

TWO-FACE: NEUTRAL AND IONIZED LIGHT BREEZE IN THE LOCAL UNIVERSE

ALICE CONCAS

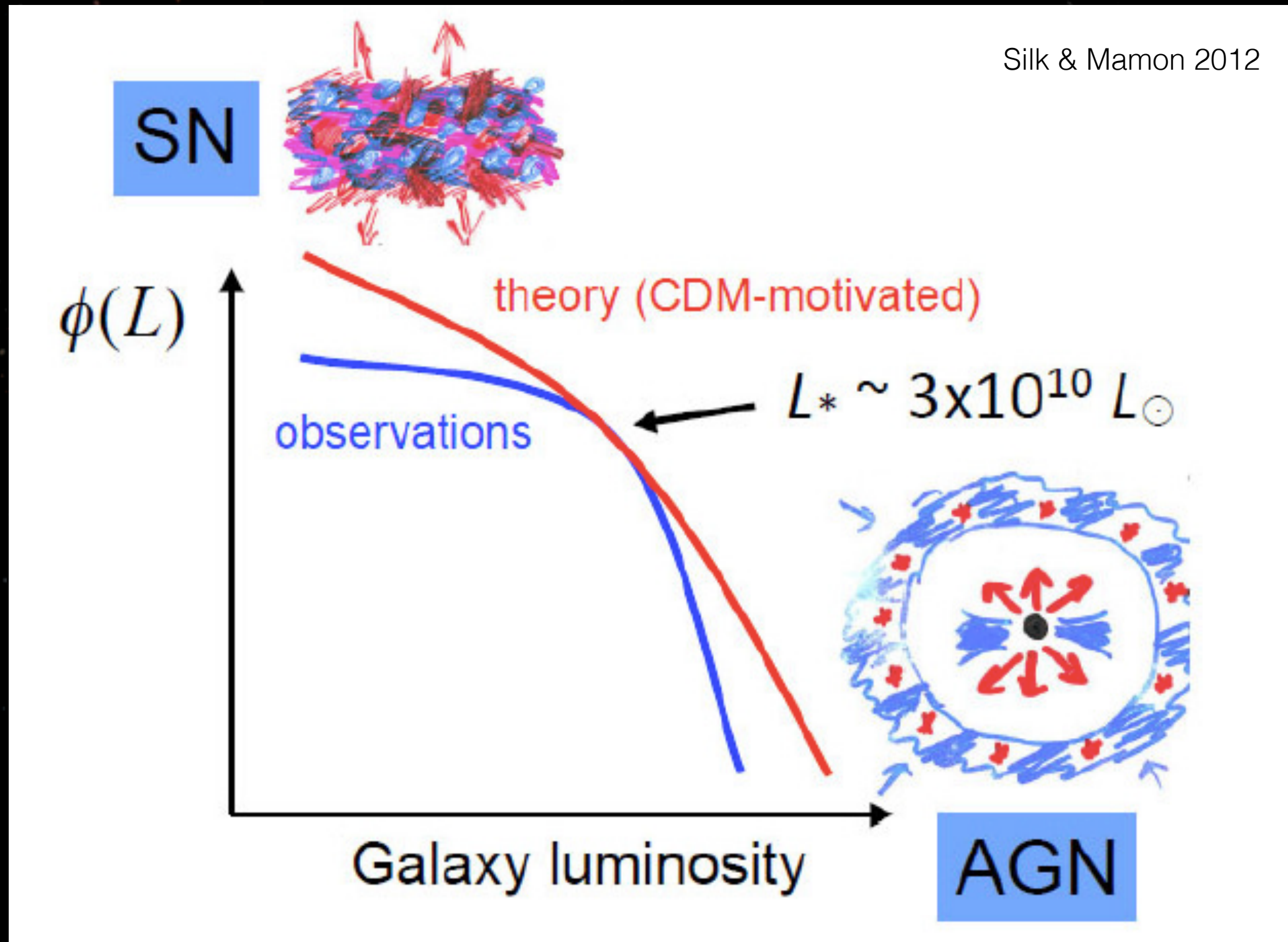
Excellence Cluster Universe
Technische Universität München

P.Popesso(EC), M.Brusa (DIFA), V.Mainieri (ESO),
C.Maraston (ICG), D.Thomas (ICG), D.Goddard (ICG),
G.Erfanianfar (MPE), L.Morselli (EC)

credit:Miguel Aragon (Johns Hopkins University) berkeleylab



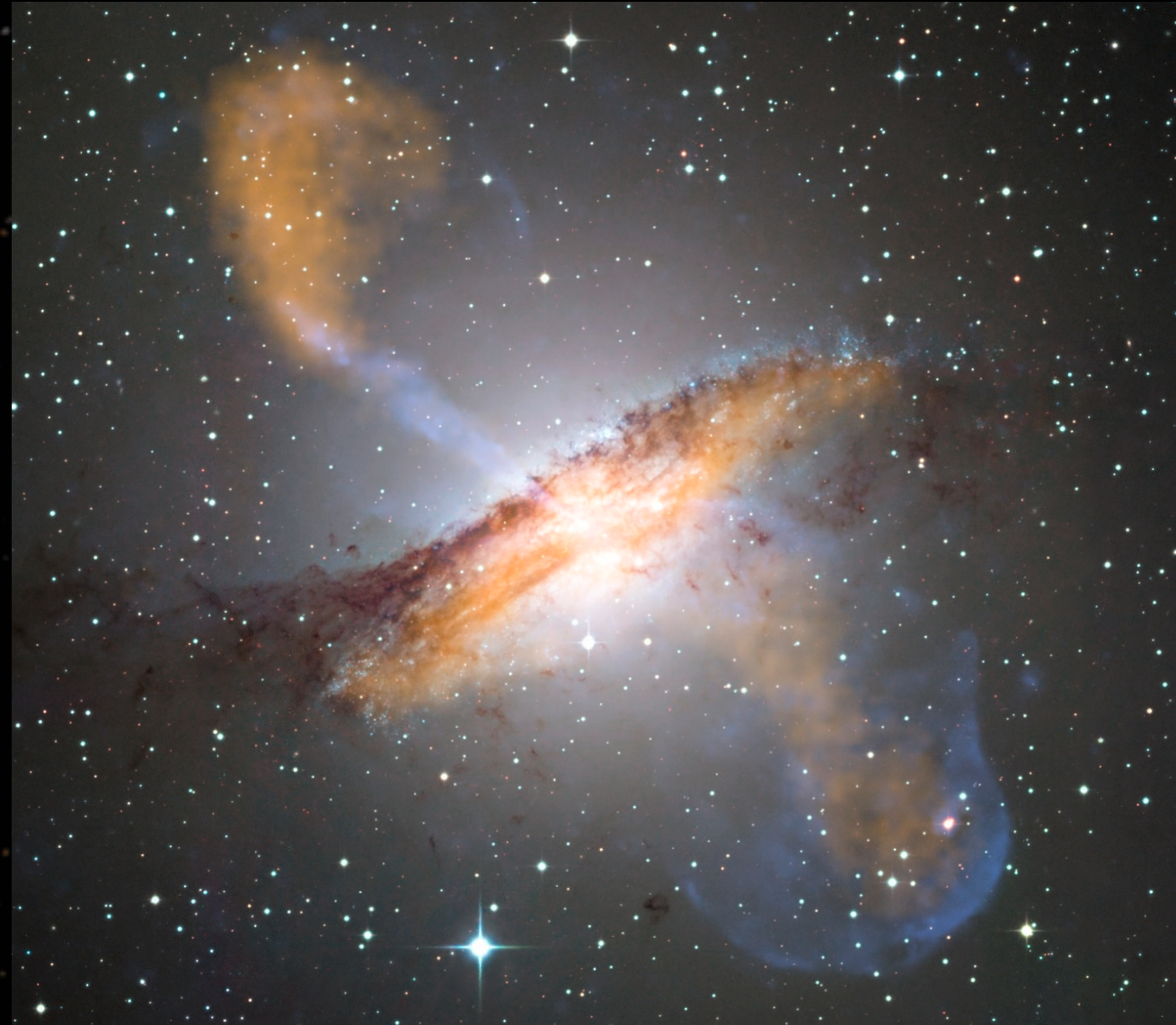
WHY OUTFLOWS IN GALAXIES?



OUTFLOWS IN STARBURST AND AGN



M82 from Mutchler+2007



Centaurus A ESO public images

OPEN QUESTIONS:

1. Are the Galactic Outflows “**ubiquitous**”?
2. Are the Galactic Outflows related to a particular ejection mechanism? **SF** and/or **AGN feedback**?
3. Can the Galactic Outflows reduce the gas reservoir and than **regulate** the **SF activity**?

DATA SAMPLE

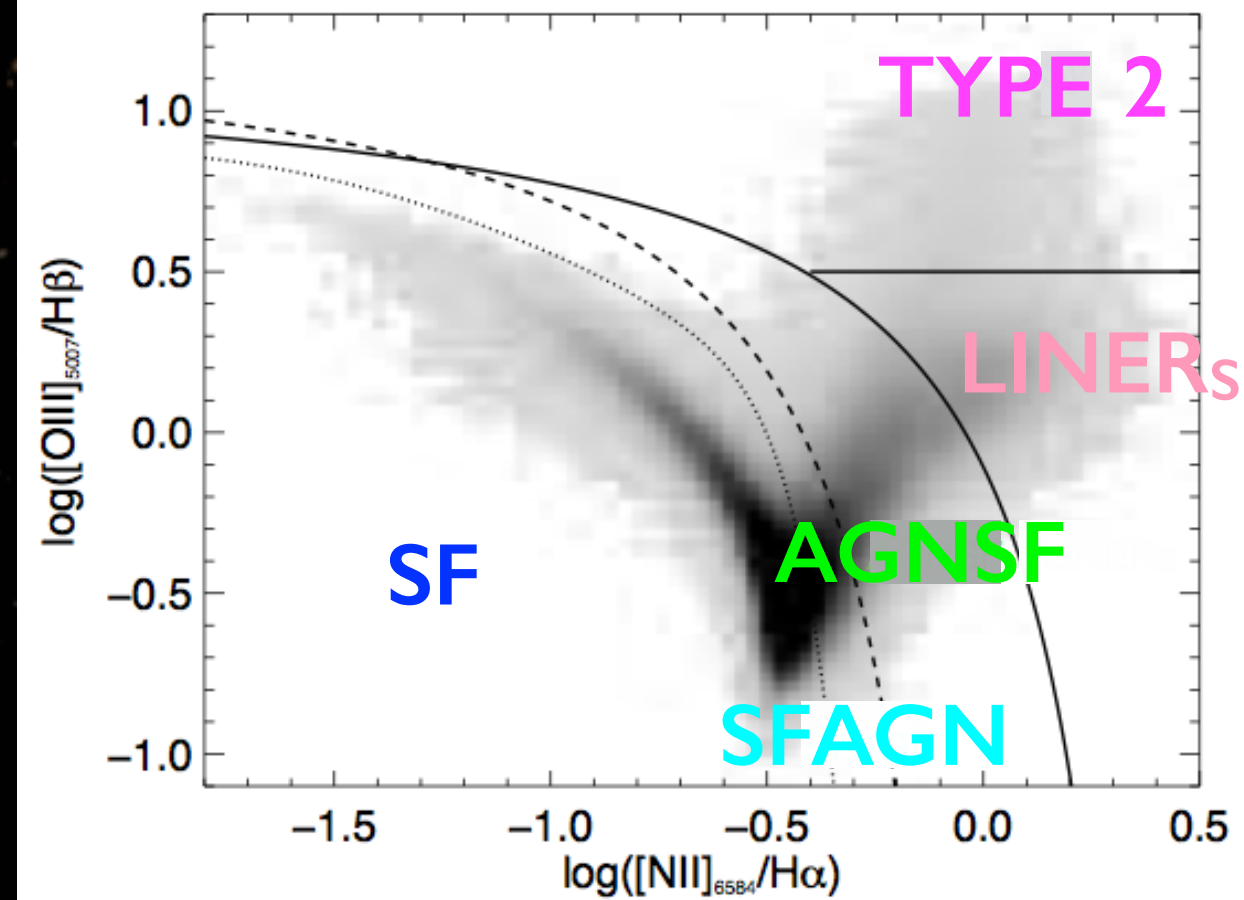
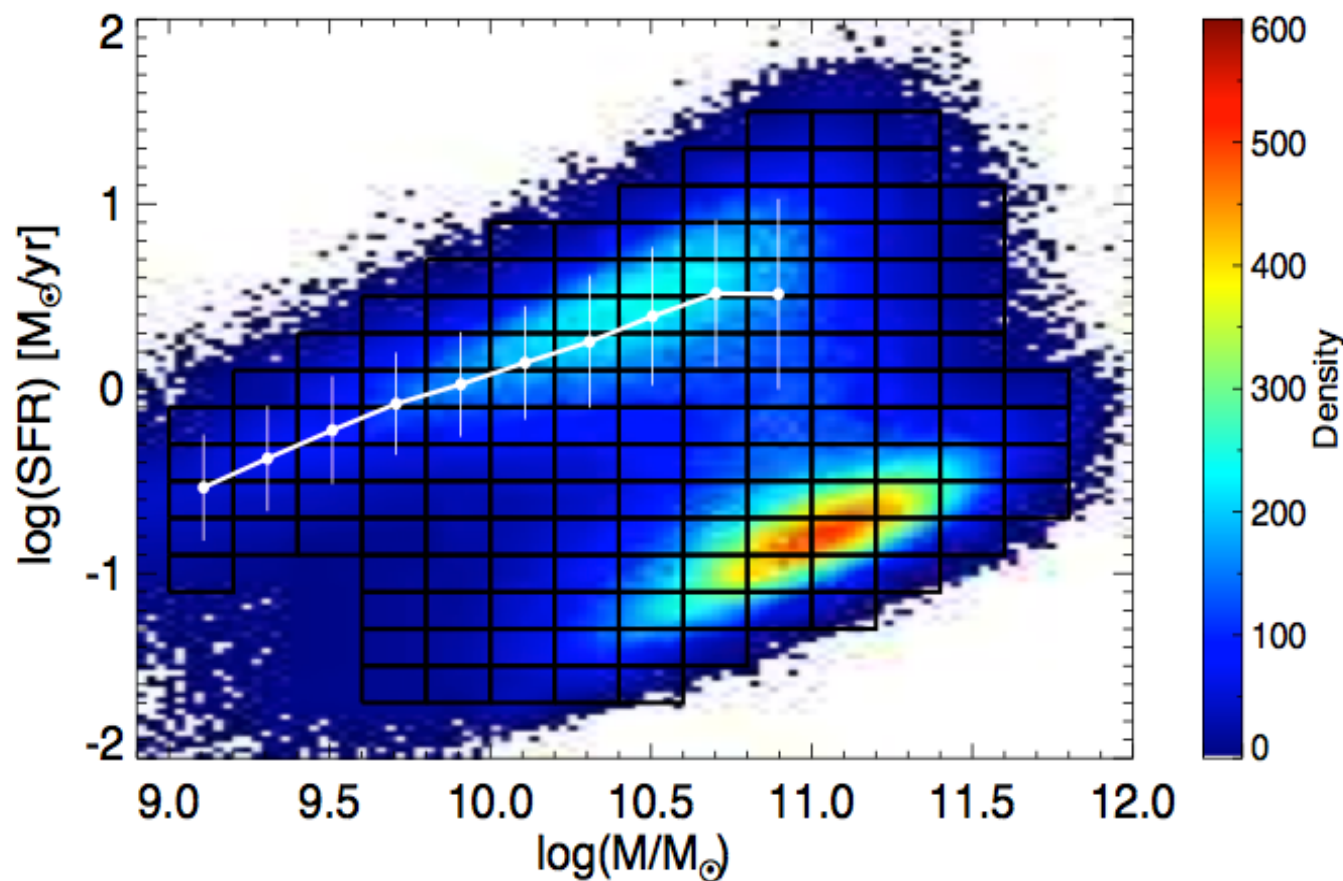
SEARCHING FOR GALACTIC OUTFLOWS

