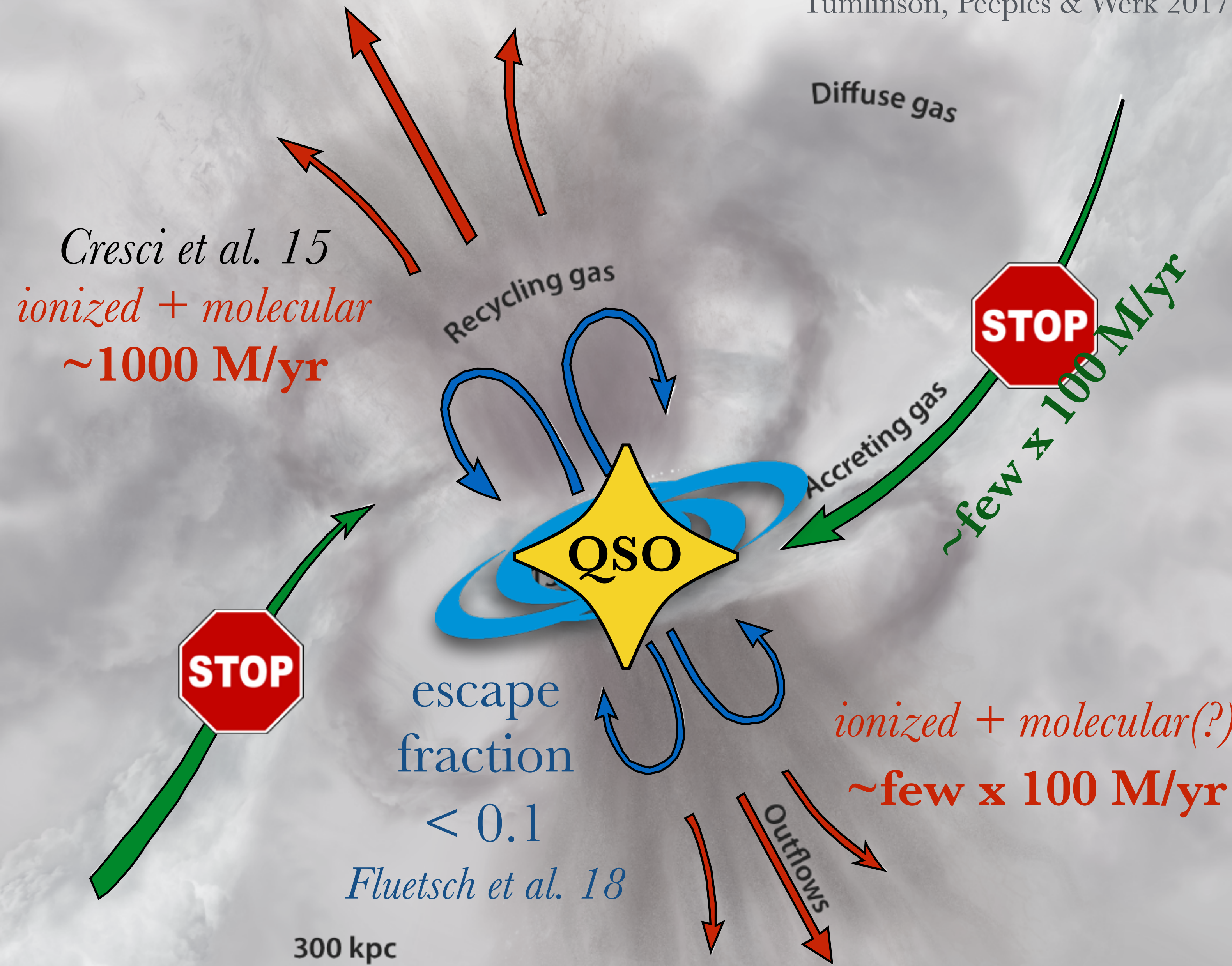


ALMA Workshop

22.03.2019

Tumlinson, Peebles & Werk 2017



$z \sim 1-3$

accreting gas

$$\dot{M}_{in} \propto M_{halo}$$

outflows

(1) *preventive*

