The Inner Kpc Region of Mrk 273 with Keck Adaptive Optics

Mrk 273
Not to scale!

Vivian U

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In collaboration with:

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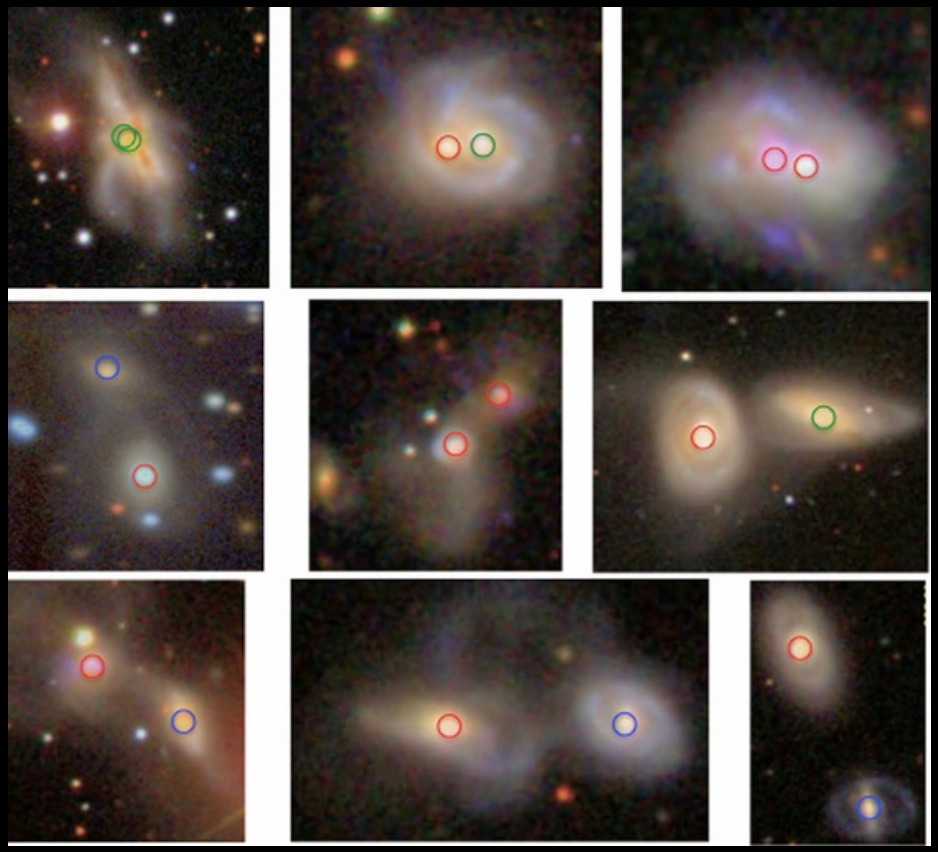
X-ray Detected Dual AGN



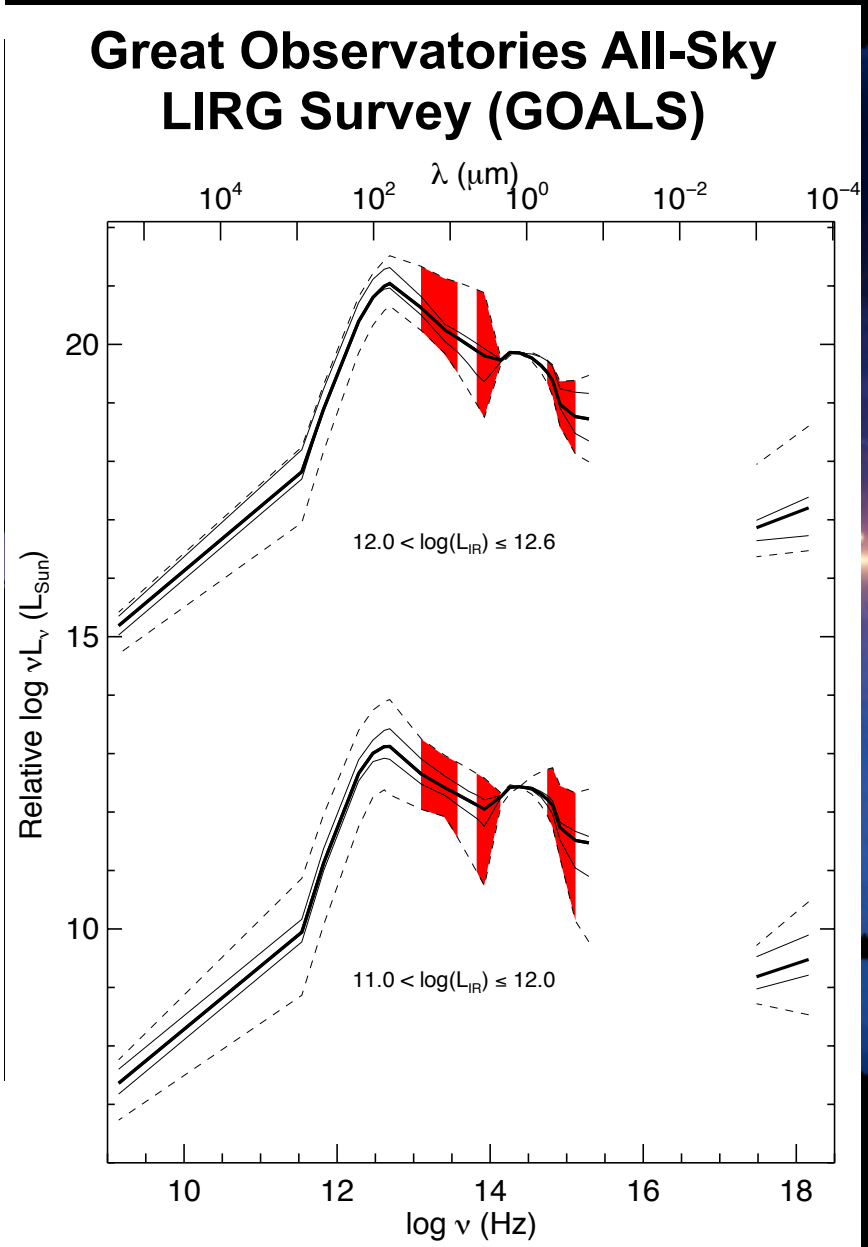
SWIFT/BAT-detected dual AGN (Koss+12)

NGC 6240
(Komossa+03)

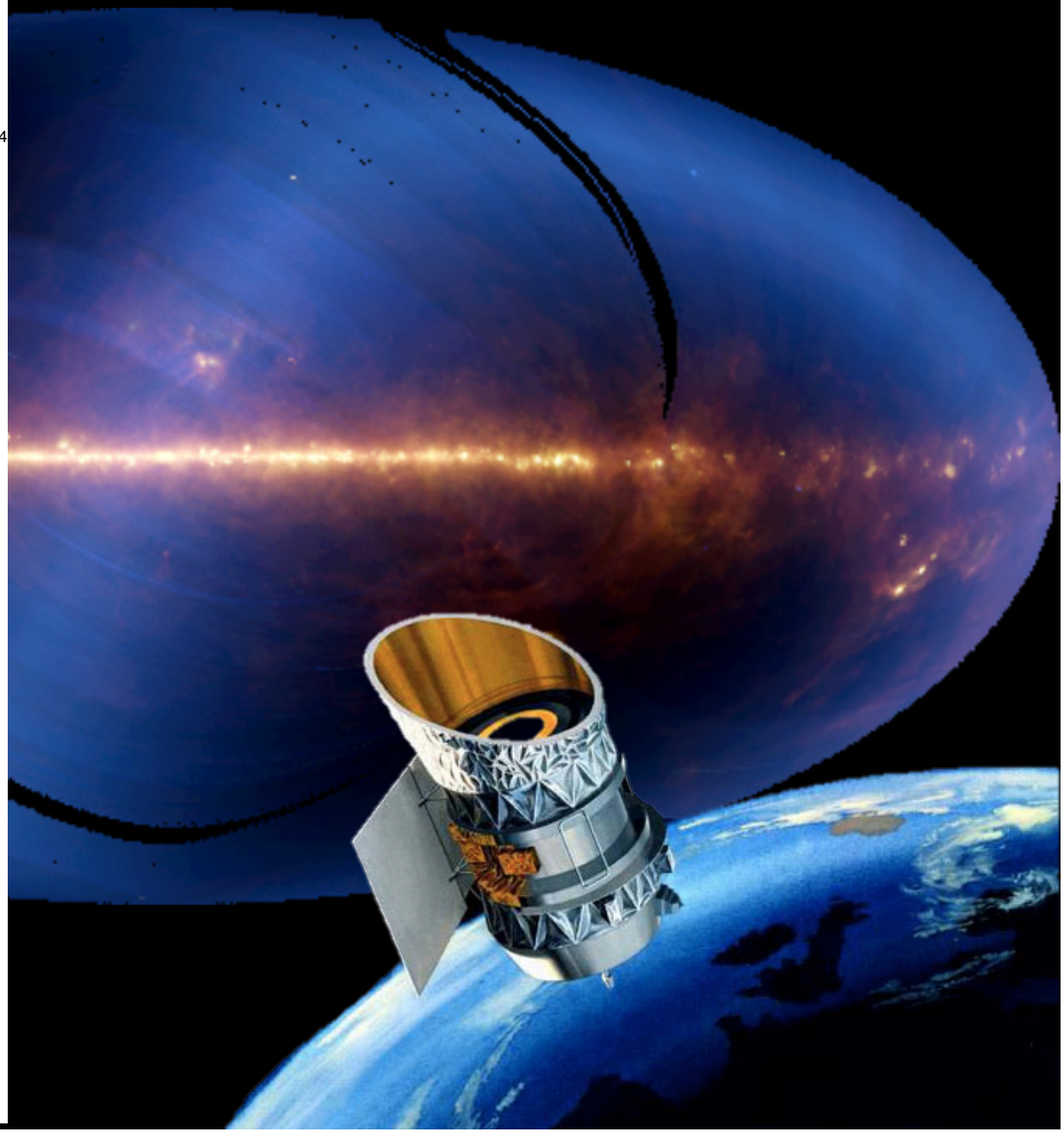
Confirmed dual AGN:
see also Ballo+04, Fu+11, Liu +11, McGurk+11, Gerke+07, Mazzarella+12, etc.

...AGN-Merger connection!?

InfraRed Astronomical Satellite (IRAS)

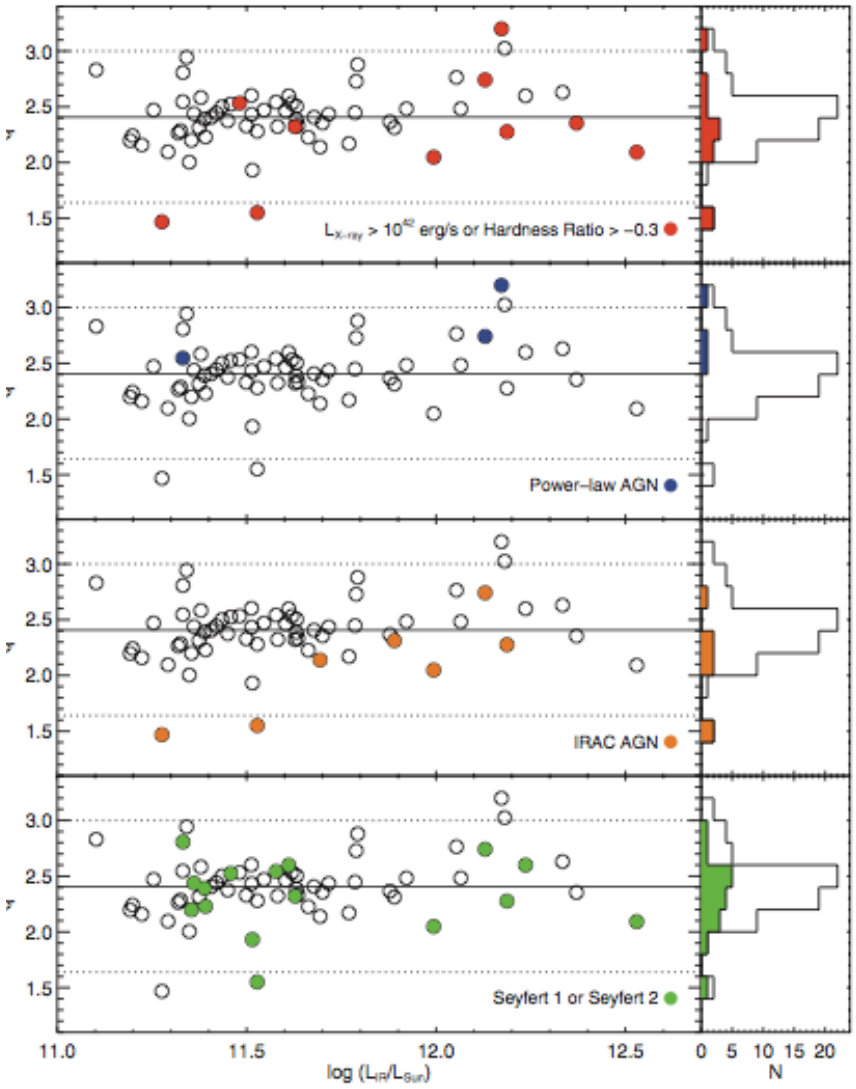


U+ 2012a, ApJS, 203, 9



InfraRed Astronomical Satellite (IRAS)

Great Observatories All-Sky LIRG Survey (GOALS)