Stacked Spectra of 600000 galaxies

Bins:

SFR & M_{star}

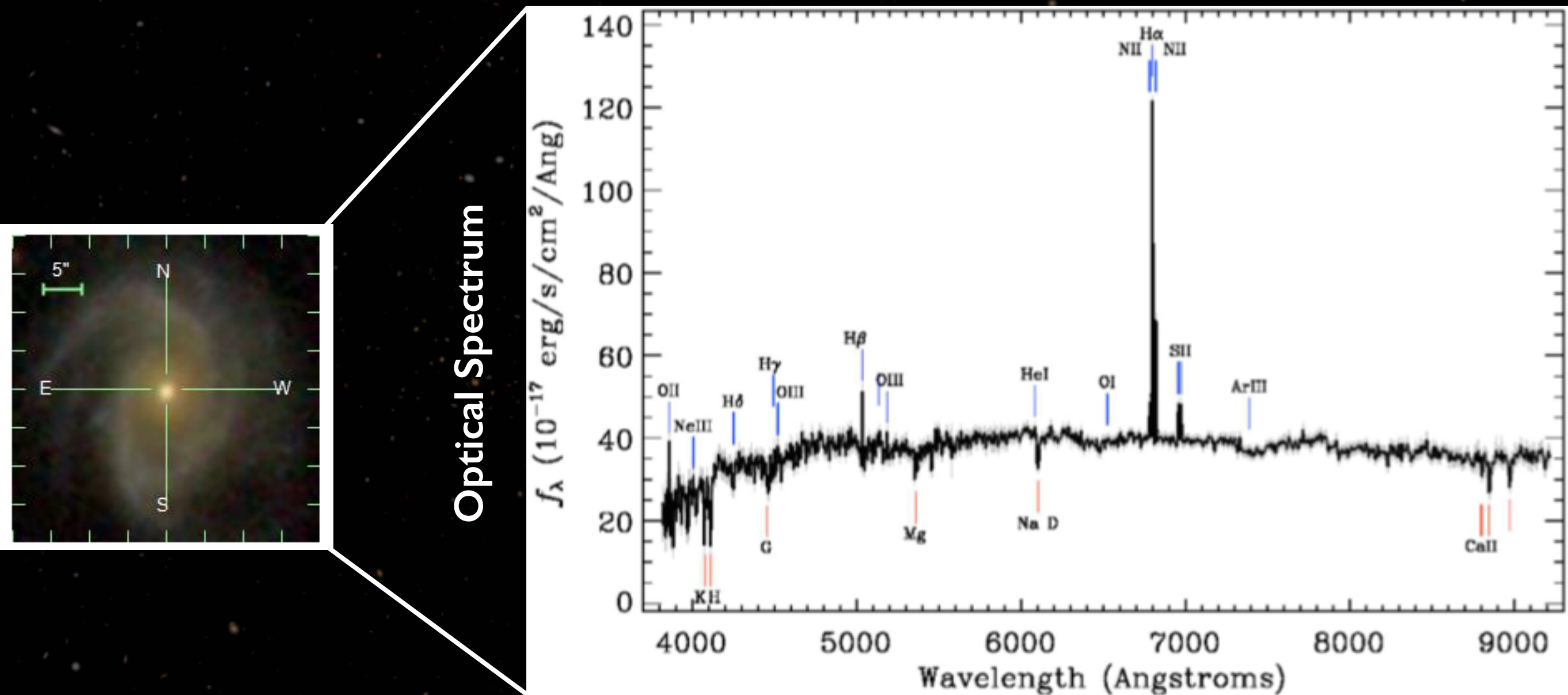
SFG vs AGN



Concas, Popesso, Brusa, Mainieri+2017

DATA SAMPLE & METHODS

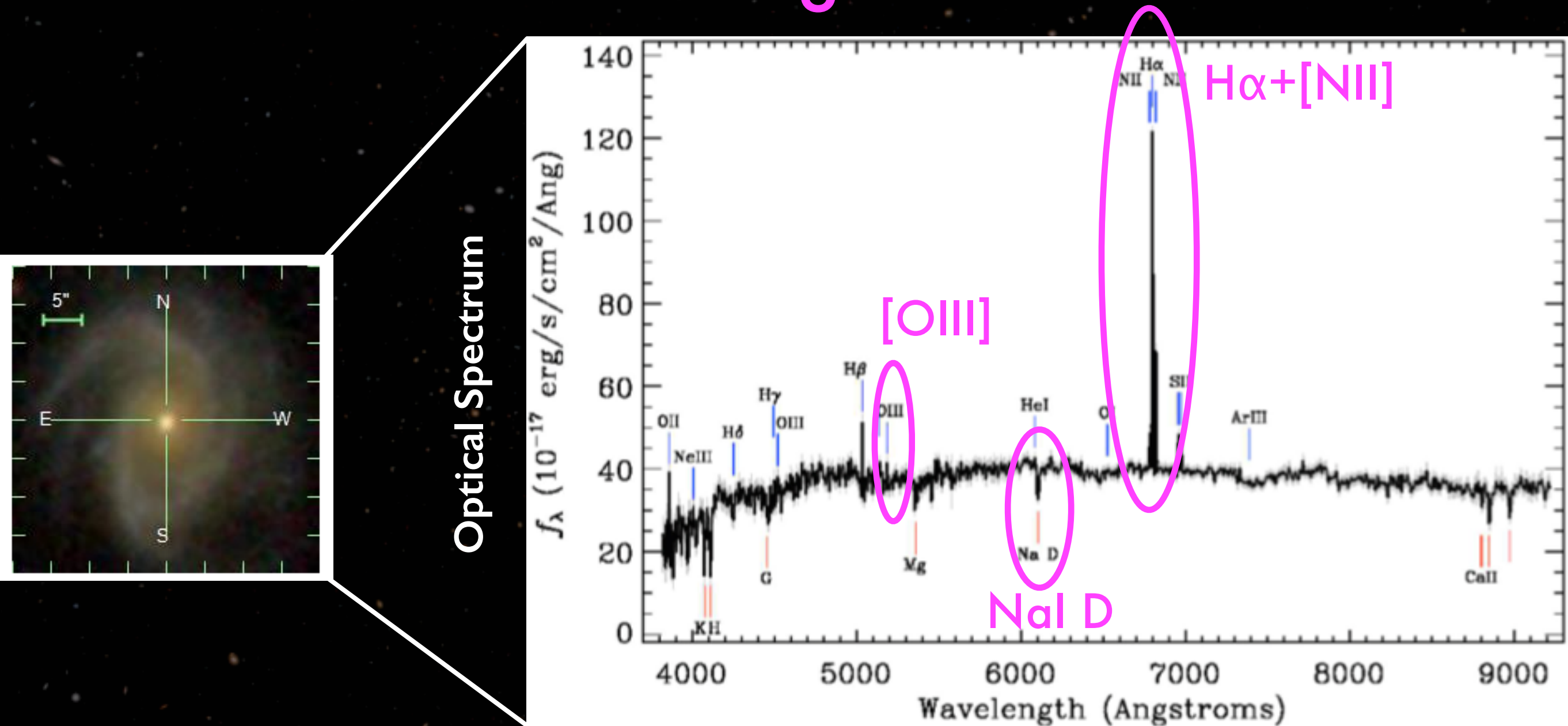
Sloan Digital Sky Survey DR7



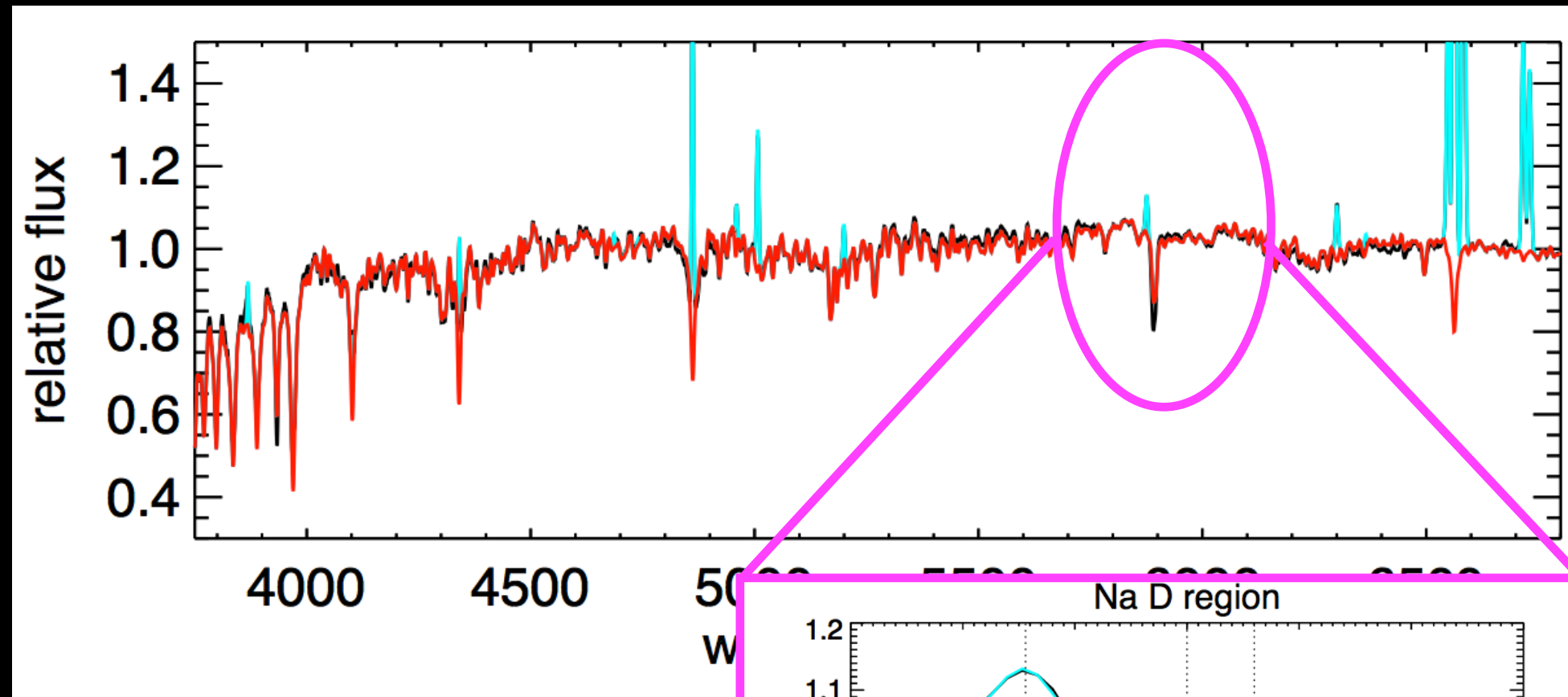
DATA SAMPLE & METHODS

Sloan Digital Sky Survey DR7

Tracers of gas winds

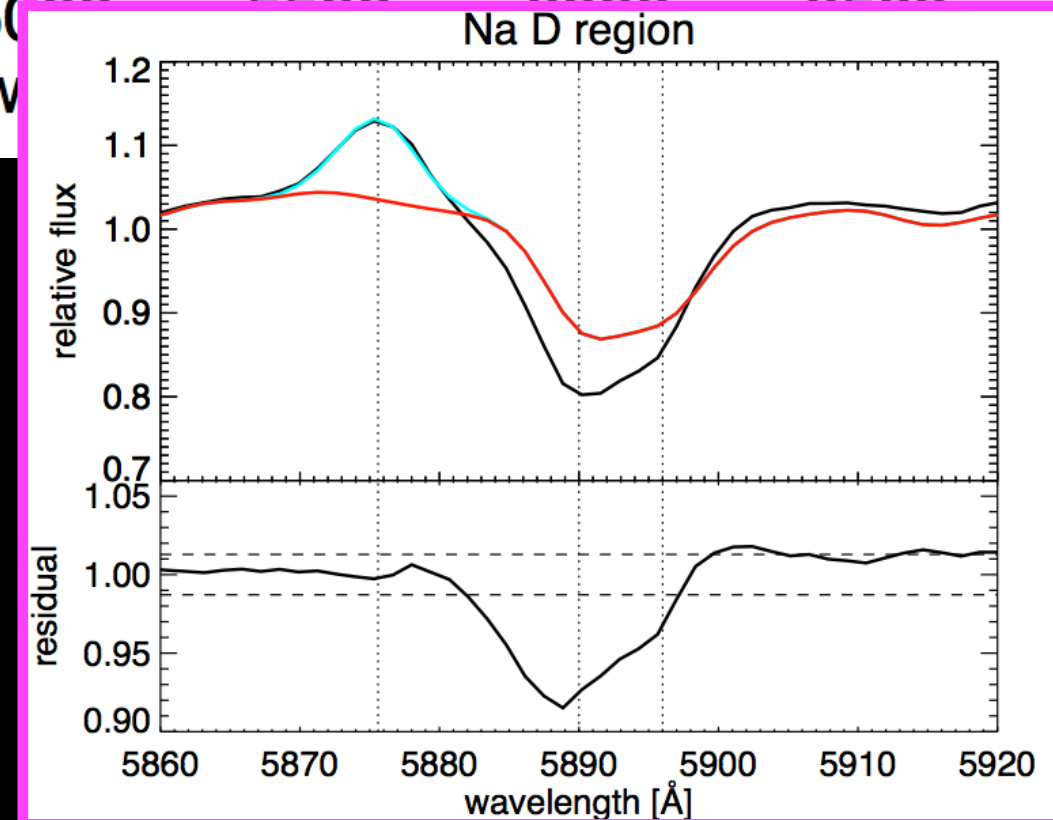


NEUTRAL GALACTIC OUTFLOWS