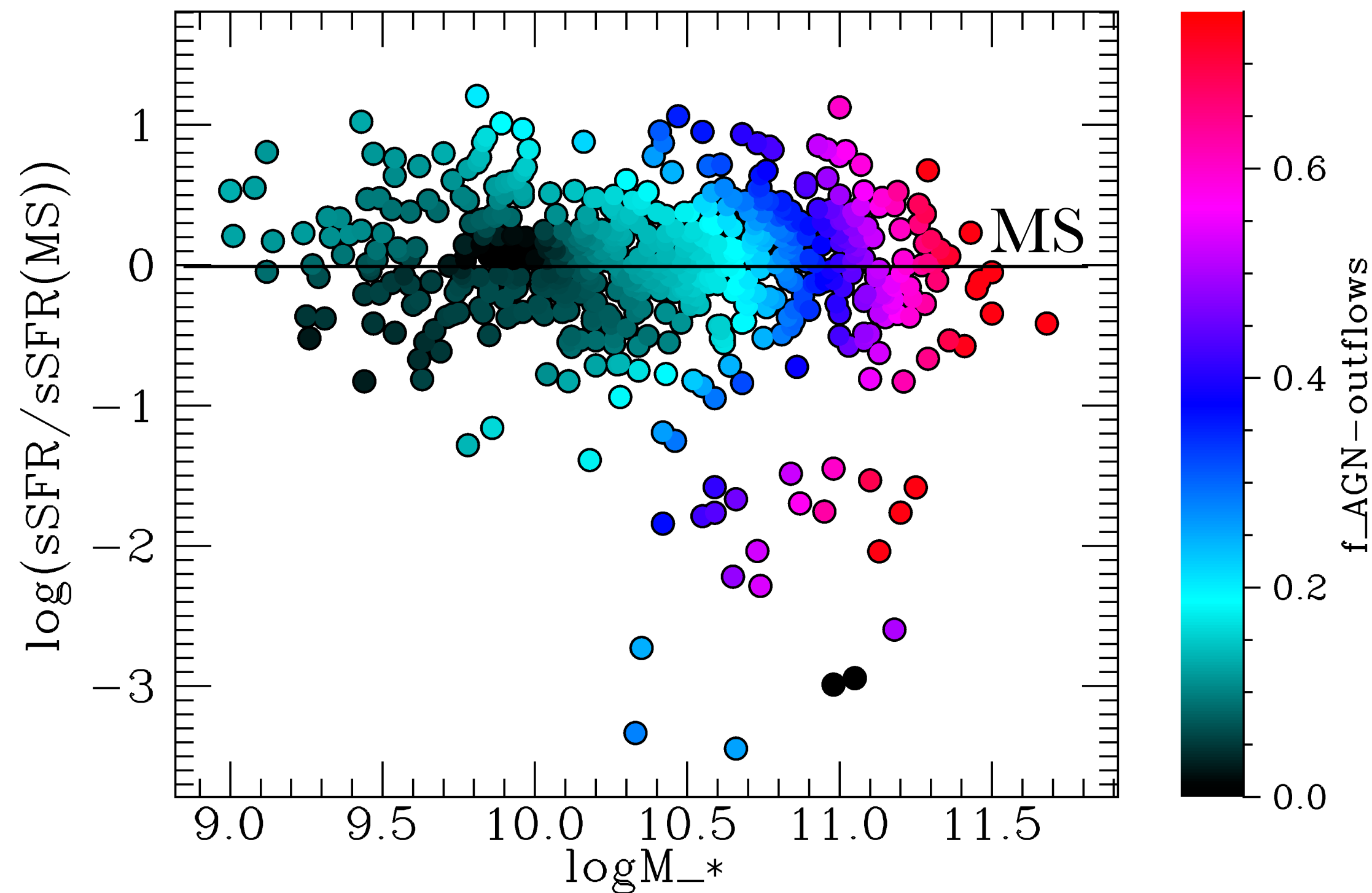
(2) *ejective*

recycled gas

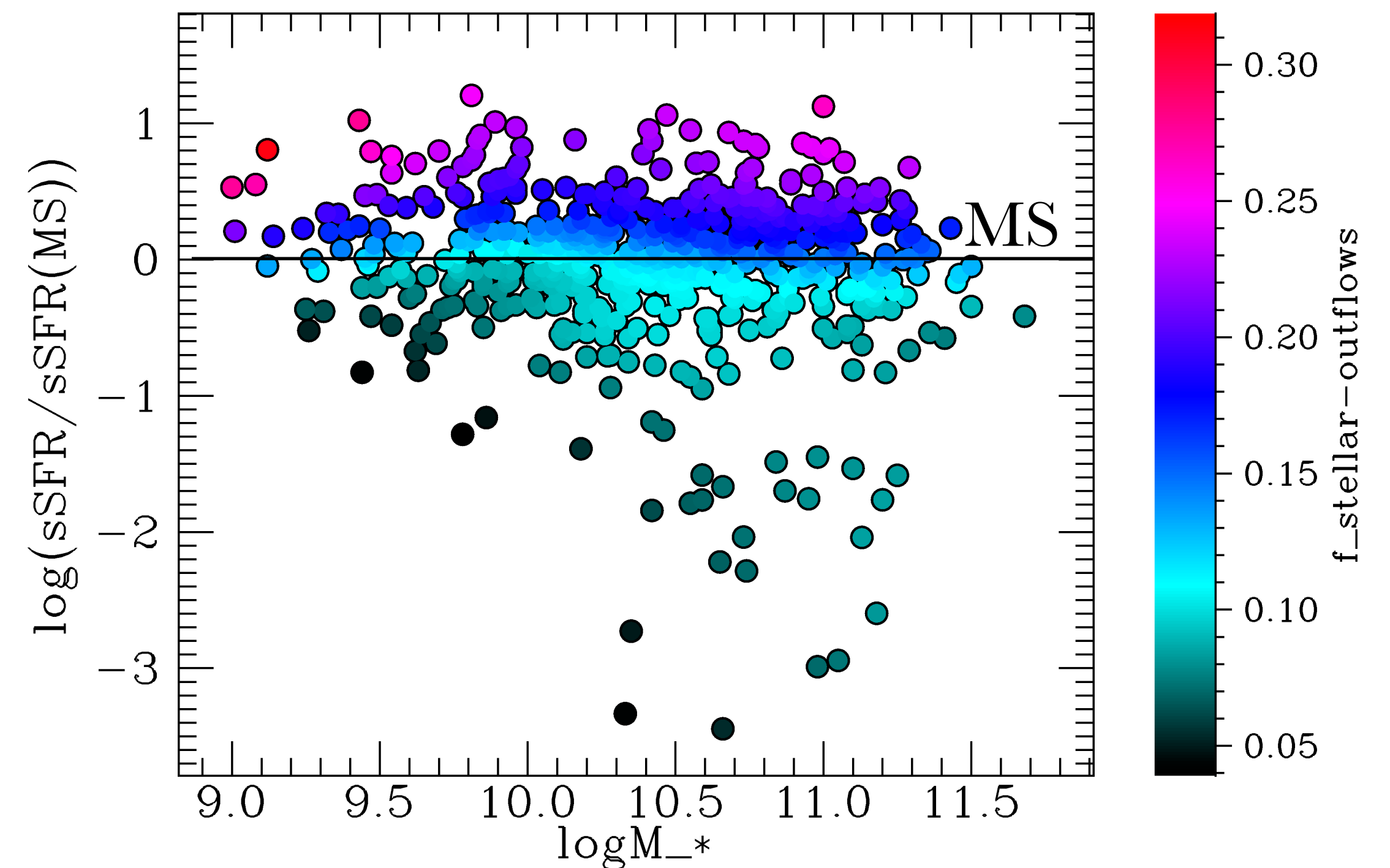
**molecular gas
& ISM properties**

outflows are ubiquitous among high- z star-forming galaxies...