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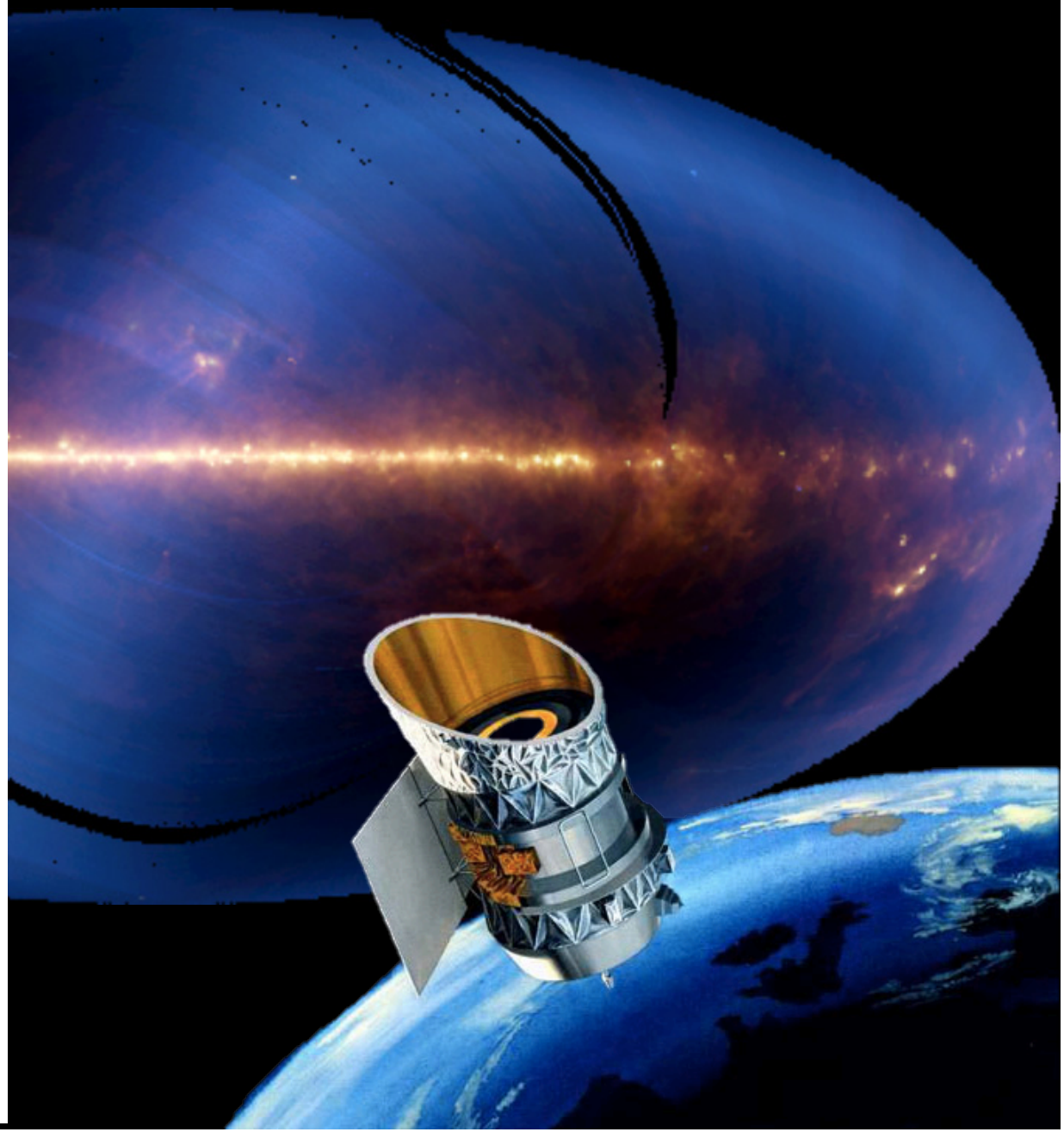
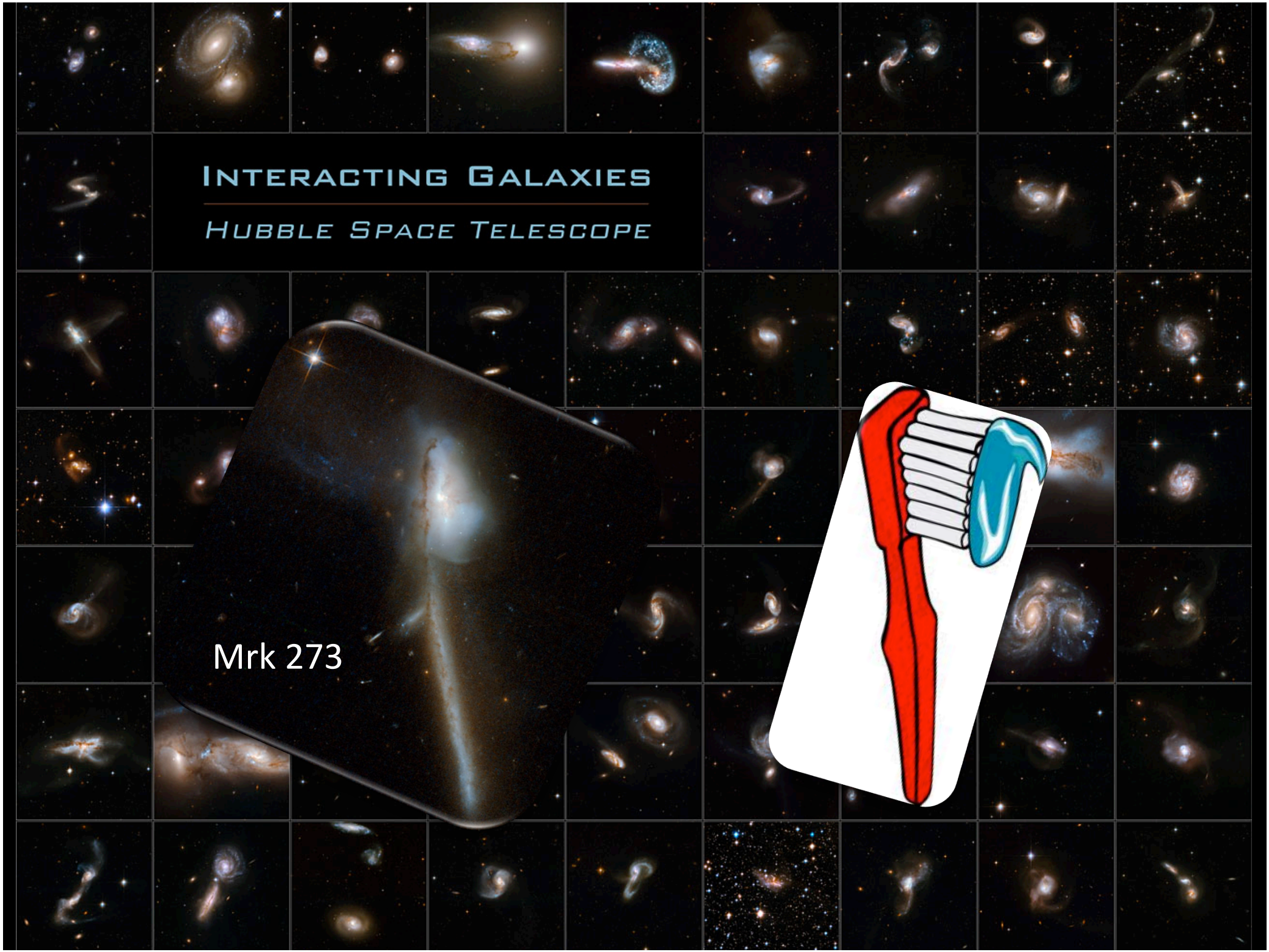
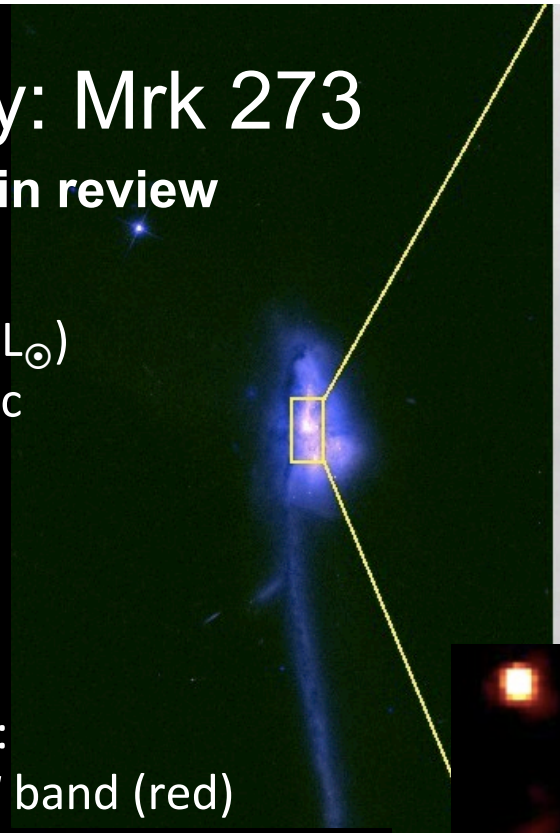


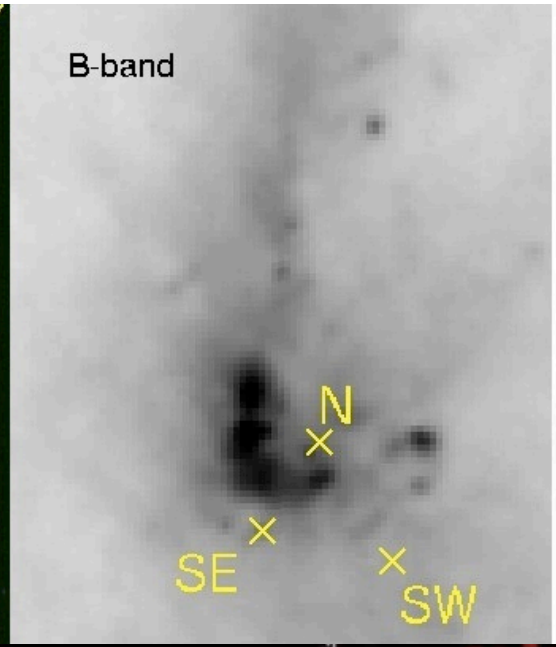

Interacting Galaxies
Hubble Space Telescope
Mrk 273

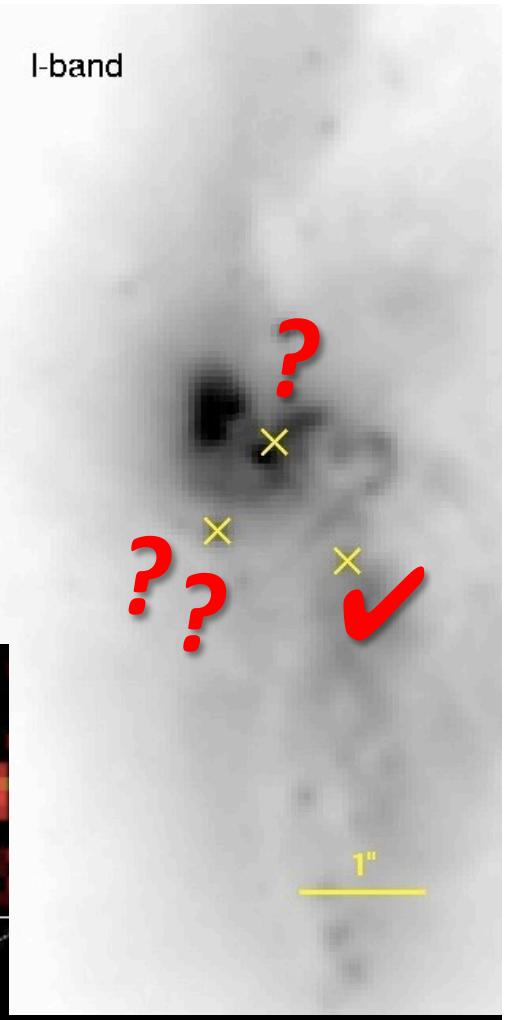
Case Study: Mrk 273

U+ 2012b, ApJ, in review

ULIRG ($L_{IR} = 10^{12.21} L_{\odot}$)
z = 0.04; 1" ~ 800pc

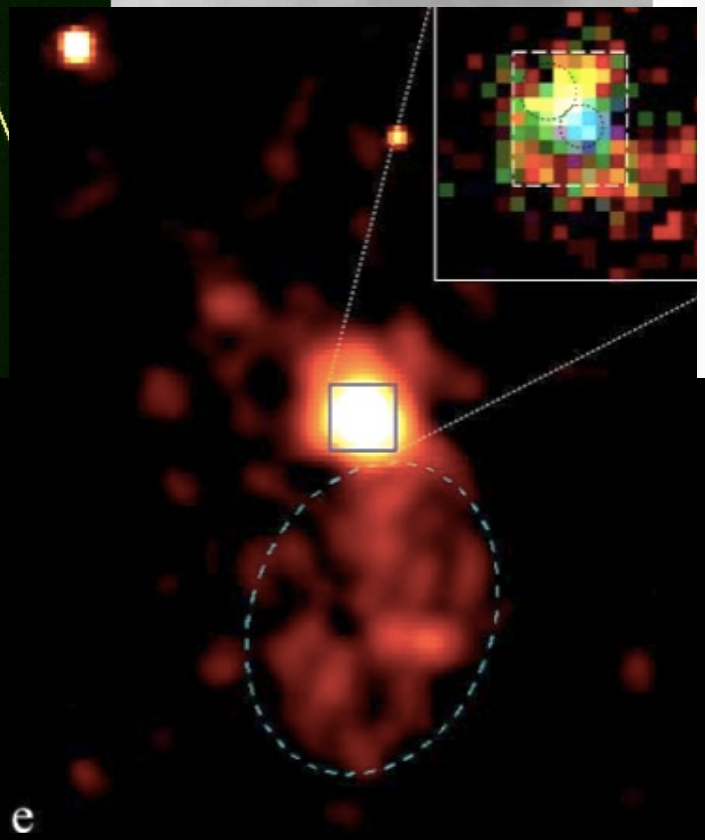






Underlying image:
I band (green) + *H* band (red)

Contours:
VLA 8.4 GHz



Hard X-ray (blue) +
Soft X-ray (yellow)