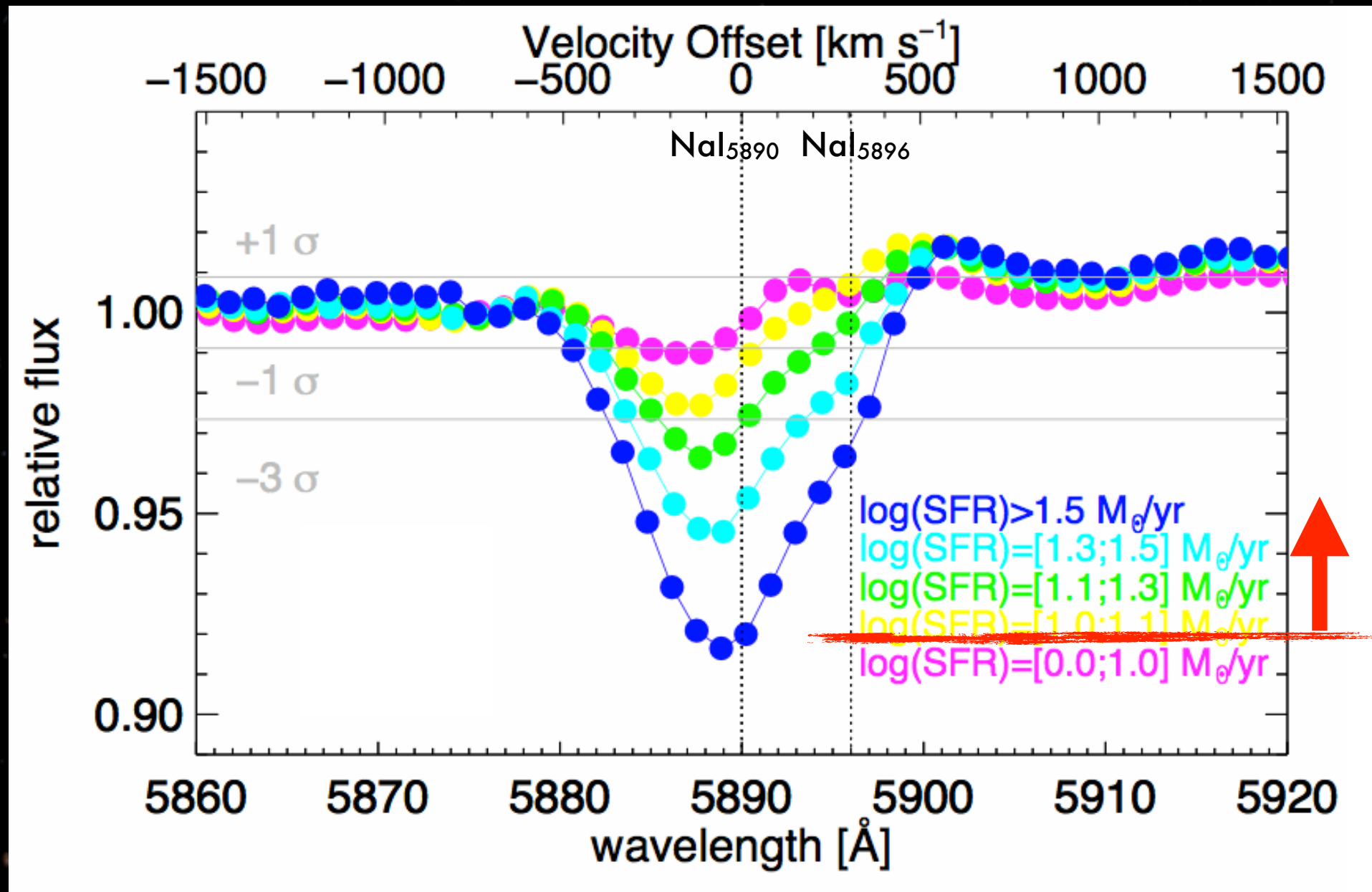
**Neutral Gas: Na I D
in Absorption**

- @ 5890, 5900 Å
- resonant line ($T < 10^3 \text{K}$)



NEUTRAL GALACTIC OUTFLOWS

NaID abs only at high SFR ($>10 M_{\odot}/\text{yr}$)

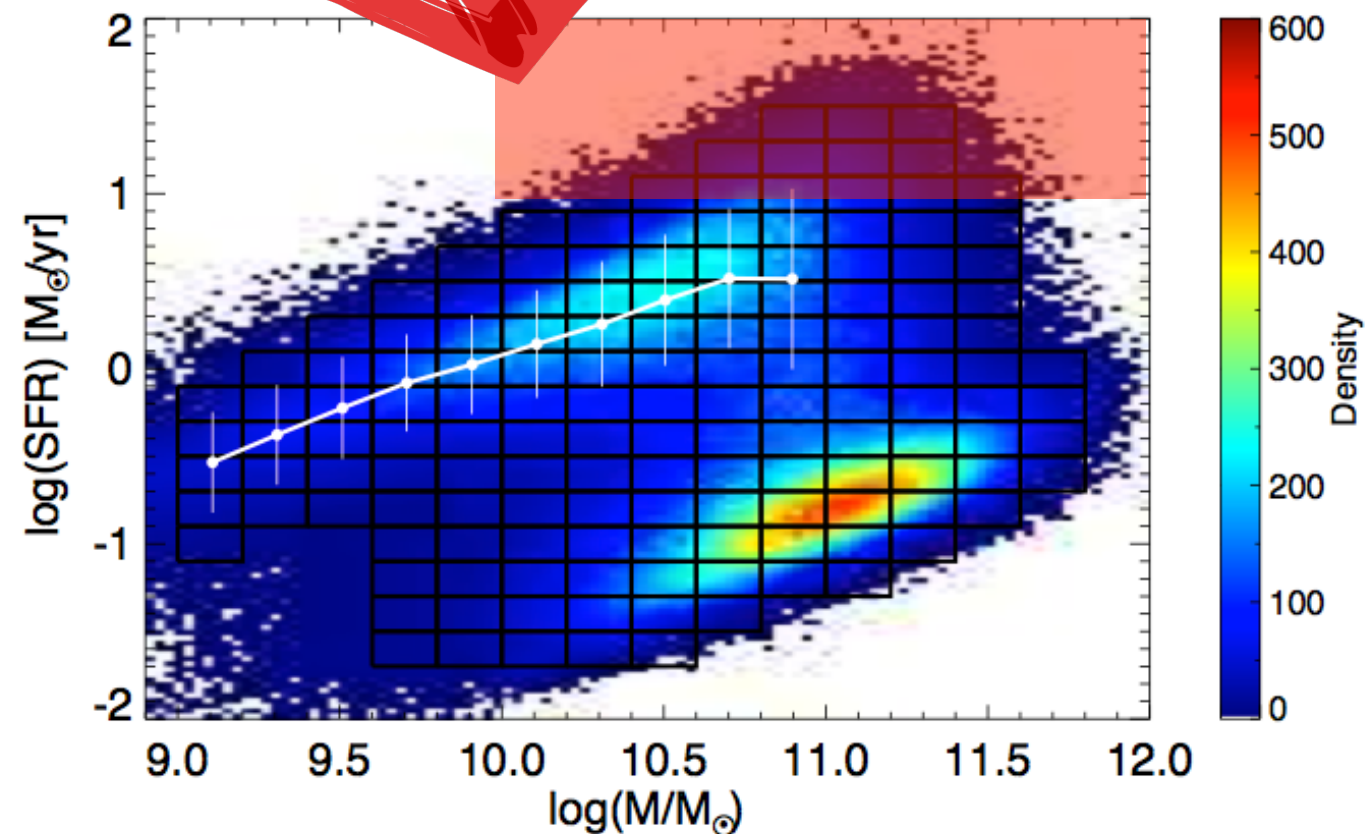
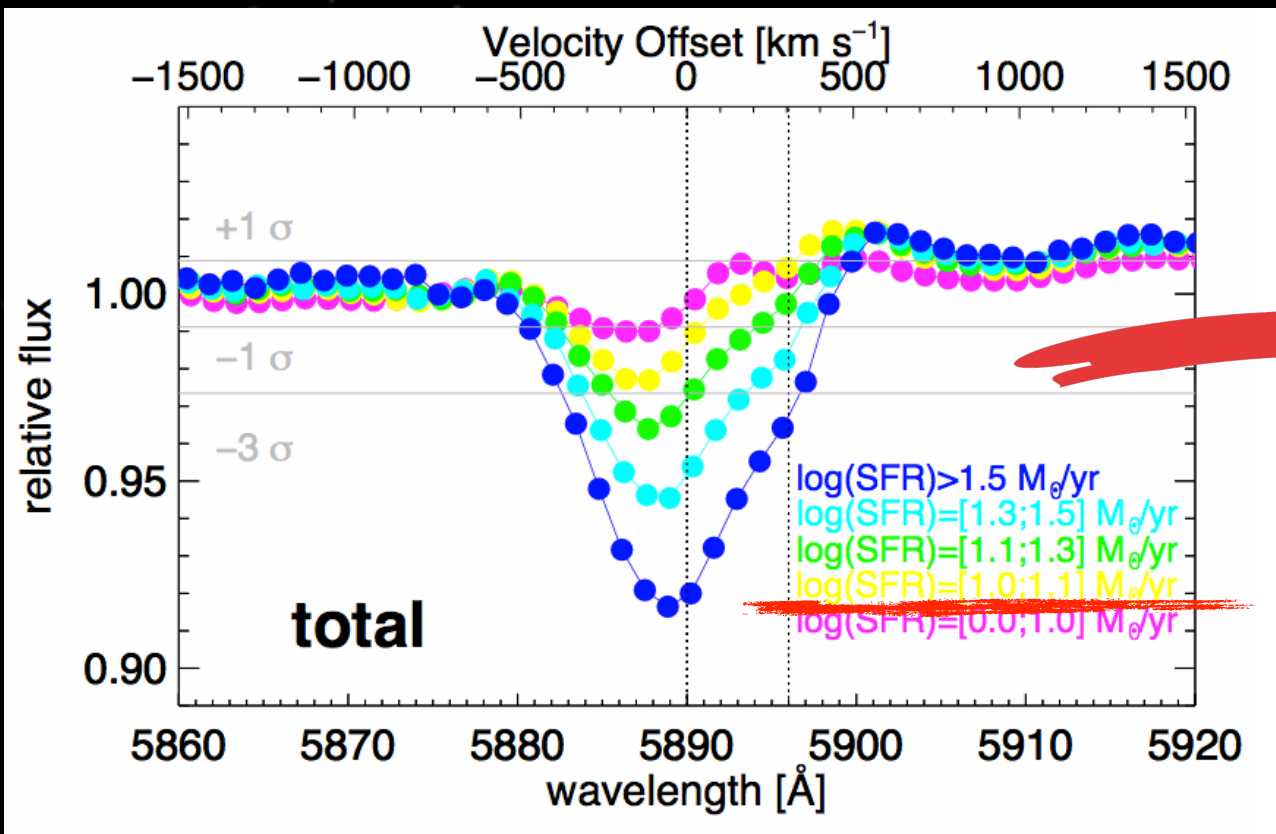


Concas+2018 arXiv:1710.08423

NEUTRAL GALACTIC OUTFLOWS

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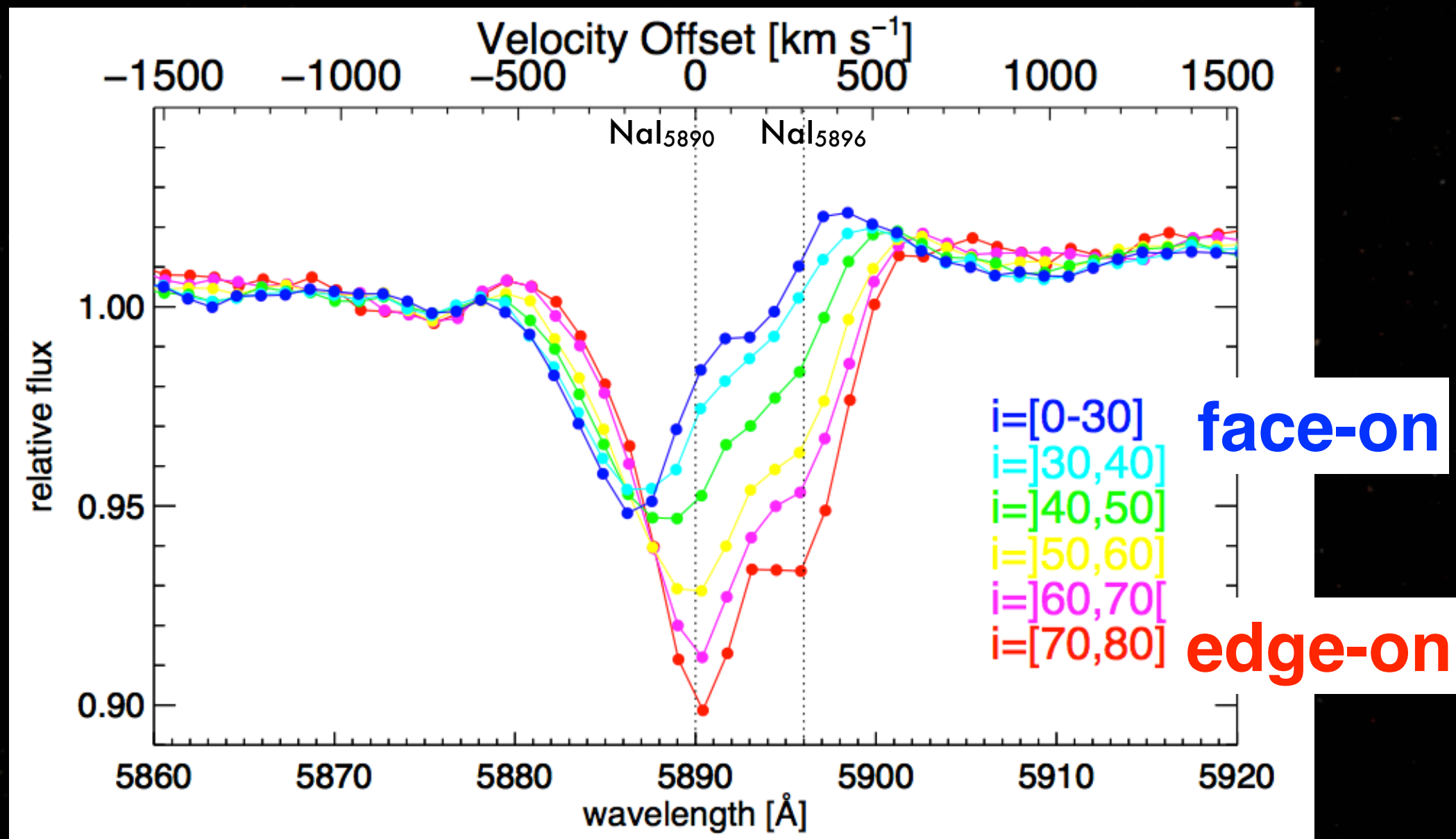
NaID winds



