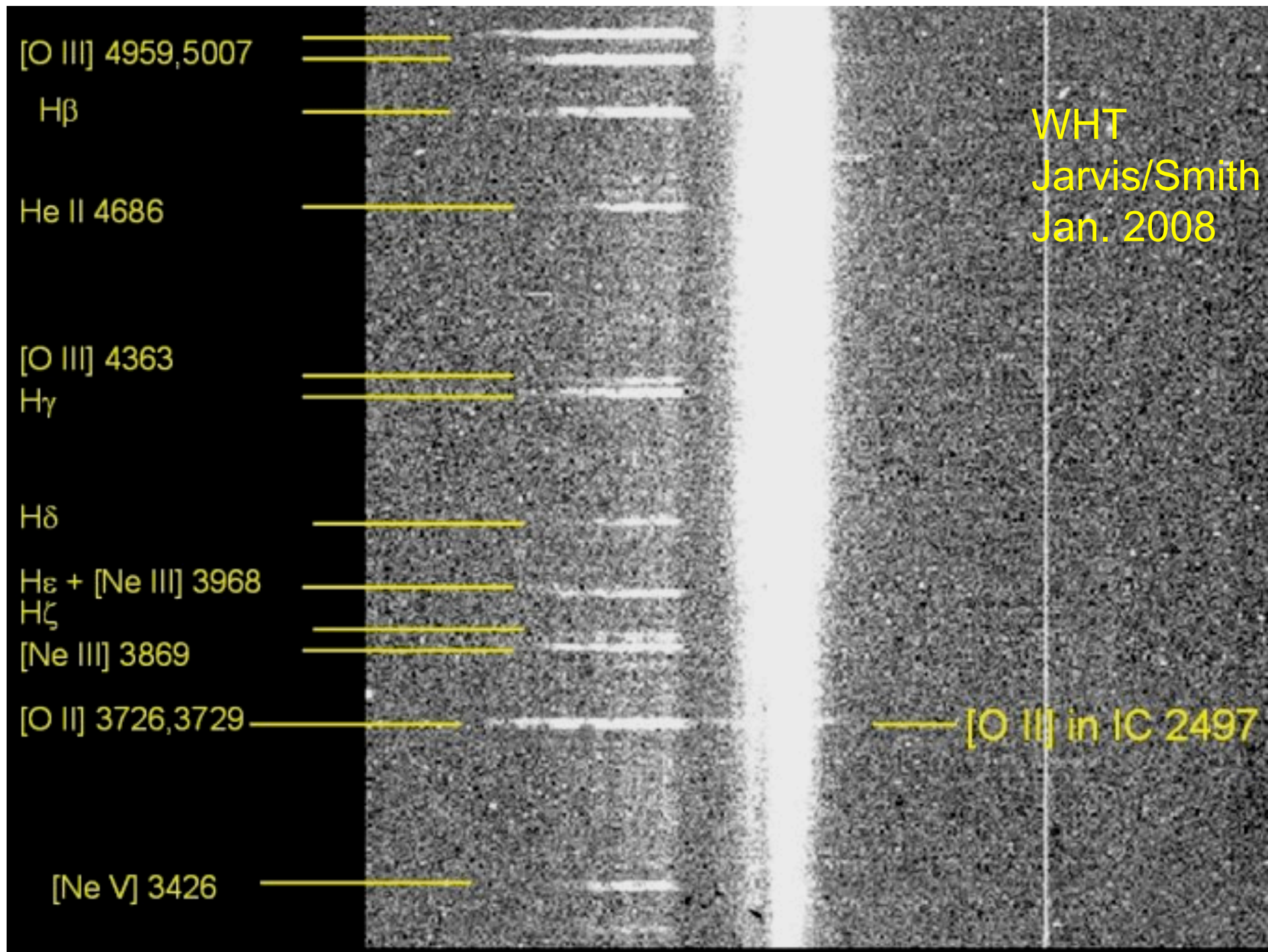
[Ne V] 3426

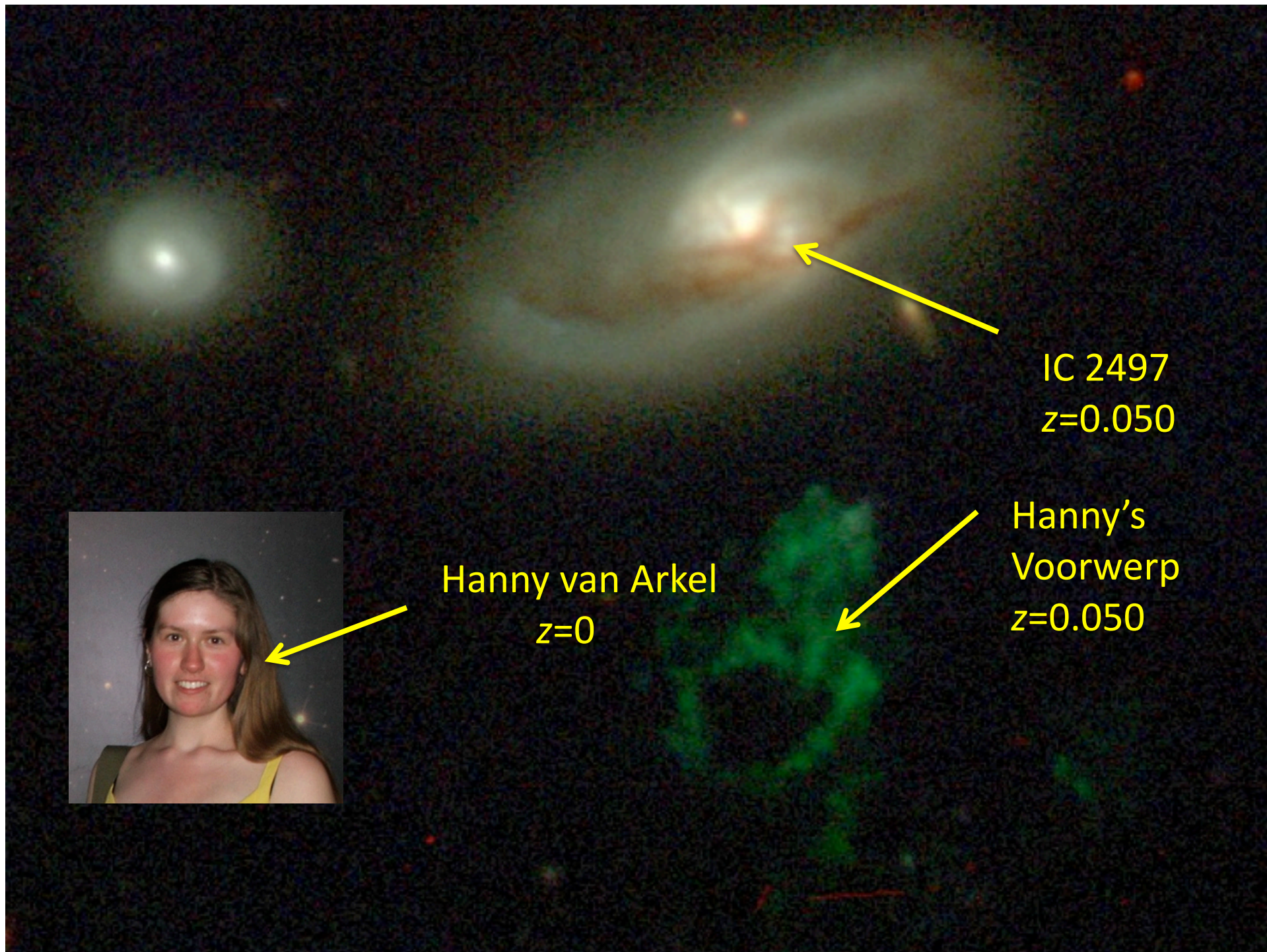
WHT

Jarvis/Smith

Jan. 2008

[O II] in IC 2497

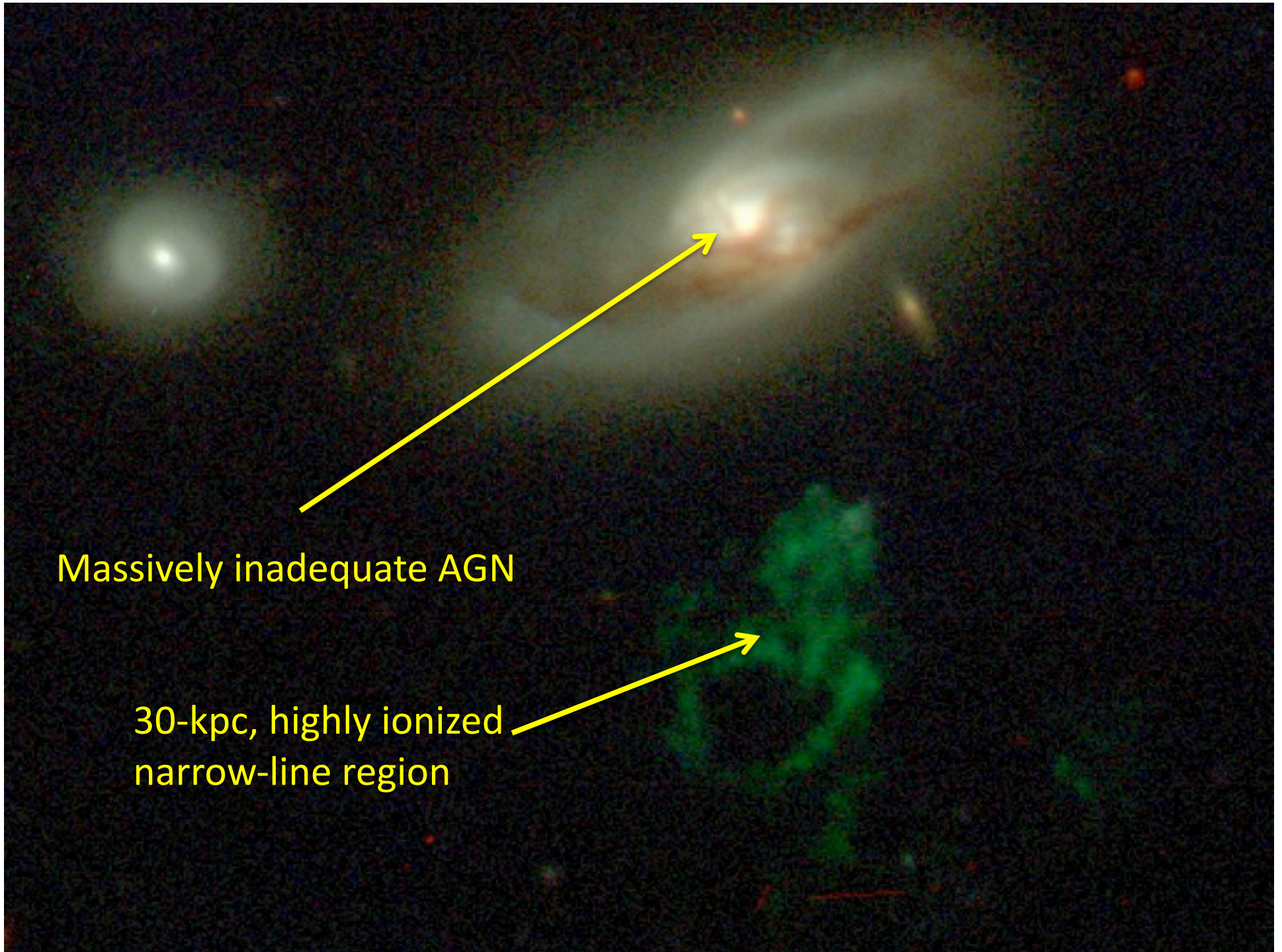




IC 2497
 $z=0.050$

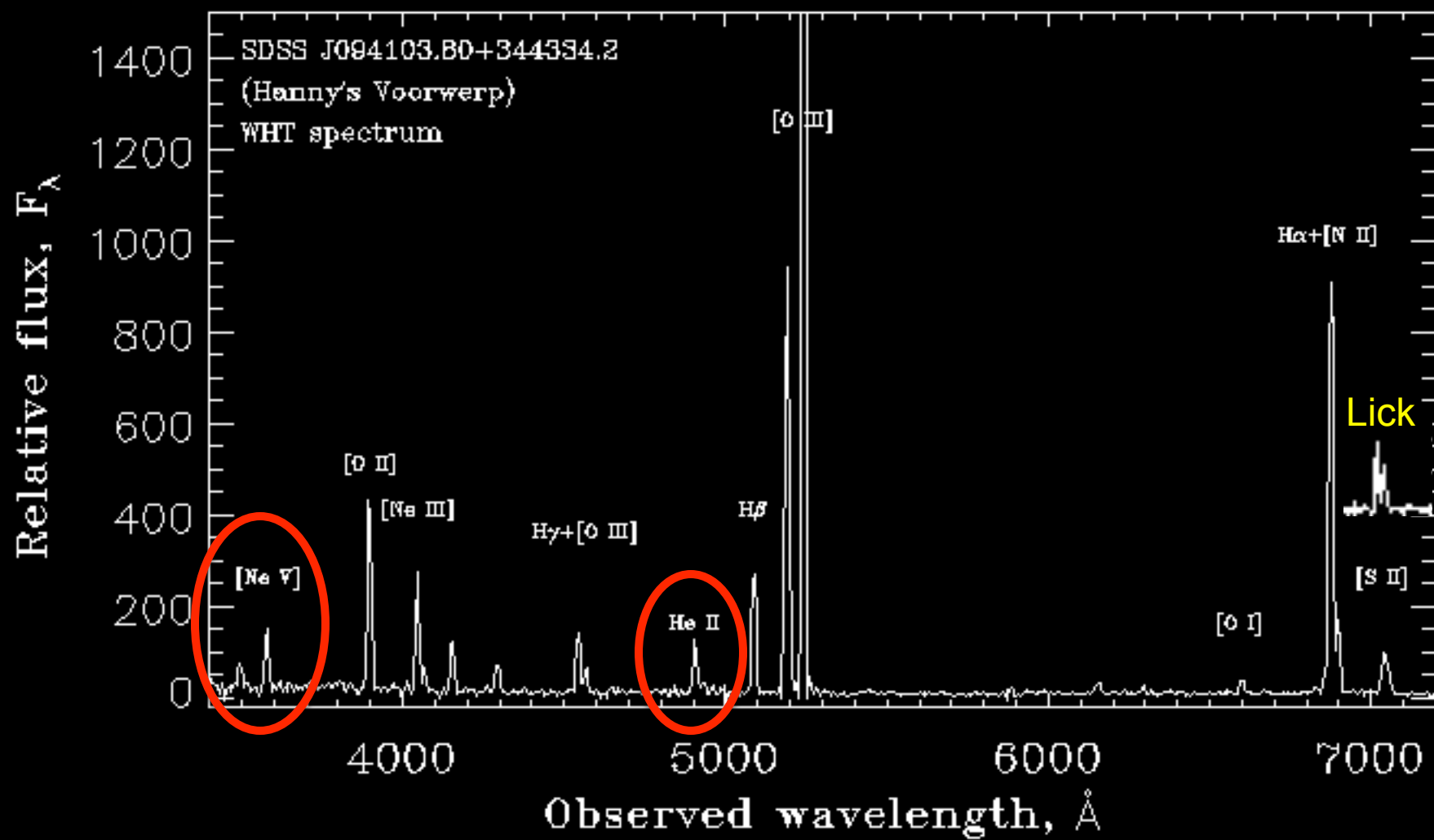
Hanny's
Voorwerp
 $z=0.050$

