Discovery of a Fading AGN in a ULIRG with Kpc-scale Fast Wind

(Chen et al. 2020, ApJL, 905, L2)

#o29-chen@slack

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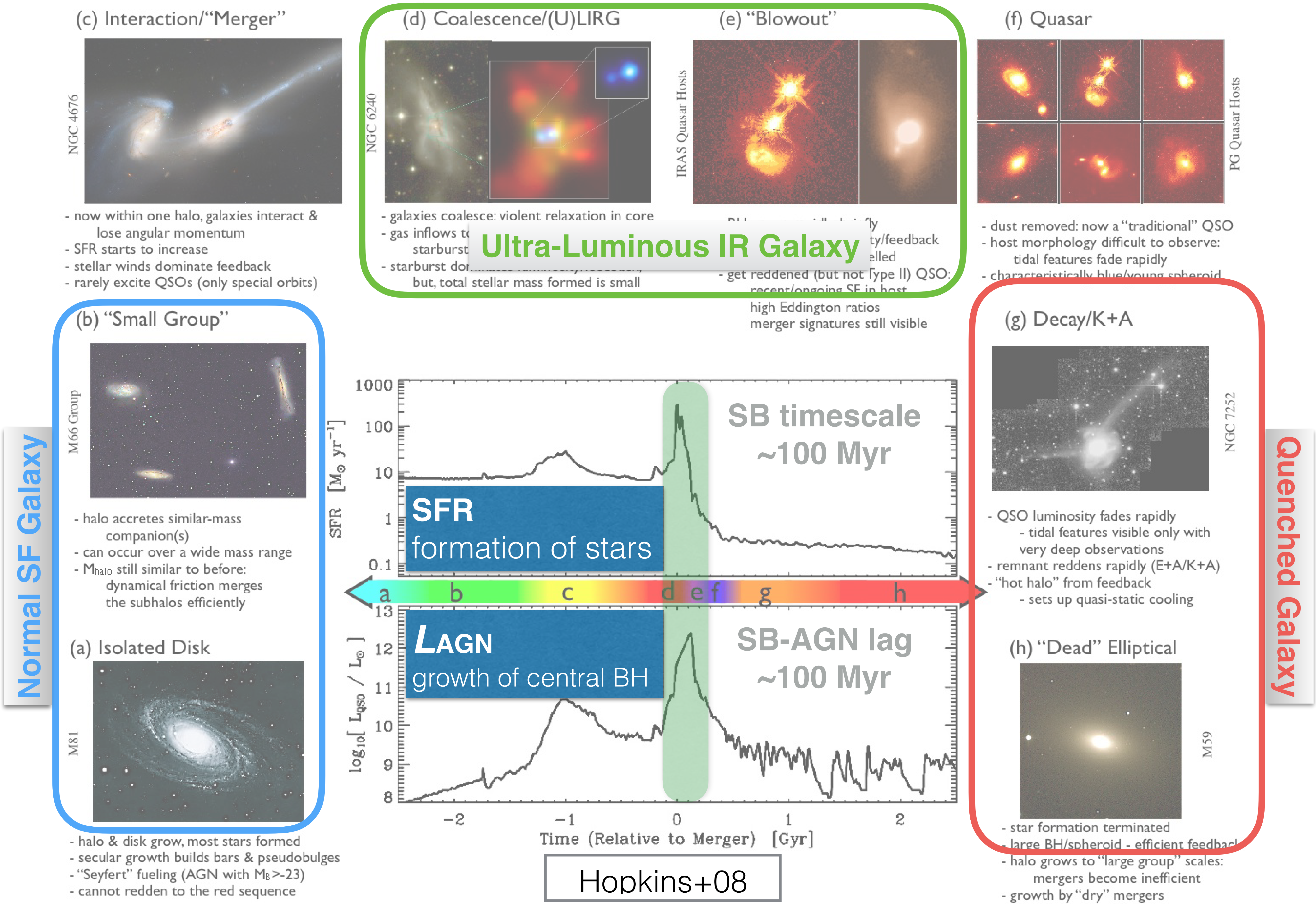
Subaru Users Meeting FY2020, March 3-5, 2021

Merger-induced evolutionary scenario of massive galaxies



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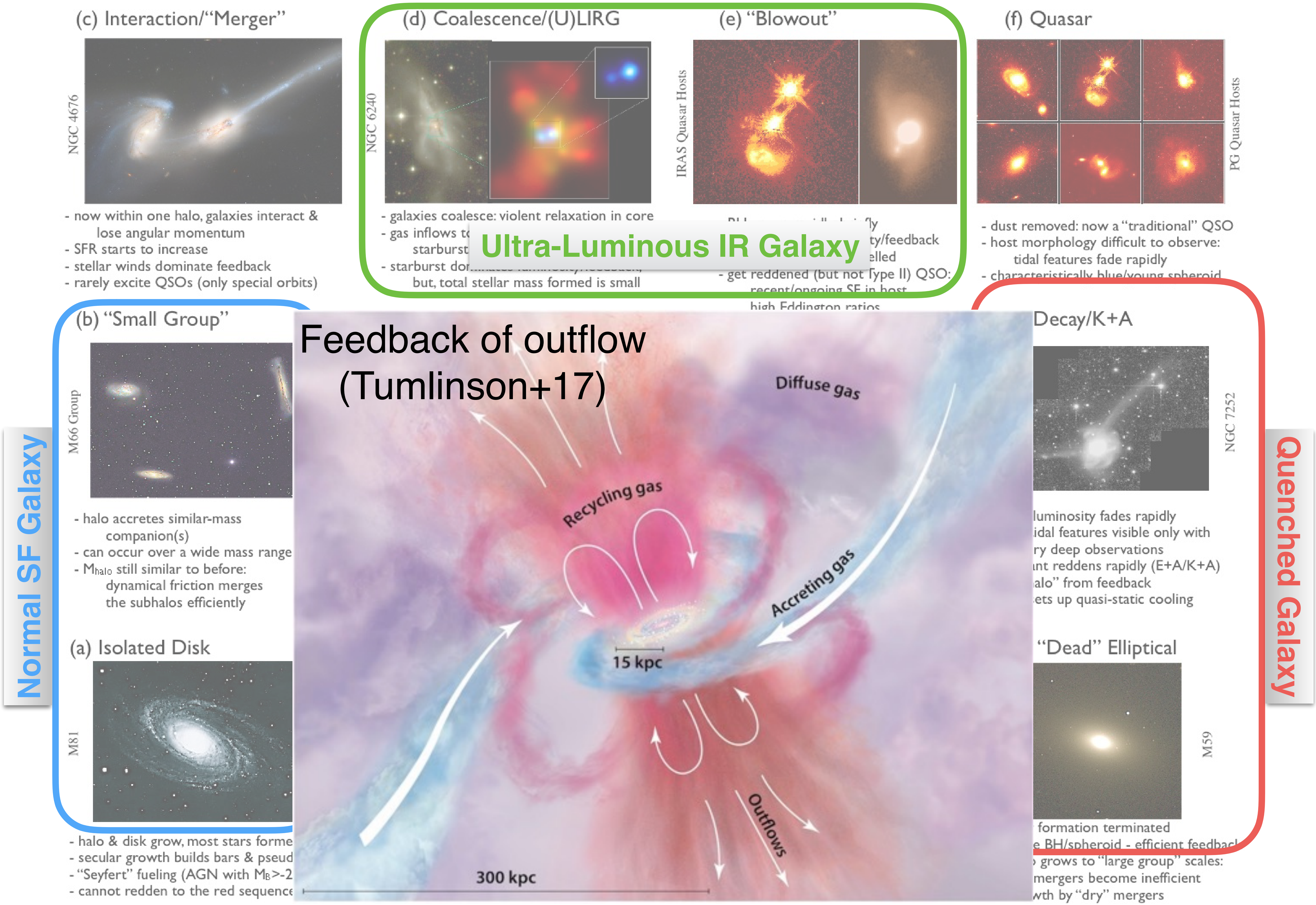
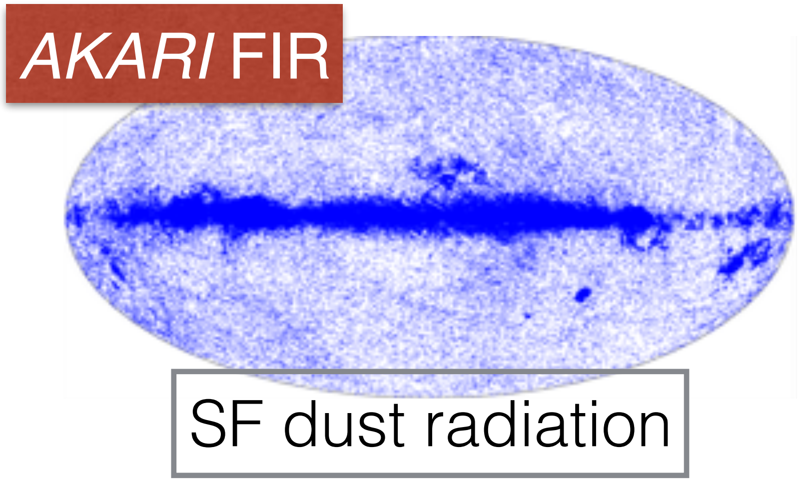
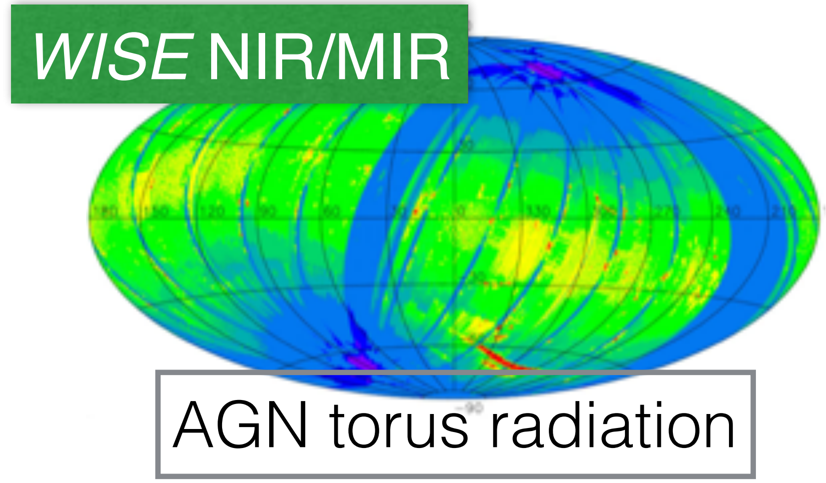
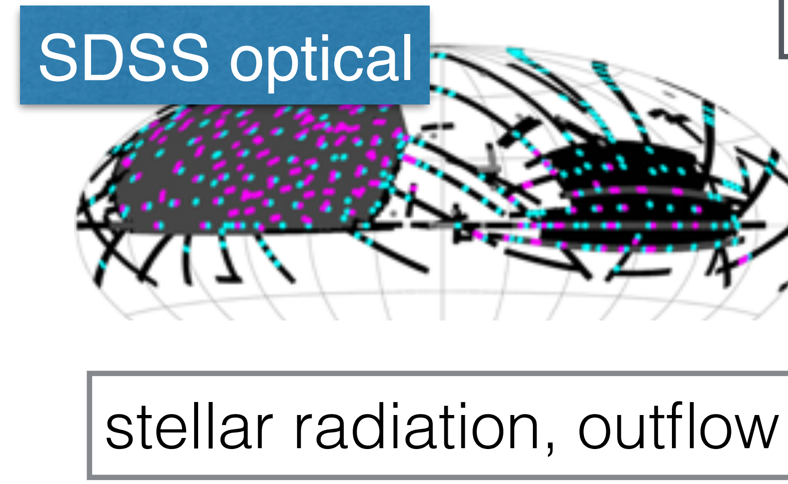
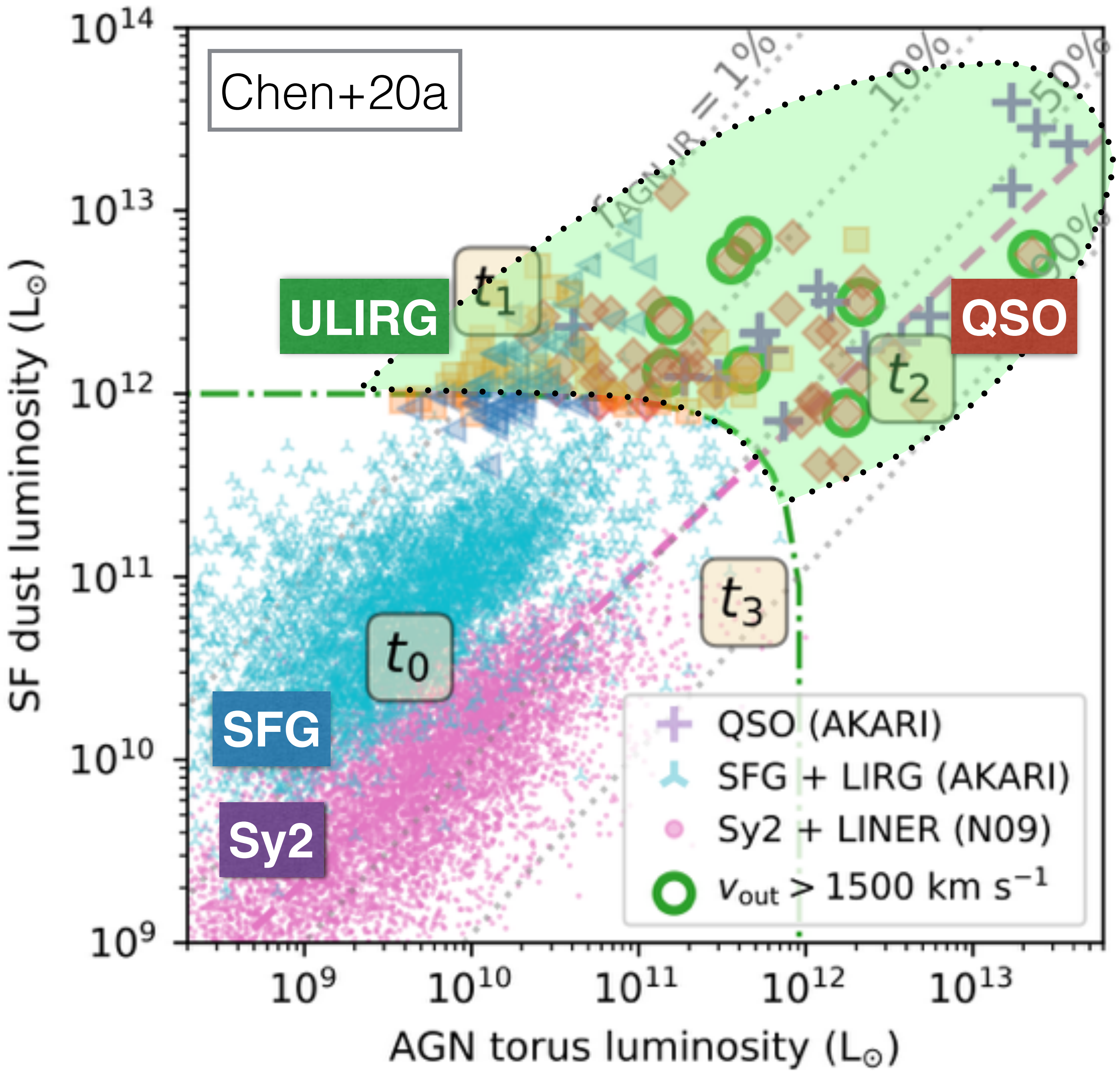