AGN



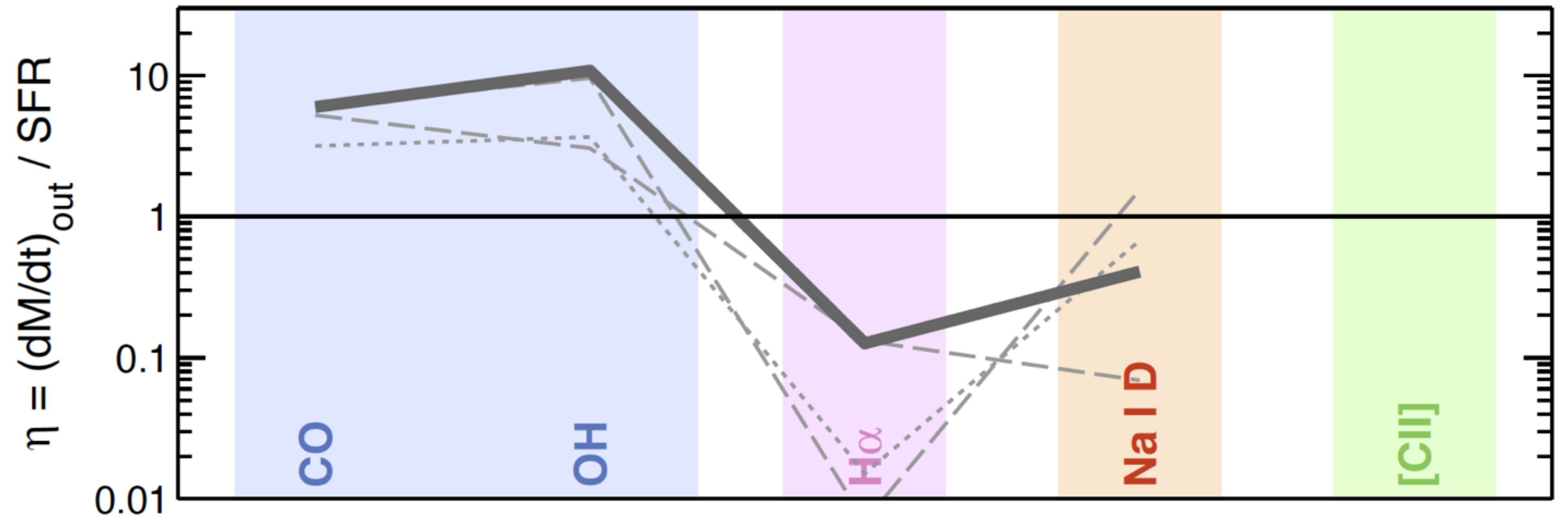
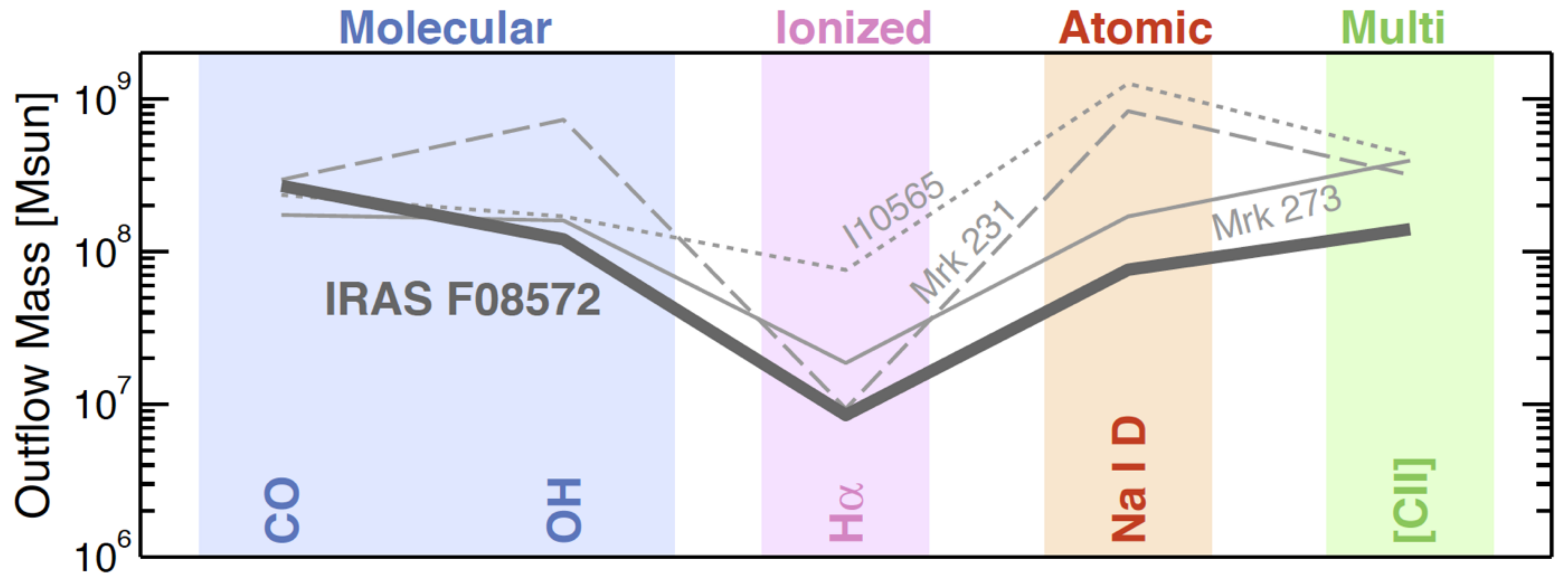
star formation