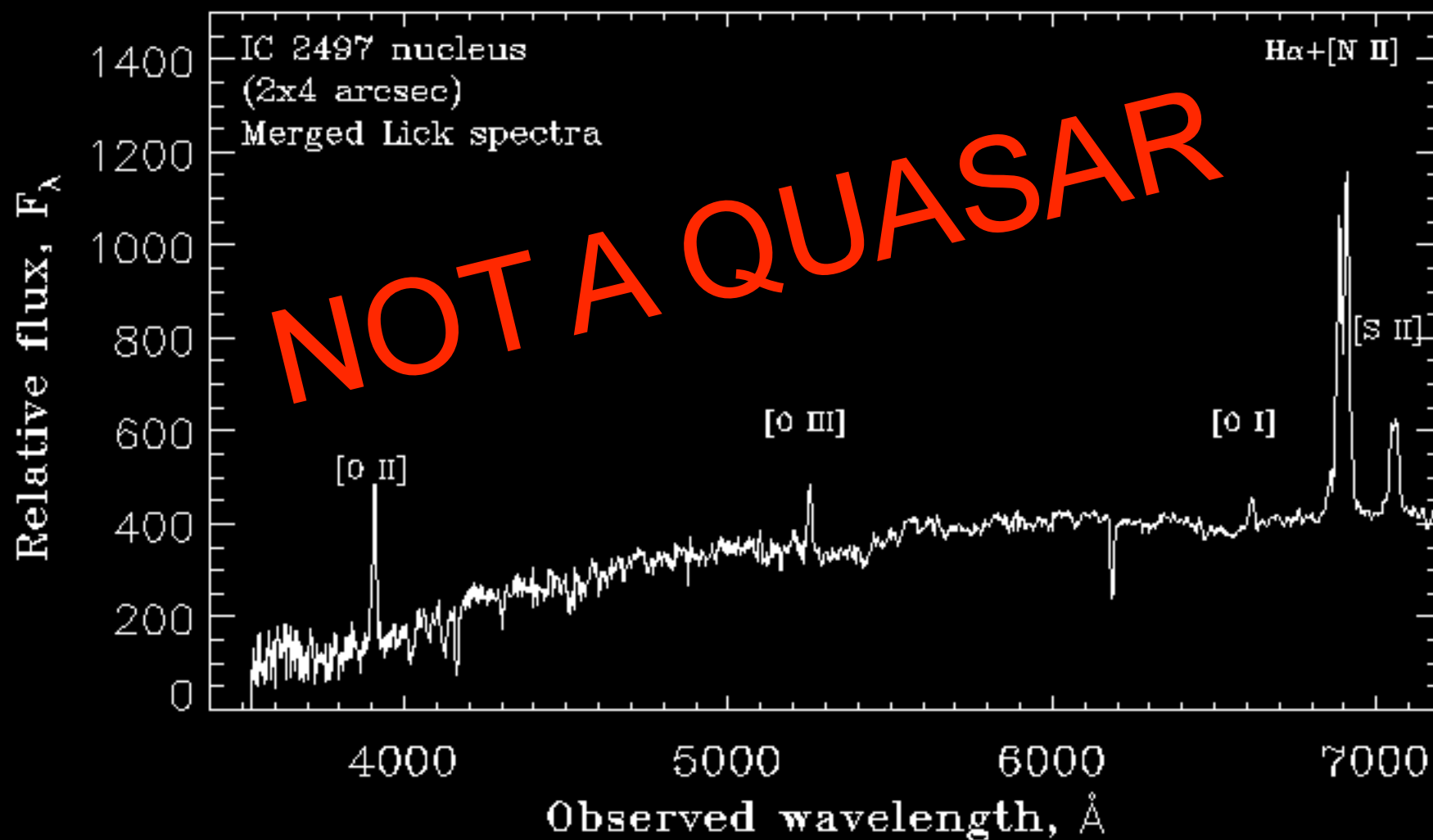
Hanny van Arkel
 $z=0$

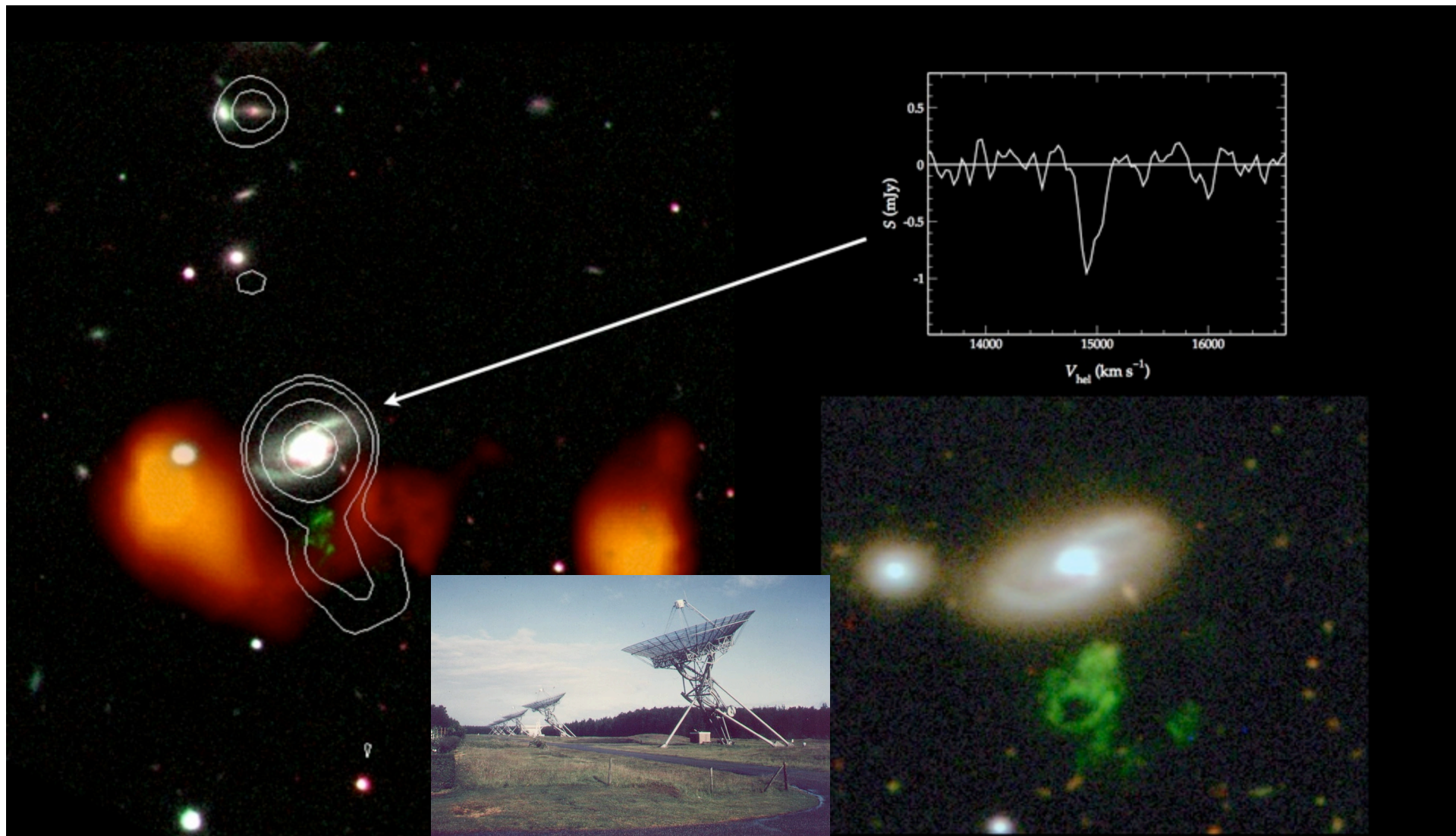


Massively inadequate AGN

30-kpc, highly ionized
narrow-line region







WSRT results (Garrett et al. 2009): $9 \times 10^9 M_{\odot}$ H I arc (Voorwerp is an ionized part)
relic of interaction?