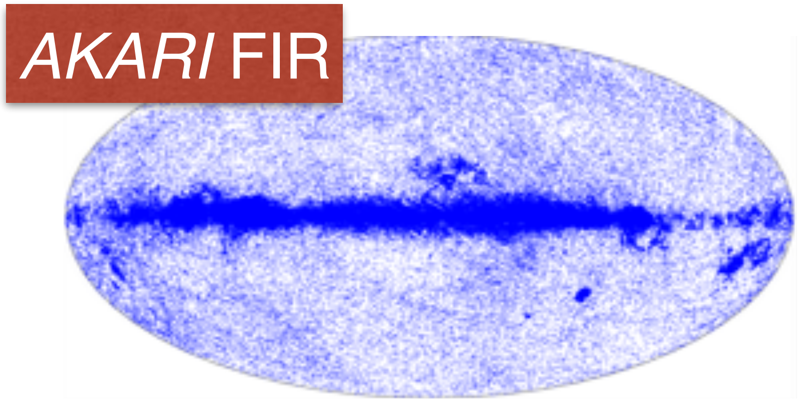


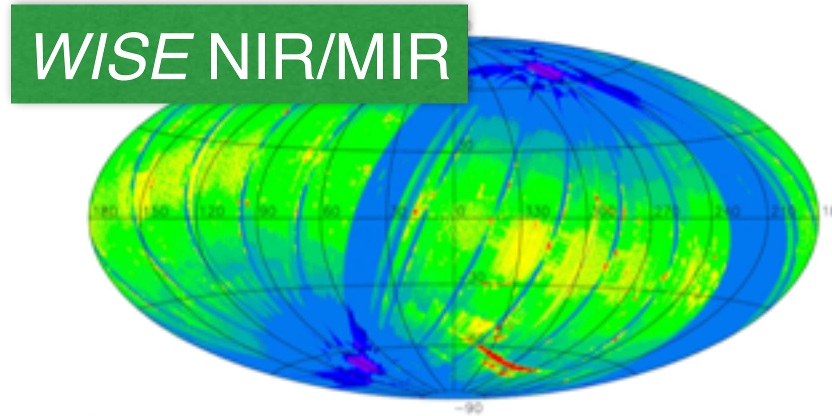


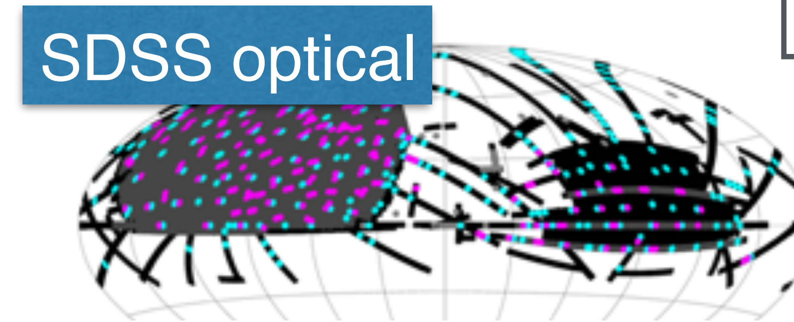


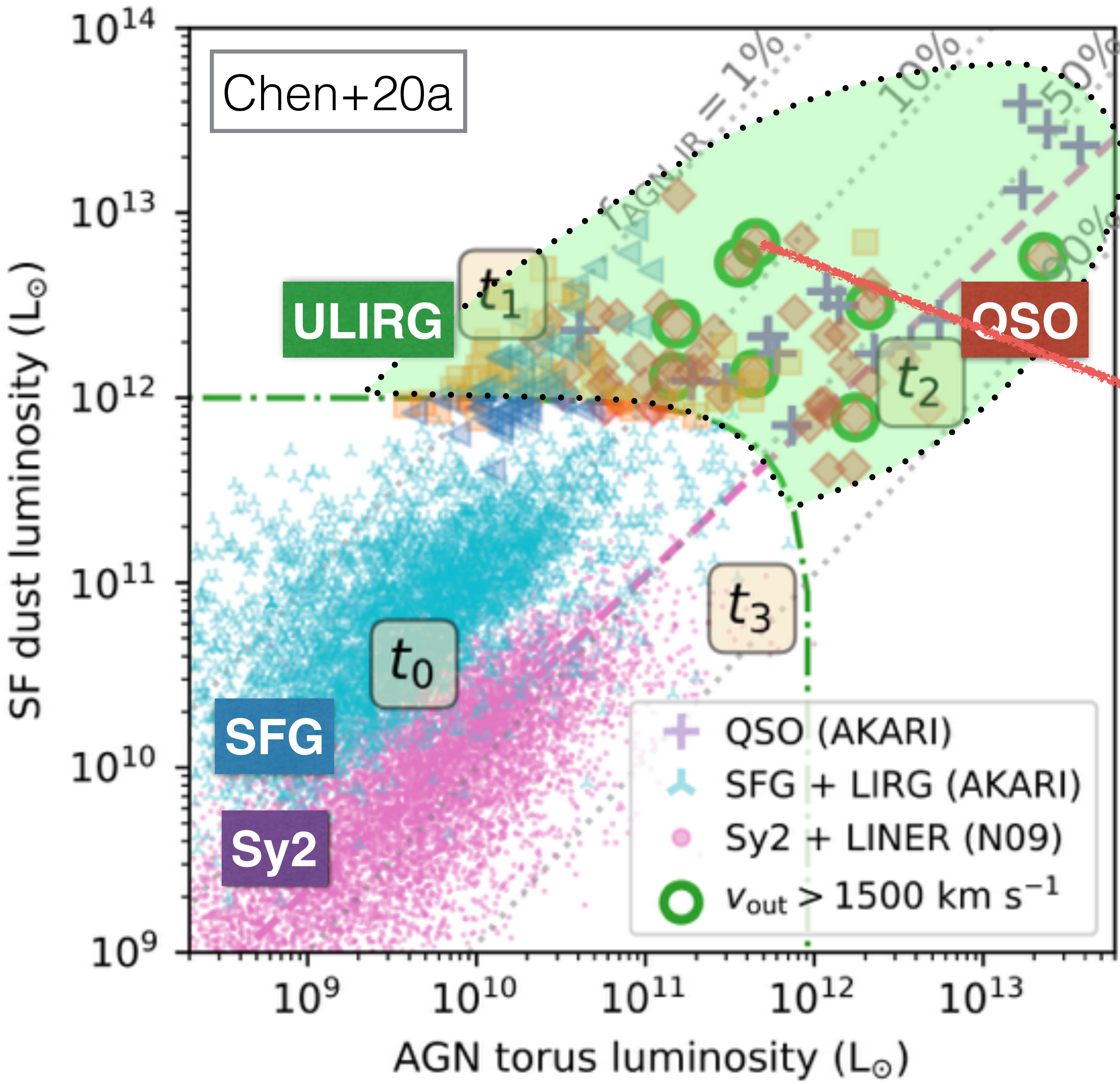


1077 ULIRGs selected with
AKARI+*WISE*+*SDSS*:
202 with SDSS or FOCAS spectra









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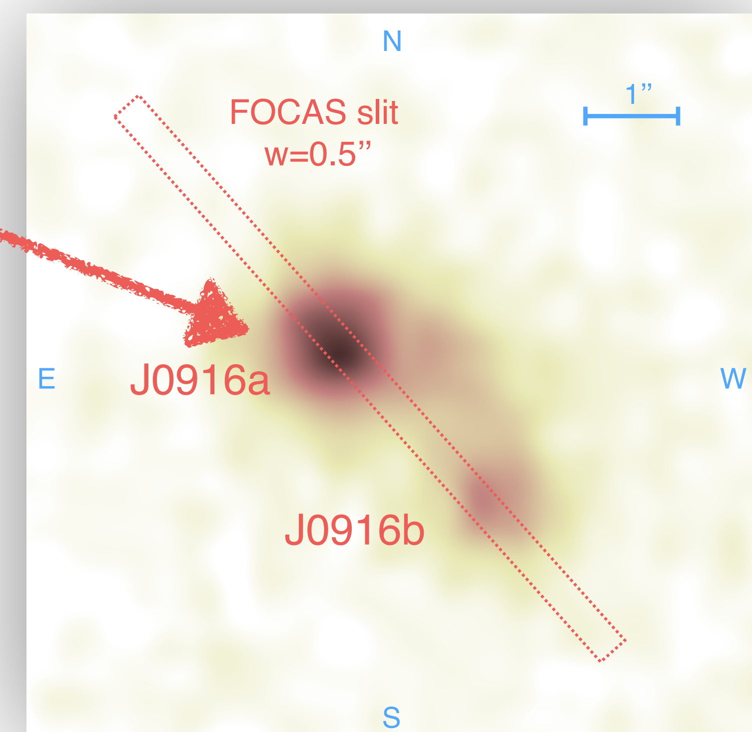
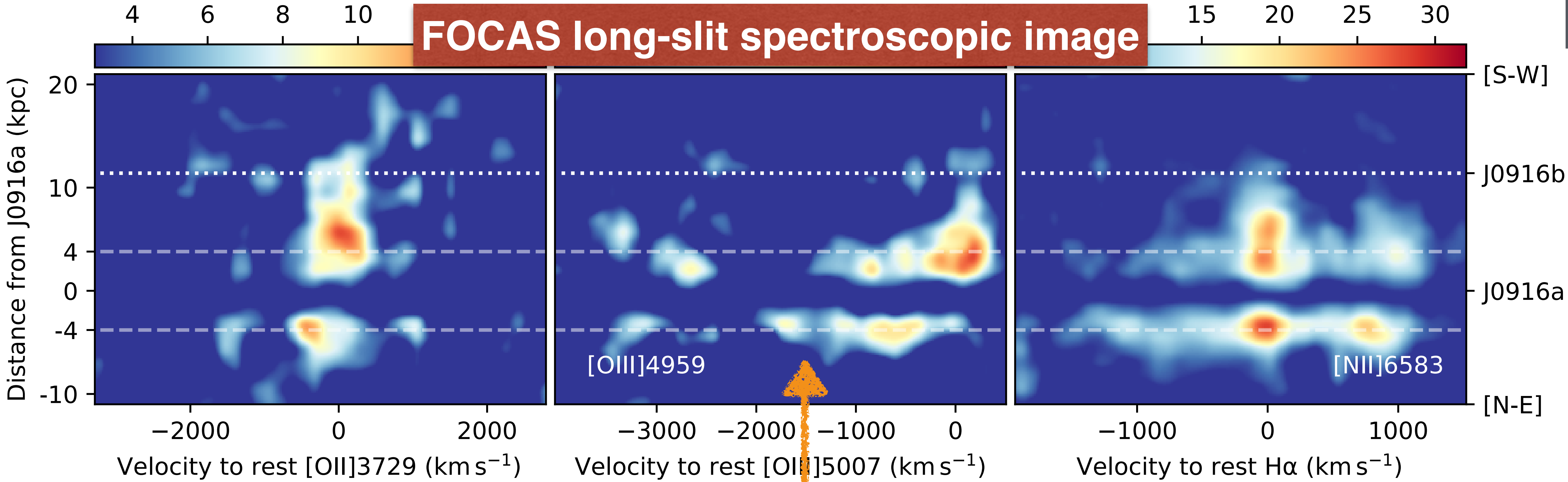
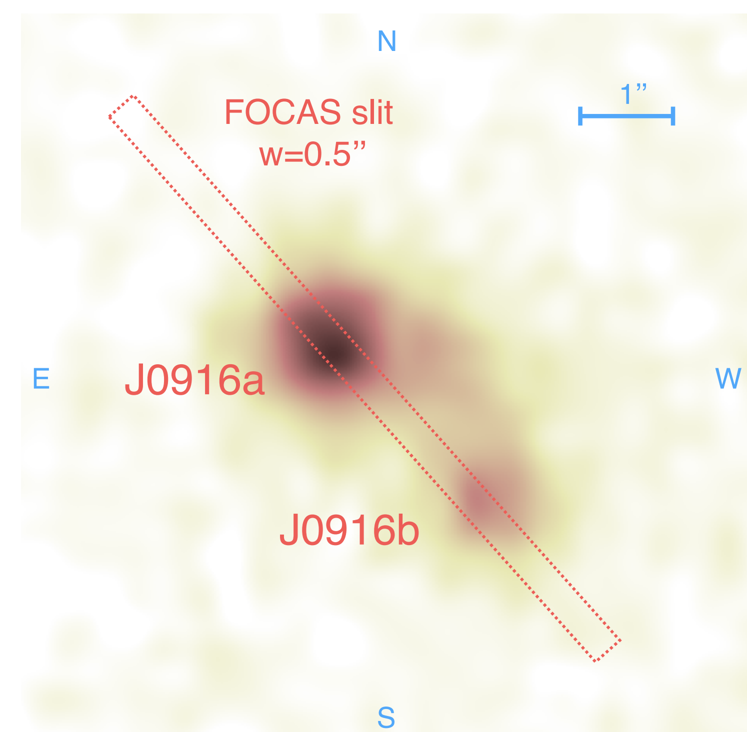