*outflow incidence scale with M_**

outflow incidence scale with sSFR

Nearby Universe: (U)LIRGs

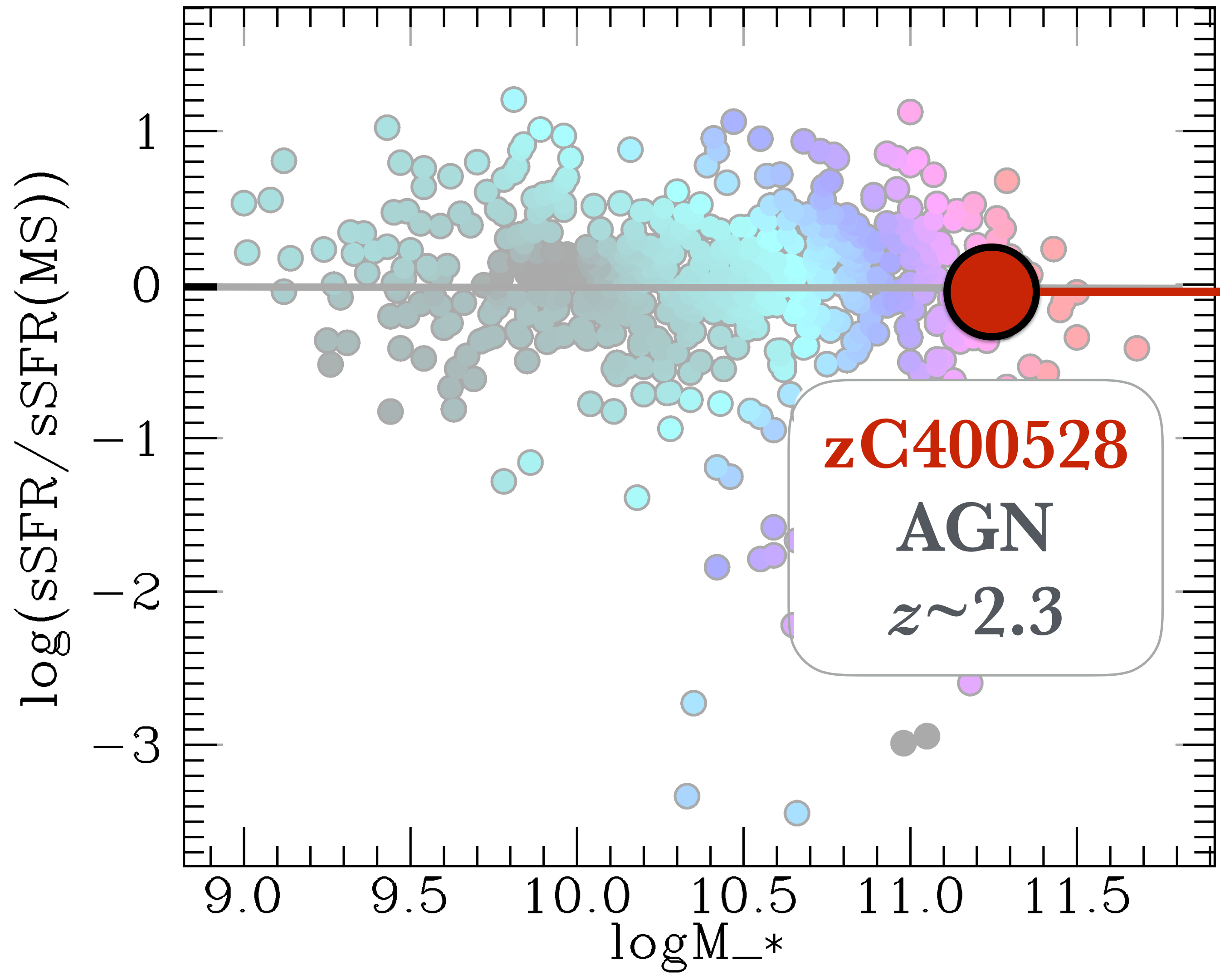


see also:
Fluetsch+18
Fiore+17
Feruglio+15

Project I

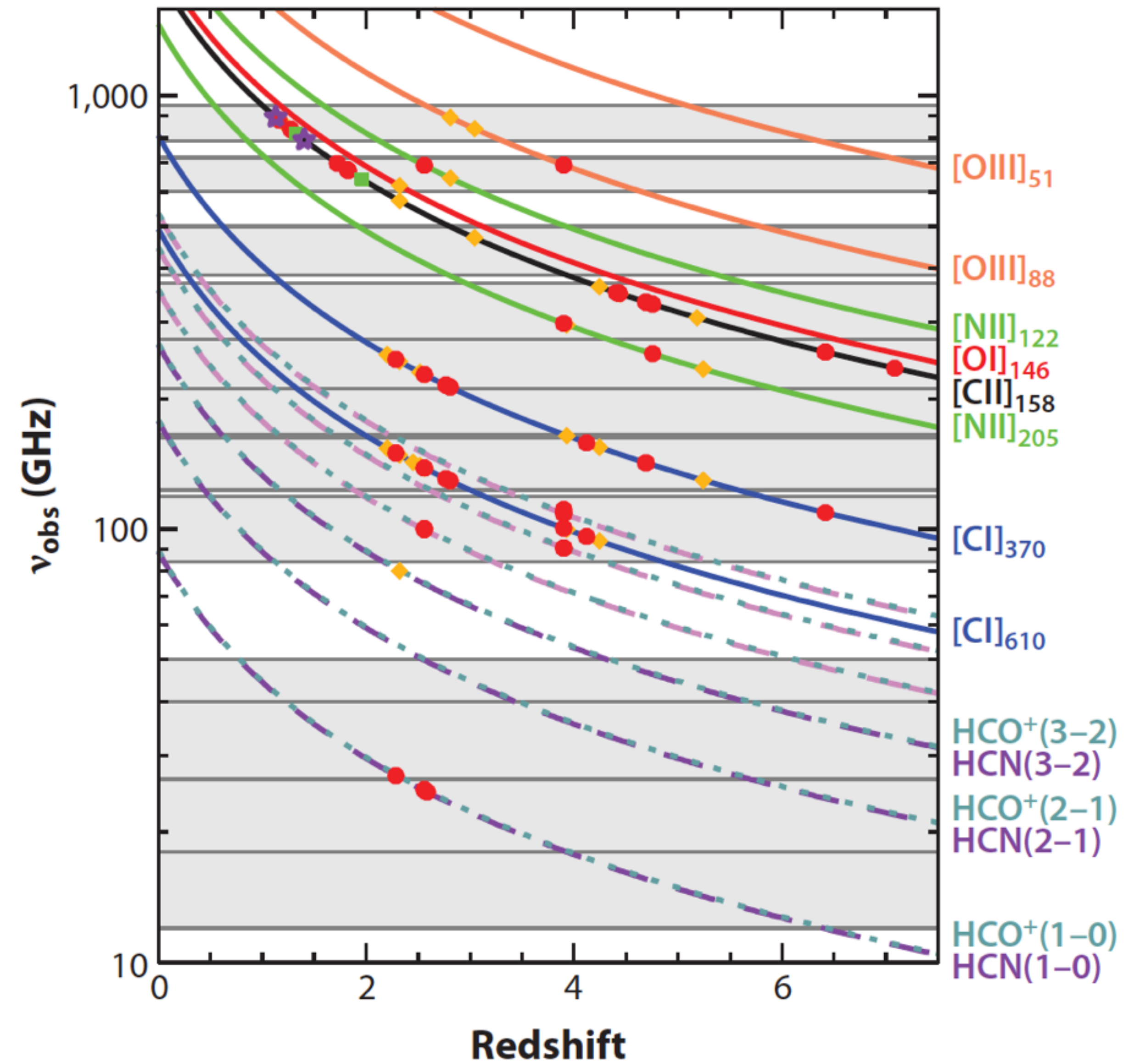