Concas+2018 arXiv:1710.08423

NEUTRAL GALACTIC OUTFLOWS

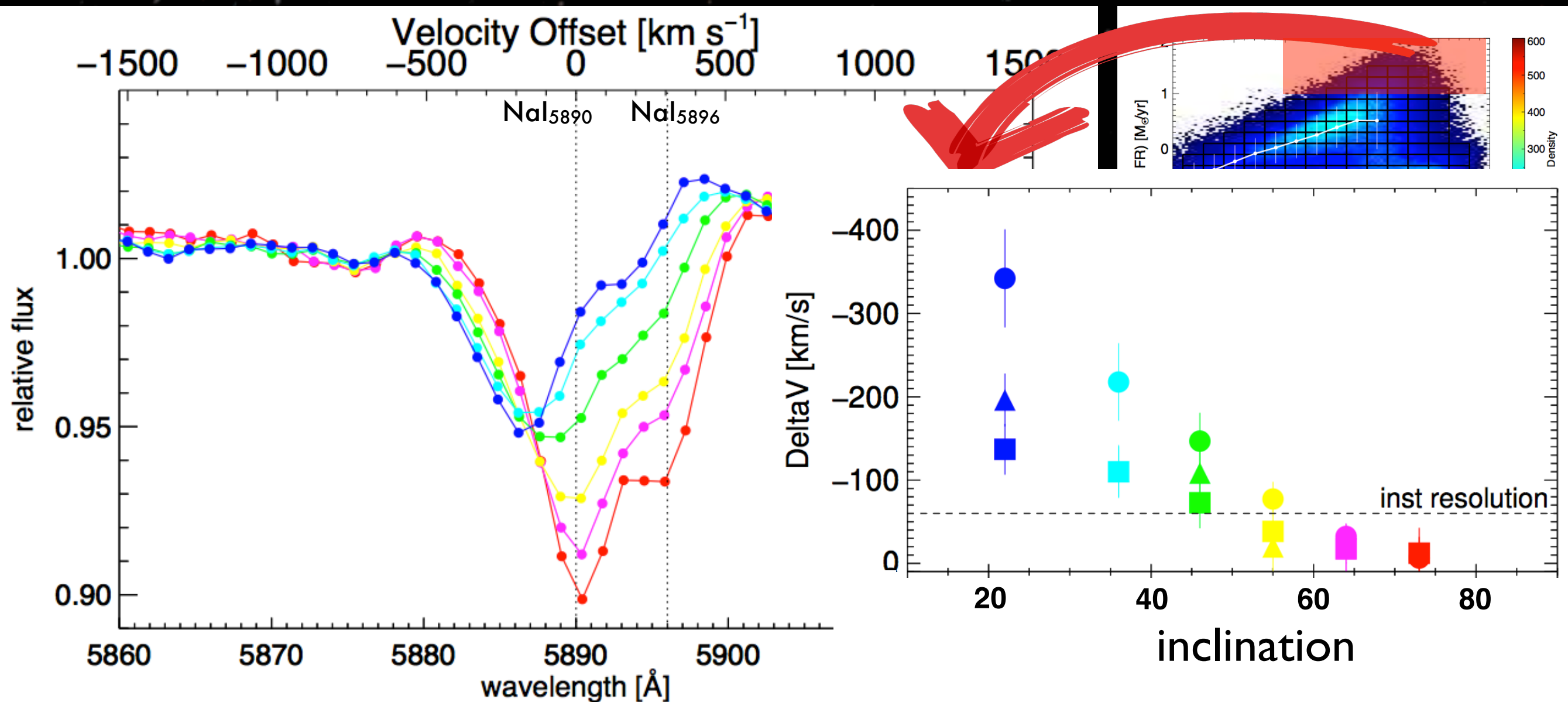
Gas wind perpendicular to the disk



Concas+2018 arXiv:1710.08423

NEUTRAL GALACTIC OUTFLOWS

Gas wind perpendicular to the disk

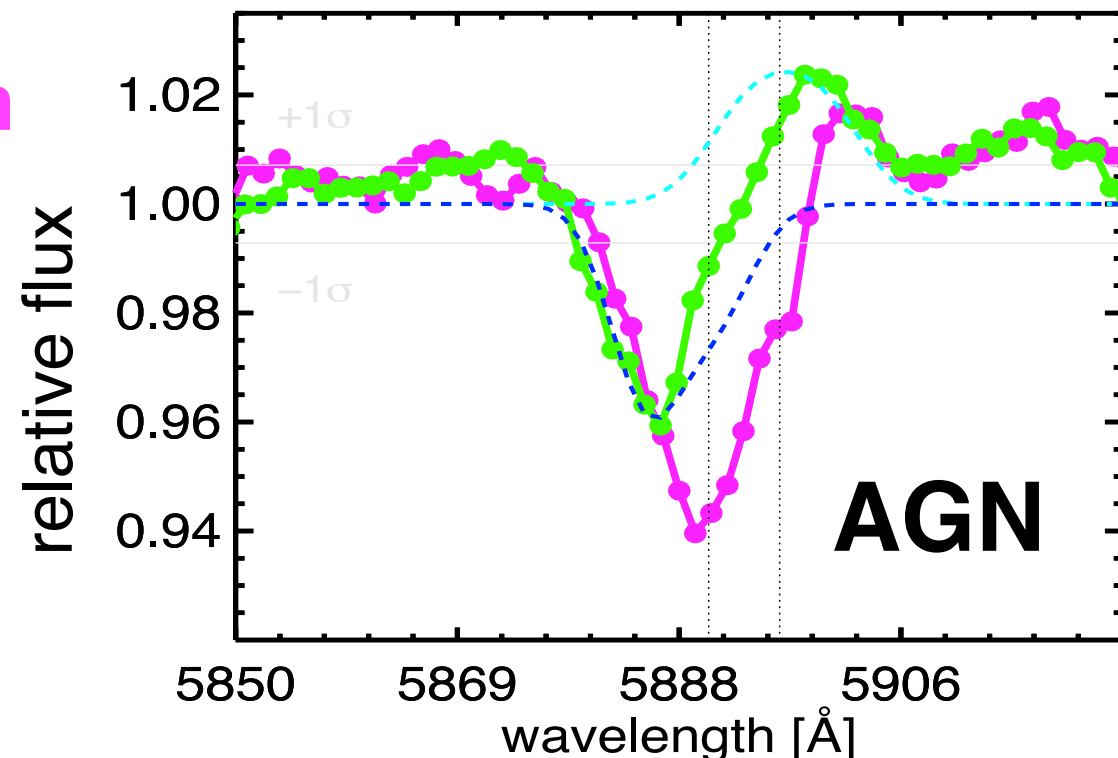
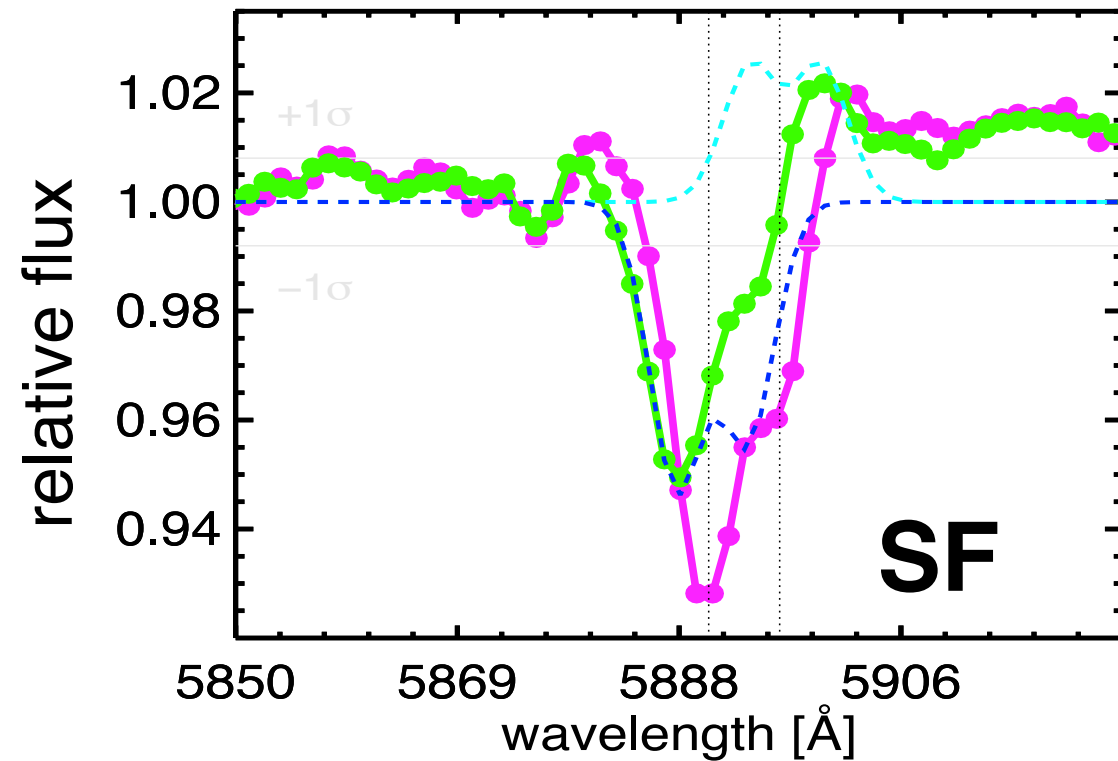


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NEUTRAL GALACTIC OUTFLOWS

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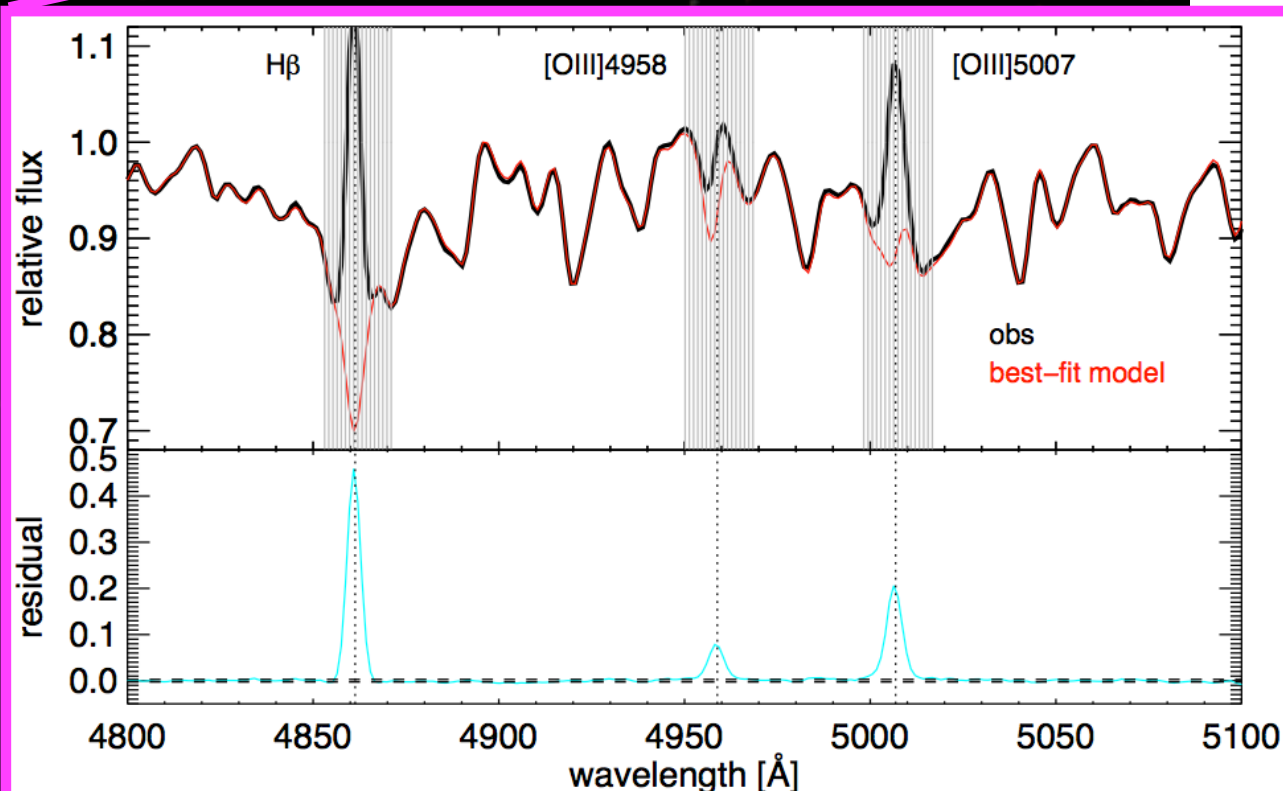
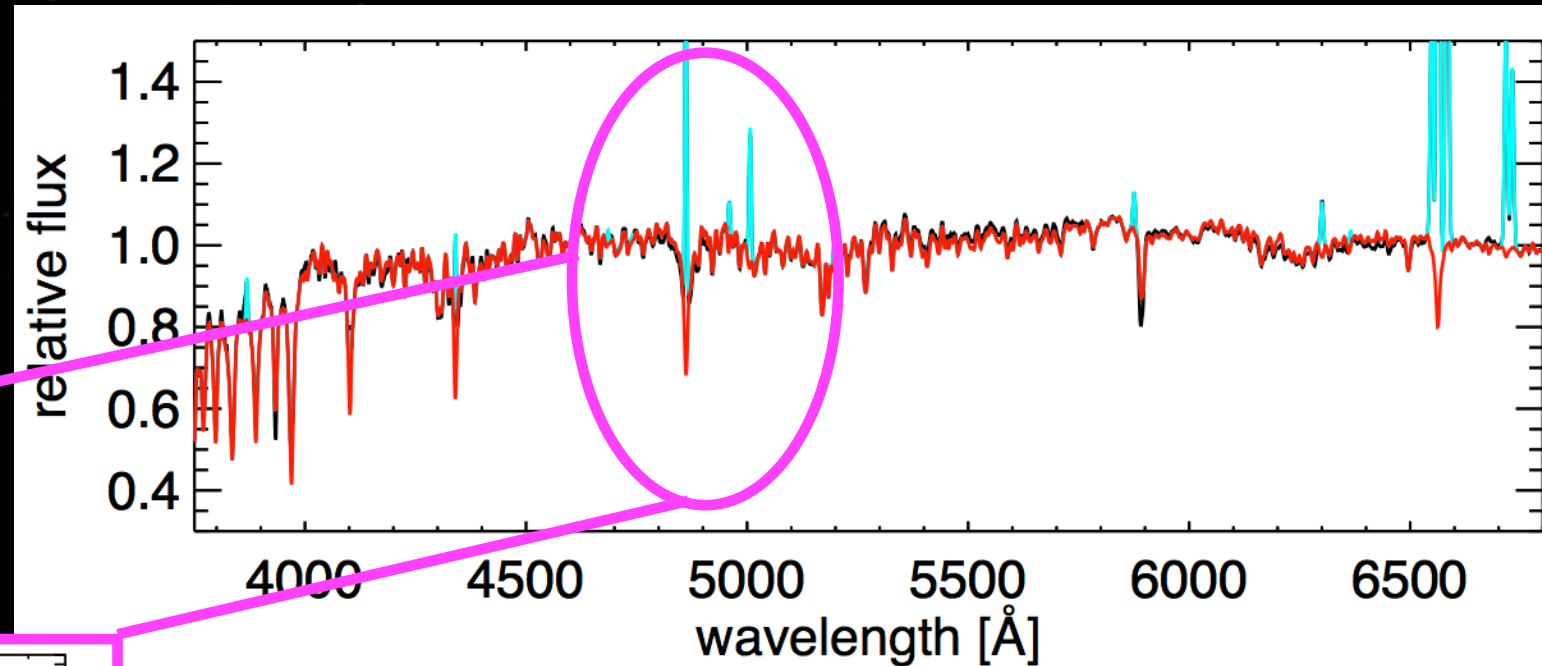
face-on
 $i=[0,50]$
 $i=[50,90]$
edge-on