Subaru/FOCAS (PI:Akiyama, S17A)

FOCAS long-slit spectroscopic image



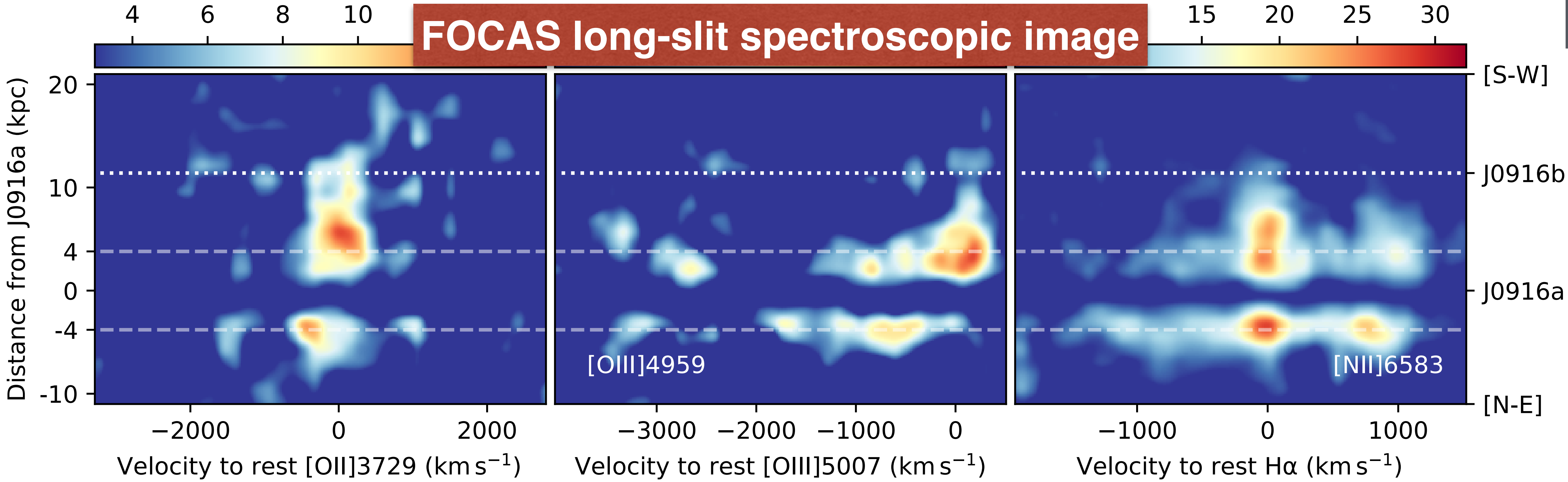
Chen+19



J0916a, an *AKARI*-ULIRGs at z=0.49

1) **[OIII] outflow** up to 2000 km/s extends to 4 kpc scale;

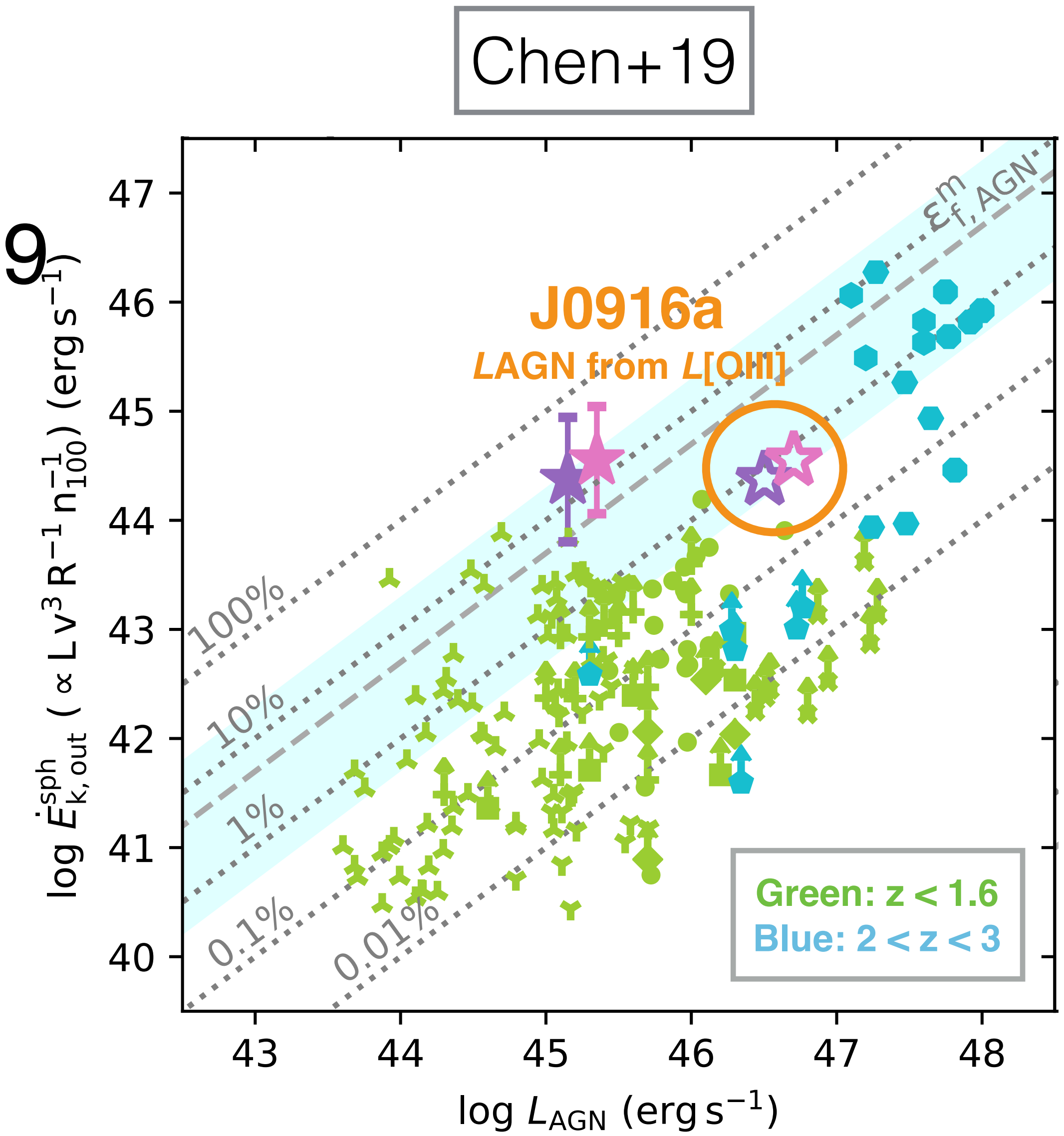
Subaru/FOCAS (PI:Akiyama, S17A)

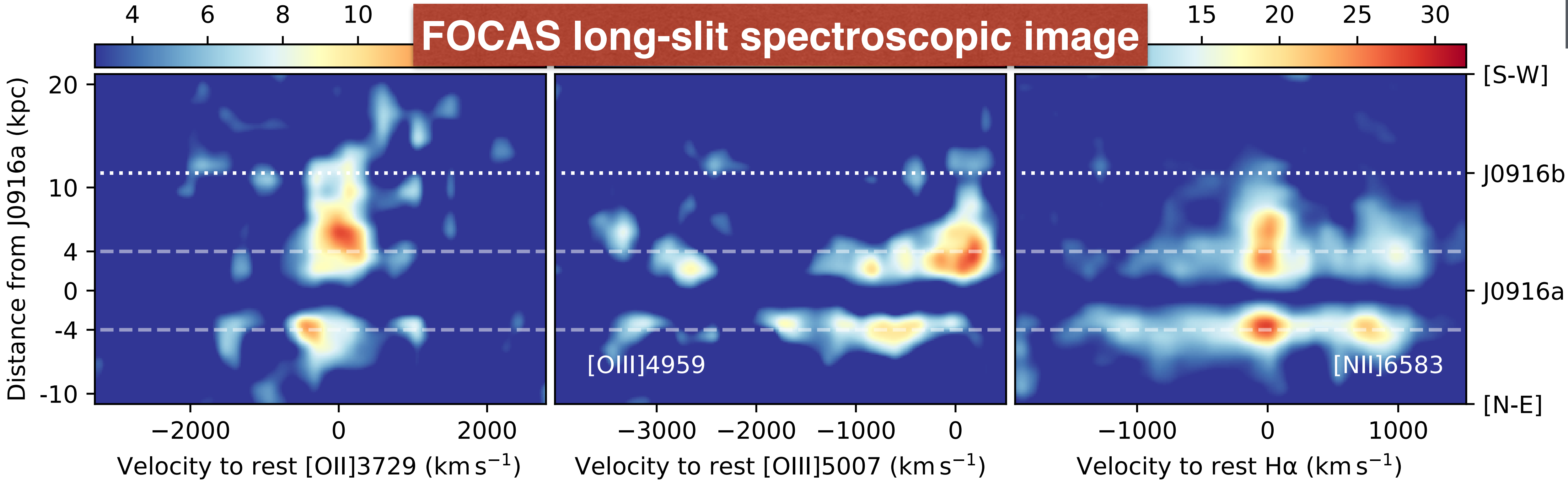


J0916a, an *AKARI*-ULIRGs at z=0.49

1) **[OIII] outflow** up to 2000 km/s extends to 4 kpc scale;