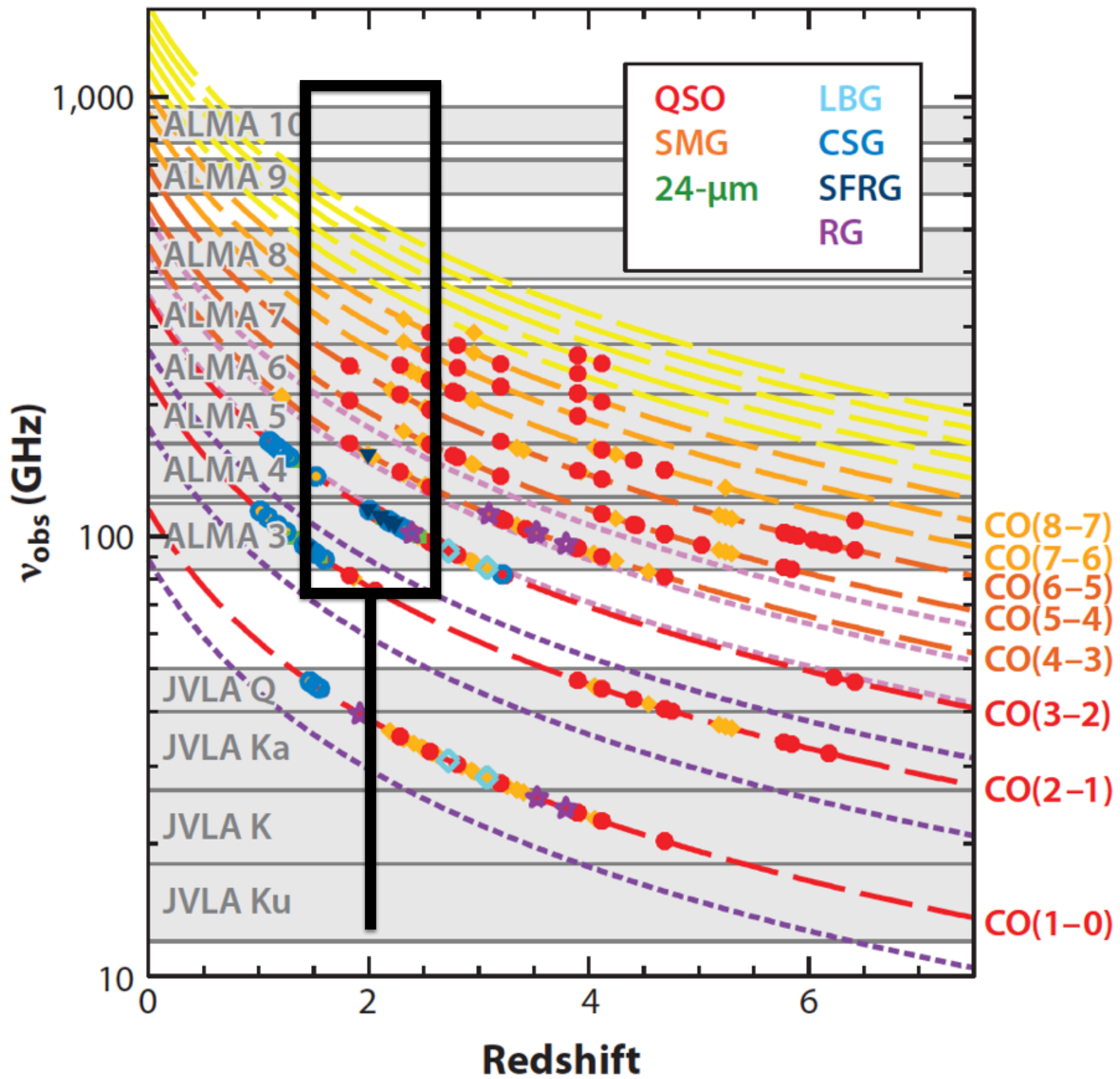
AGN-driven molecular outflow at $z \approx 2$

ionized outflow



$M_{\text{ion,out}} \sim 50 M_{\odot}/\text{yr}$

Genzel et al. 2014



Carilli & Walter 2013

Maximum Recoverable (angular) Scale (MRS)