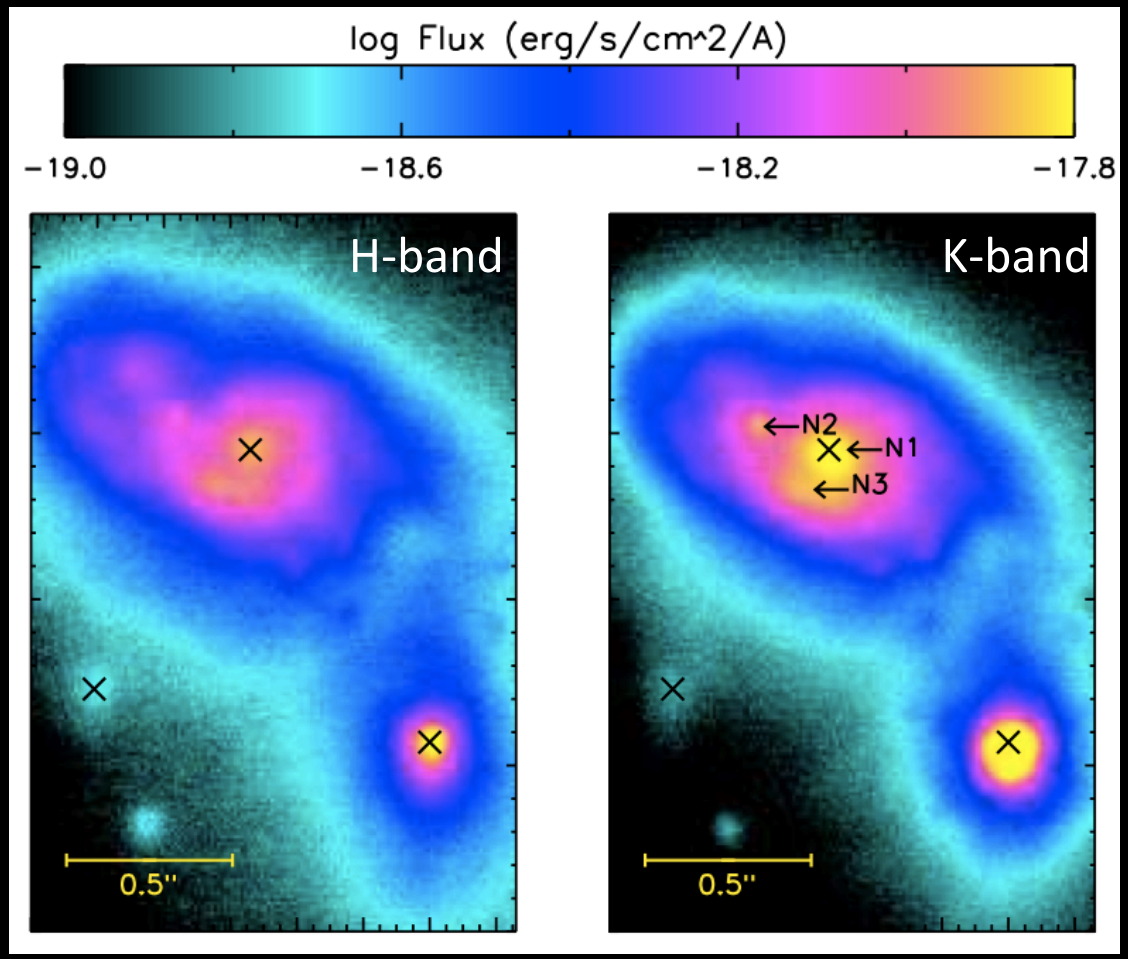
Iwasawa+11, Scoville+00, Condon+91, etc.

Keck NIR AO Campaign

- Goals: distribution and dynamics of nuclear gas, black hole masses

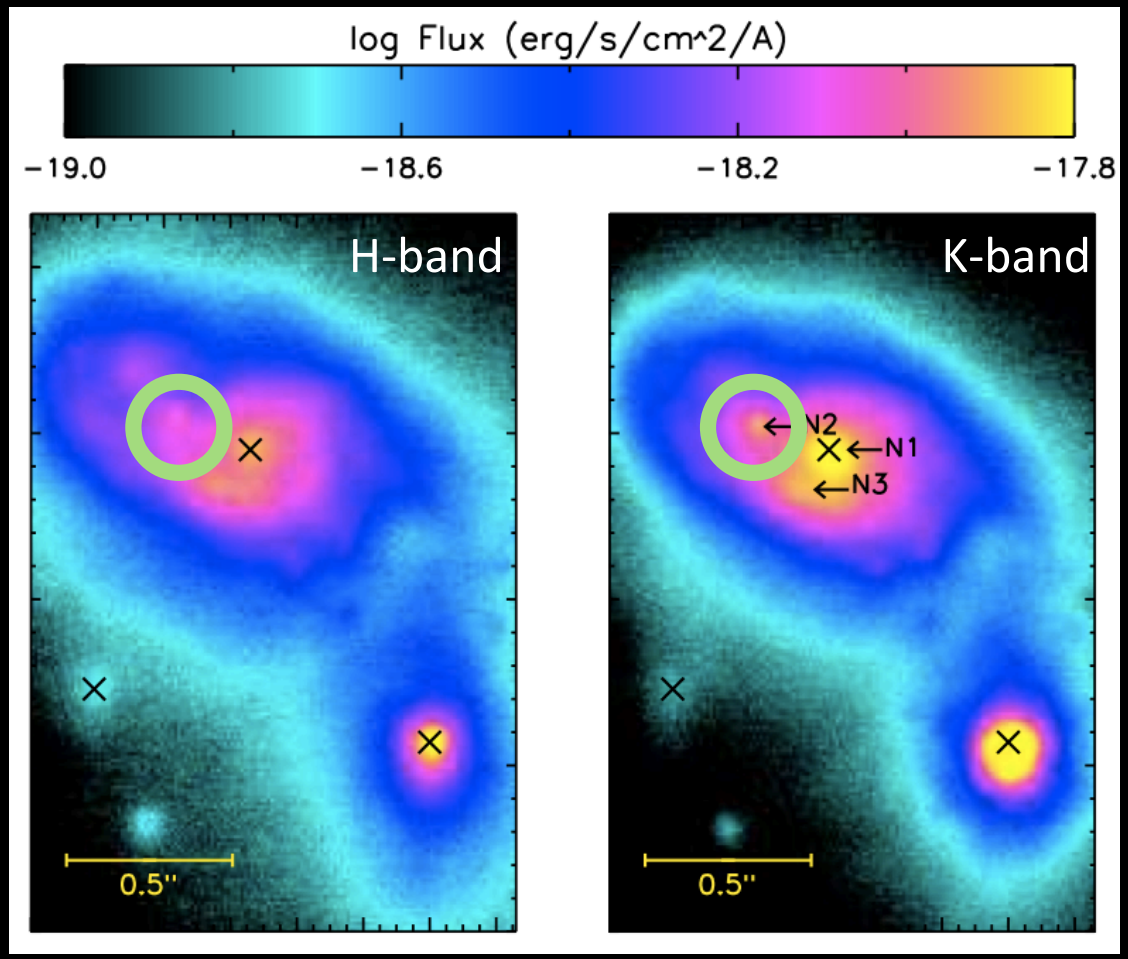
- ***Strategies:***
  - ***NIRC2 and OSIRIS, LGS (NGS) AO (FWHM ~0.05")***
  - ***H or K bands, 0.01" (NIRC2) and 0.035"-0.100" (OSIRIS)***
  - ***Molecular and atomic gases, stellar dynamics: H_2, Br, He I, [Si VI], CO bandheads, etc.***

NIRC 2 images (0.01"/px, or 8pc/px)



NIRC 2 images (0.01"/px, or 8pc/px)

site of SNe;
dust extinction



NIRC 2 images (0.01"/px, or 8pc/px)

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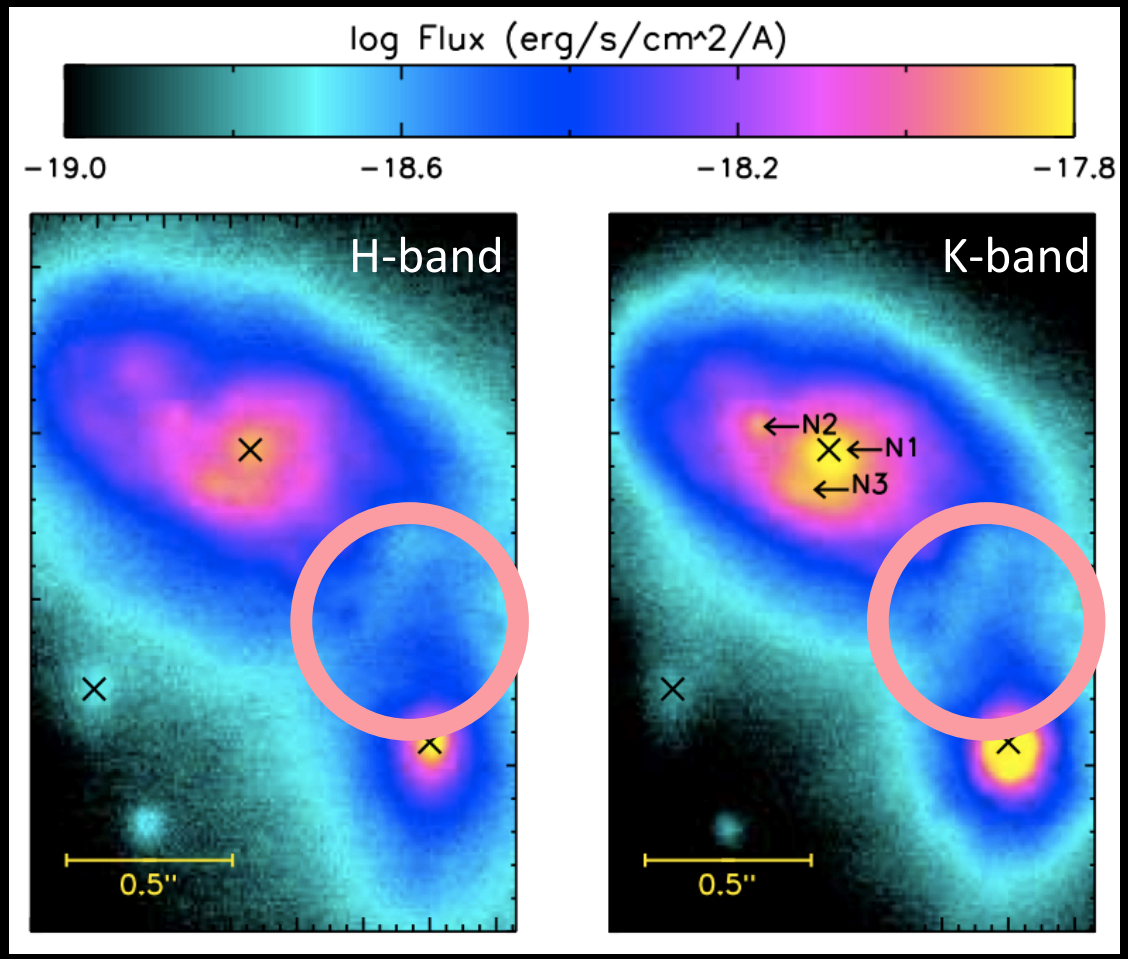
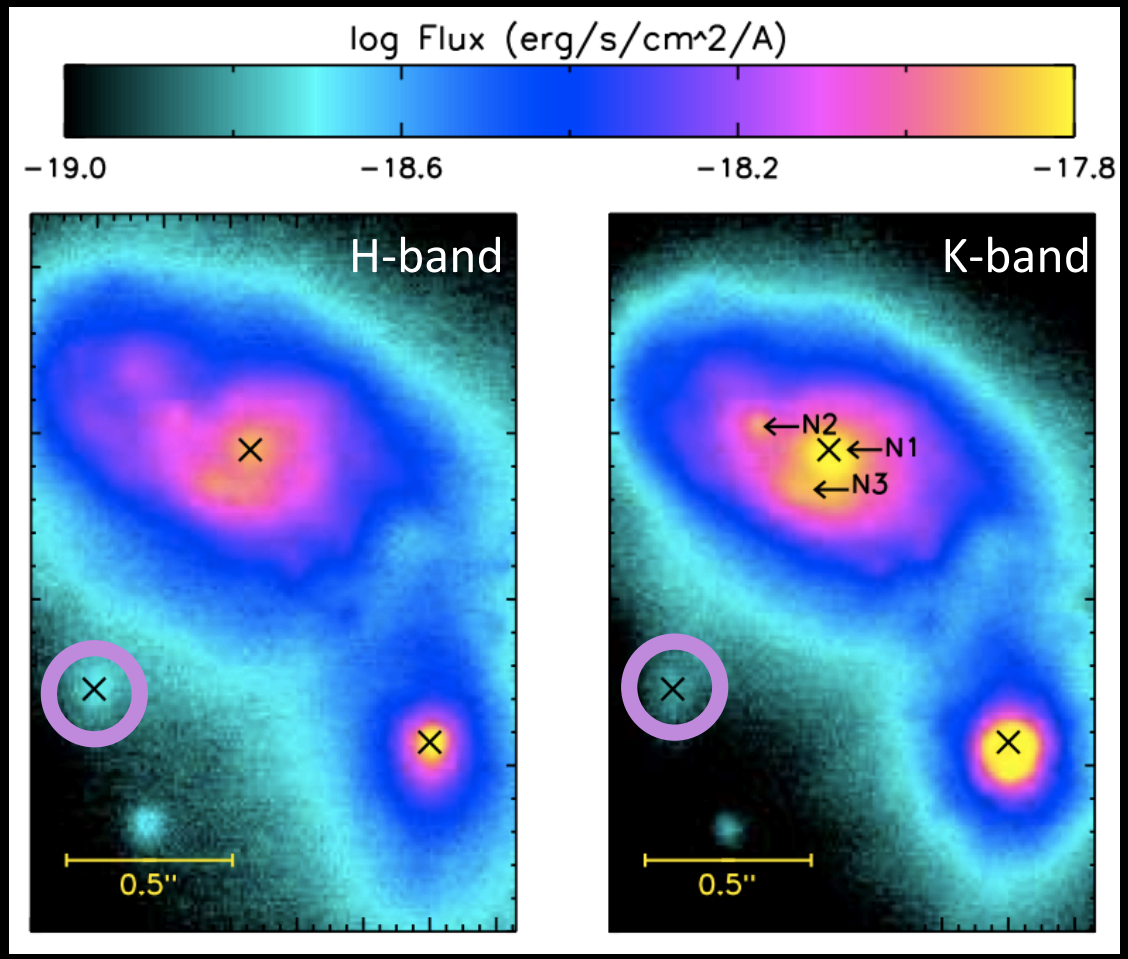