Possible jet or outflow in this direction (clearing a path for radiation?)

H I absorption at core (which is a weak VLBI source): obscuration may be high

Some emission-line astrophysics:

[S II] ratio: density $n_e < 50 \text{ cm}^{-3}$

[O III] 5007/4363: $T_e = 13500 \text{ K}$ (photoionization, not shocks)

He II/H β , [O III]/H β : $\log U = -2.1$

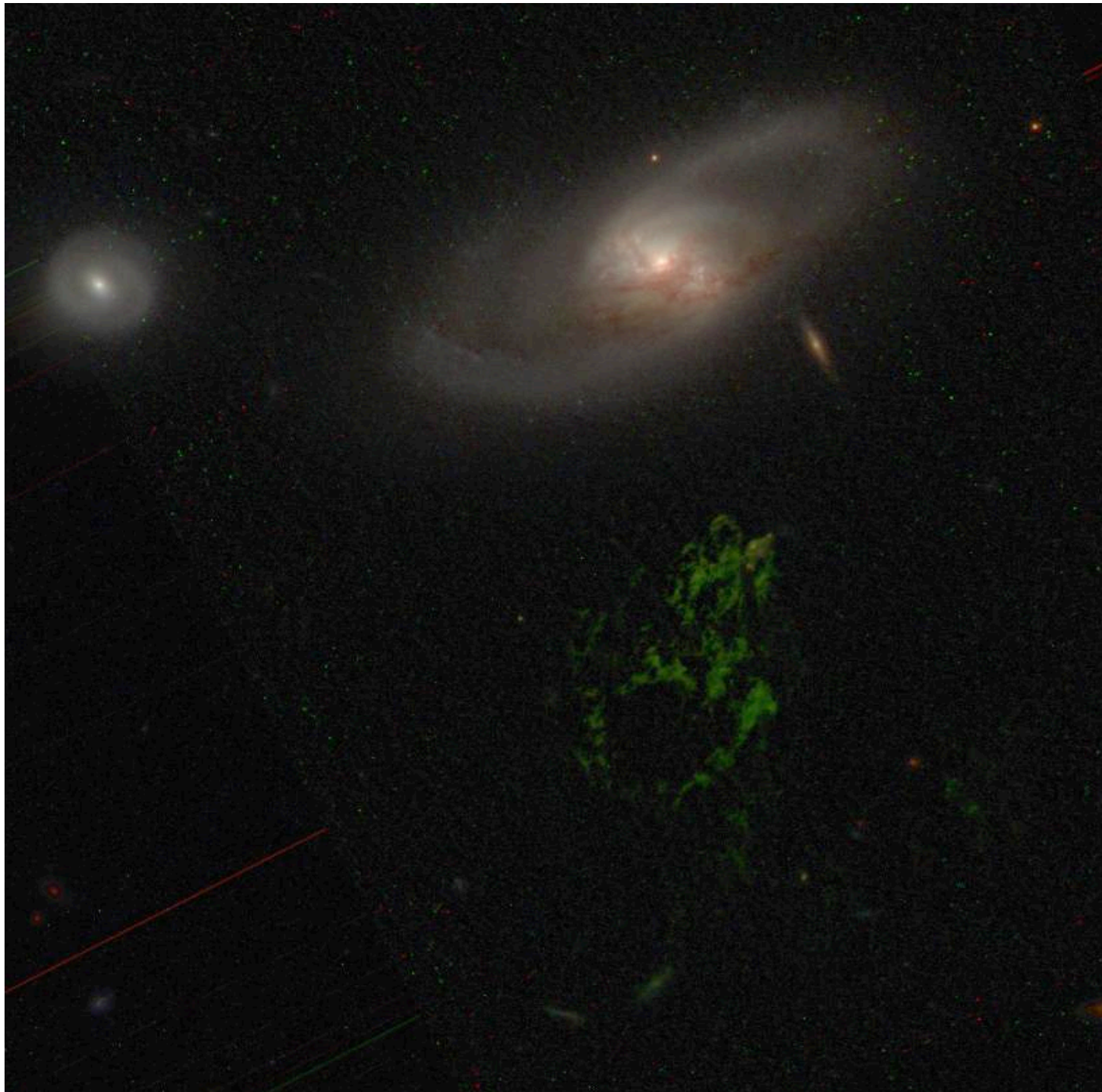
[Ne V]/[Ne III]: continuum extends to $>95 \text{ eV}$ (soft X-rays)

Energy balance from $L(\text{H}\beta)$: $L_{\text{ion}} > 10^{45} \text{ erg/s}$

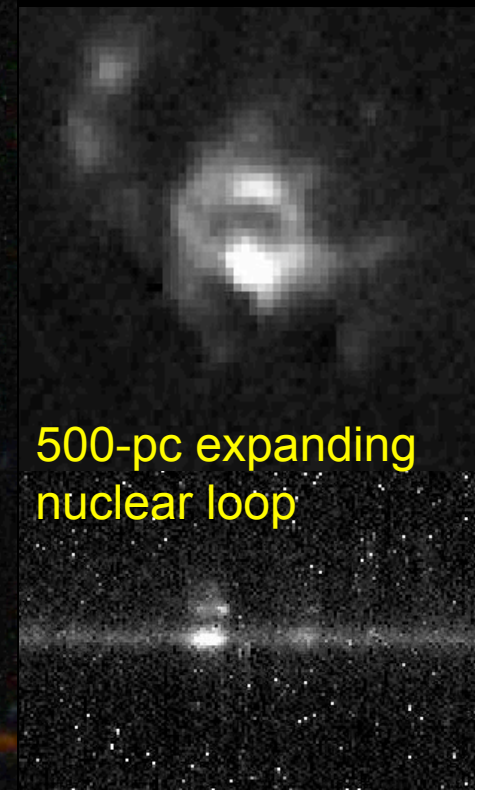
Ionization parameter plus n_e : $L_{\text{ion}} < 4 \times 10^{45} \text{ erg/s}$

Abundances roughly $\frac{1}{4}$ solar

The gas, part of a massive tidal tail, is ionized by a quasar.