Deep CO 3-2 observation to constrain properties of molecular outflow

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.30"	0.7"	100 μ Jy, 130.4 mK	80 km/s, 27.2 MHz	345.795990 GHz	6.09 μ Jy, 7.9 mK	7.336 GHz	XX,YY	No

Use of 12m Array (40 antennas)

t_total(all configs)	t_science(C40-6)	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
7.4 h	4.6 h	0.0 h	19.0 "	1	offset	57.0 "	16510.4 s	32.0 GB	1.2 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	345.795990	CO v=0 3-2	3840	1875.00 MHz	7812.500 kHz	5506.5 km/s	22.944 km/s	22
2	340.000000	CS v=0 7-6	3840	1875.00 MHz	7812.500 kHz	5600.3 km/s	23.335 km/s	21
3	305.618500	Continuum 1	128	1875.00 MHz	31.250 MHz	6230.4 km/s	103.839 km/s	5
4	298.864500	Continuum 2	128	1875.00 MHz	31.250 MHz	6371.1 km/s	106.186 km/s	5

1 Target

Expected Source Properties

	Peak Flux	SNR	Pol.	Pol. SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity
Line	4.00 mJy	57.8	0.0%	0.0	500 km/s	69.21 μ Jy, 90.2 mK	6.25
Continuum	0.00 μ Jy	0.0	0.0%	0.0			

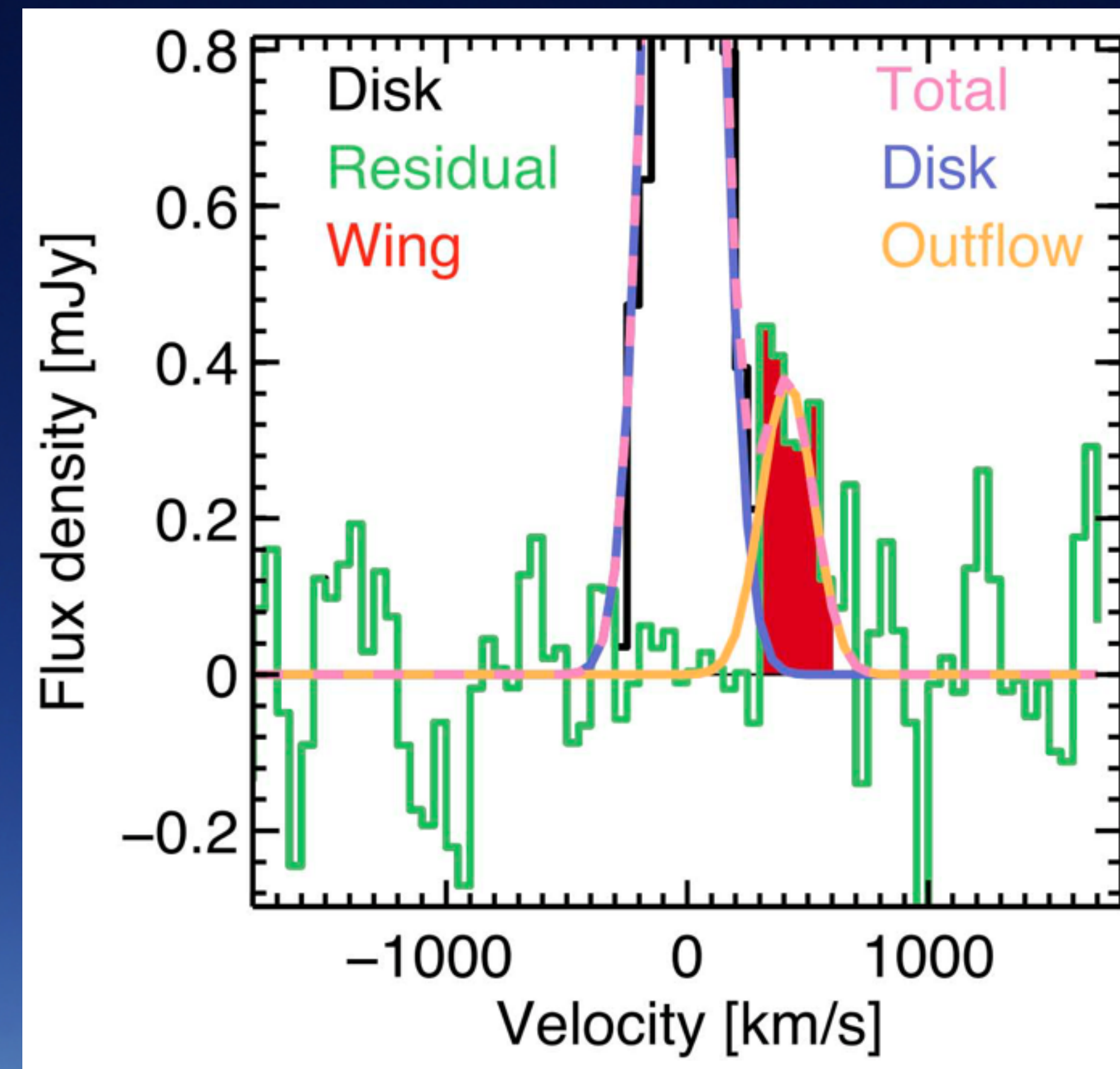
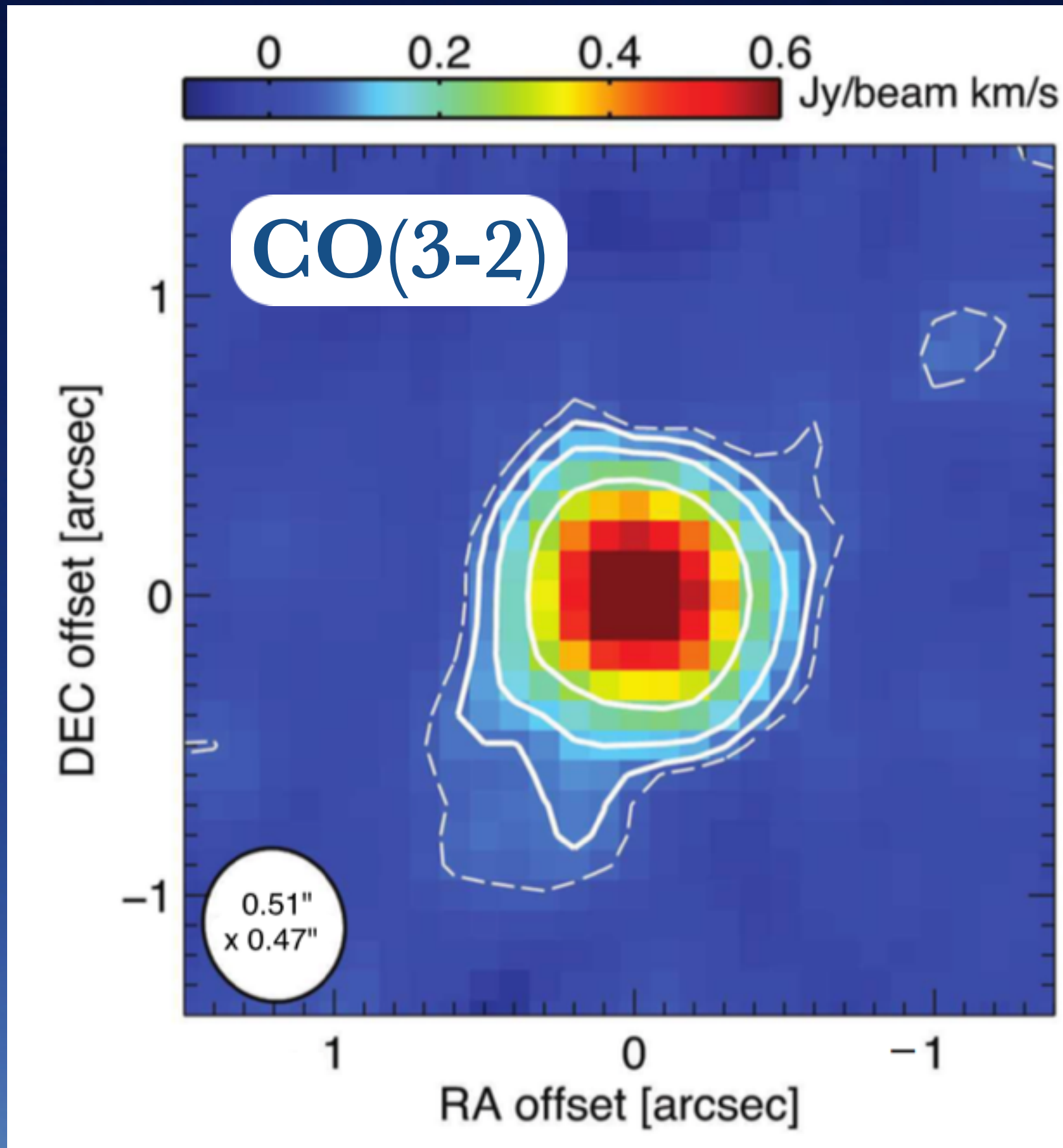
Dynamic range (cont flux/line rms): N/A