disrupted tidal
feature

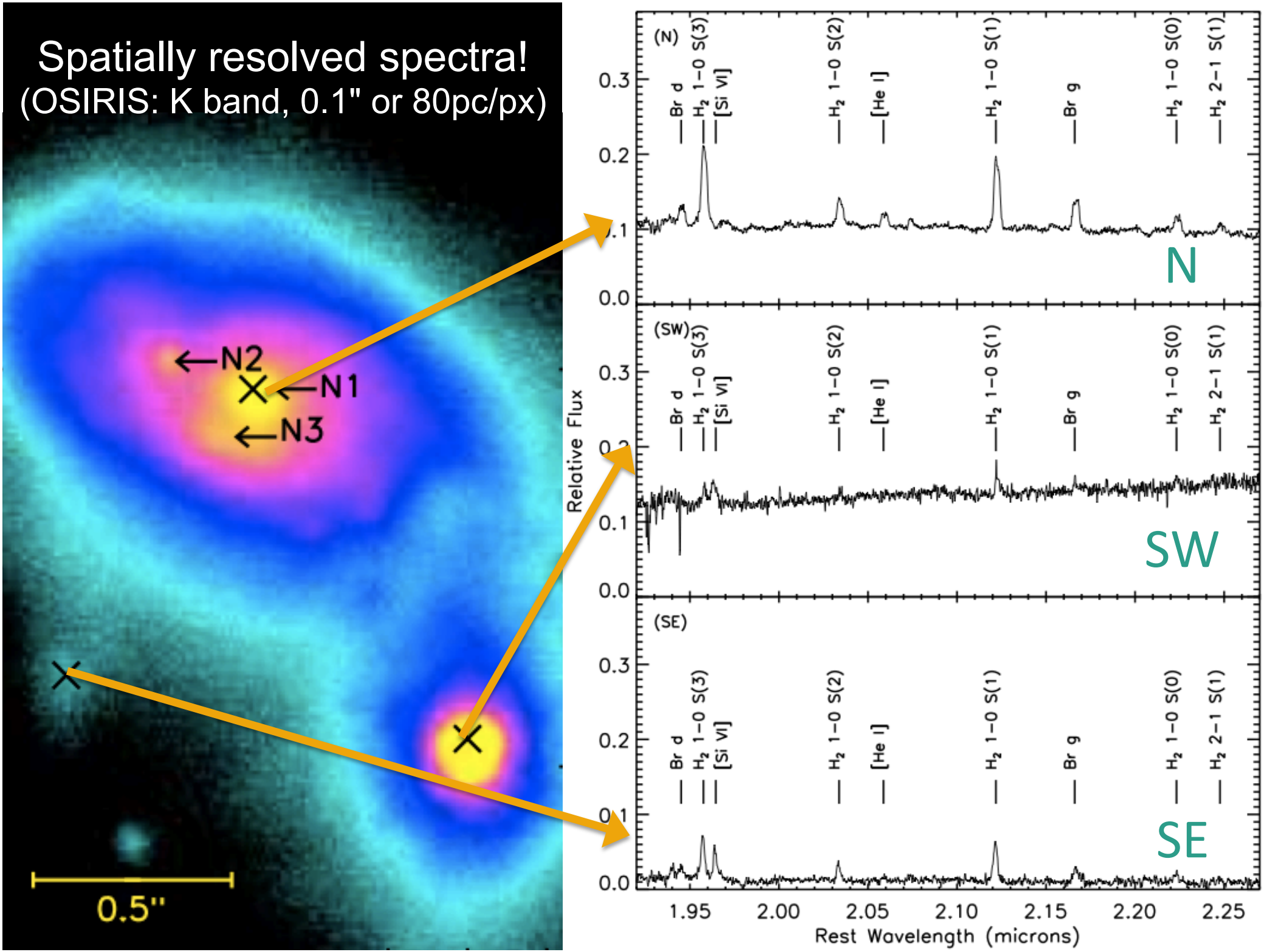
NIRC 2 images (0.01"/px, or 8pc/px)

site of SNe;
dust extinction



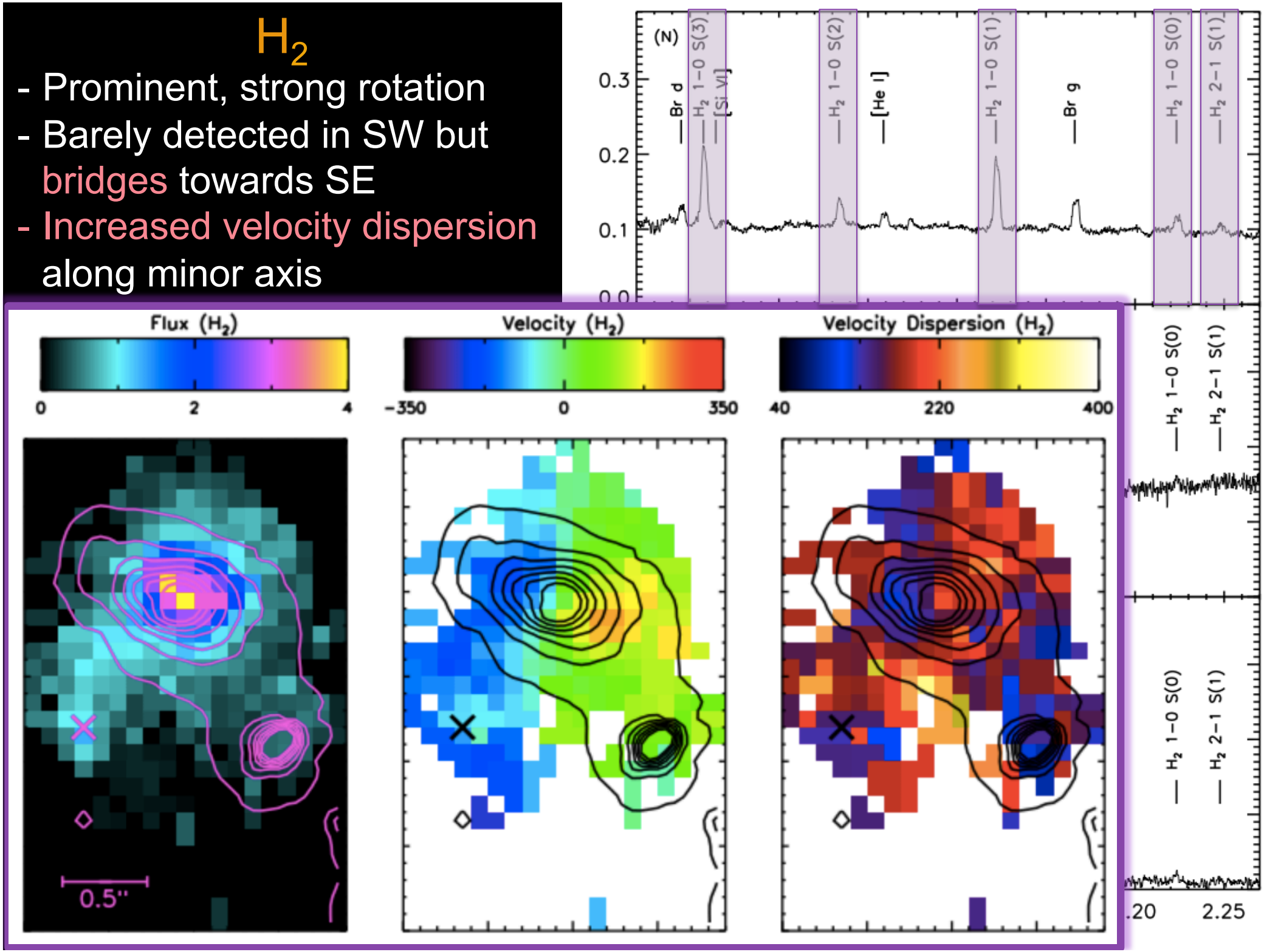
disrupted tidal
feature

extended component
associated with N


Spatially resolved spectra!
(OSIRIS: K band, 0.1" or 80pc/px)
N2
N1
N3
0.5"
(N)
(SW)
(SE)
Br d
H2 1-0 S(3)
[Si VI]
H2 1-0 S(2)
[He I]
H2 1-0 S(1)
Br g
H2 1-0 S(0)
H2 2-1 S(1)
N
SW
SE
Relative Flux
Rest Wavelength (microns)
0.0
0.1
0.2
0.3
1.95
2.00
2.05
2.10
2.15
2.20
2.25

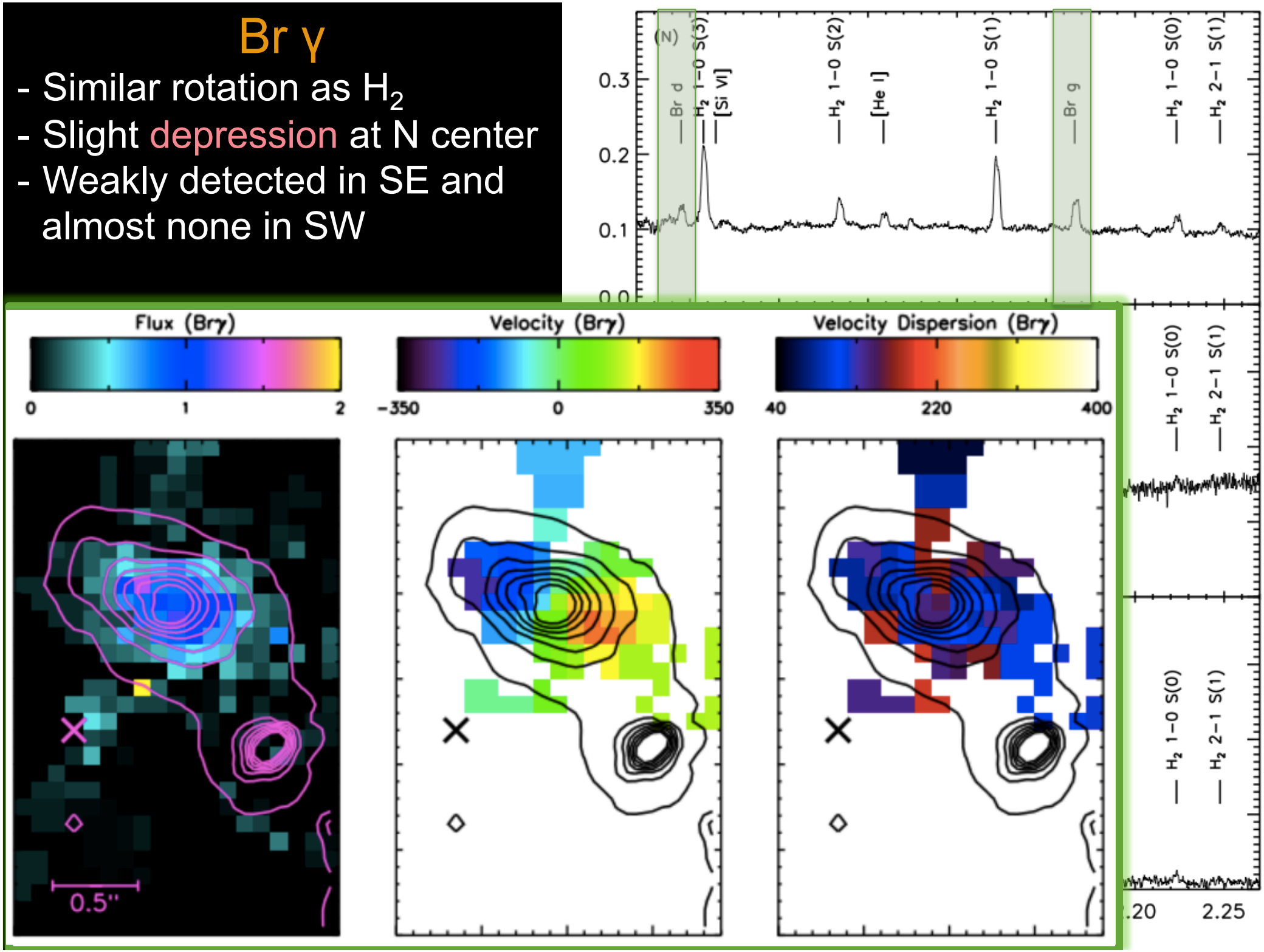
H_2

- Prominent, strong rotation
- Barely detected in SW but bridges towards SE
- Increased velocity dispersion along minor axis