HST data,
galaxy color
refined with
WIYN images



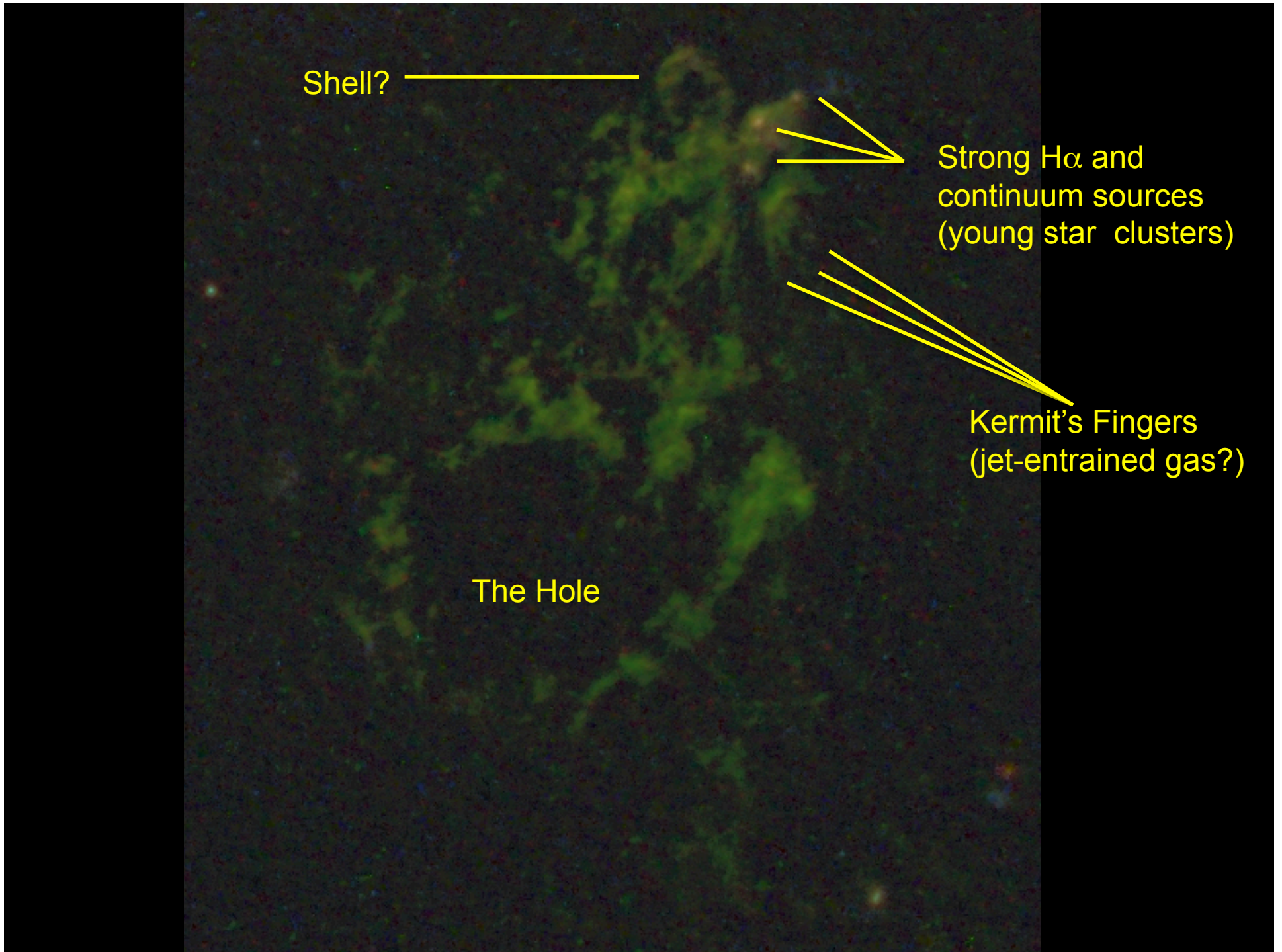
500-pc expanding
nuclear loop

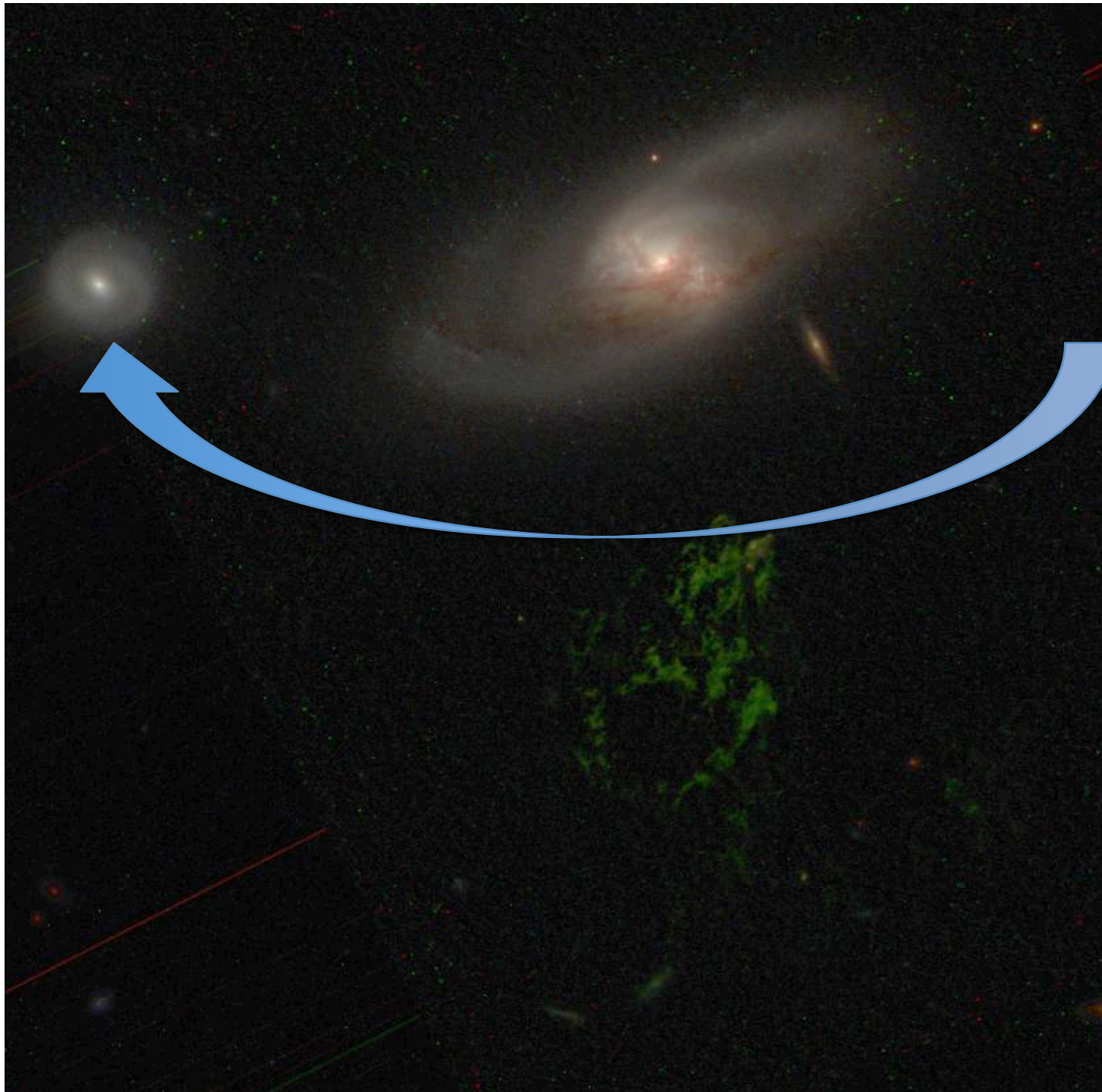
Shell?

Strong H α and
continuum sources
(young star clusters)

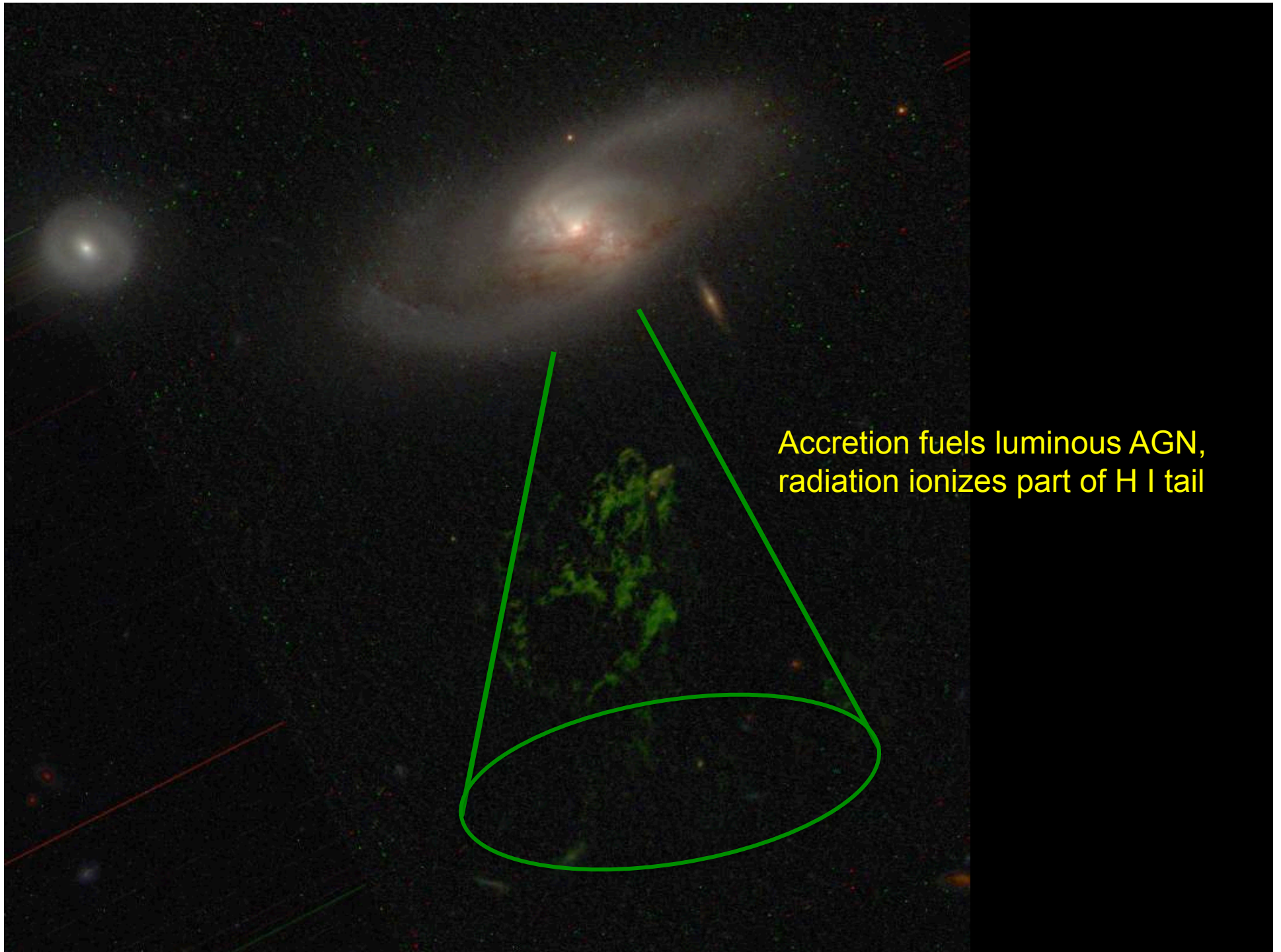
Kermit's Fingers
(jet-entrained gas?)