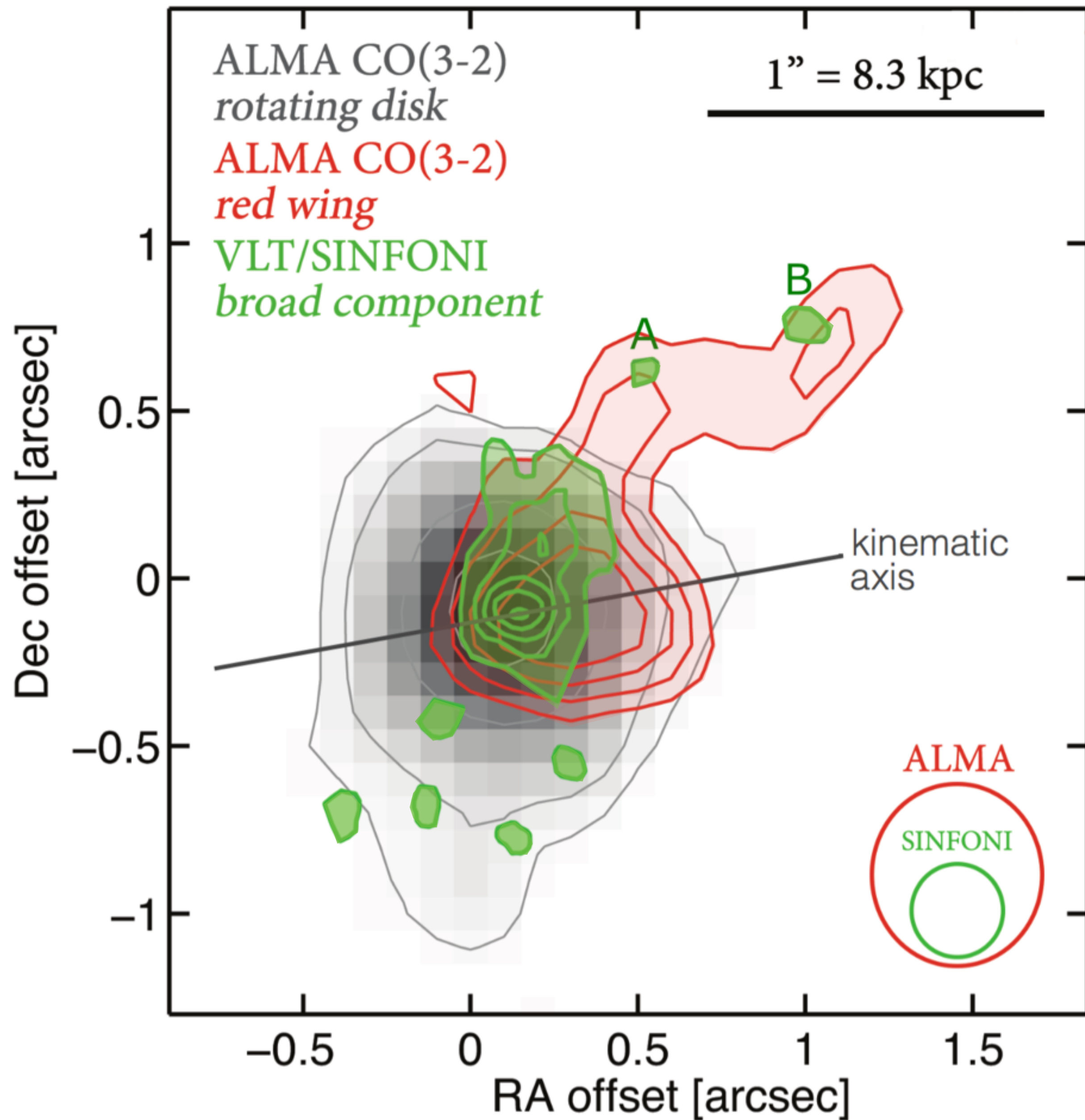
1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1	102.083011	99.89 μ Jy, 130.2 mK	94.96 μ Jy - 99.89 μ Jy