Gas wind perpendicular
to the disk in both SFGs
and AGN

IONIZED GALACTIC OUTFLOWS

Concas, Popesso, Brusa, Mainieri+2017



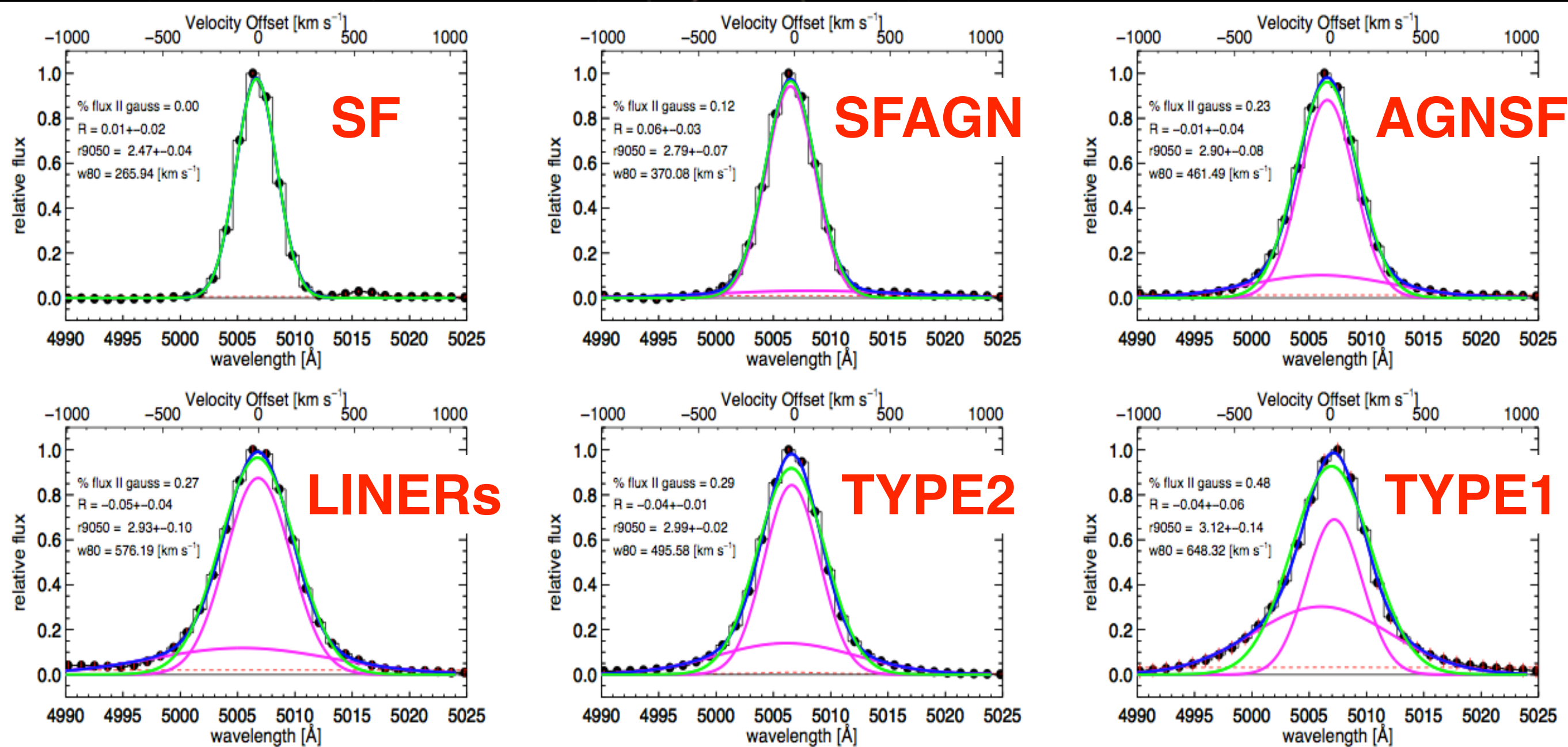
**Ionized Gas: [OIII]5007
in Emission**

- @ 5007 Å
- forbidden line (T~ 10⁴K)

IONIZED GALACTIC OUTFLOWS

1 Gauss
2 Gauss

Outflows evidence only in AGN

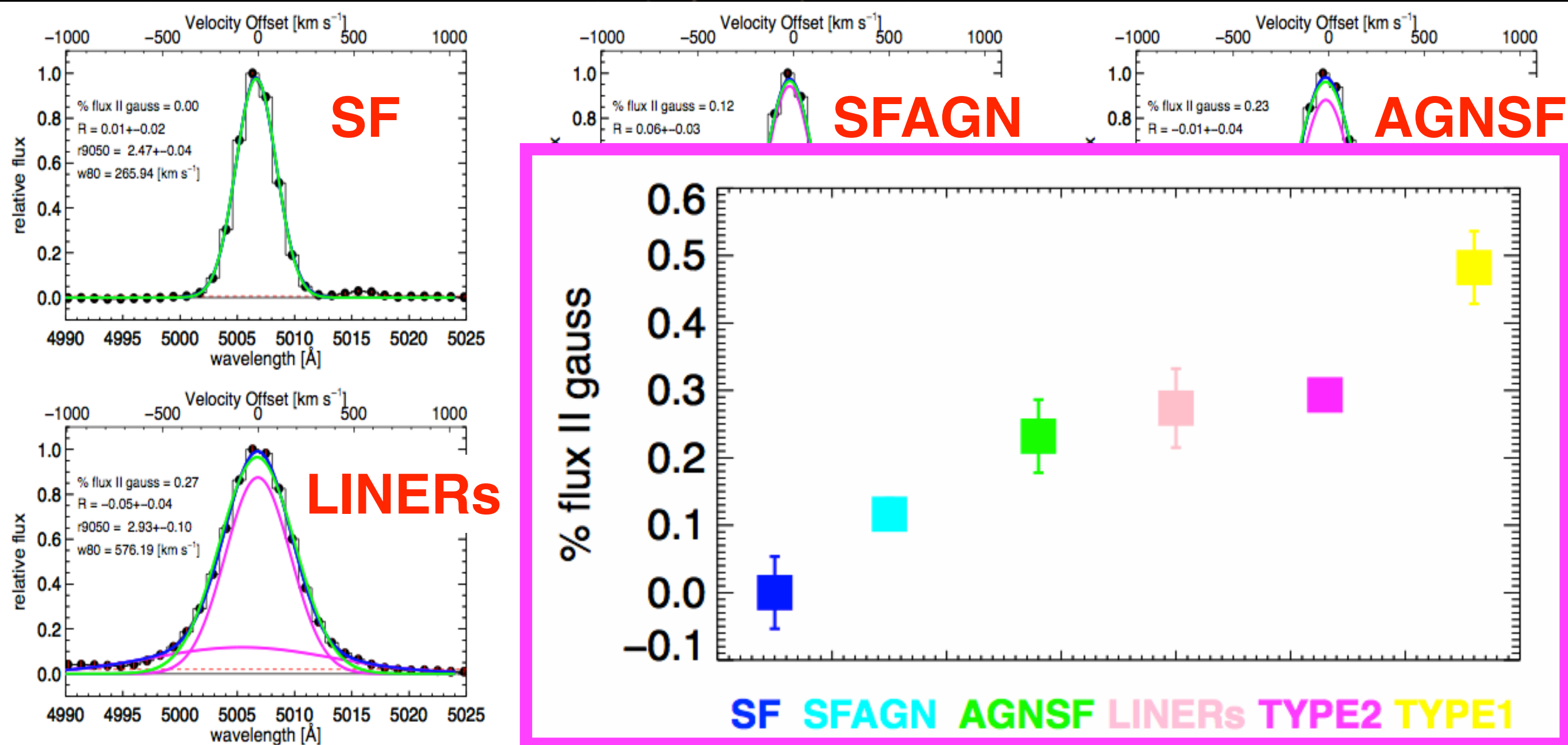


Concas, Popesso, Brusa, Mainieri+2017

IONIZED GALACTIC OUTFLOWS

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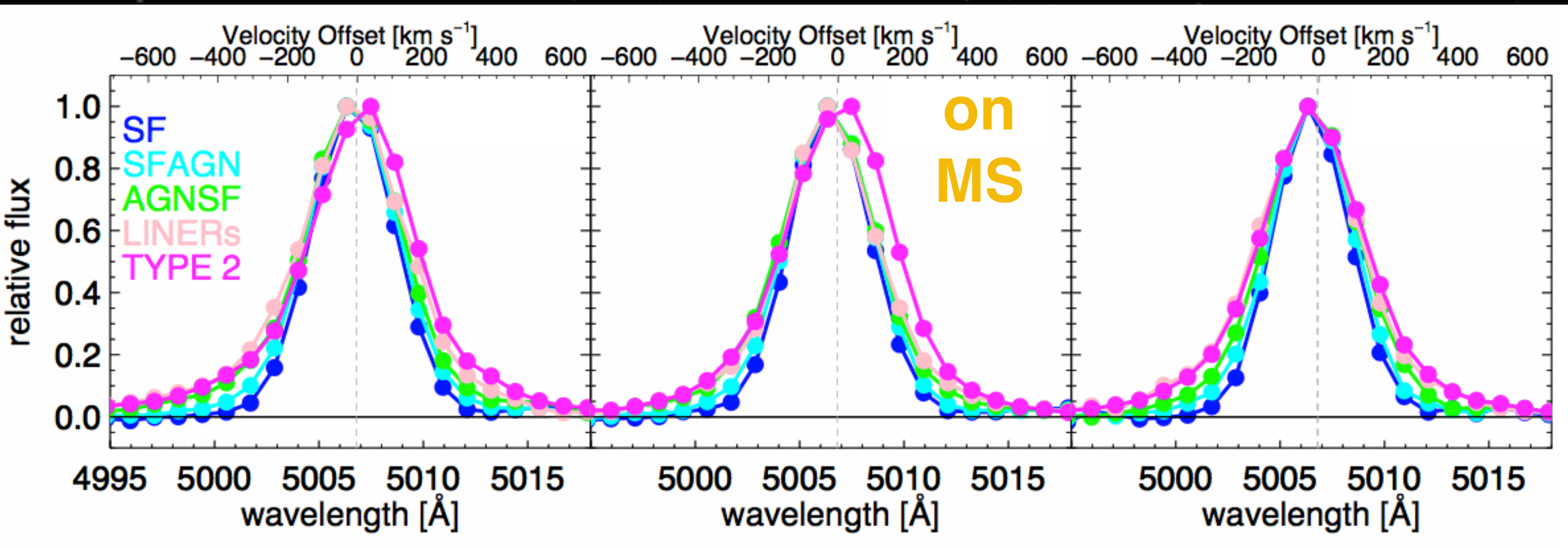
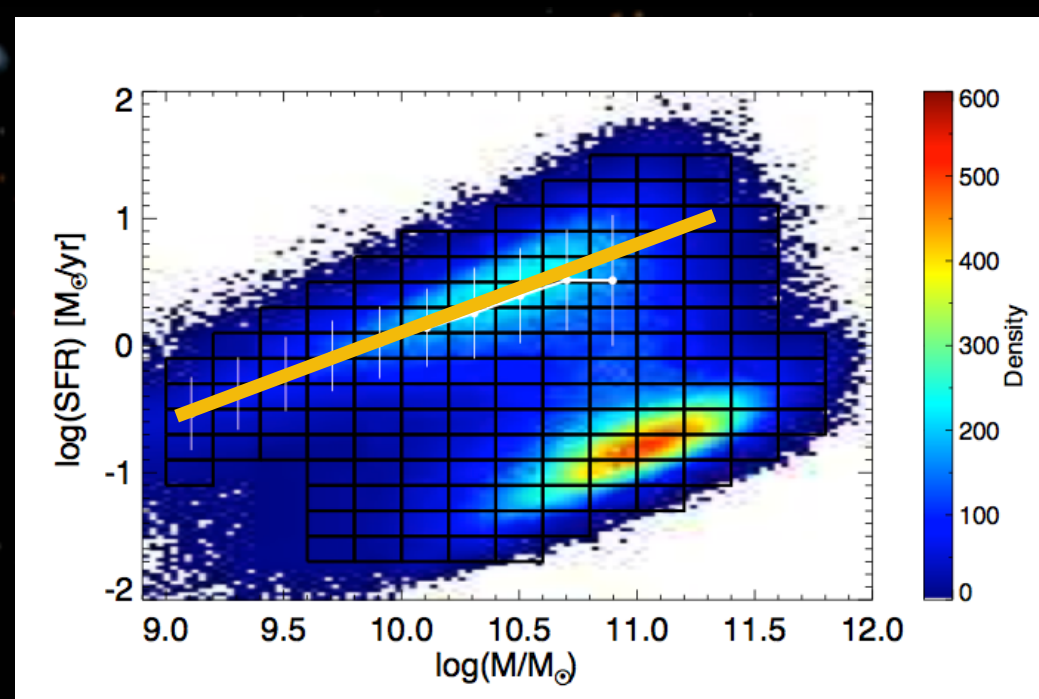
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IONIZED GALACTIC OUTFLOWS