2) **highest kinetic-energy ejection rate** at ULIRGs/AGNs at z < 1.6;





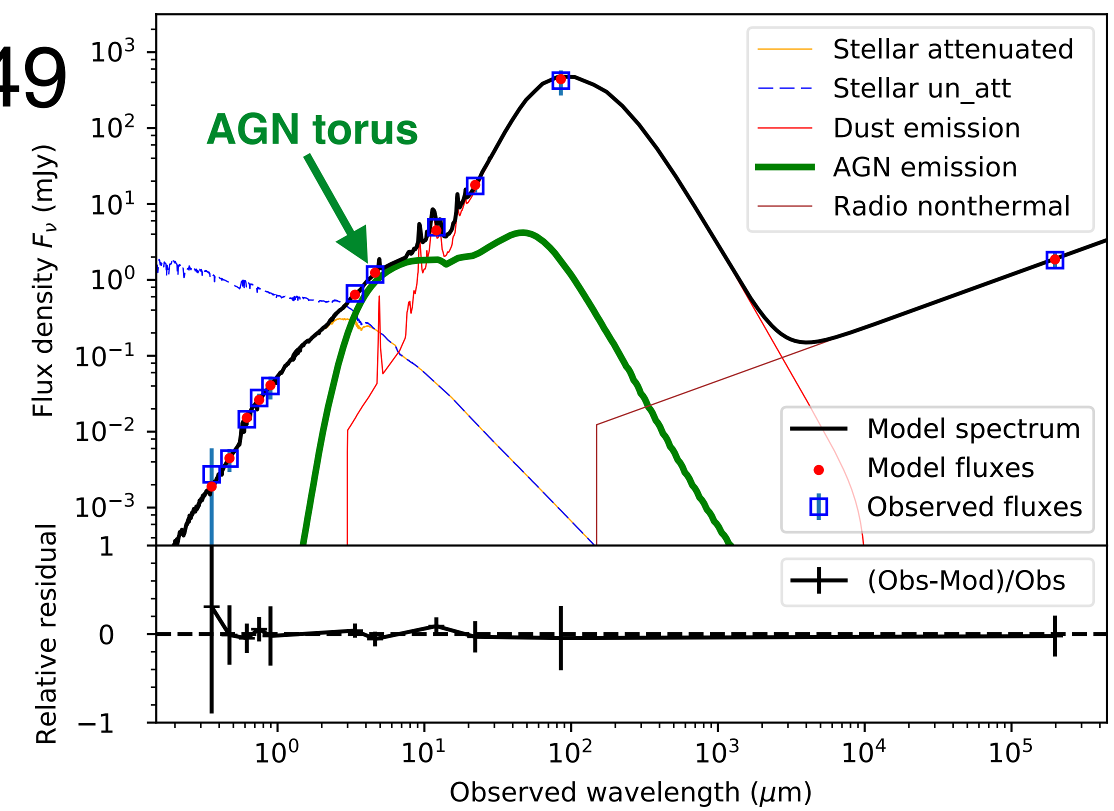
Chen+19

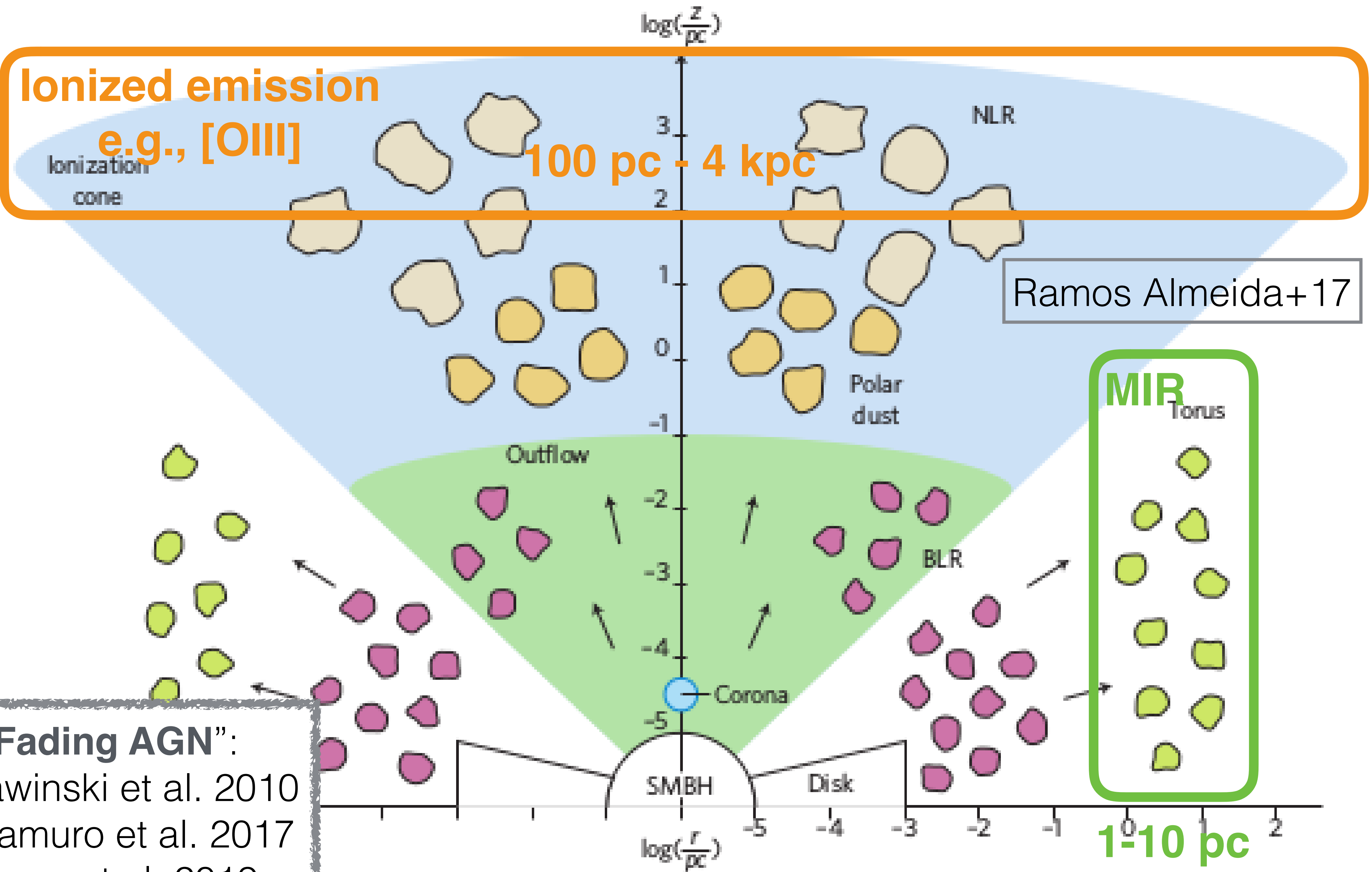
J0916a, an *AKARI*-ULIRGs at z=0.49

1) **[OIII] outflow** up to 2000 km/s extends to 4 kpc scale;

2) **highest kinetic-energy ejection rate** at ULIRGs/AGNs at z < 1.6;

3) **$L_{\rm AGN}$ (MIR) is fainter** (30%) than the $L_{\rm AGN}$ estimated from **[OIII].**



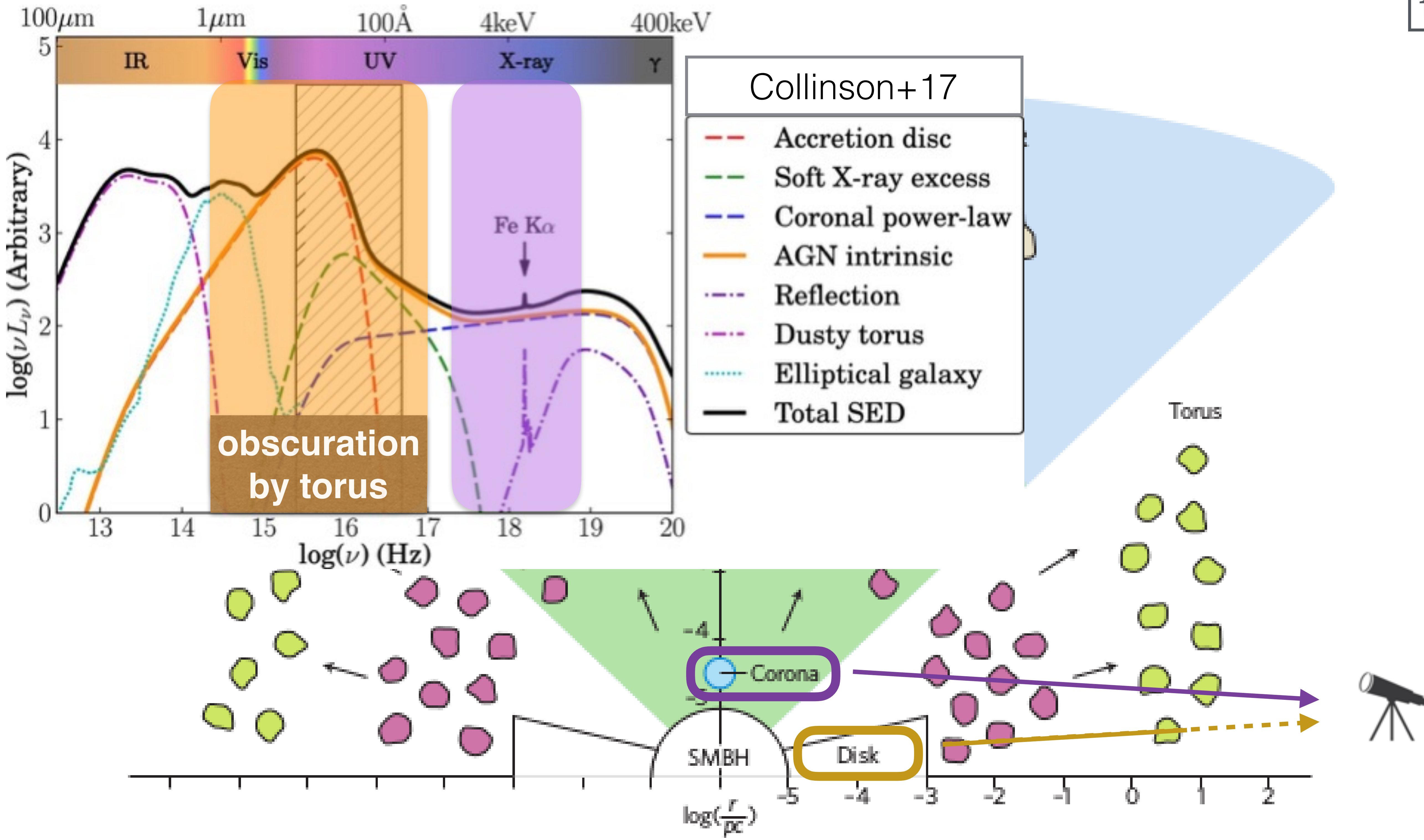


"**Fading AGN**":
Schawinski et al. 2010
Kawamuro et al. 2017
Ichikawa et al. 2019ac

L_{AGN} (MIR) < L_{AGN} ([OIII])

AGN is faint in the central region (in space)

AGN is currently **fading** (in time)