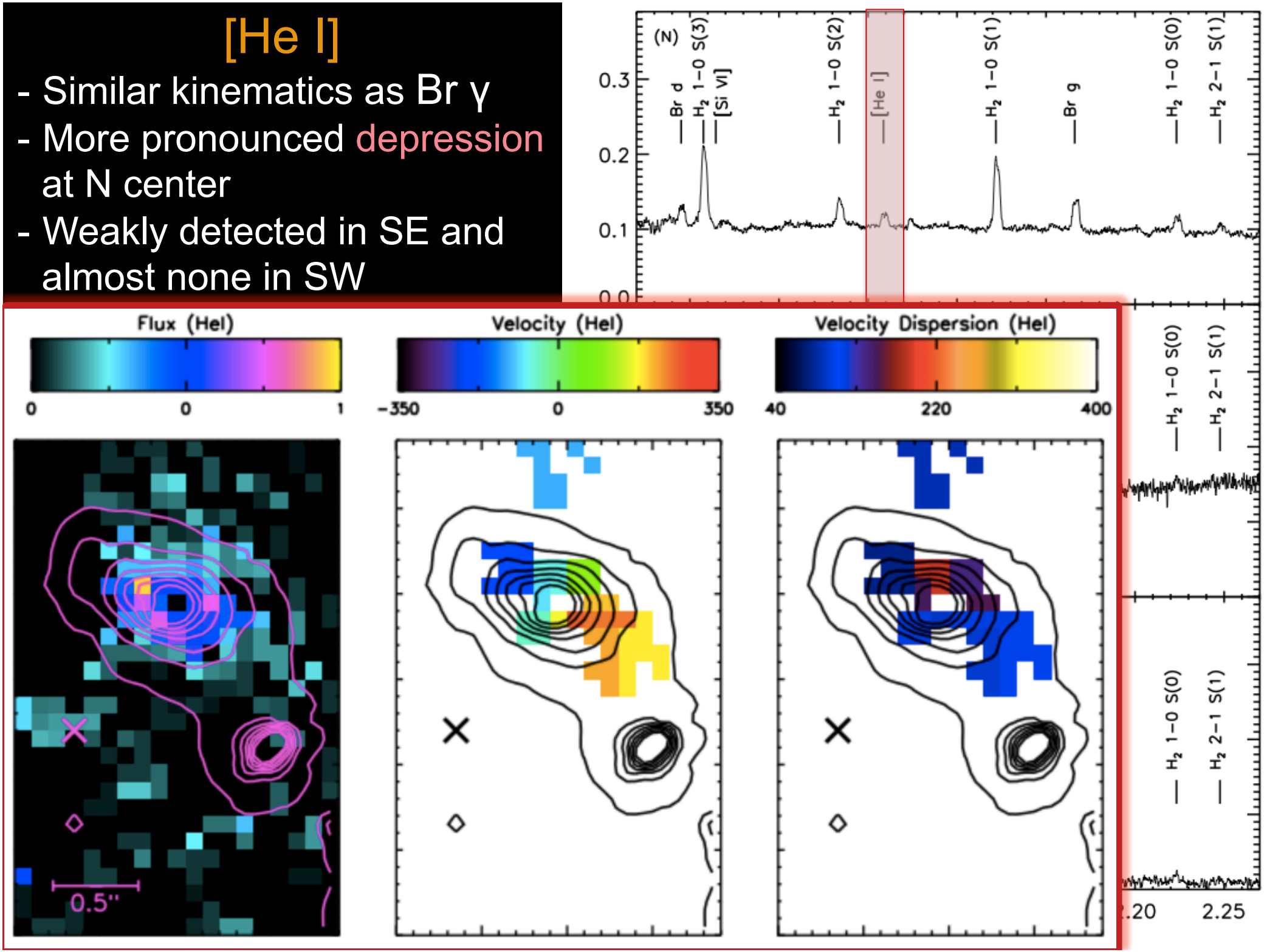
Br γ

- Similar rotation as H_2
- Slight depression at N center
- Weakly detected in SE and almost none in SW



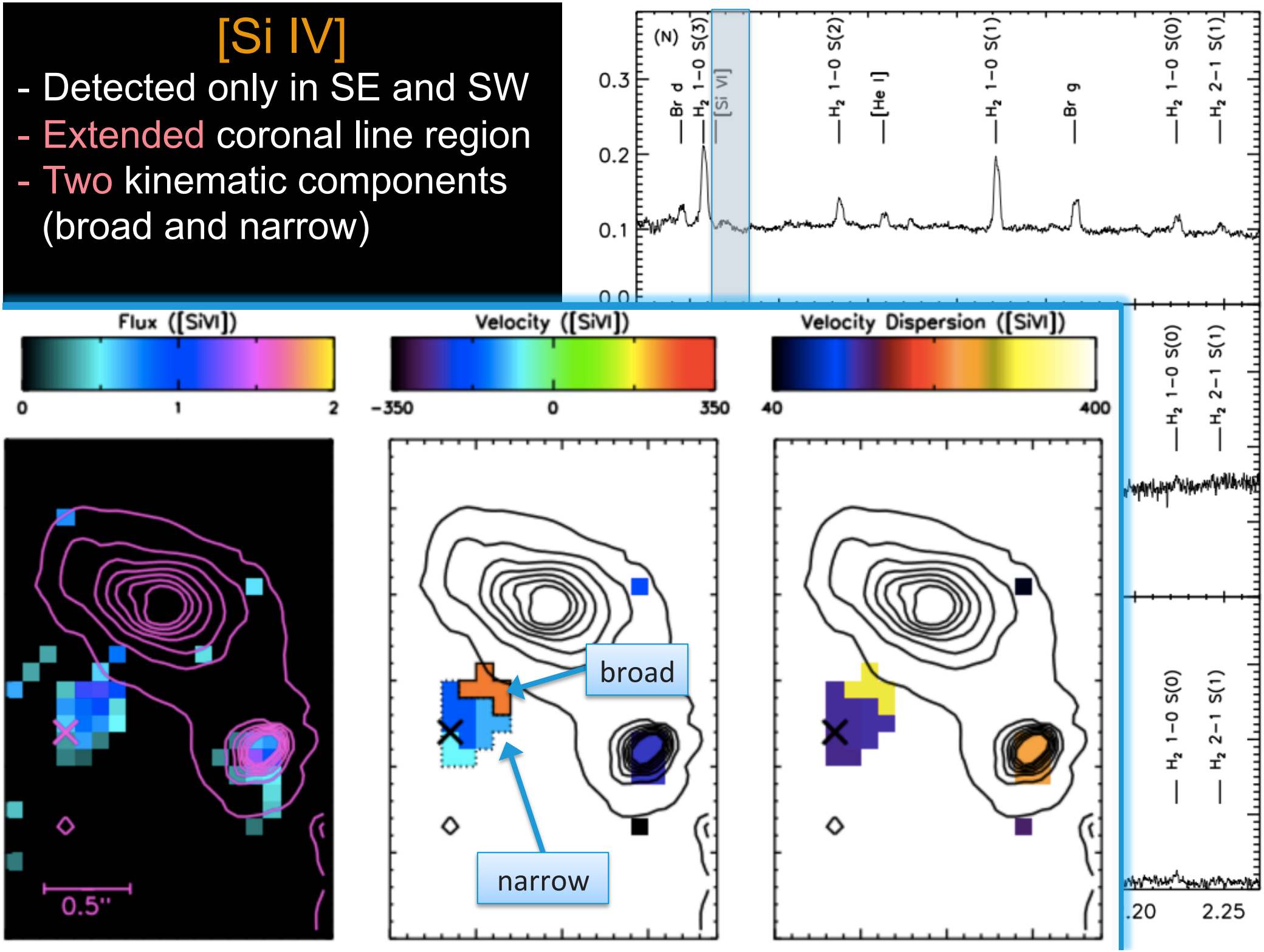
[He I]

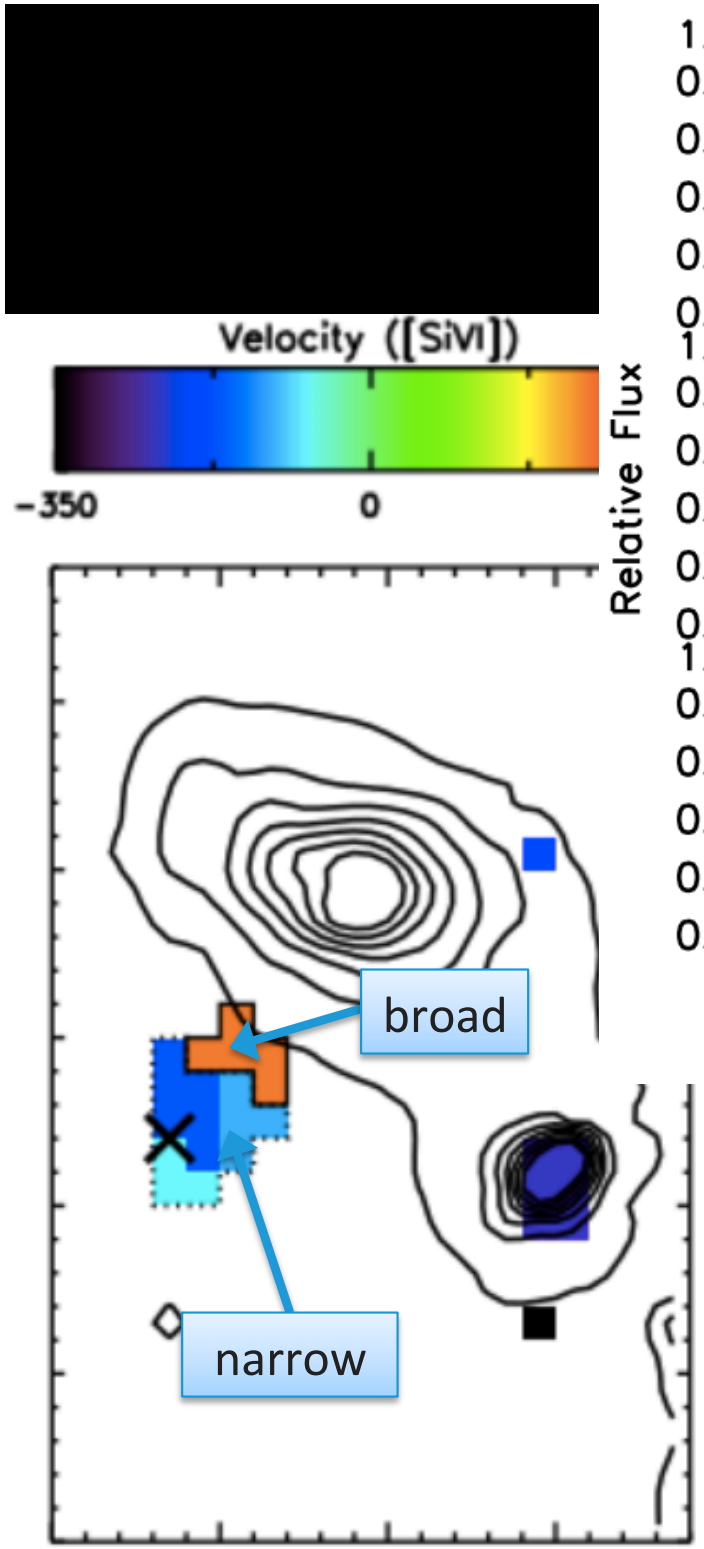
- Similar kinematics as Br γ
- More pronounced depression at N center
- Weakly detected in SE and almost none in SW

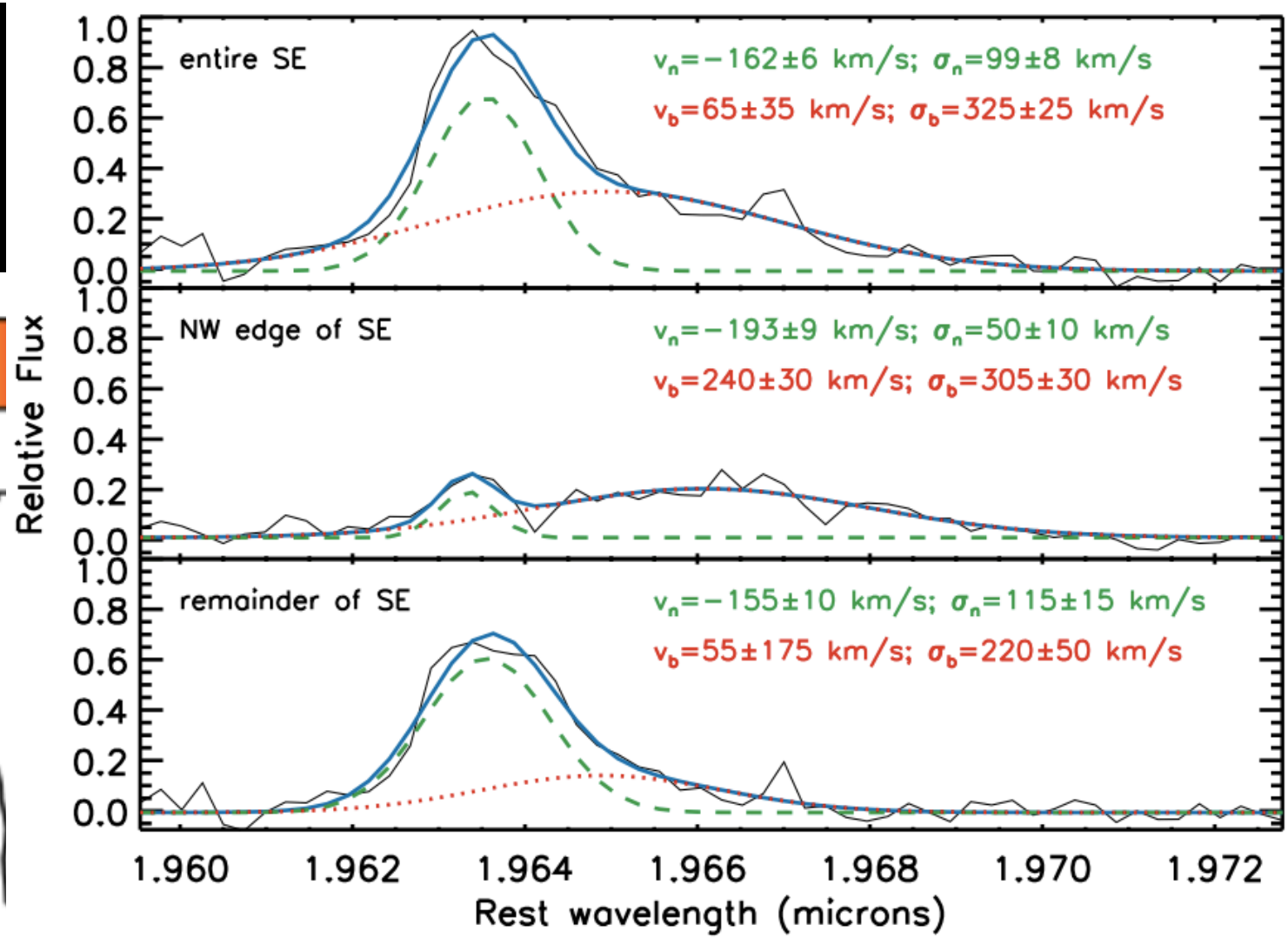


[Si IV]