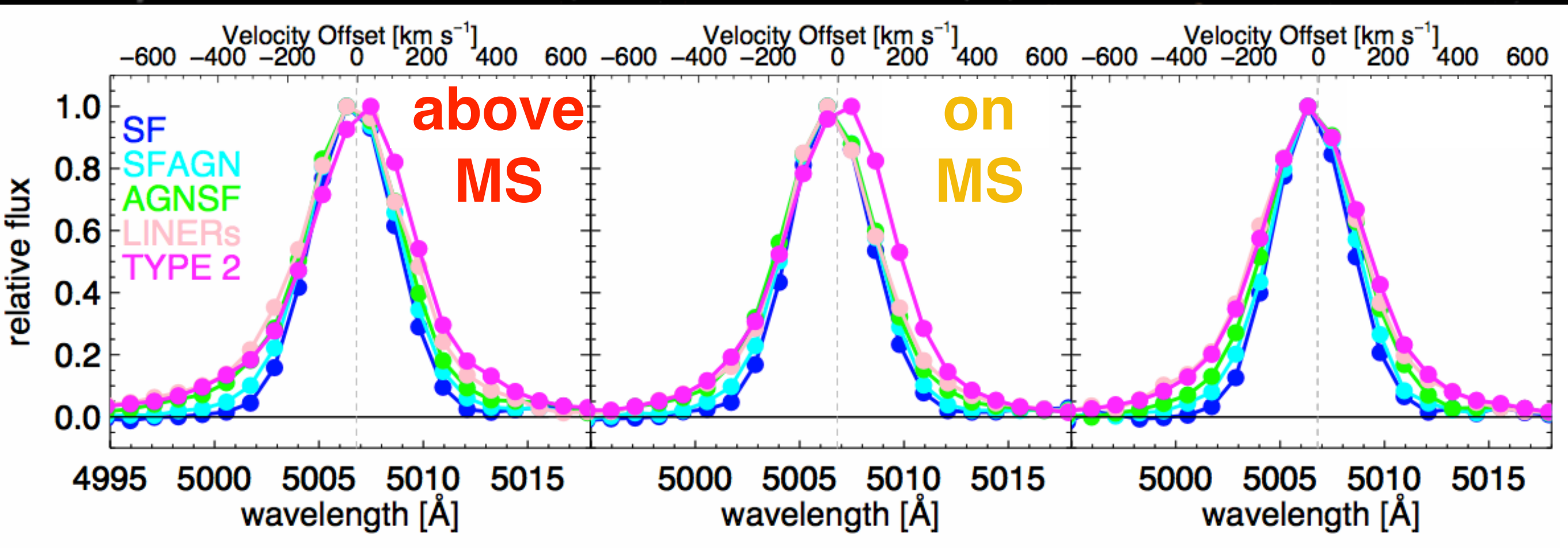
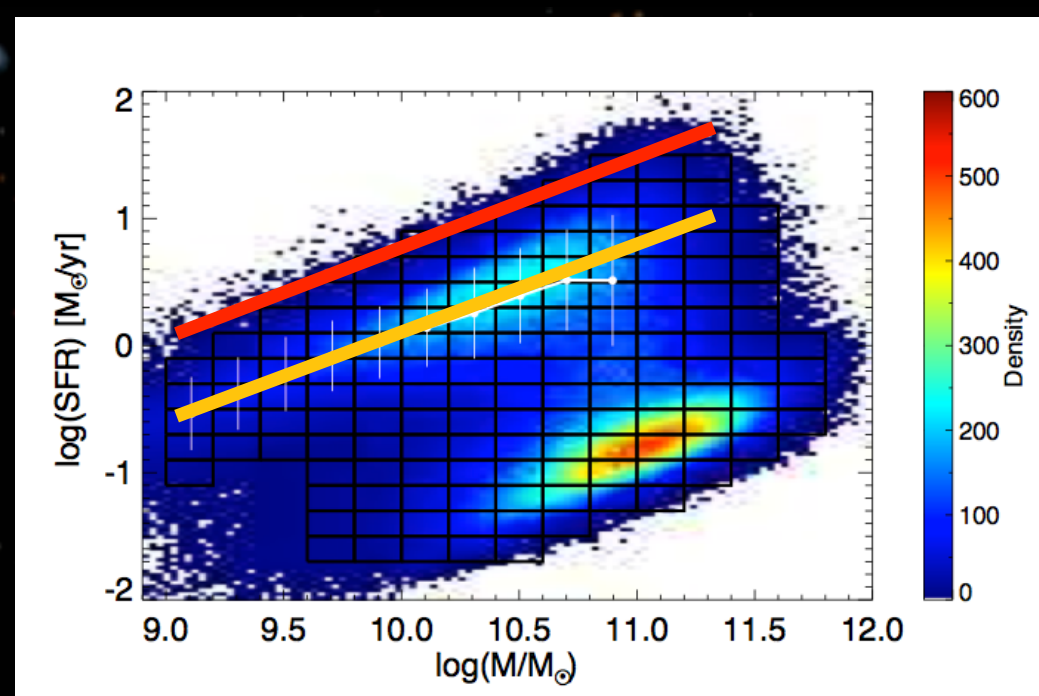
No dependence on SFR



Concas, Popesso, Brusa, Mainieri+2017

IONIZED GALACTIC OUTFLOWS

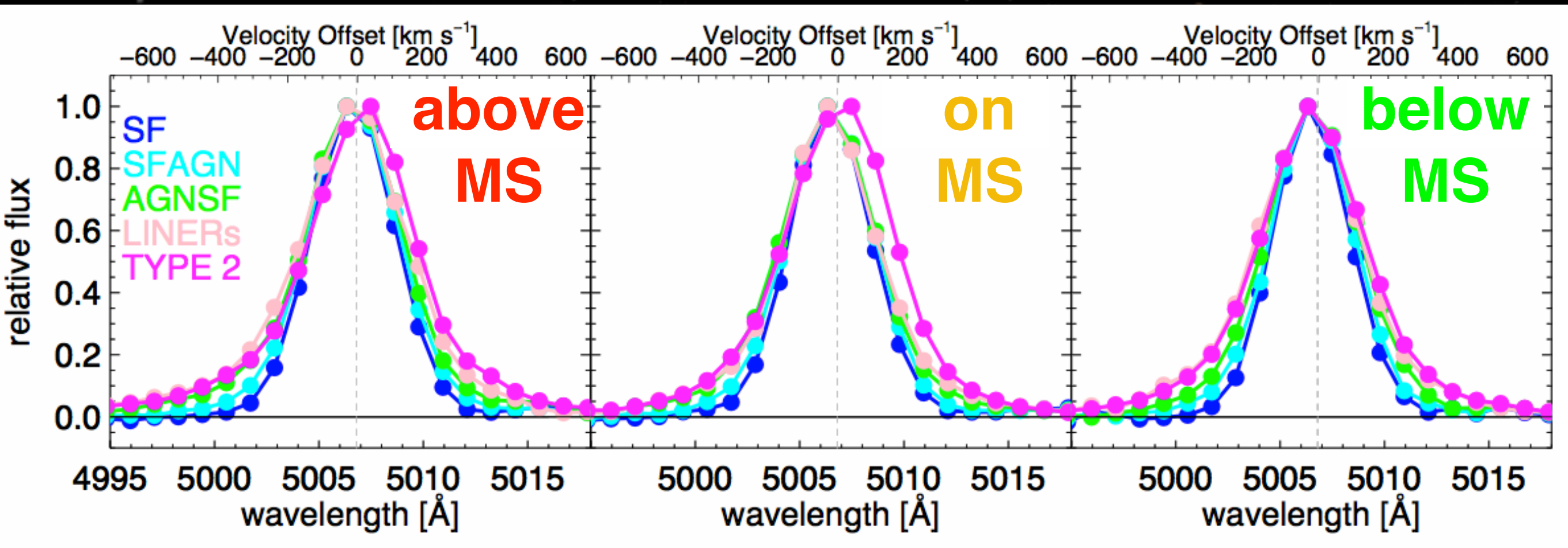
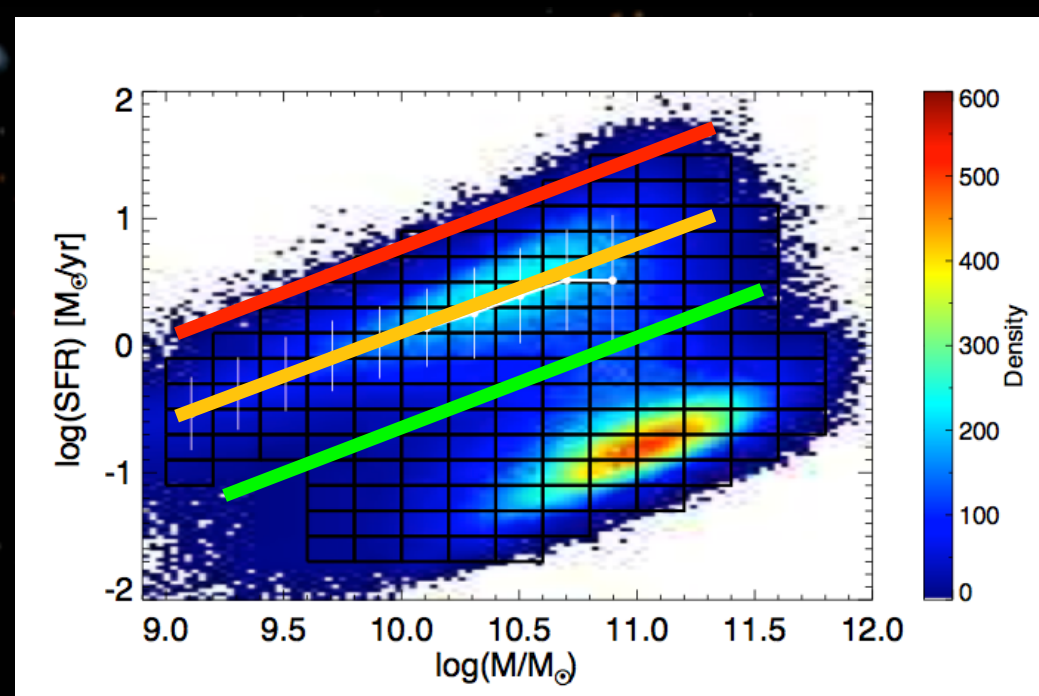
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IONIZED GALACTIC OUTFLOWS

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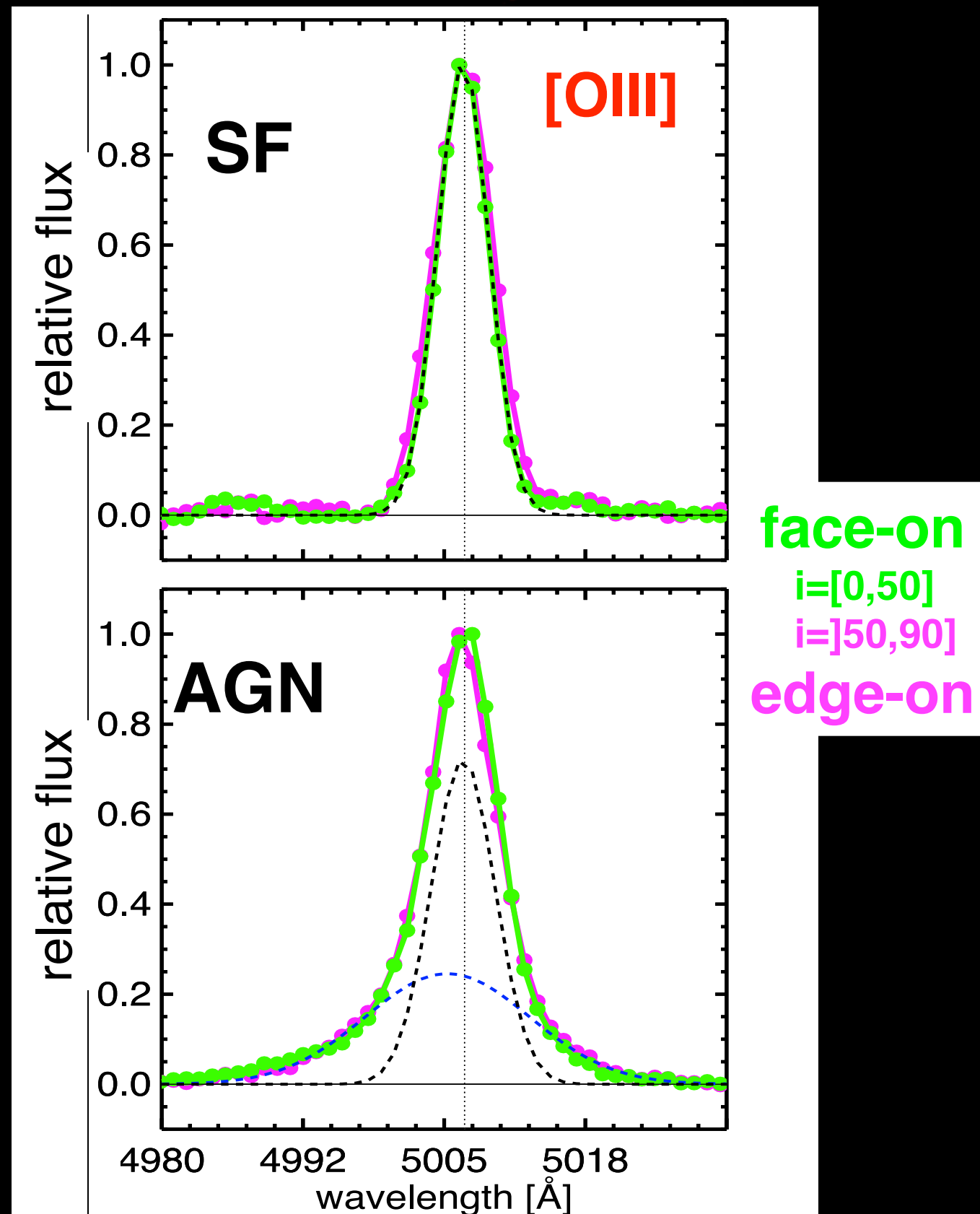