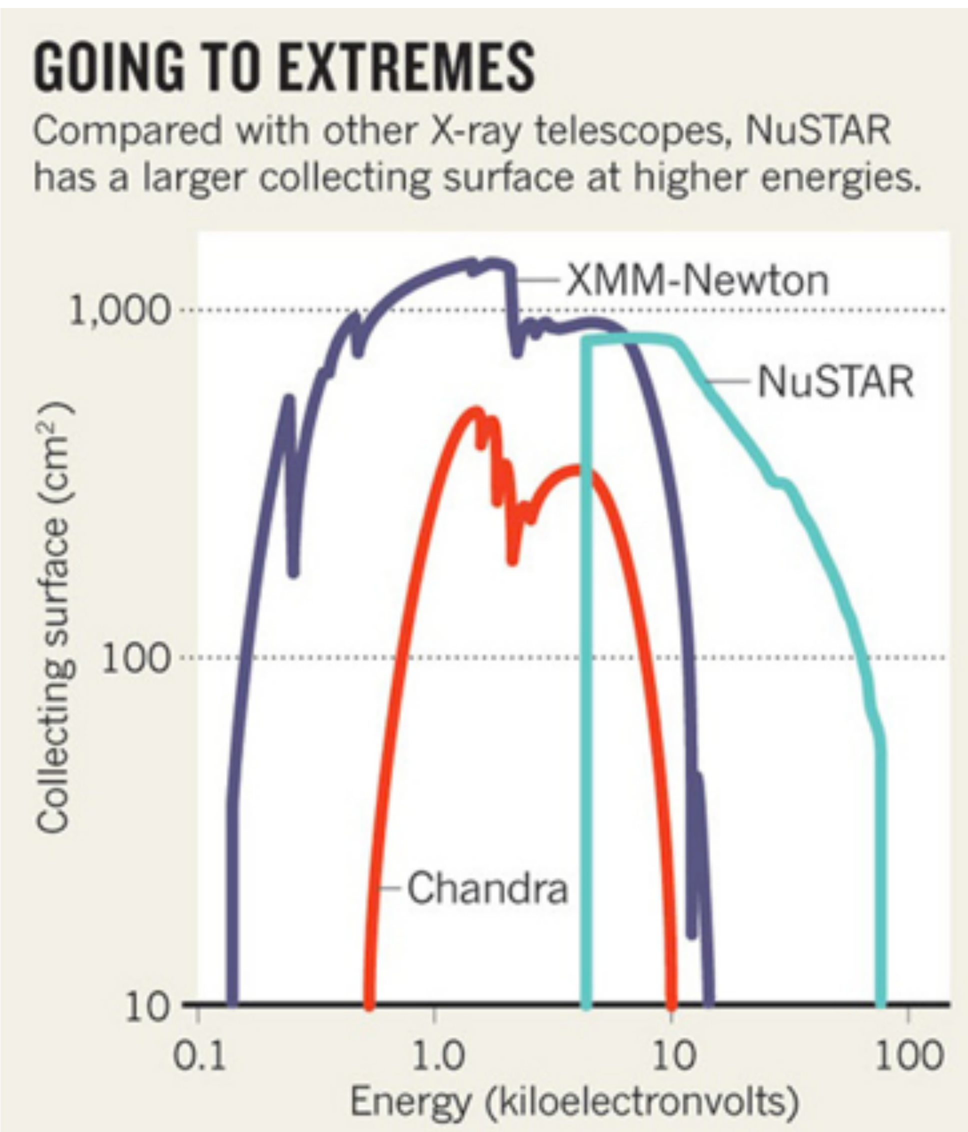


Much nearer to SMBH

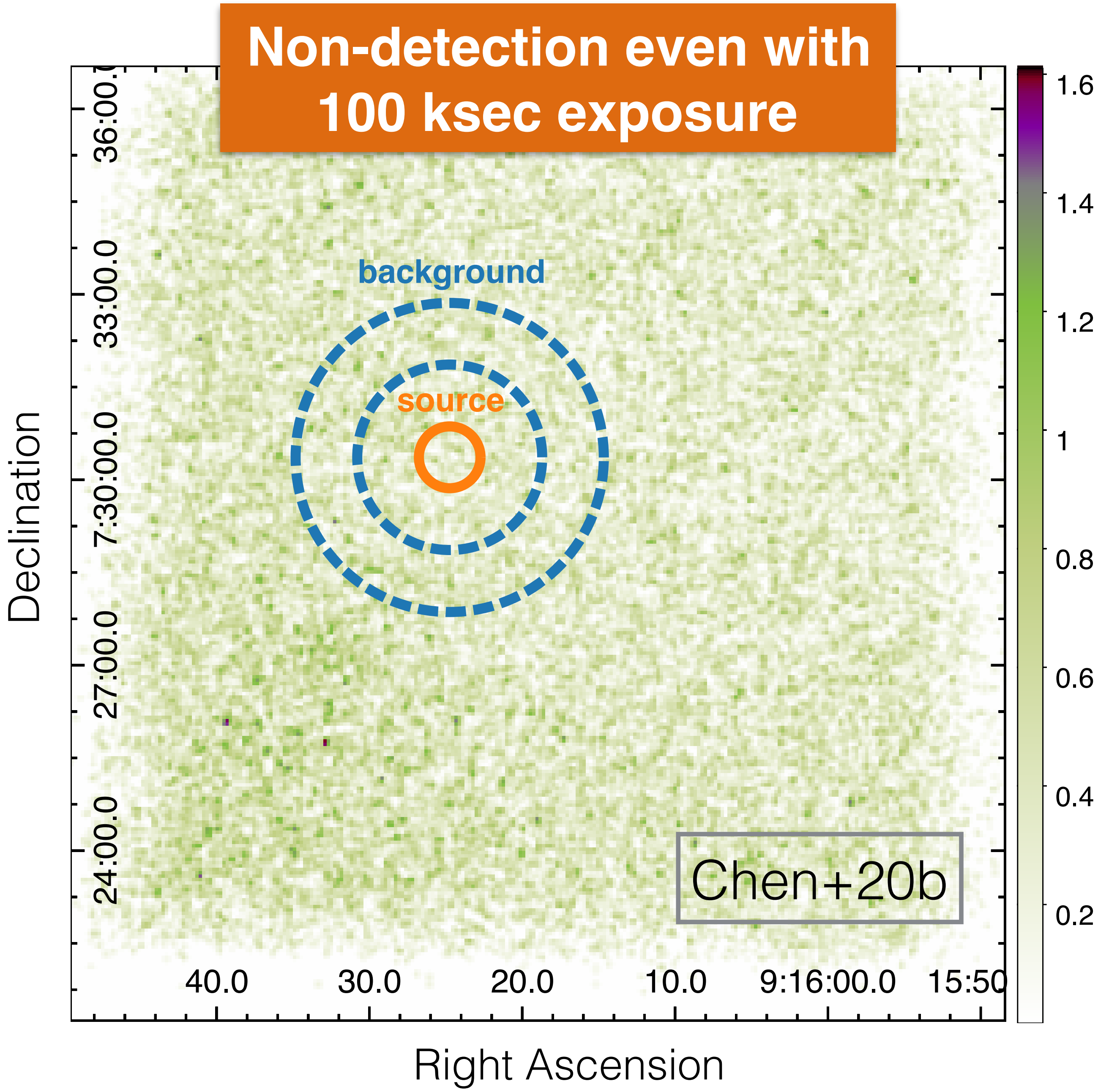
Accretion Disk (UV/Opt.) —> obscured

Corona (X-ray) —> penetrating gas/dust

especially hard X-ray (> 10 keV)



- ***NuSTAR*** is the best instrument for the **hard X-ray (> 10 keV)** follow-up of J0916a.
- **100 ksec** observation was awarded in *NuSTAR* **Cycle 6 (PI: Chen)**.
- The corona radiation could be detected if the AGN is as faint as shown by torus/MIR.



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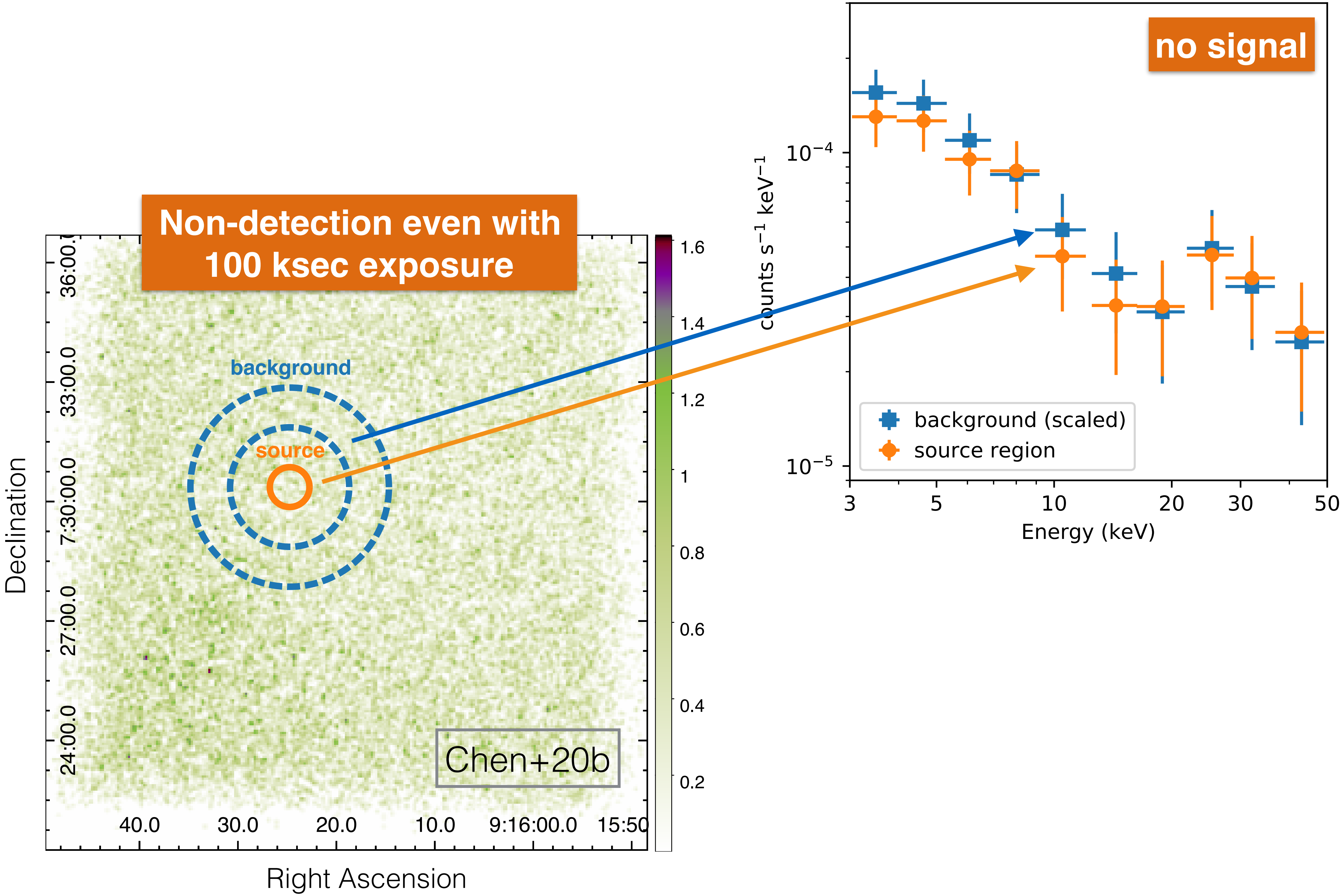
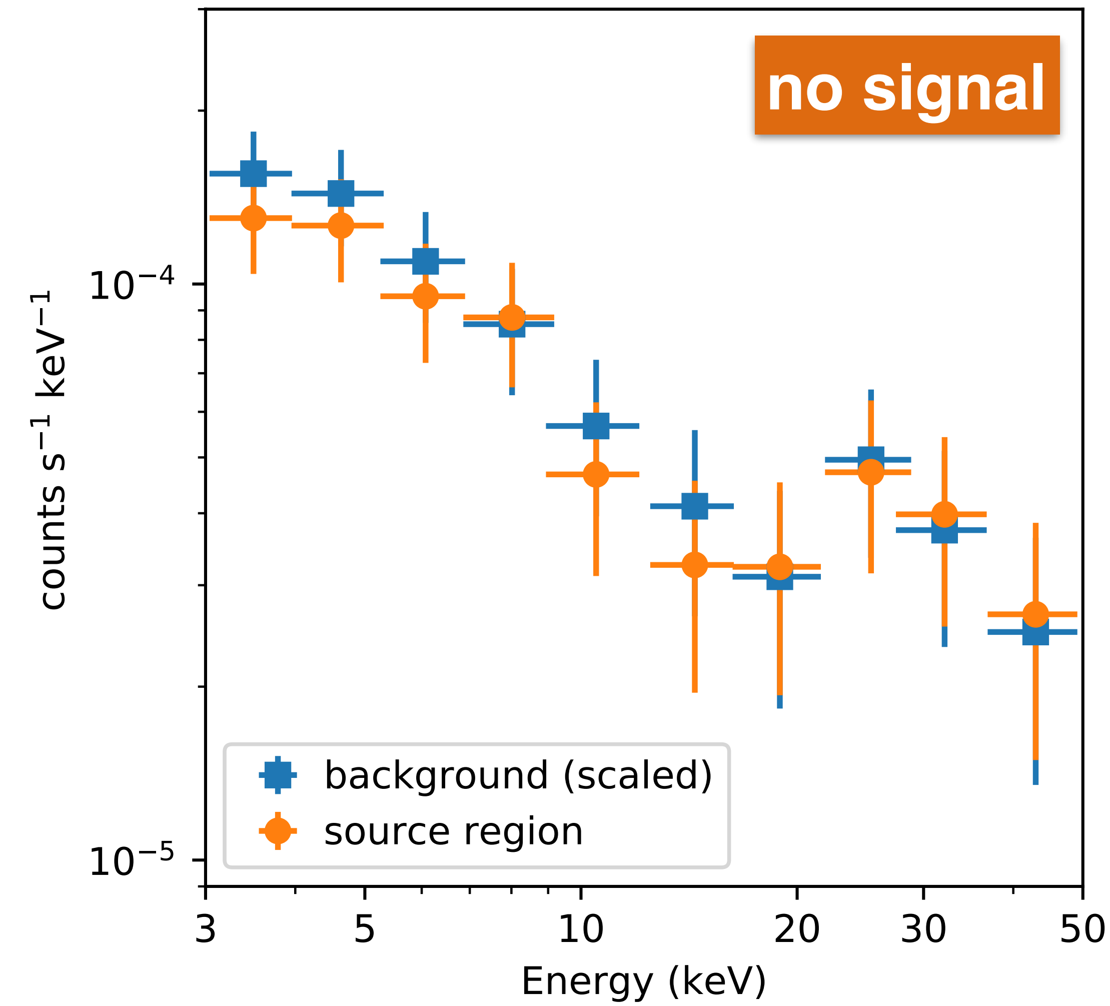
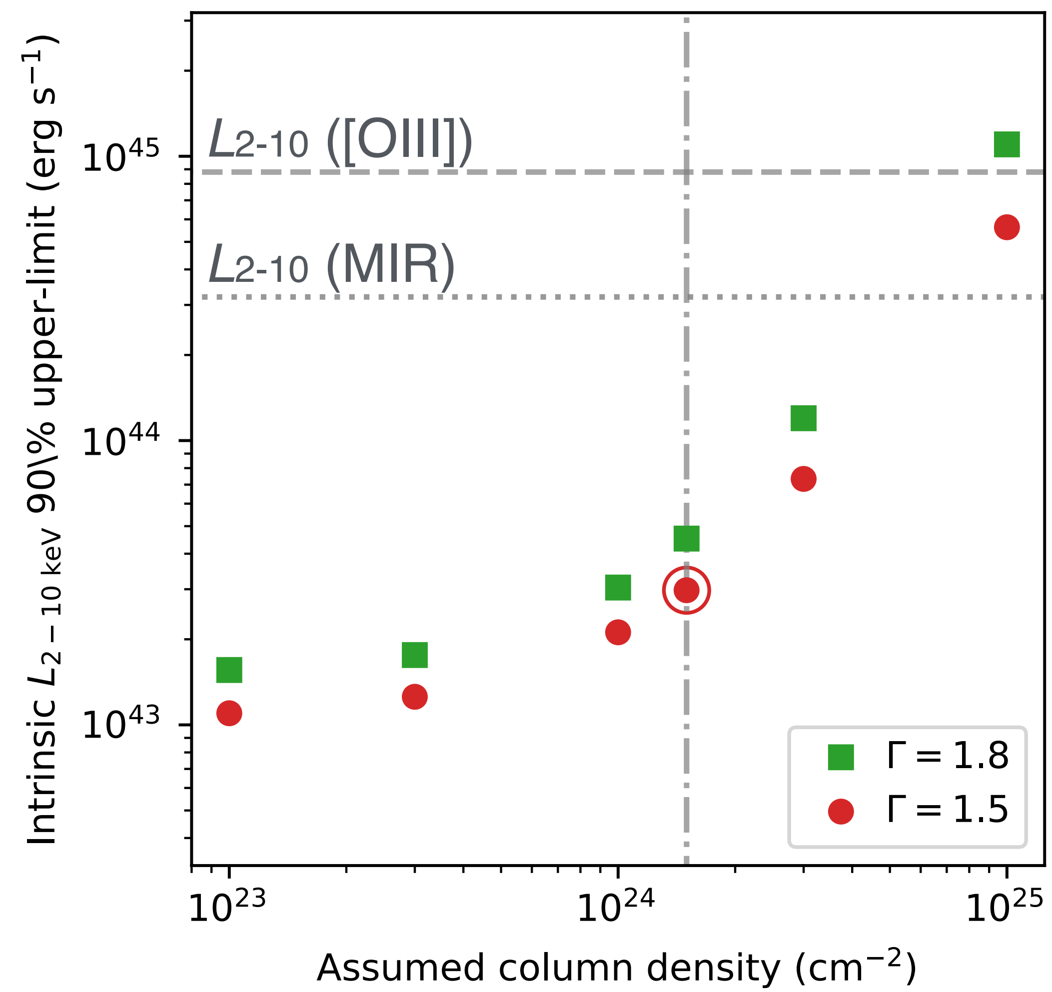
L_{AGN} (X-ray) < L_{AGN} (MIR)