The Hole

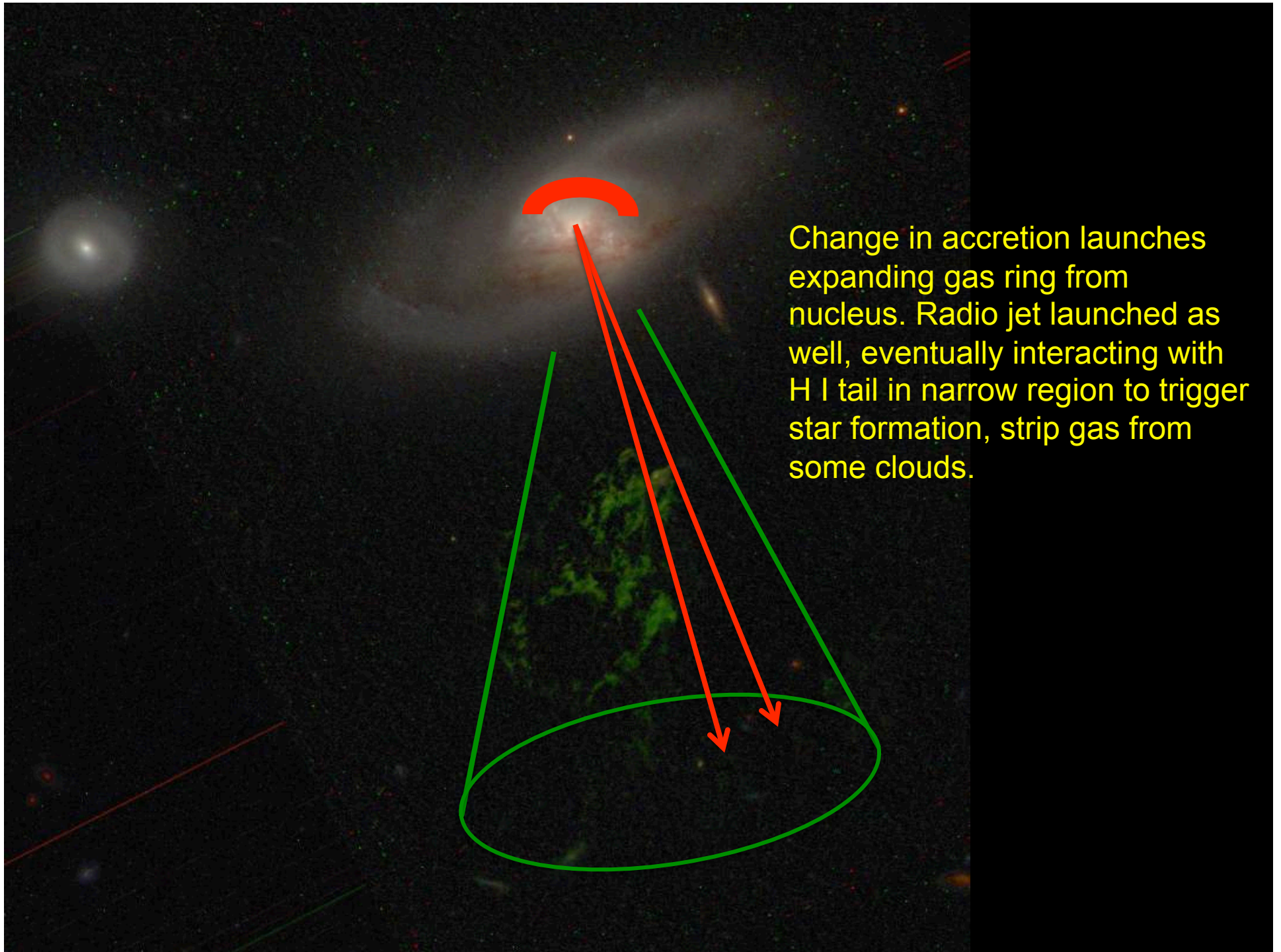




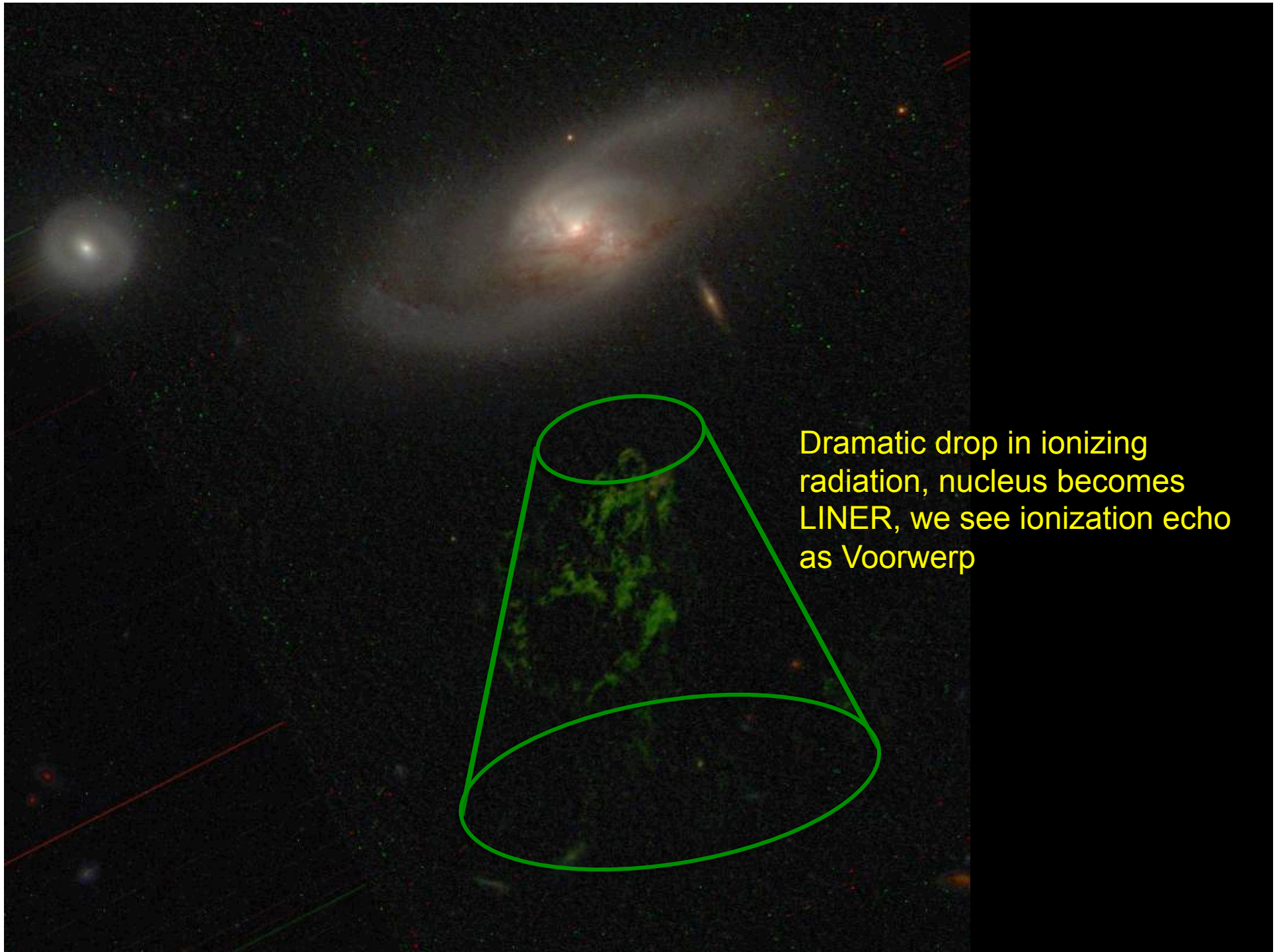
Earlier encounter
(not necessarily
with the small,
symmetric spiral
companion)
releases H I tail



Accretion fuels luminous AGN,
radiation ionizes part of H I tail



Change in accretion launches expanding gas ring from nucleus. Radio jet launched as well, eventually interacting with H I tail in narrow region to trigger star formation, strip gas from some clouds.



Dramatic drop in ionizing radiation, nucleus becomes LINER, we see ionization echo as Voorwerp

What do we learn?

- Hanny's Voorwerp is ionized by a quasar
- The AGN has quickly faded by $\sim 1000\times$. Turnoff or a mode switch?
- IC 2497 is a local quasar host galaxy
- AGN duty cycles, 10^5 - 10^6 -year timescales
- Can we find more like this? One is a pet rock, ten comprise a sample.

Zooites could find more!

- AGN-ionized gas blue/purple in *gri* images
- Finds from forum (recovered known EELRs)
- Specific call for more on GZ forum/blog
- Targeted hunt: examine Veron-Cetty/Veron AGN catalog at $z < 0.1$, all SDSS AGN/composite nuclei. 16,000 galaxies, ~200 Zooites, >10 views each, <6 weeks. 7 looked at all of them!
- Extract top-rated galaxies for image analysis and spectroscopy



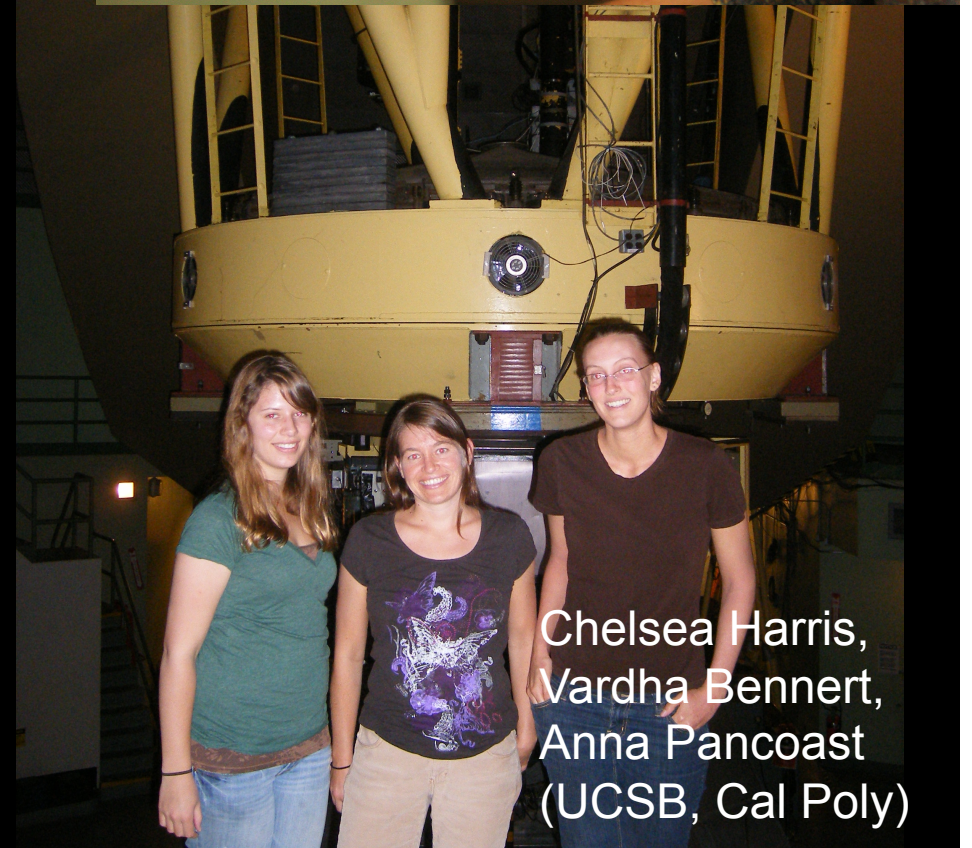
Vardha, Chris
Lintott, Peter
Maksym



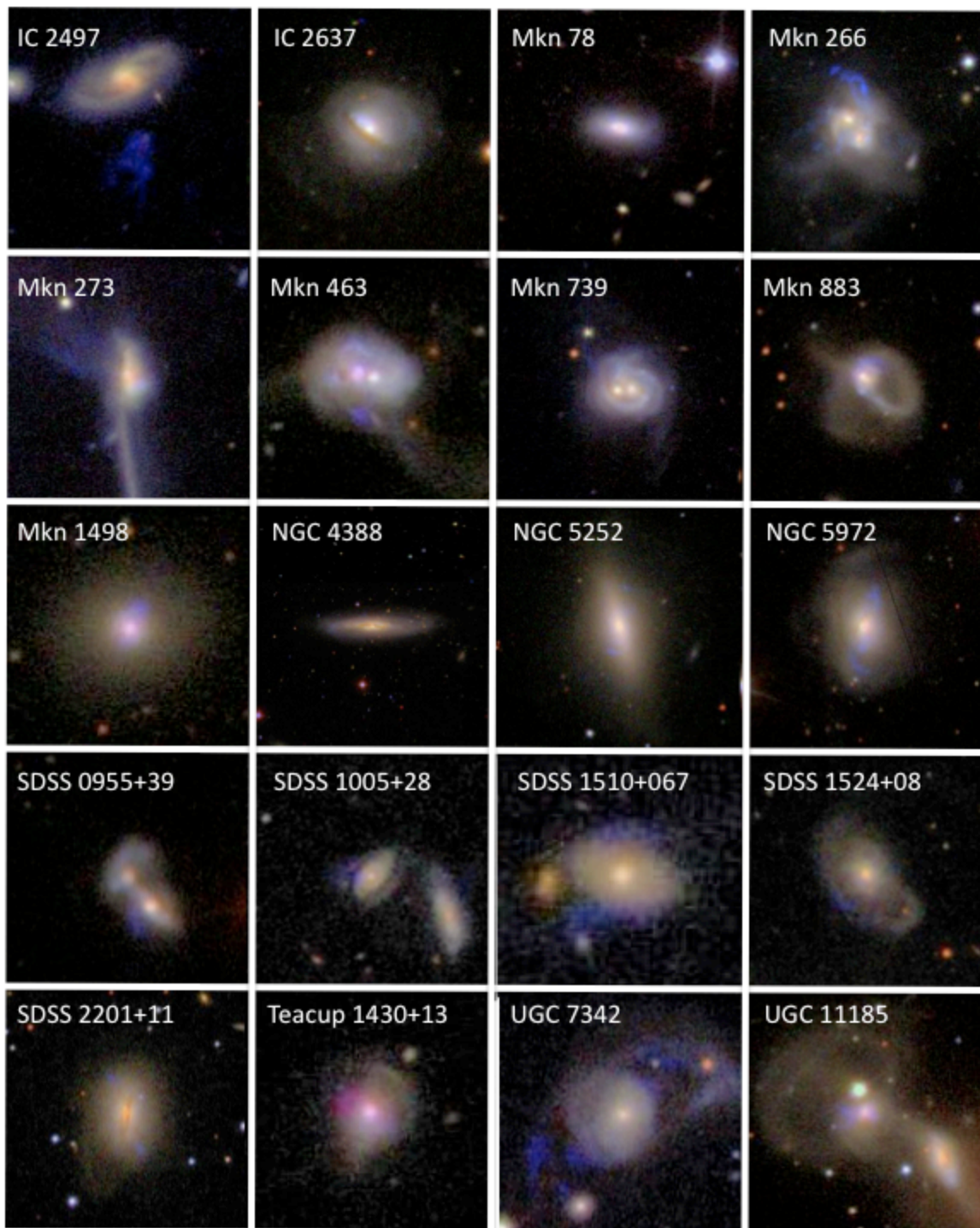
Alexei Moiseev
inside 6m tel



Drew Chojnowski
(TCU → UVa)