Concas, Popesso, Brusa, Mainieri+2017

IONIZED GALACTIC OUTFLOWS

Gas wind only in AGN
galaxies
no clear inclination
dependence

Concas+2018 arXiv:1710.08423



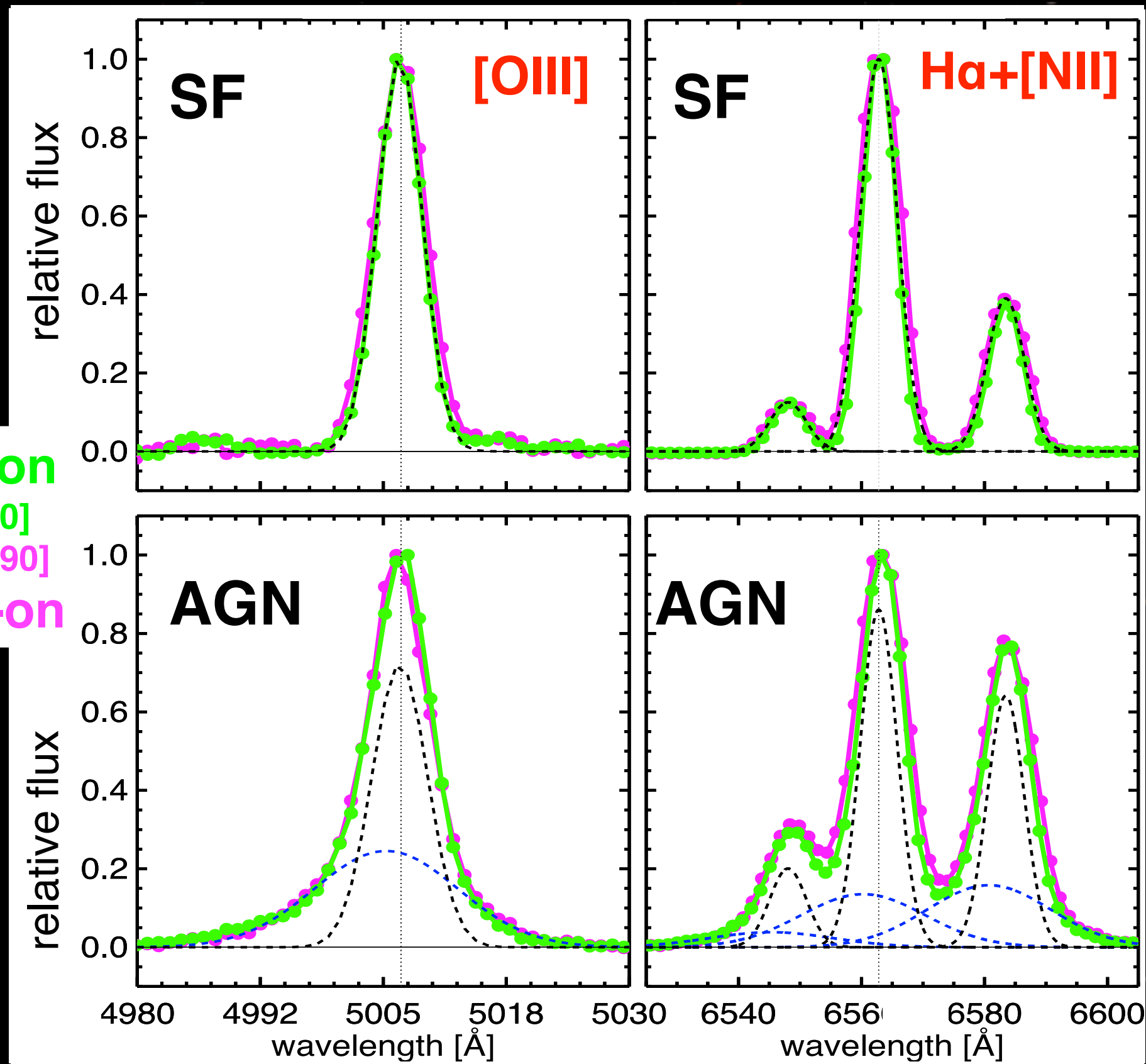
IONIZED GALACTIC OUTFLOWS

[OIII] & H α + [NII]

Gas wind only
in AGN
galaxies
no clear
inclination
dependence

face-on
 $i=[0,50]$
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edge-on

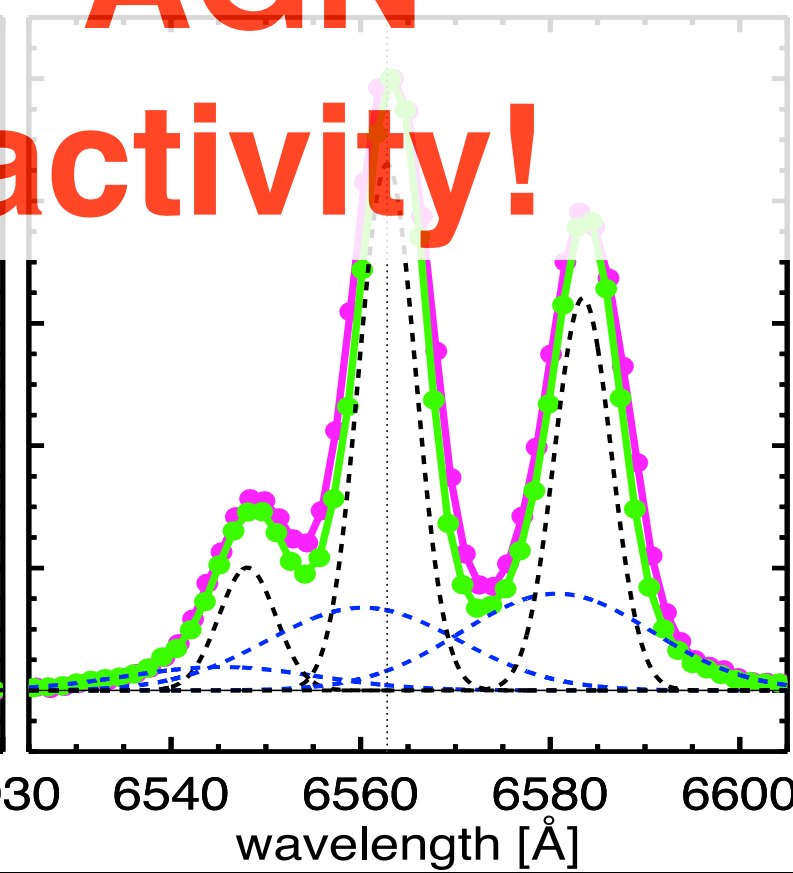
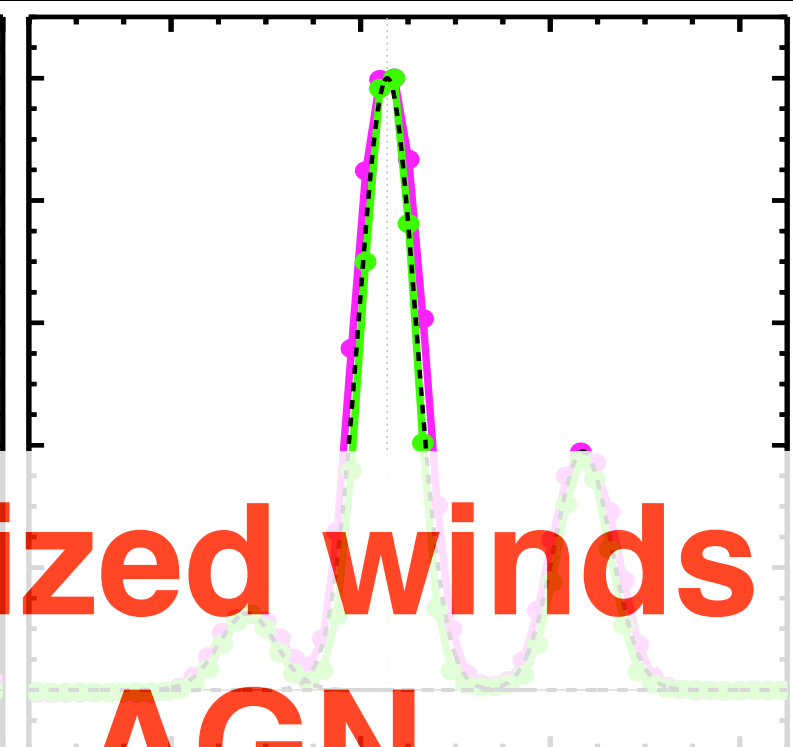
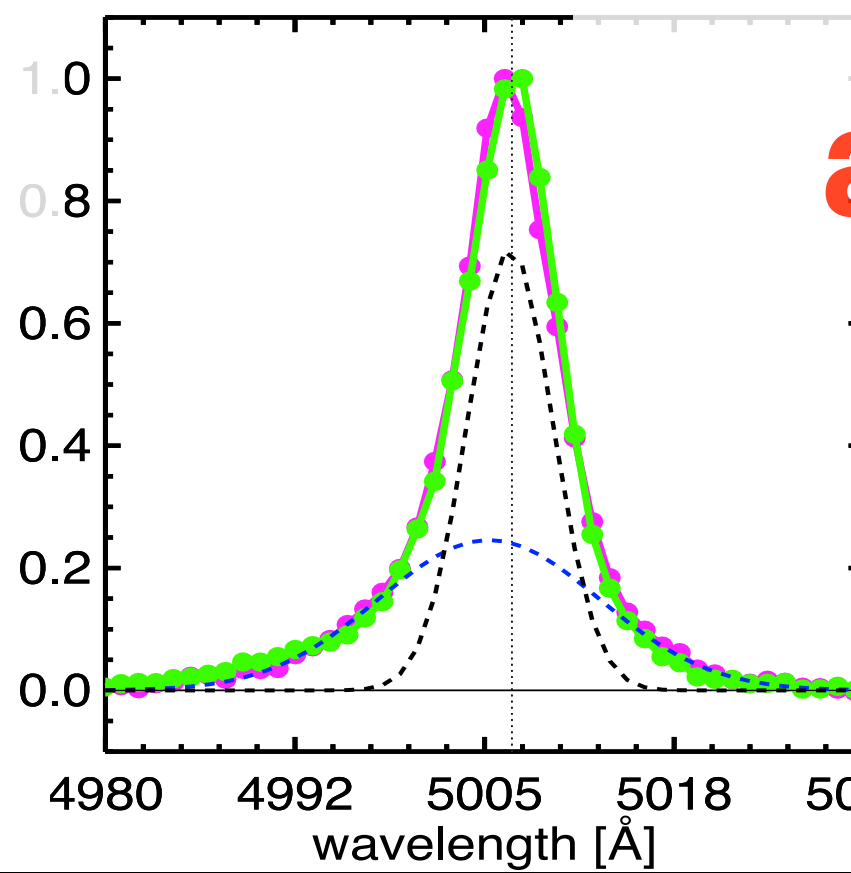
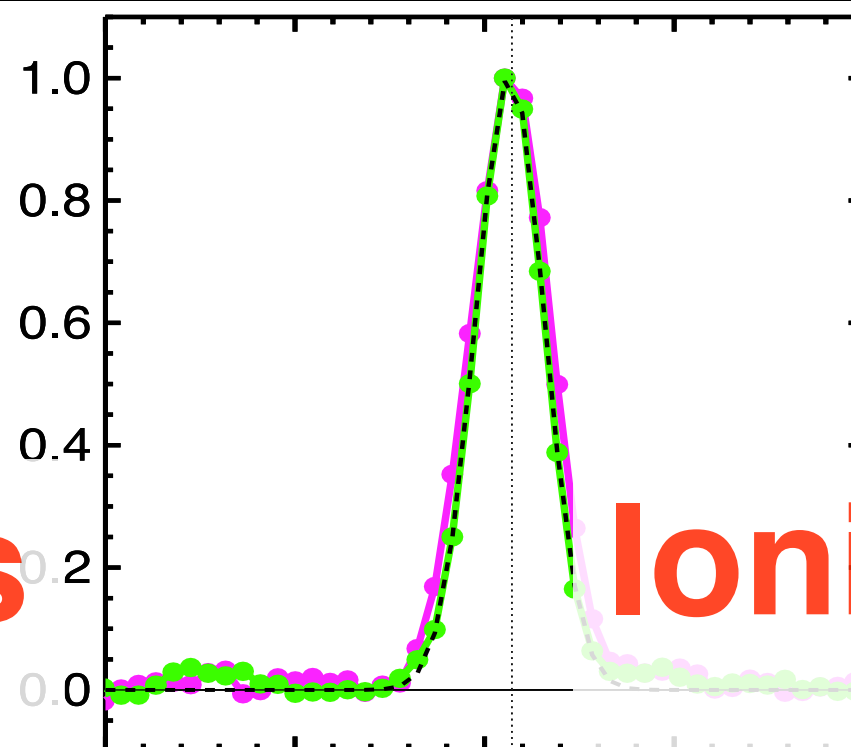
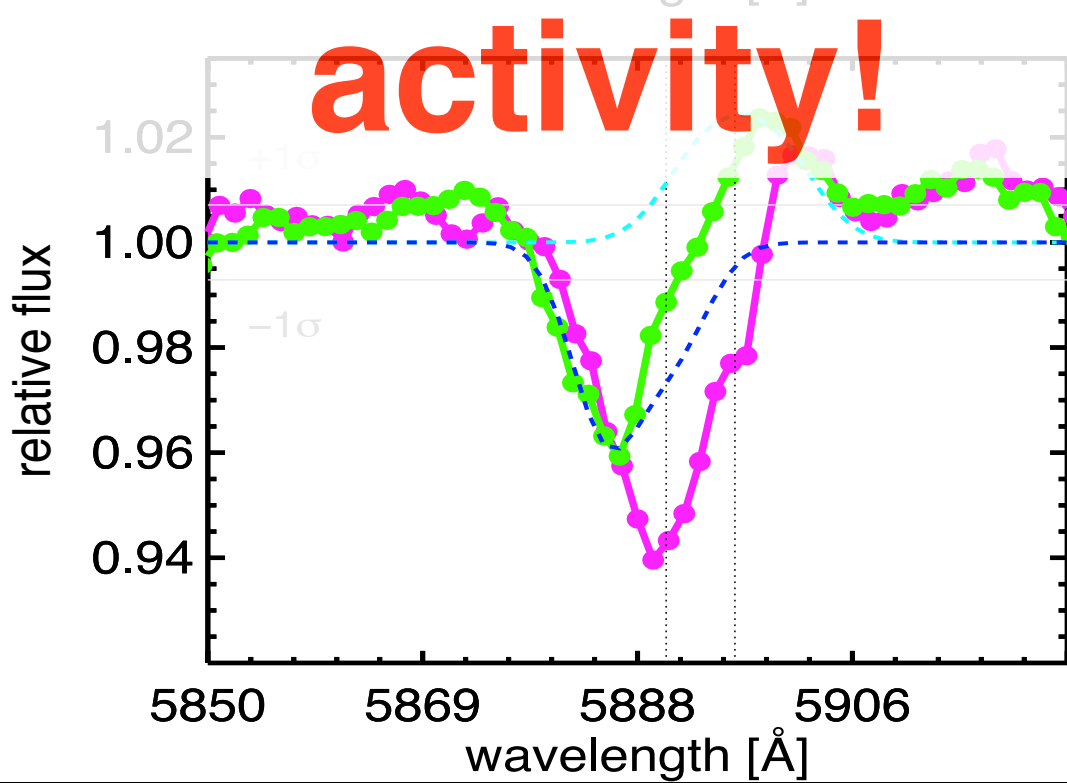
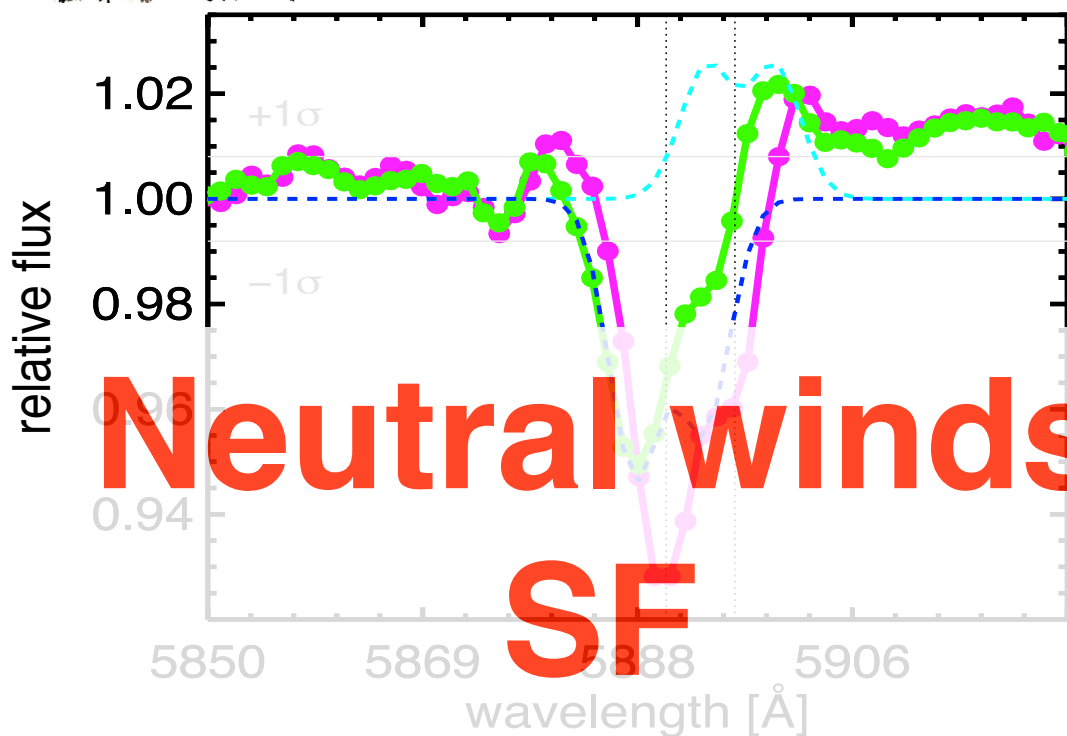
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TWO-FACES OUTFLOWS