Non-detection even with 100 ksec exposure
background
source
Chen+20b
Declination
Right Ascension
36:00.0
33:00.0
7:30:00.0
27:00.0
24:00.0
40.0
30.0
20.0
10.0
9:16:00.0
15:50
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
no signal
counts s^{-1} keV^{-1}
10^{-4}
10^{-5}
3
5
10
20
30
50
Energy (keV)
background (scaled)
source region



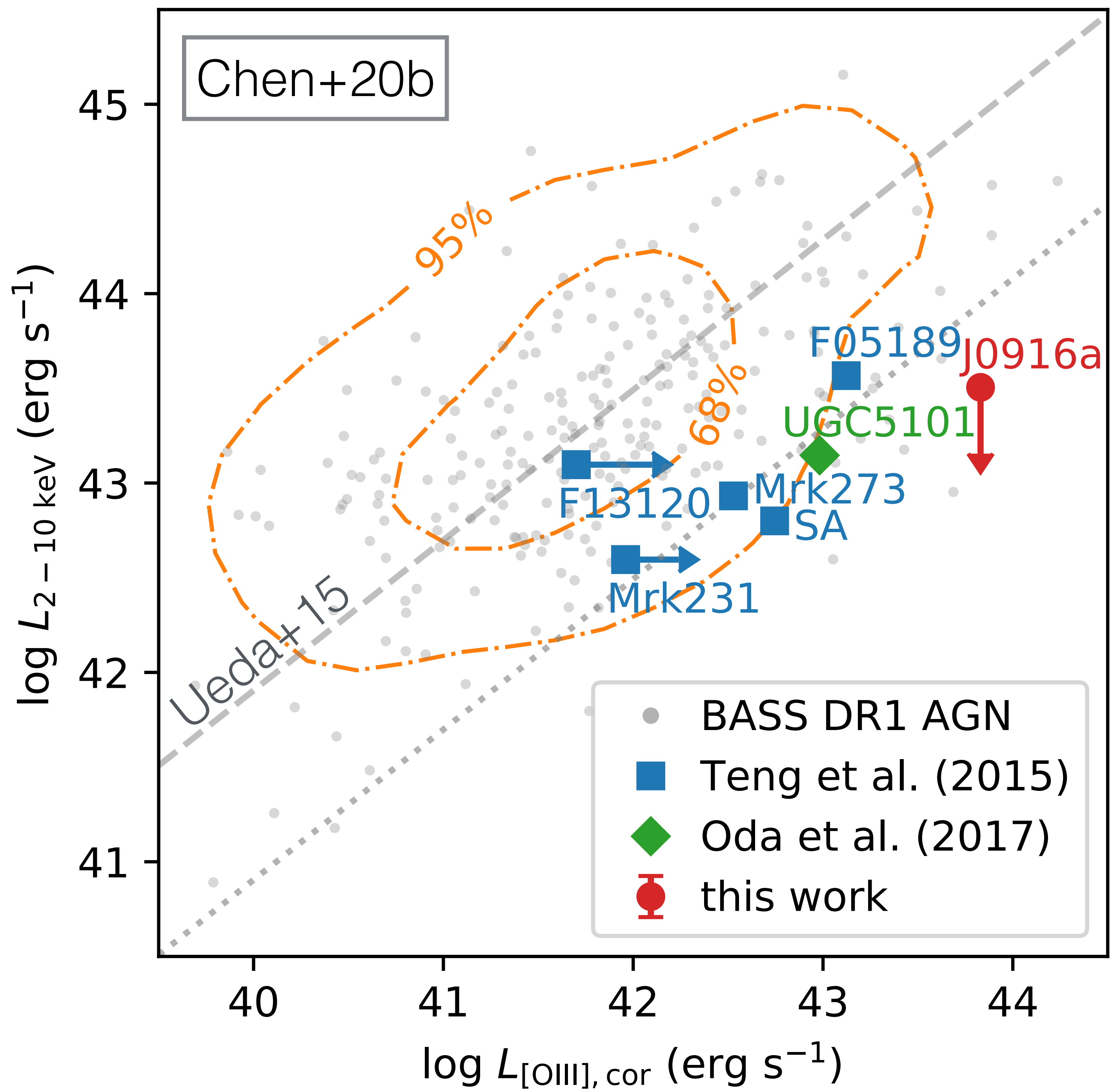
- The estimation of upper-limit of L_{AGN} (X-ray) depends on assumption of gas column density, N_H.

- Assuming typical N_H of ULIRGs of 1.5e24 cm-2 (e.g., Teng+15), the **90% upper-limit of 2-10 keV luminosity** is **3.0e43 erg/s**.



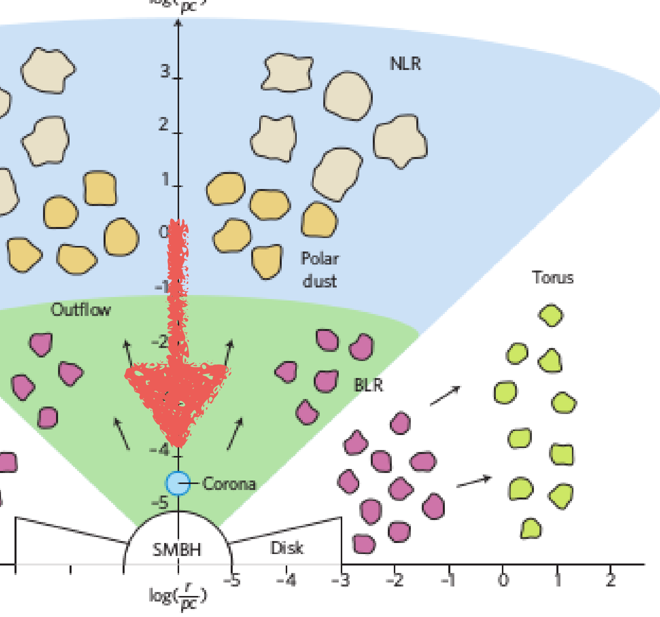
BASS: (*Swift*-)BAT AGN Spectroscopic Survey (Koss+17)