Chelsea Harris,
Vardha Bennert,
Anna Pancoast
(UCSB, Cal Poly)



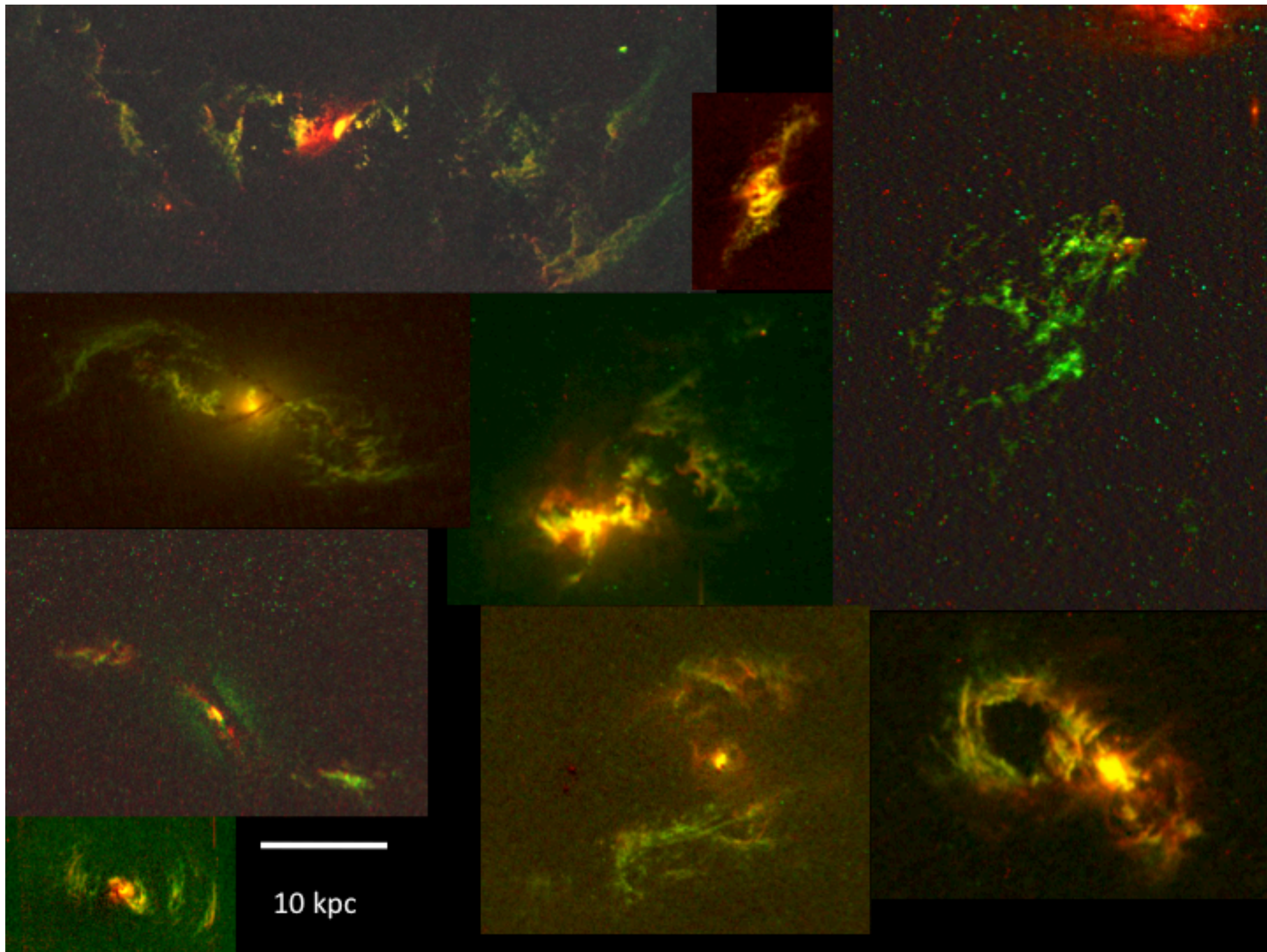
Obscuration versus history

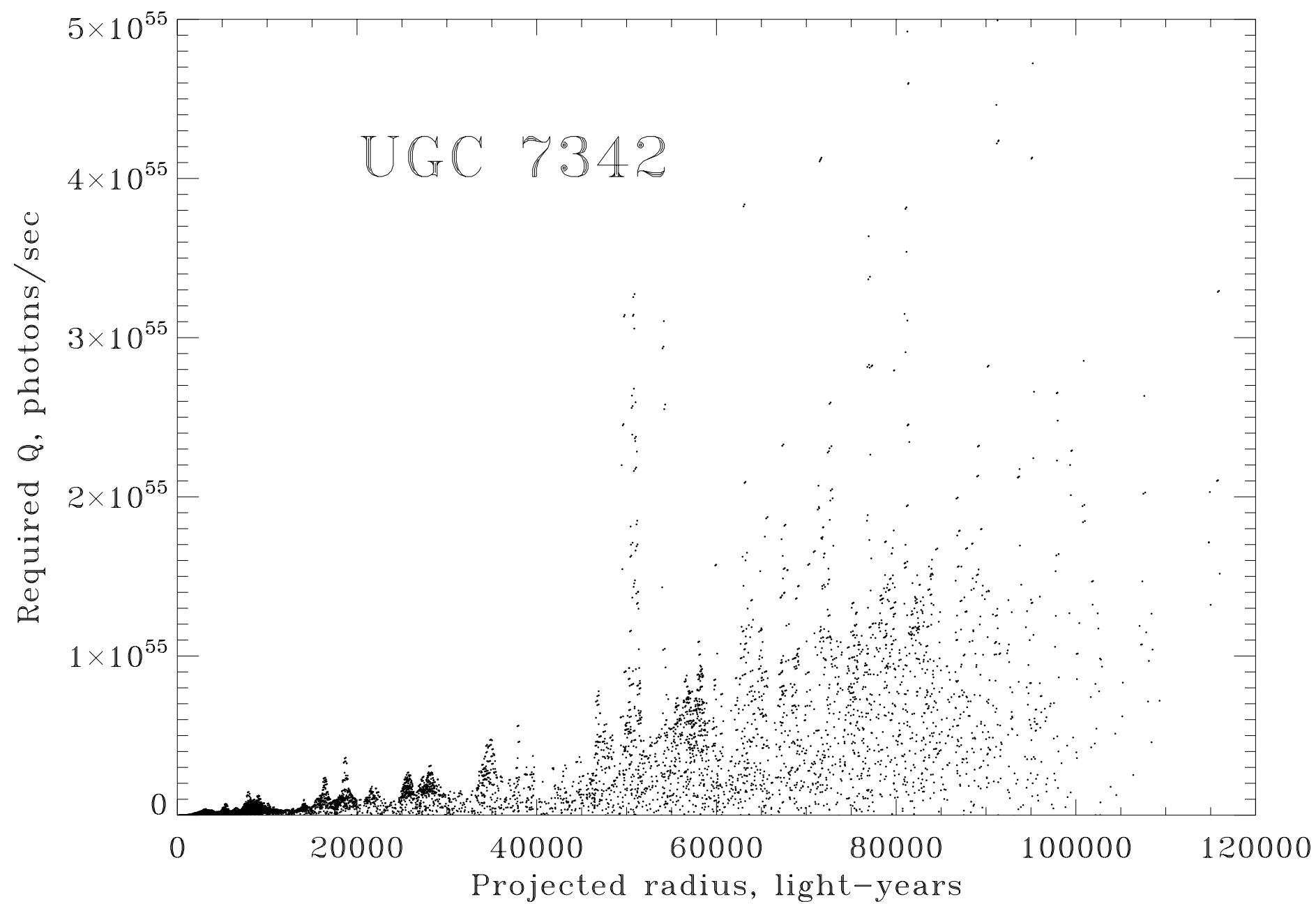
Ionizing luminosity from
recombination & ion. Parameter
Total luminosity with M/FIR

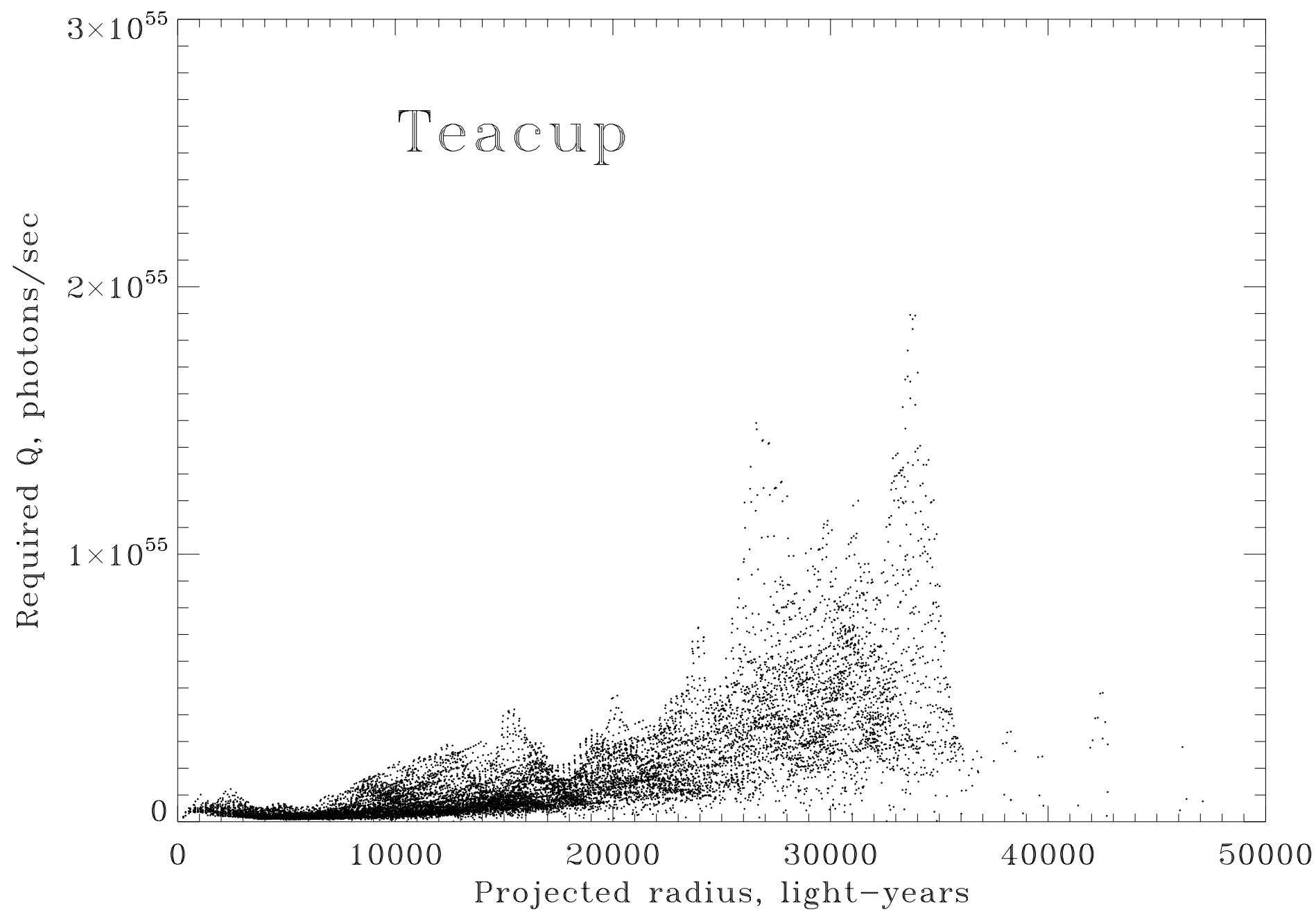
FUV-dominant by 10X to FIR-
dominant by 100x; have HST
imagery for 7 that have faded.