- Detected only in SE and SW
- Extended coronal line region
- Two kinematic components (broad and narrow)



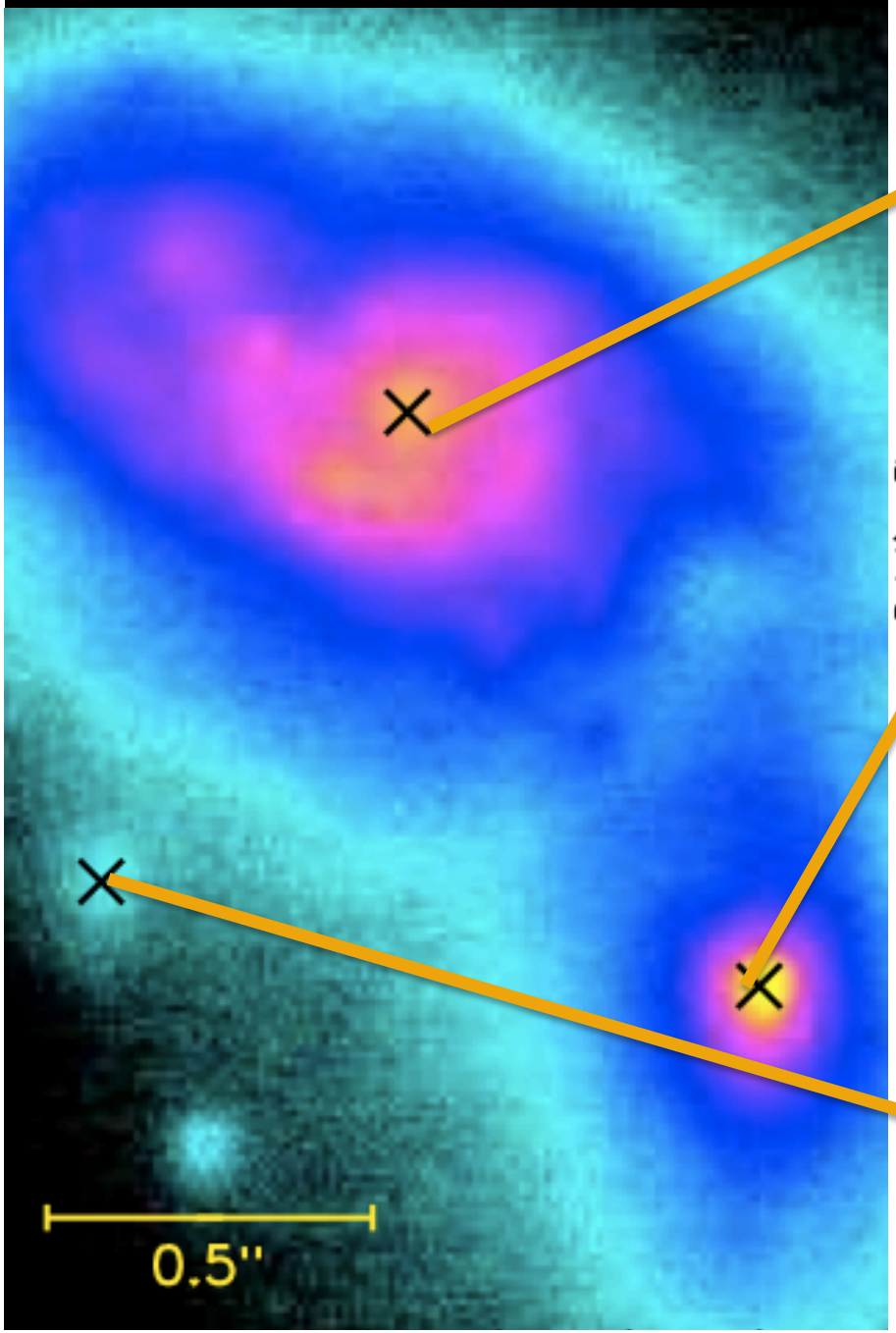


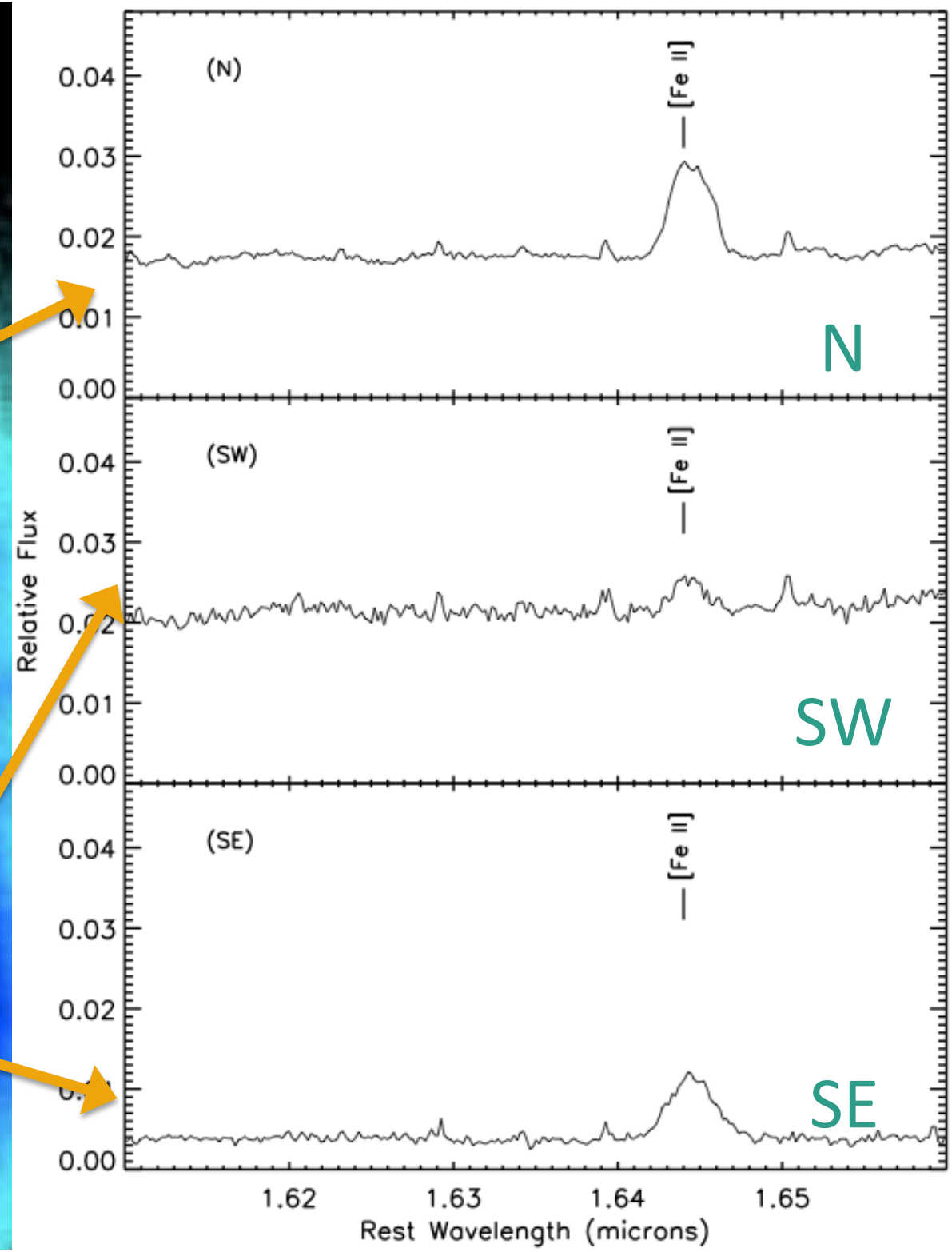


[Si VI] line in the SE

Vivian U

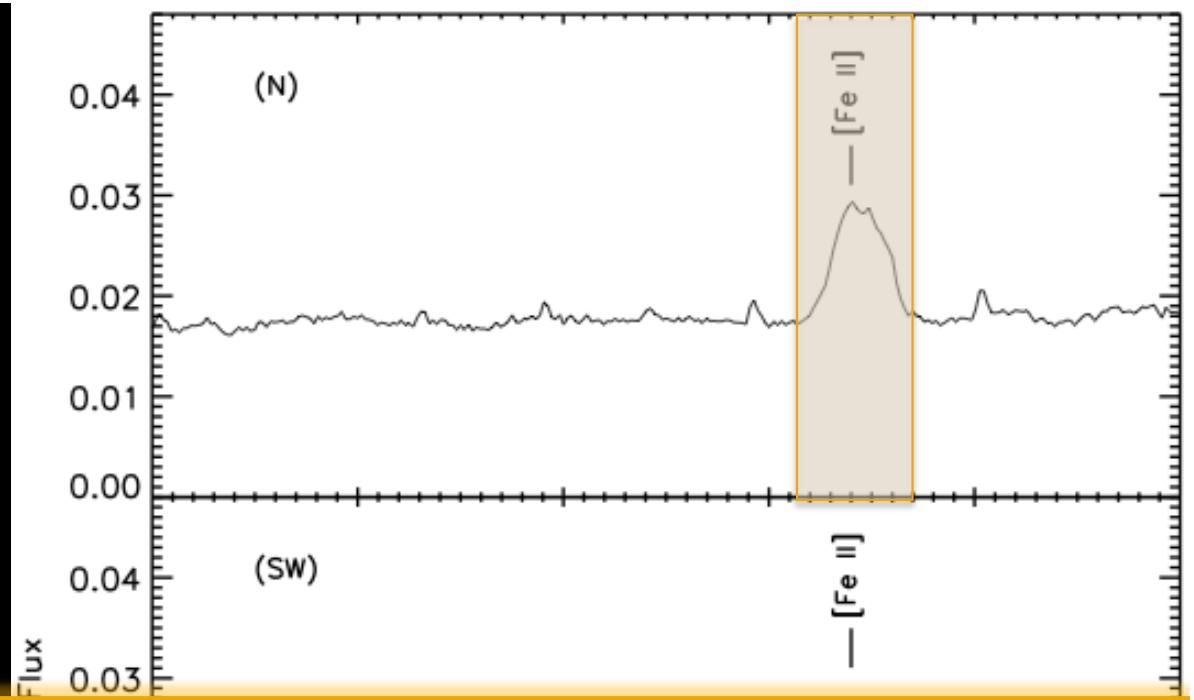
Spatially resolved spectra!
(H band, 0.035" or 28pc/px)

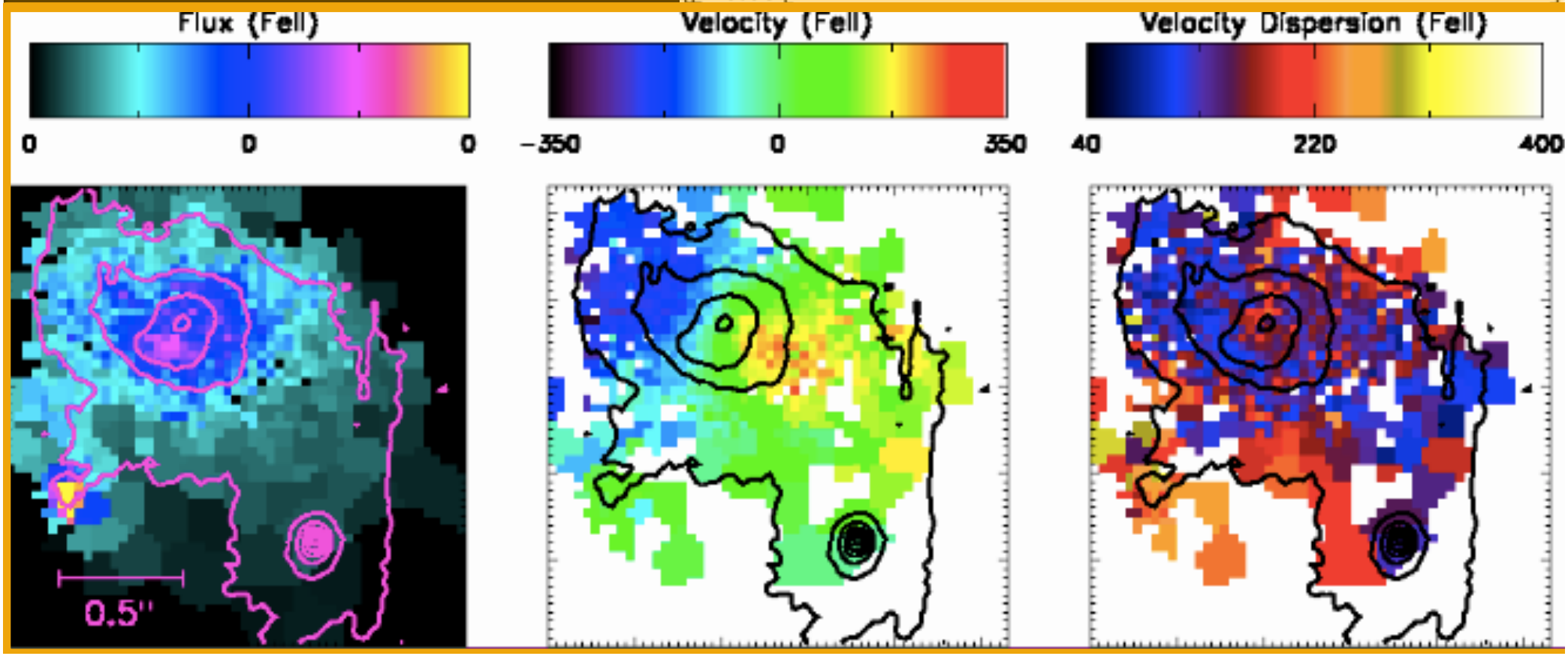




[Fe II]

- H band: 0.035" or 28pc/px
- Shock indicator from SNR or AGN
- N clumps match NIRC2 ones
- N rotation: ±240 km/s
- SE dominates the surface brightness