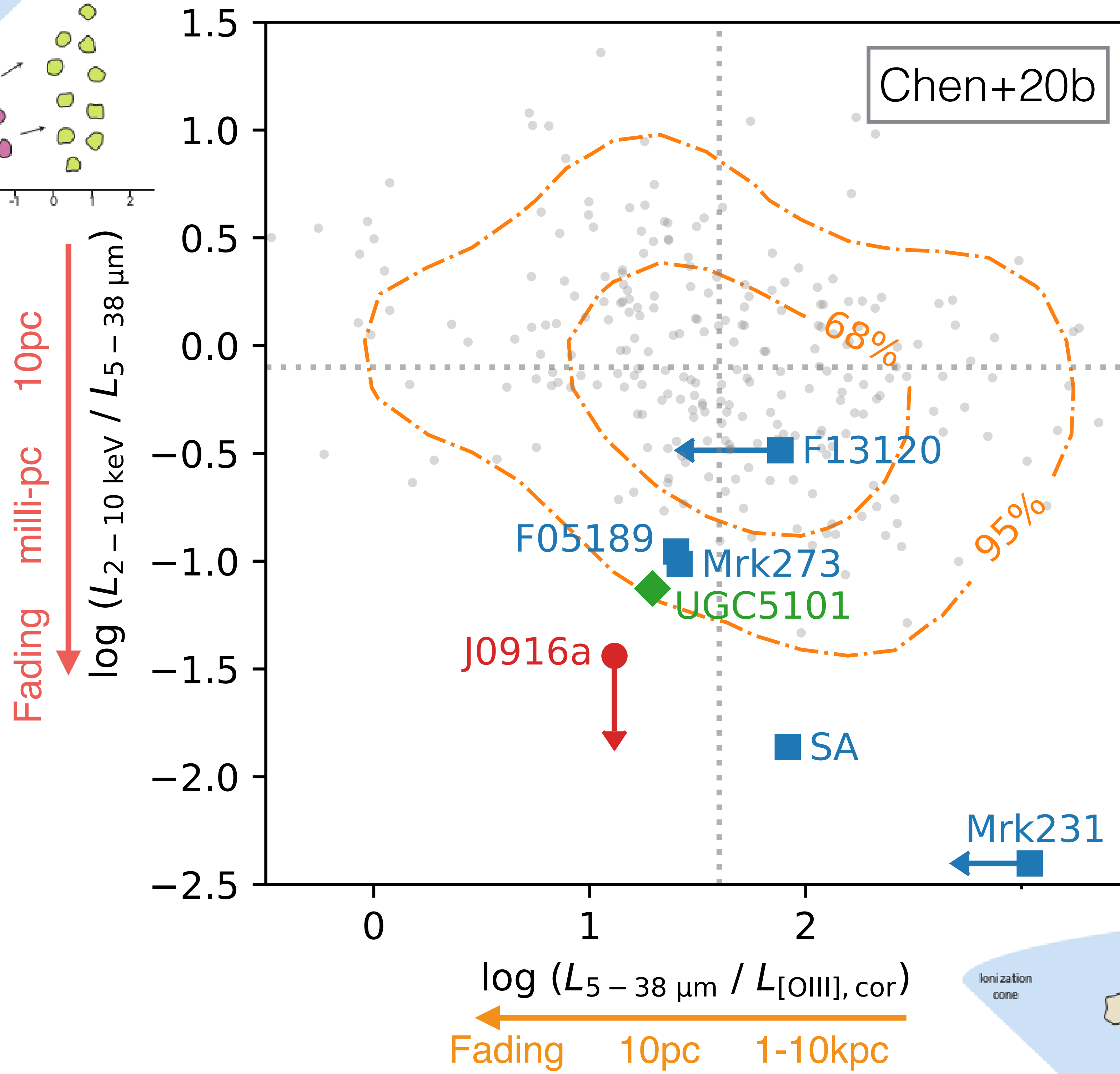
Compared to ULIRGs/AGNs

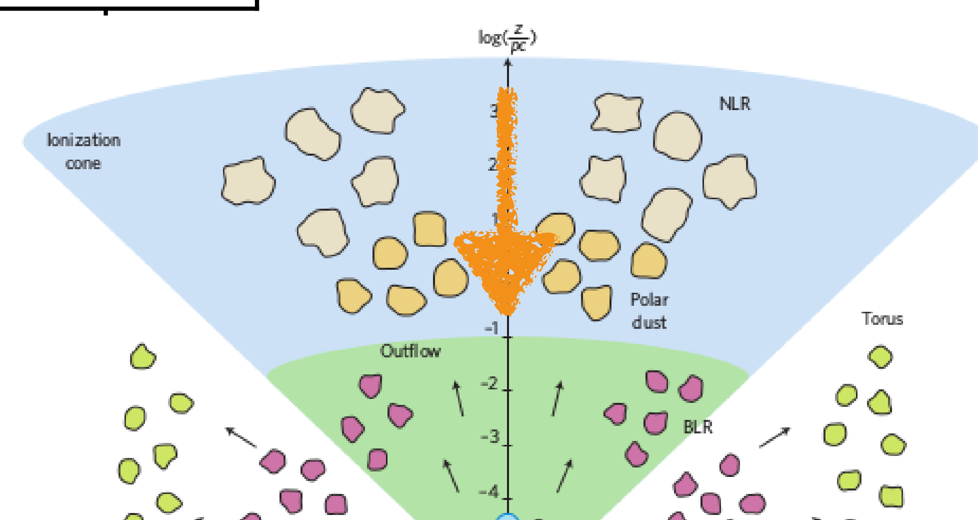


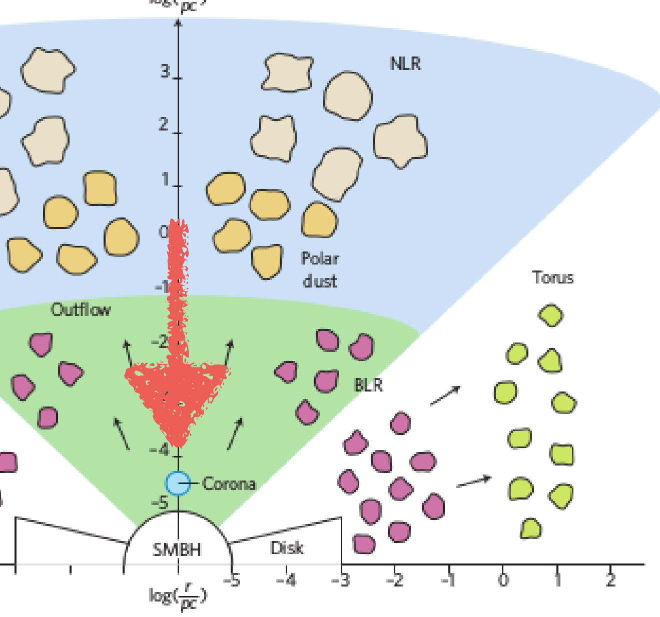
J0916a:
the most extreme
X-ray deficit
(< 3.6%).

Compared to ULIRGs/AGNs









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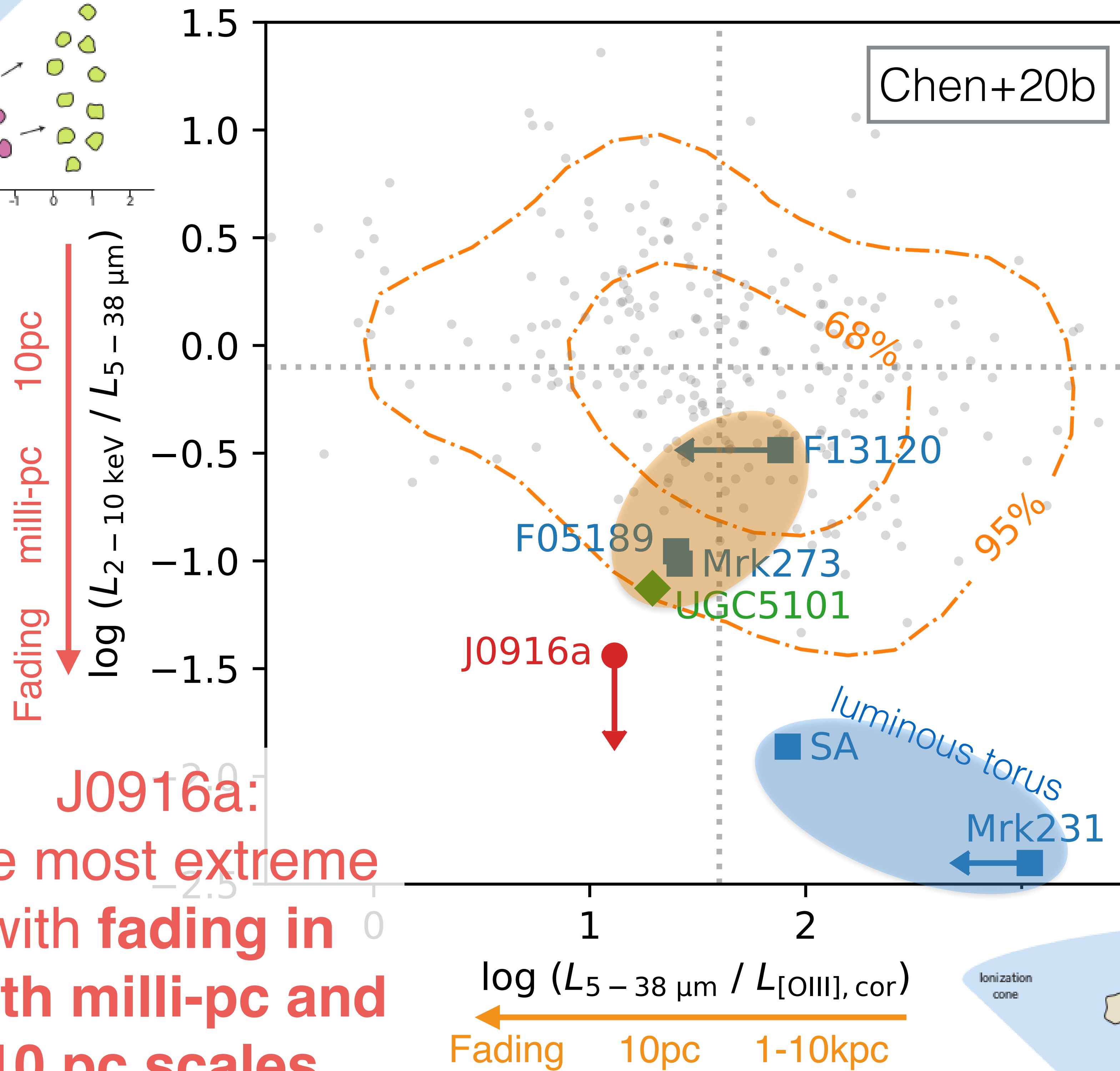
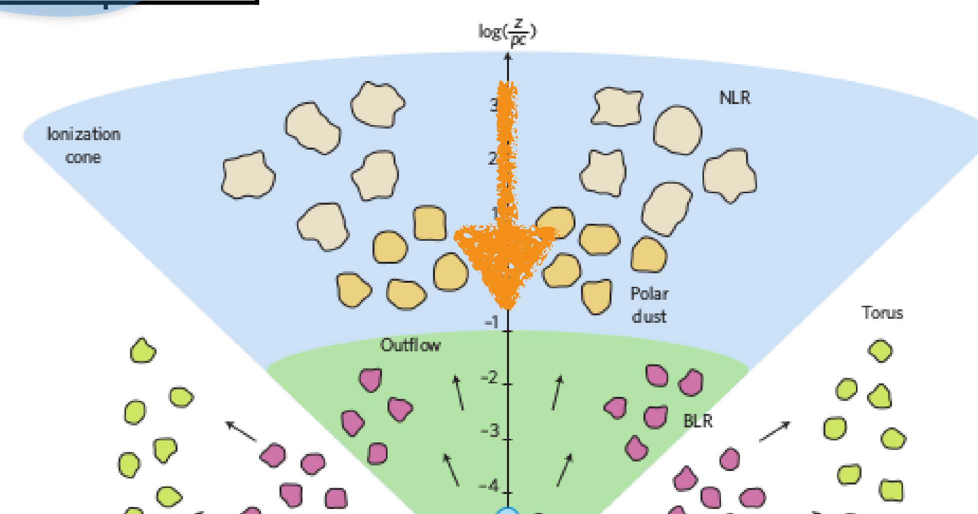
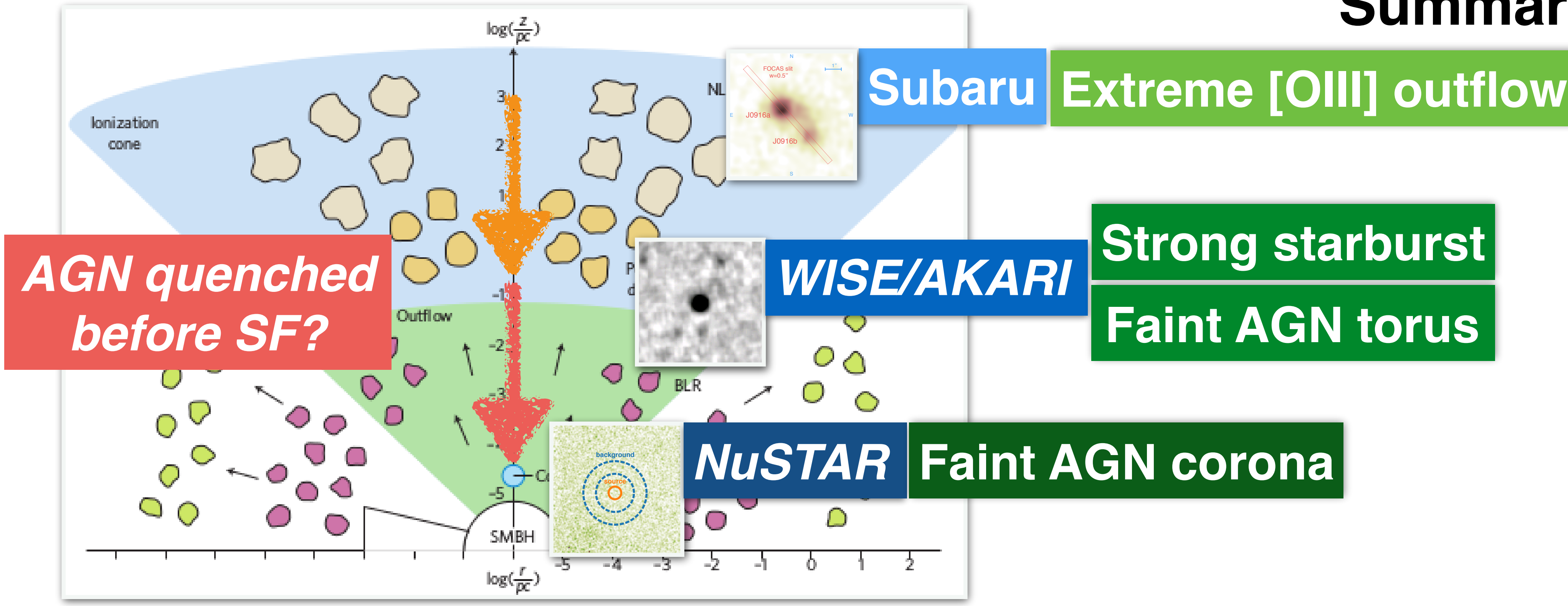