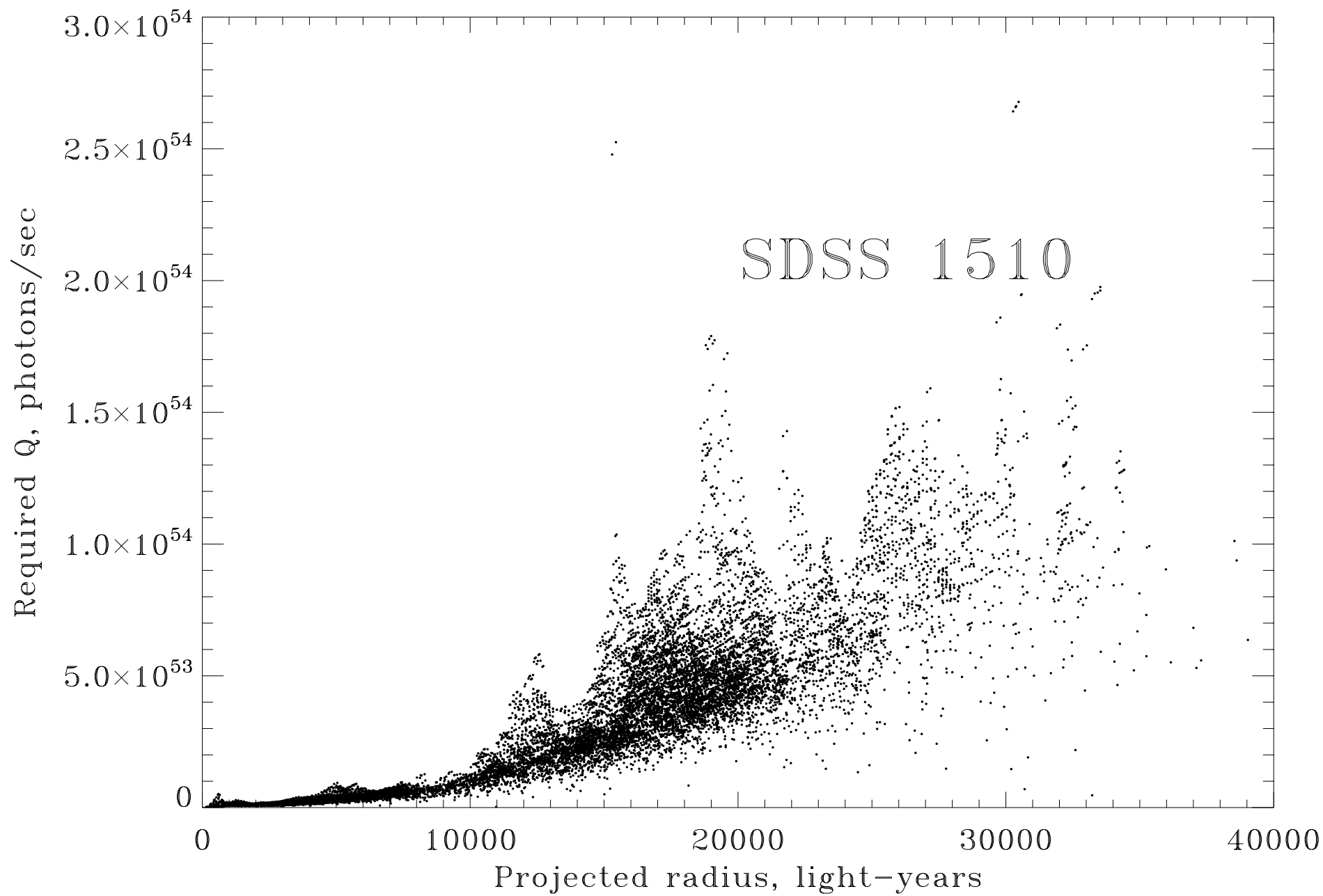
70 kpc

Speaking of Zoos –
 $\frac{3}{4}$ of these are interacting or
merging. Ionized tidal debris is
an excellent way to spot
radiation from the nucleus in
other directions (and at different
times).

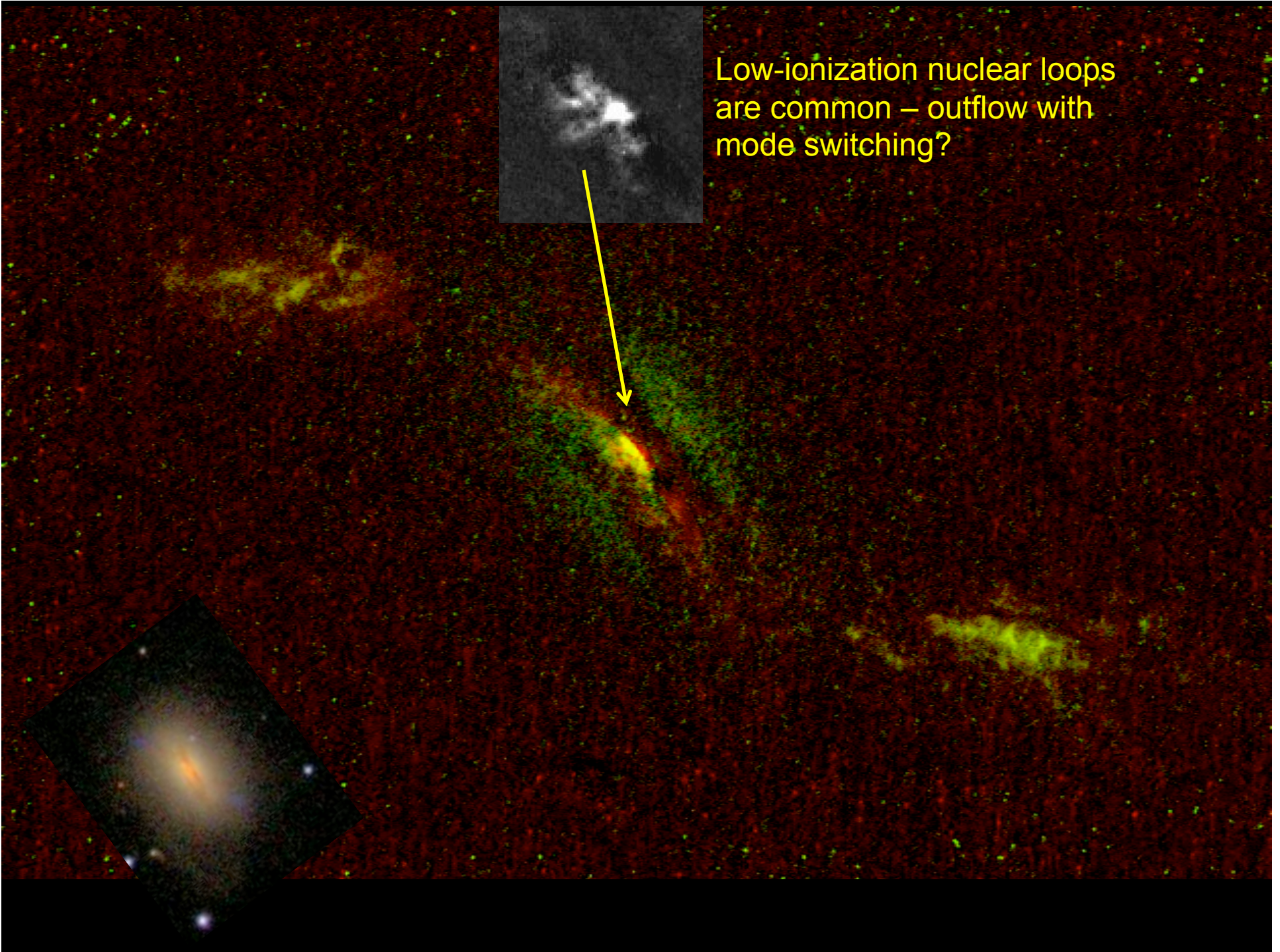
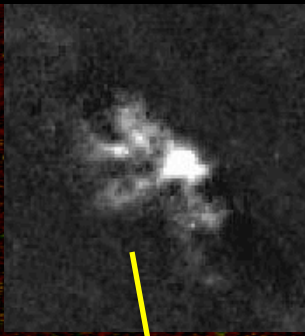