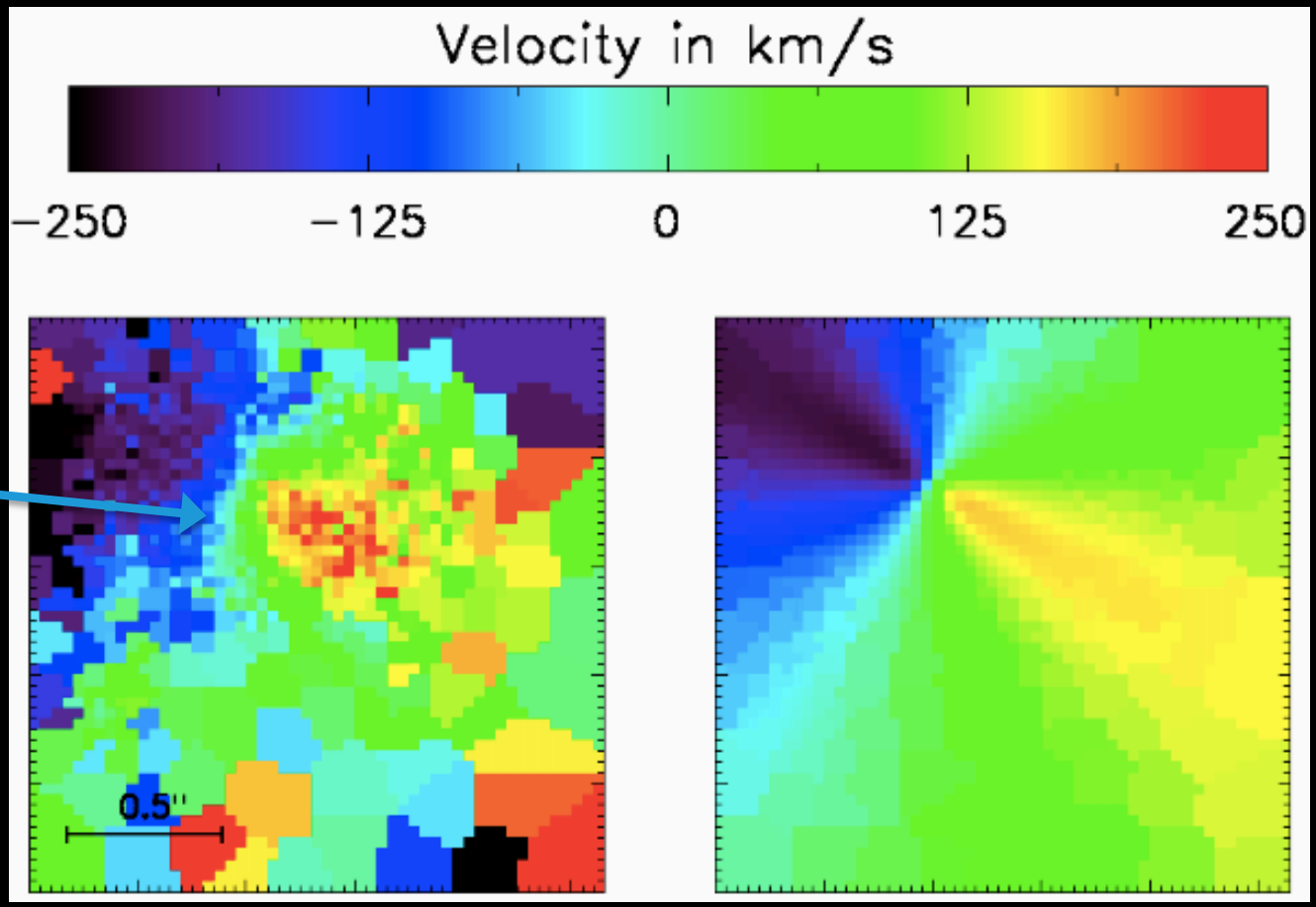


Black Hole Dynamical Mass

$$v = \sqrt{\frac{GM_{encl}(r)}{r}}$$

$$M_{encl}(r) = M_{BH} + \rho_0 r^{\gamma}$$

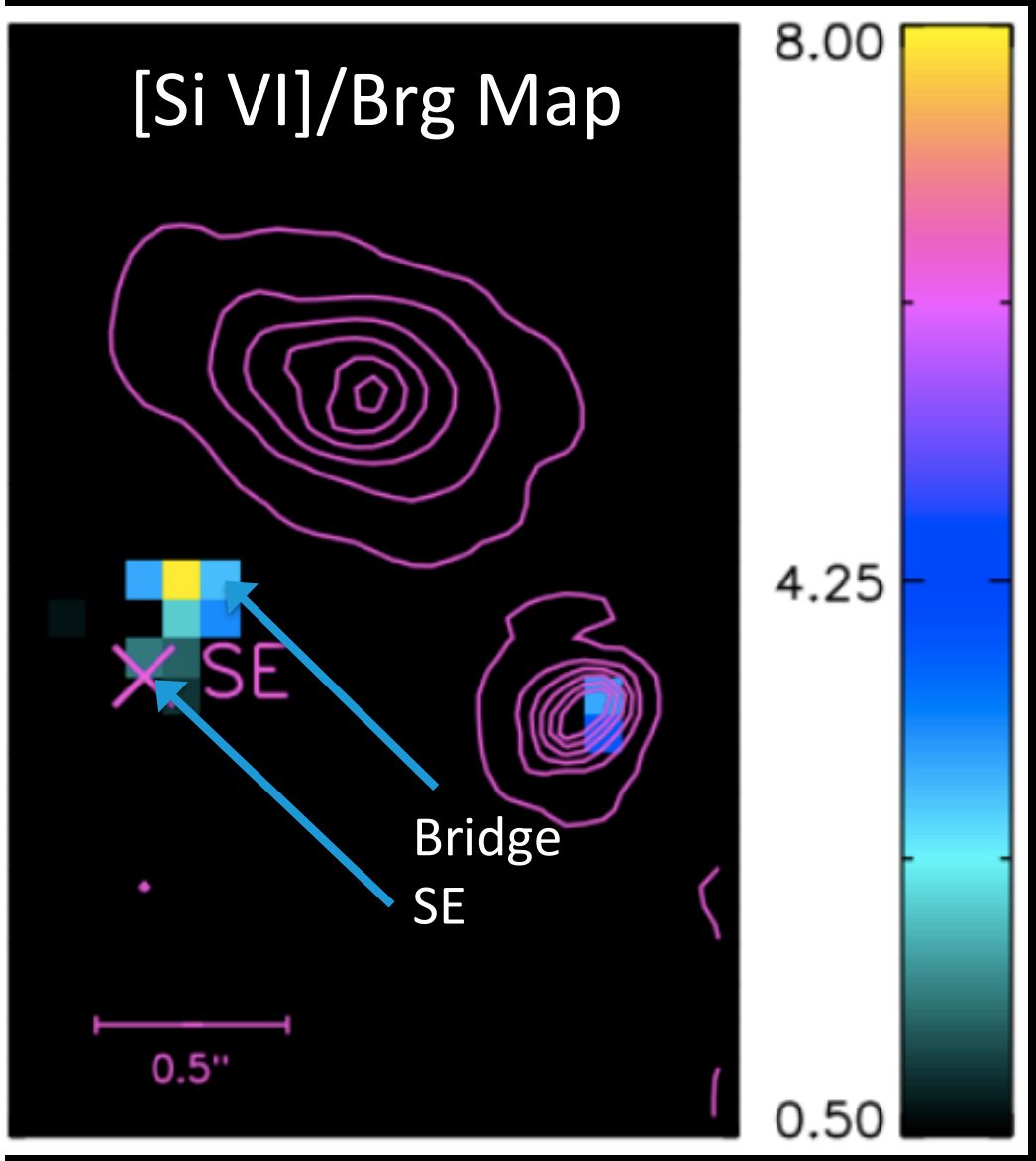
Spatial resolution: 28pc/px, resolving within sphere of influence!



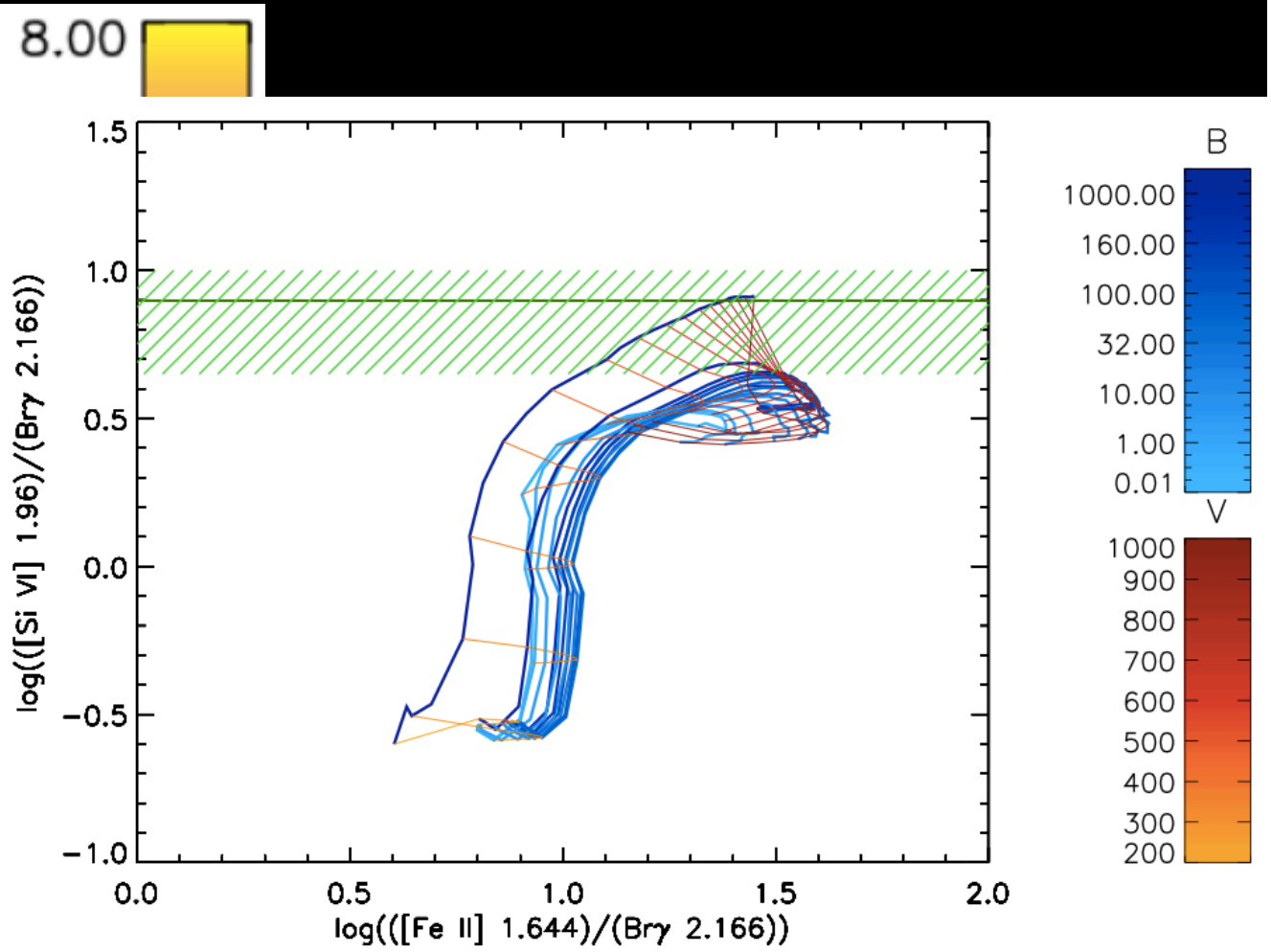
$M_{BH} = 1.1 \pm 0.1 \times 10^9\ M_\odot$

From OH maser (Klockner & Baan 04):
$M_{BH} = 1.39 \pm 0.16 \times 10^9\ M_\odot$