J0916a:
the most extreme
with **fading in both milli-pc and 10 pc scales.**

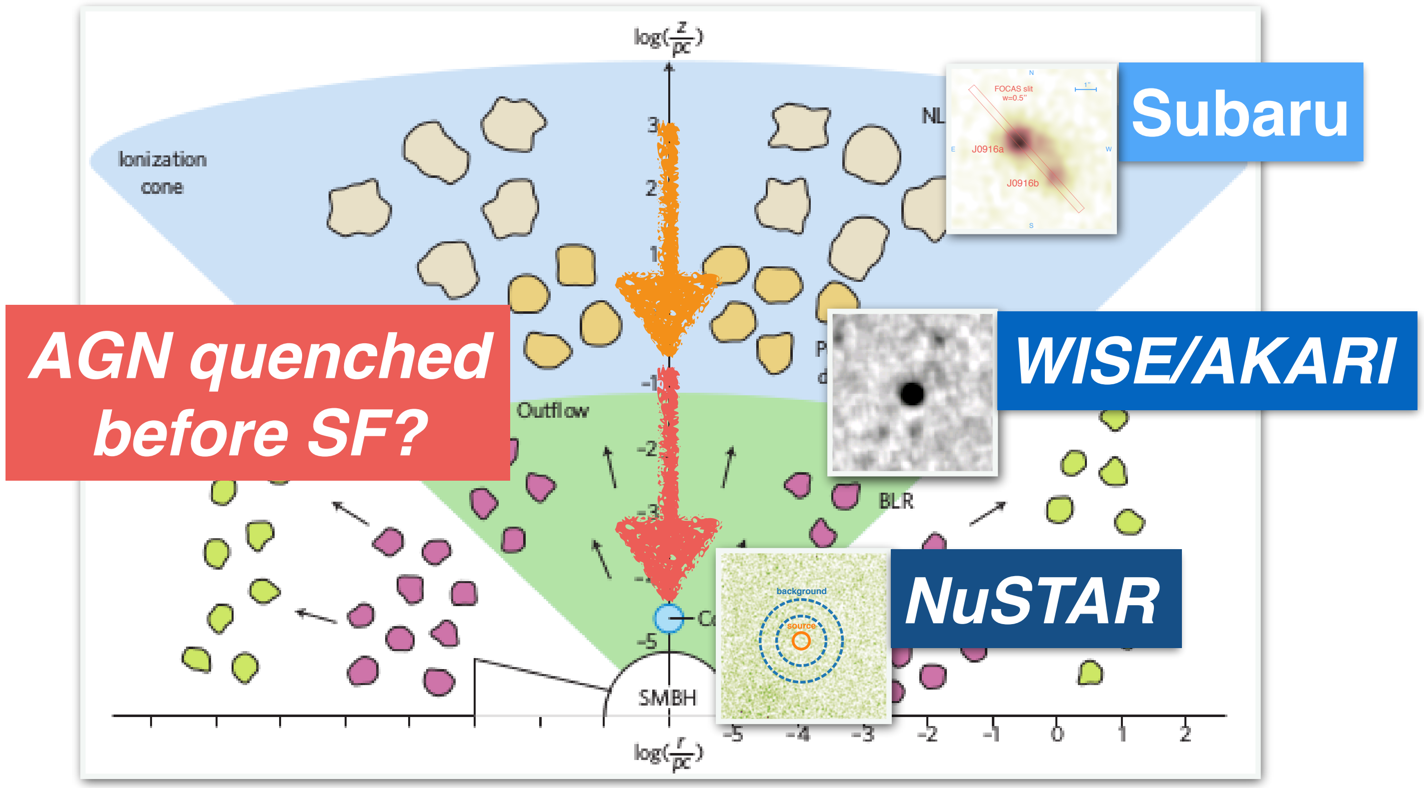


Summary & Discussion



L_{AGN} (corona) < L_{AGN} (torus) < L_{AGN} ([OIII])
—> AGN in J0916a is **currently fading**.

—> the active epoch of the AGN is limited by the fading timescale, i.e., < 0.01-1 Myr (light/outflow traveling), much shorter than the duration of starbursts, e.g., 100 Myr (e.g., Hopkins+08).



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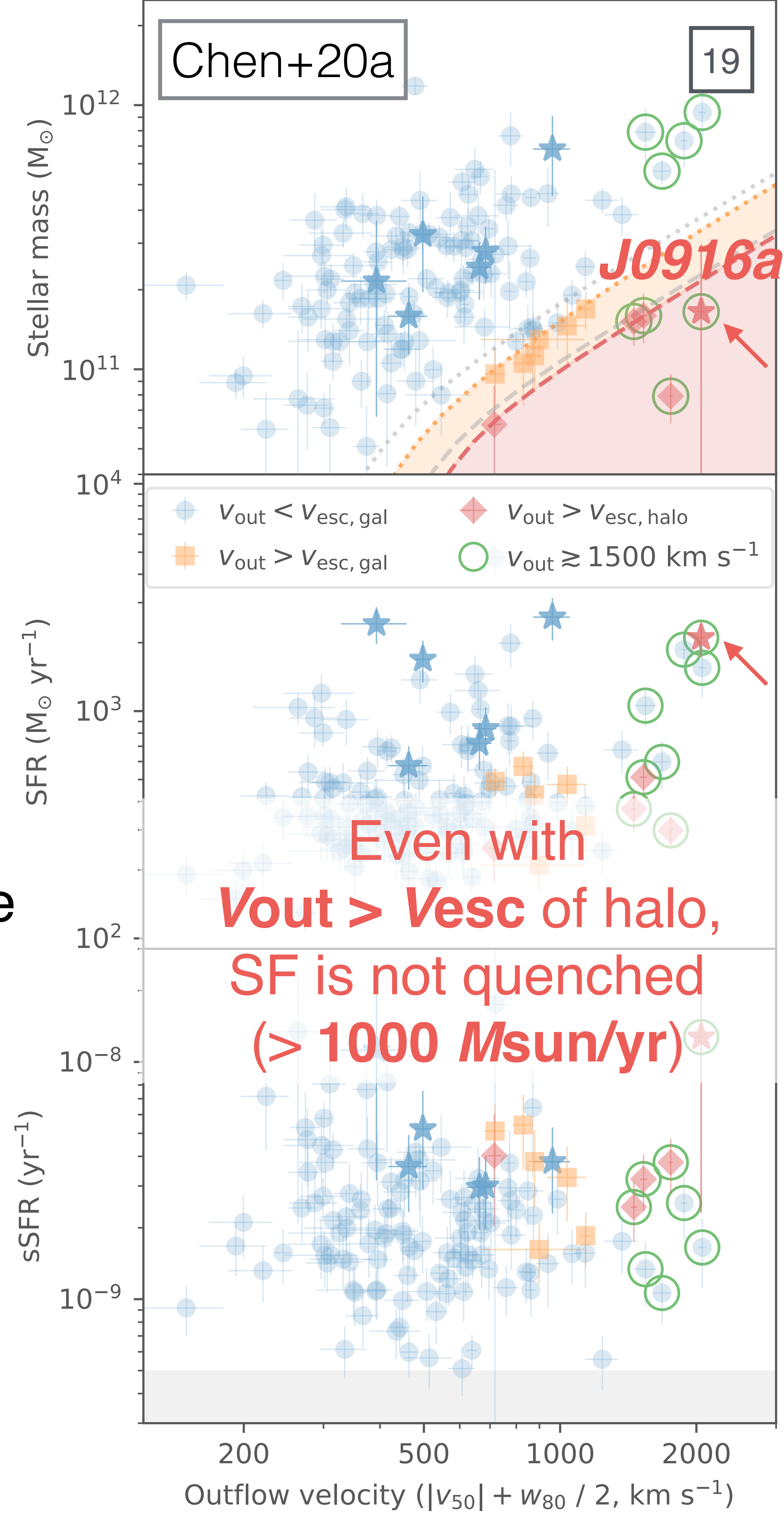
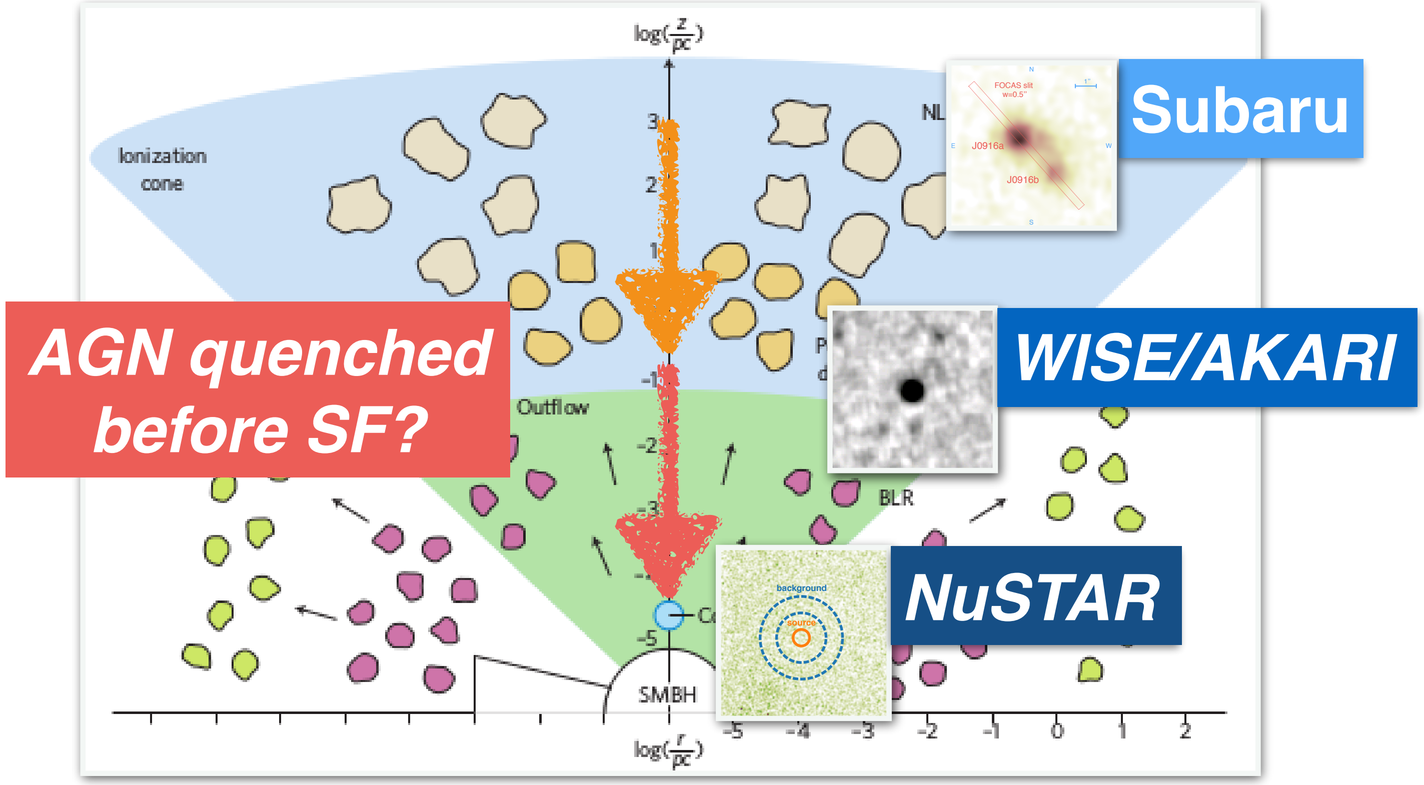
—> the powerful outflow could not last so long and thus, the cumulative effect of the AGN feedback on star formation is limited.





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Thanks for your attention.
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