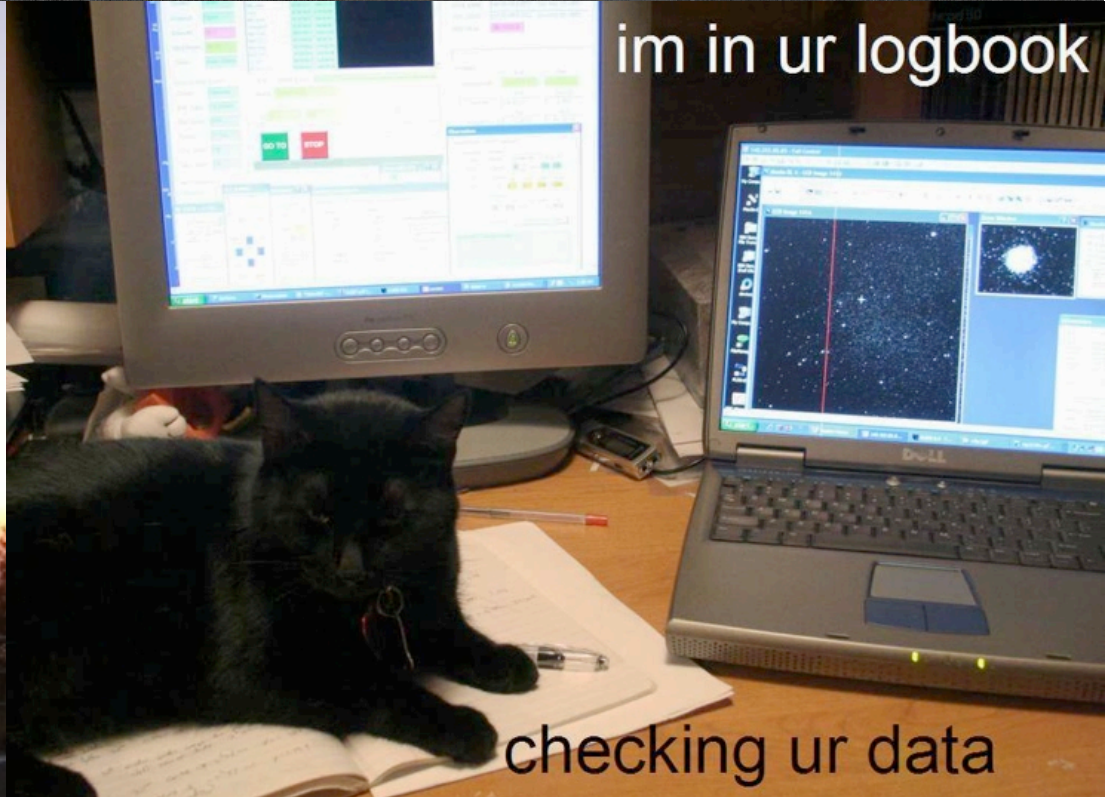
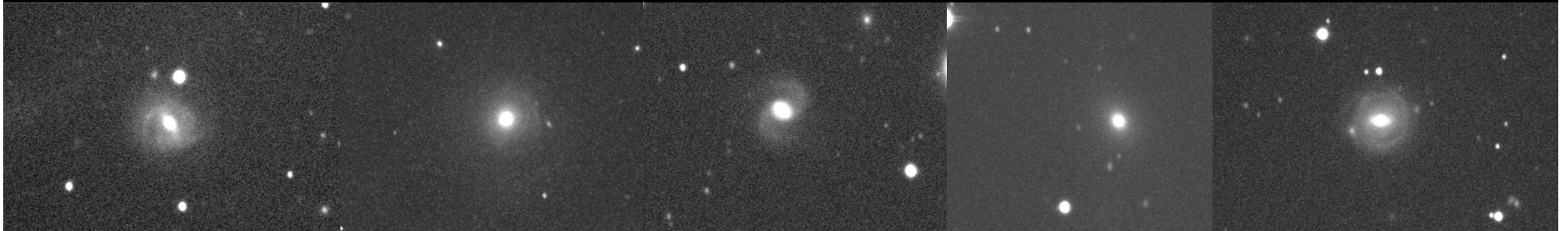


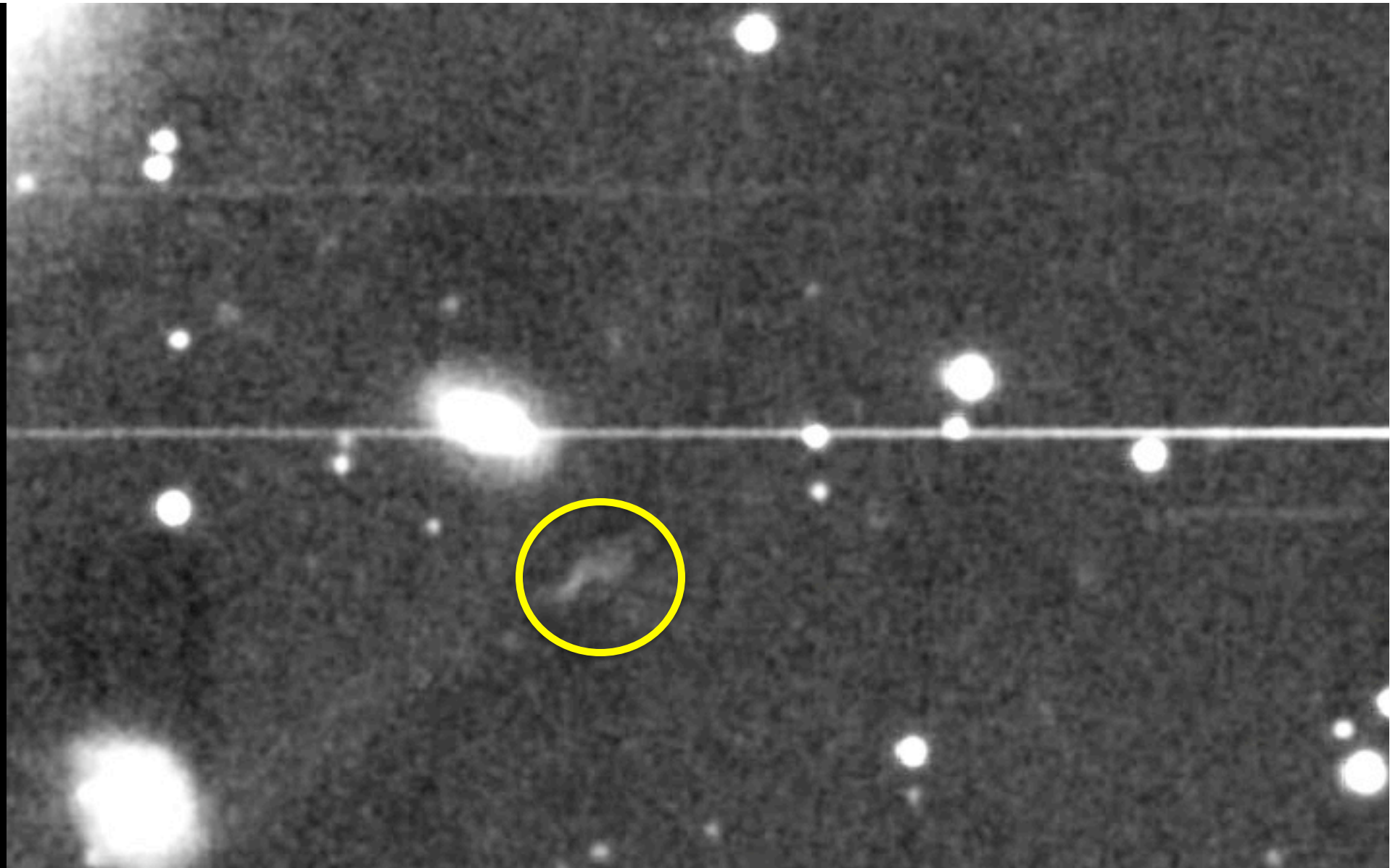


Low-ionization nuclear loops
are common – outflow with
mode switching?

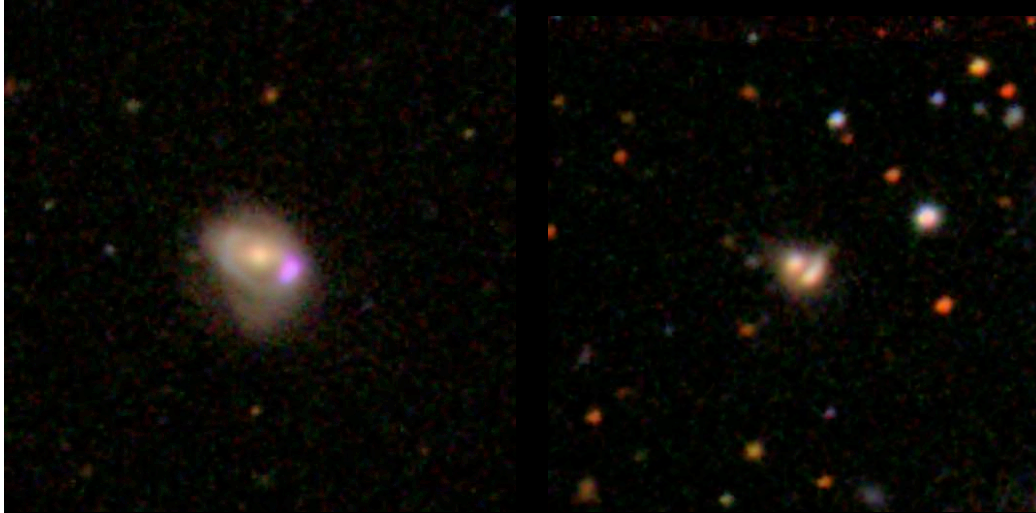
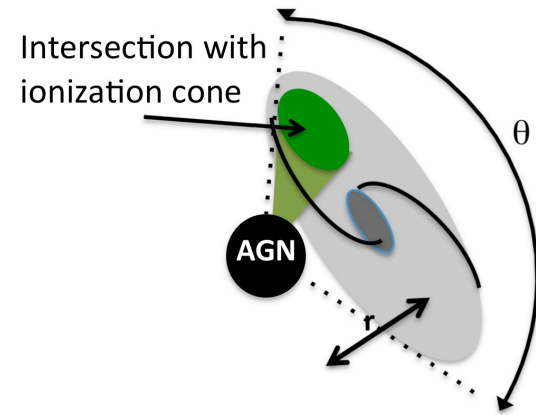
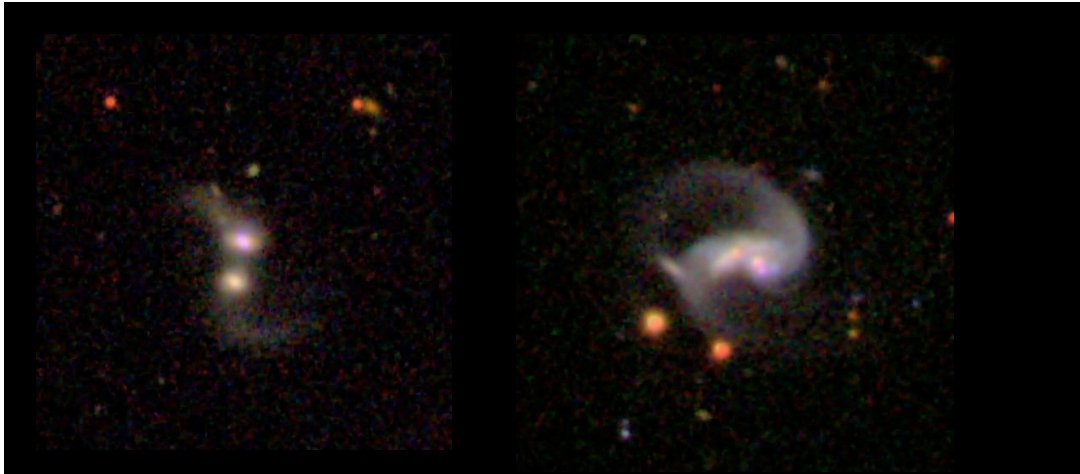


In progress, mostly from Bill's den:
~~Dead Quasar Survey~~
TELPERION





Seyfert galaxies with neutral hydrogen tails – [O III] survey. One new AGN cloud
(Erin Darnell MS thesis)



Seeking cross-ionization of gas in AGN companions:
trace ionization cones+history

Zooite-initiated science:

Peas (compact extreme star-forming galaxies)

Giant spirals

And plain surprises:

Merger regrowing disk?

Crazy long tails



Zooites are very energetic, sophisticated
Powerful role for “screening” even very
rare objects, configurations
Clarify what’s interesting
Watch forum/Talk for the unexpected!





It's a big Universe out there!

but all together we can grok more of it.

www.galaxyzoo.org



Special thanks to:

stellar190 – Alice – ElisabethB

RandyC – Mitch –laihro

Spiralmania – Budgieye

StephanieC – Waveney

(plus >300,000 others)