Nature of SE Component

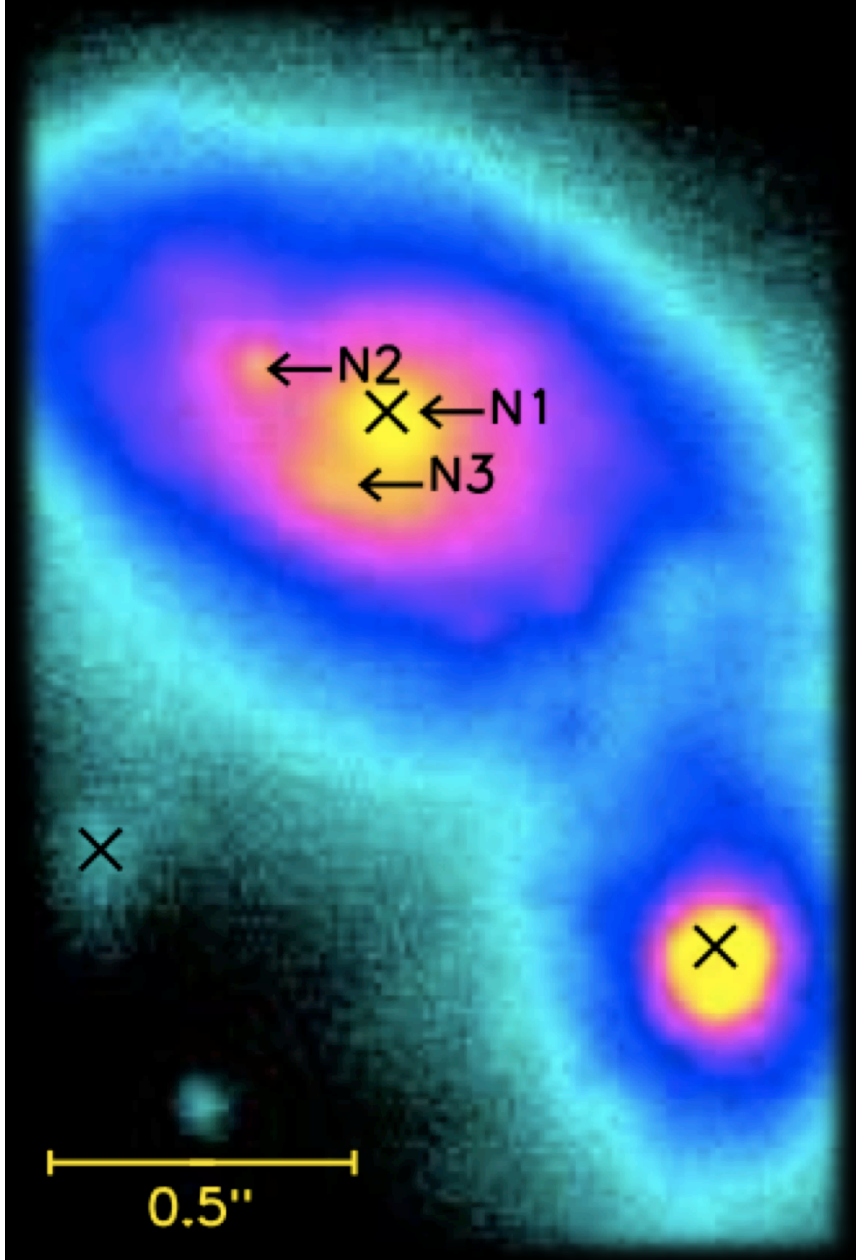


Nature of SE Component



$v_{shock} > 550$ km/s

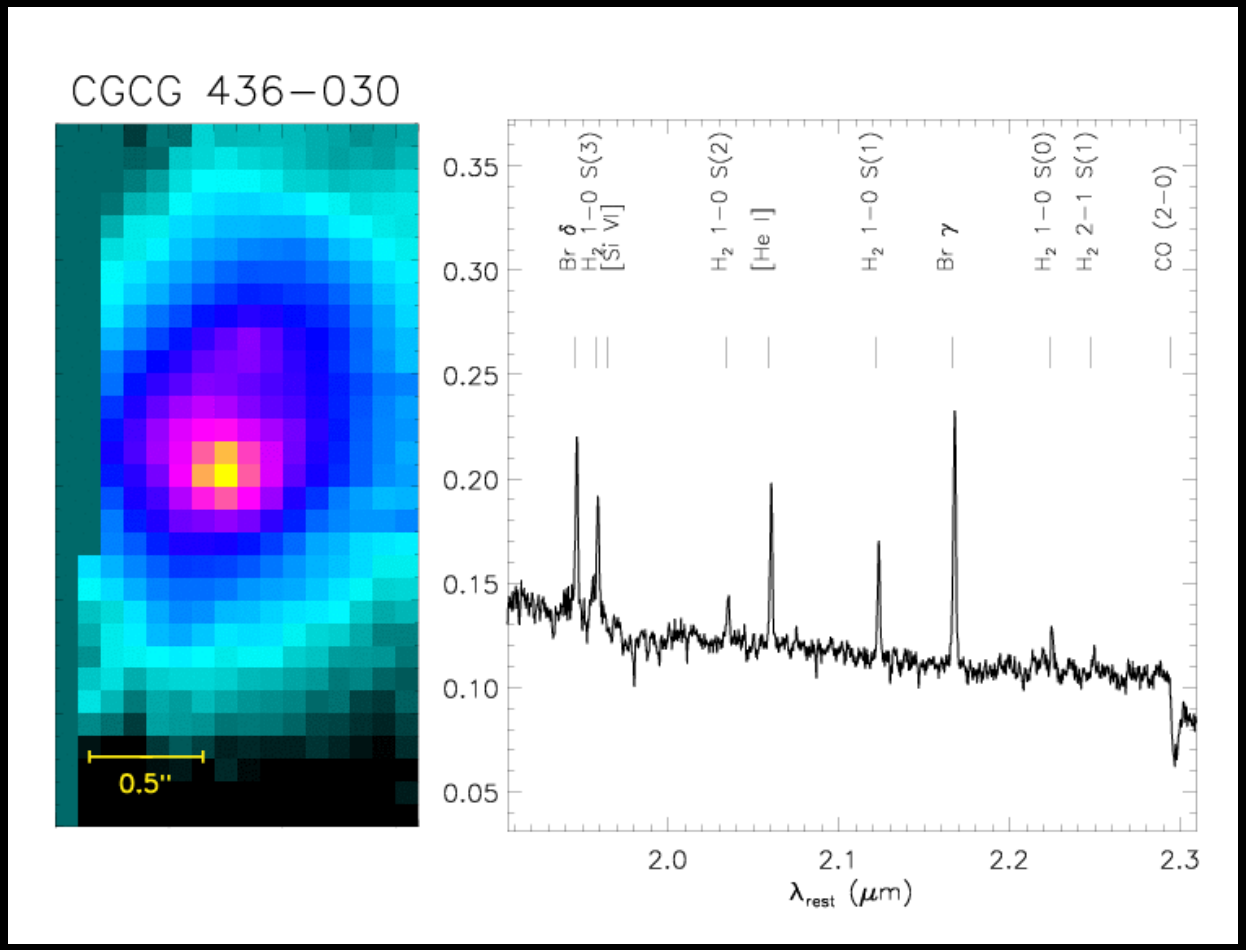
What can we conclude about Mrk 273?



- SW: Hard X-ray AGN
- N: SMBH, obscured AGN
- SE: stellar or gas clump, photoionized by obscured AGN in N or shock-heated by outflows due to N AGN or nuclear SF
- Bridge: outflow

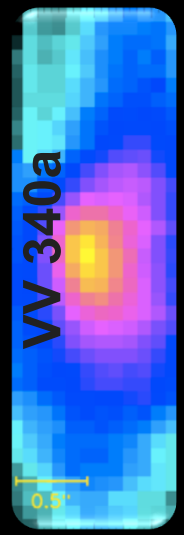
...dual AGN system!

At A Glance…



17 systems

First systematic high-resolution NIR IFU look of these local (U)LIRGs!



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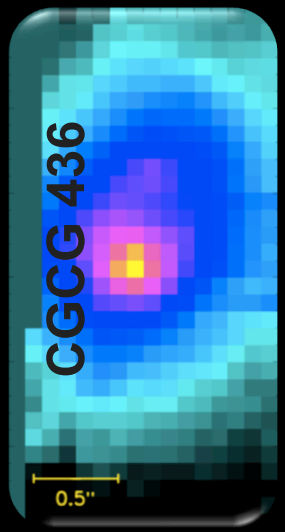

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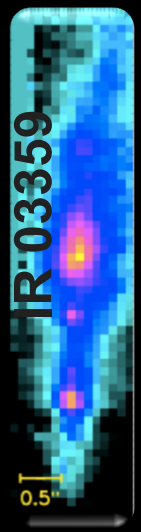

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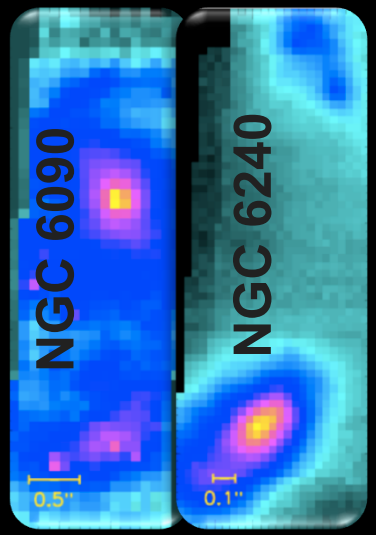
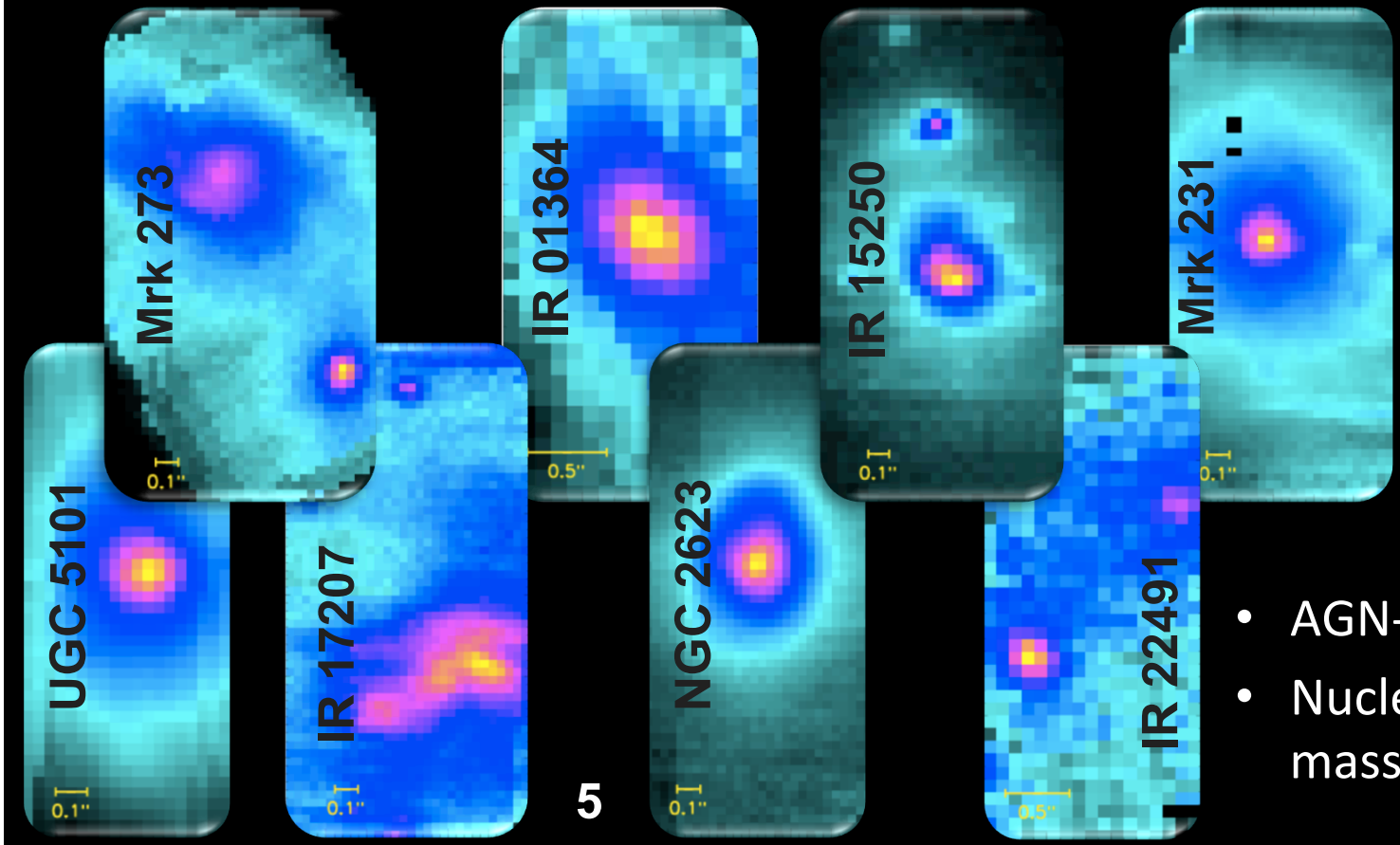
4





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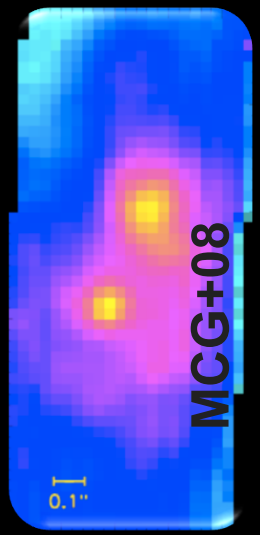
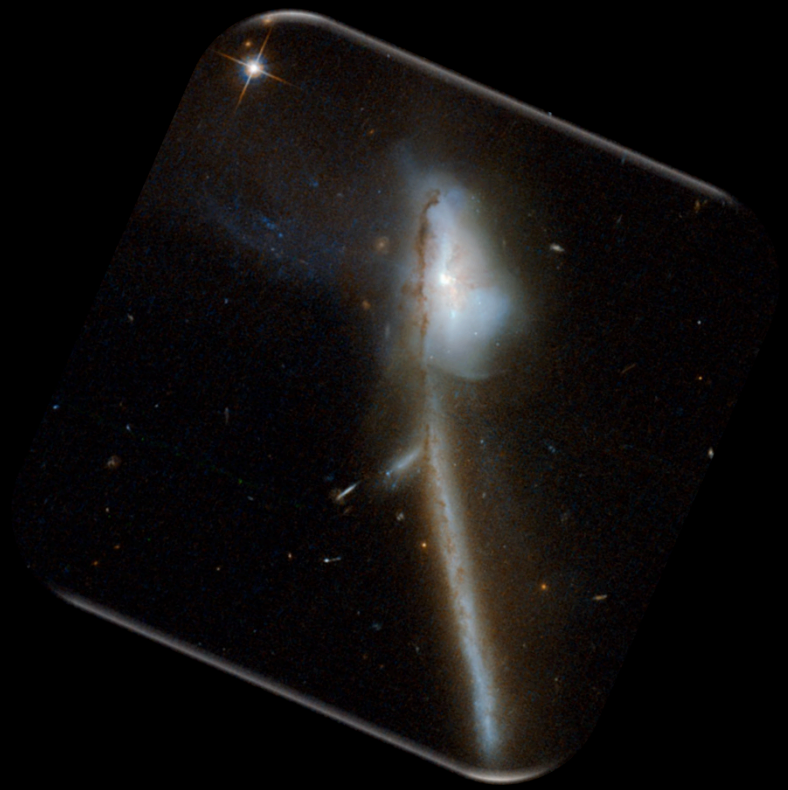


6

- AGN-SB energetics (U+ 2013)
- Nuclear disks, Black hole masses (Medling, U+ 2013ab)

What can we conclude about Mrk 273?

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