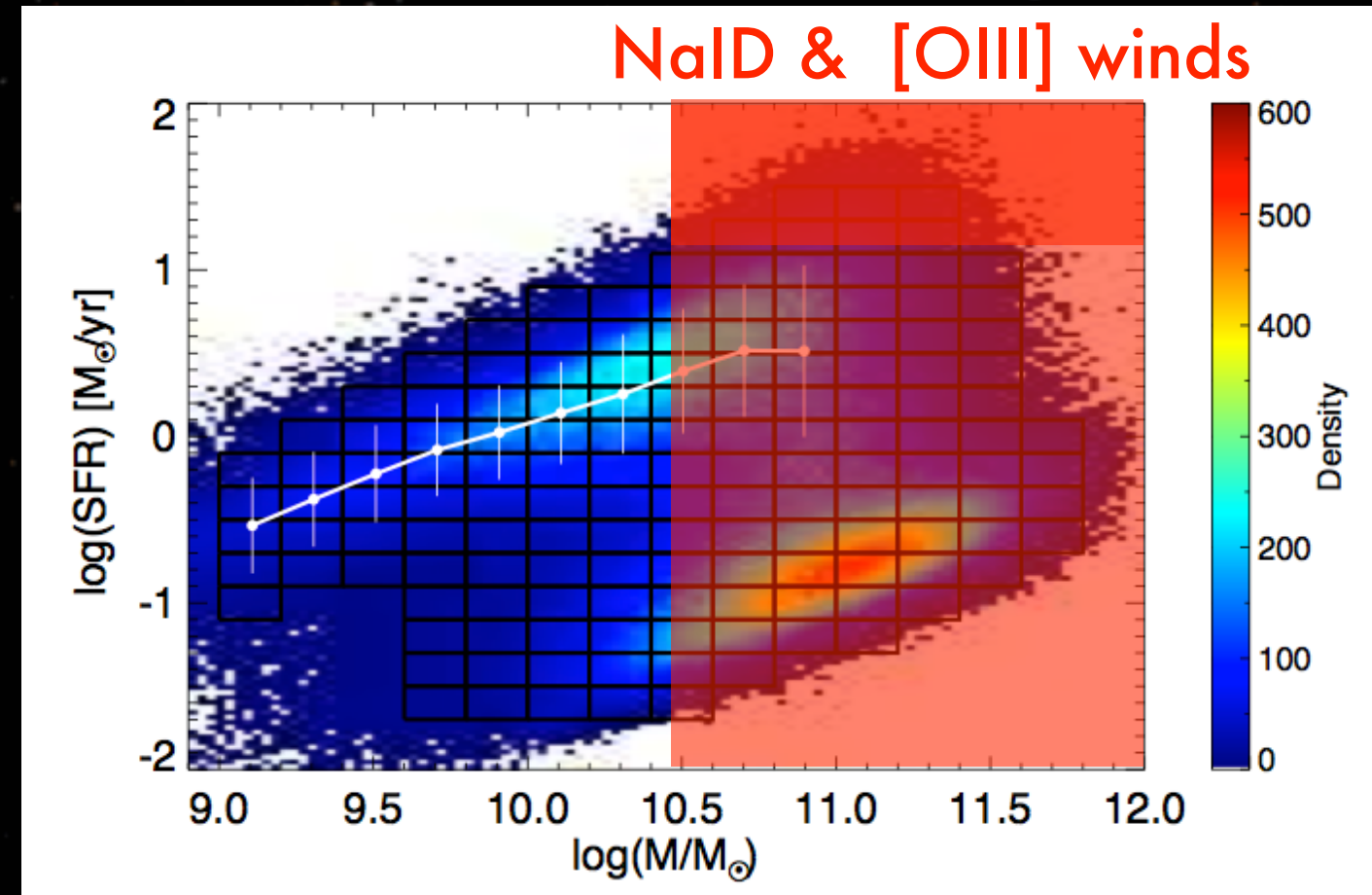
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OUTFLOWS IMPACT ON GALAXY HOST

Concas+2017, Concas+2018 arXiv:1710.08423

- outflow only at
high SFR & high M_{star}
 $M_{\text{halo}} \sim 10^{12-12.5} M_{\text{sun}}$
 $V_{\text{esc}} \simeq 1000 \text{ km/s}$
- $V_{[\text{OIII}]}$ $\simeq$ max 450 km/s
- $V_{\text{NaD}} \simeq 150\text{-}200 \text{ km/s}$



$$V_{\text{out}} \ll V_{\text{esc}}$$

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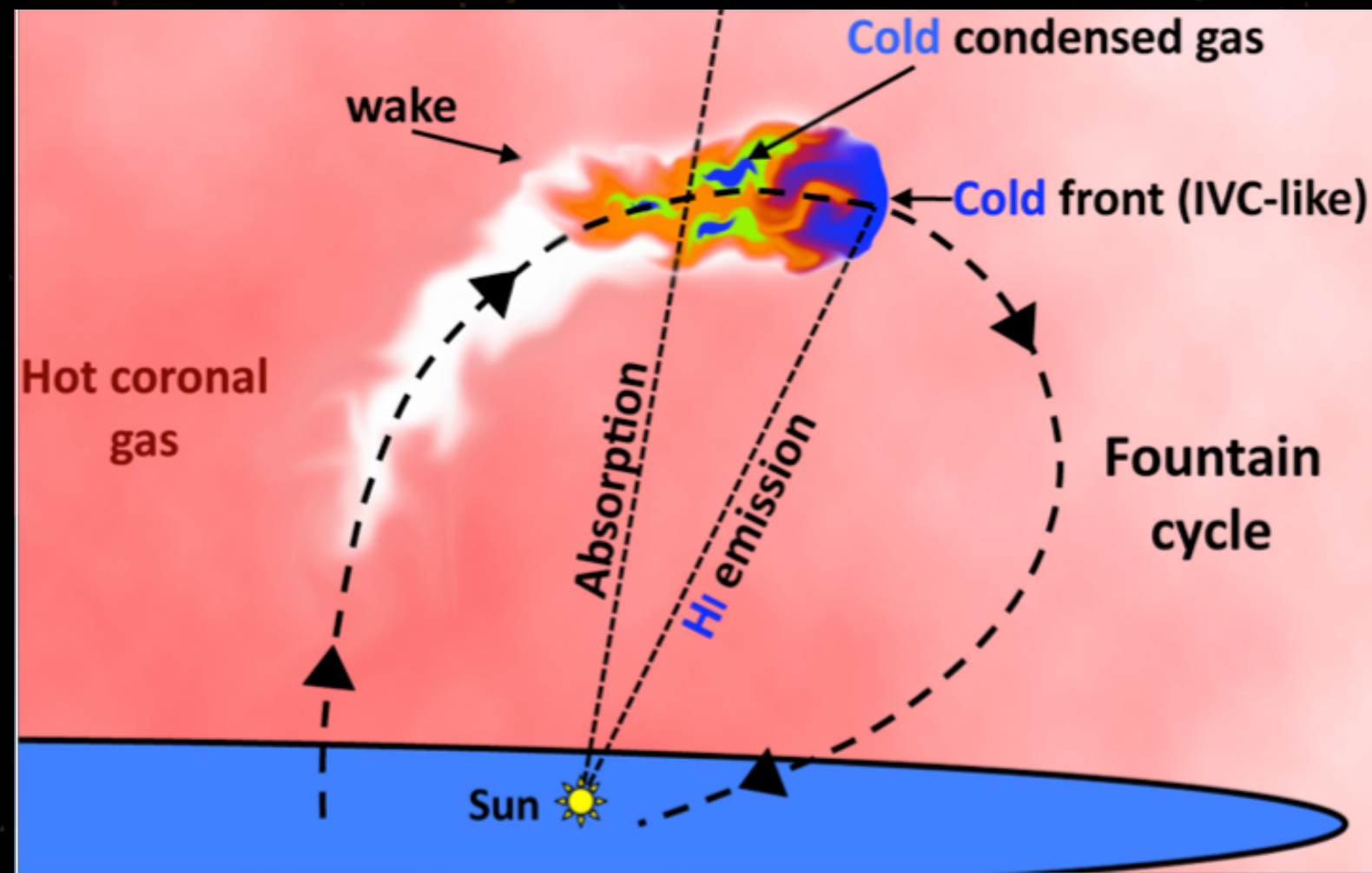
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$$V_{\text{out}} \ll V_{\text{esc}}$$

The gas does not escape!!!



Marasco, Fraternali & Binney 2012, MNRAS

OPEN QUESTIONS:

1. Are the Galactic Outflows “ubiquitous”?

NO **Neutral** gas outflows only at **high SFR** ($>10 M_{\odot}/\text{yr}$)
Ionized gas outflows only in **AGN** systems

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2. Are the Galactic Outflows related to a particular ejection mechanism? SF and/or AGN feedback?

YES **Neutral** gas outflows are related to **SF** activity
Ionized gas outflows are driven by **AGN** feedback

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2. Are the Galactic Outflows related to a particular ejection mechanism? SF and/or AGN feedback?

YES **Neutral** gas outflows are related to **SF** activity
Ionized gas outflows are driven by **AGN** feedback

3. Can the Galactic Outflows reduce the gas reservoir and then regulate the SF activity?

NO They are **not** strong enough to **leave** the Galaxy



THANK YOU

credit:Miguel Aragon (Johns Hopkins University) berkeleylab