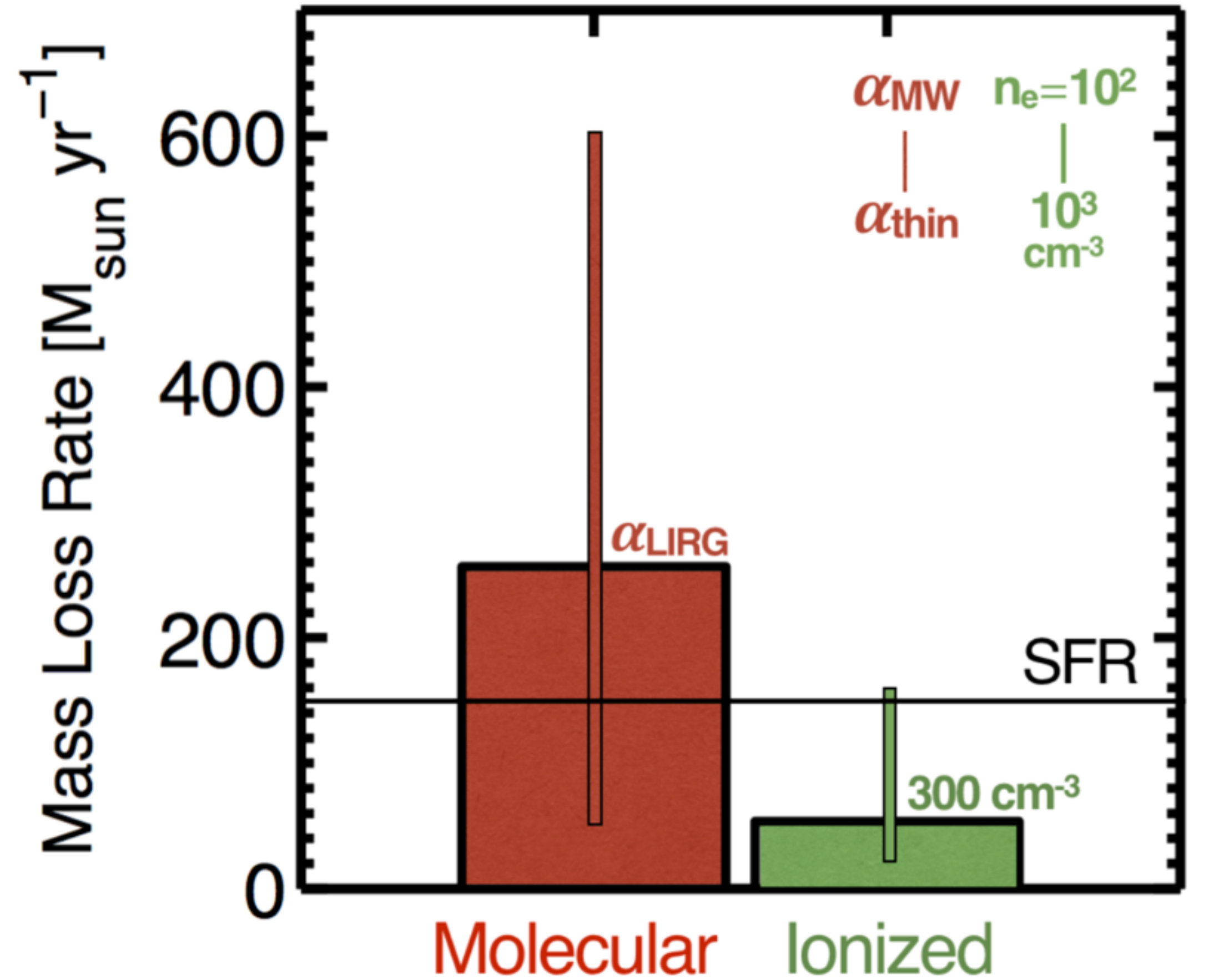
No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-zC400258	09:59:47, 01:44:19	715724.51 km/s,lsrk,OPTICAL

Molecular gas





Mass loss rate



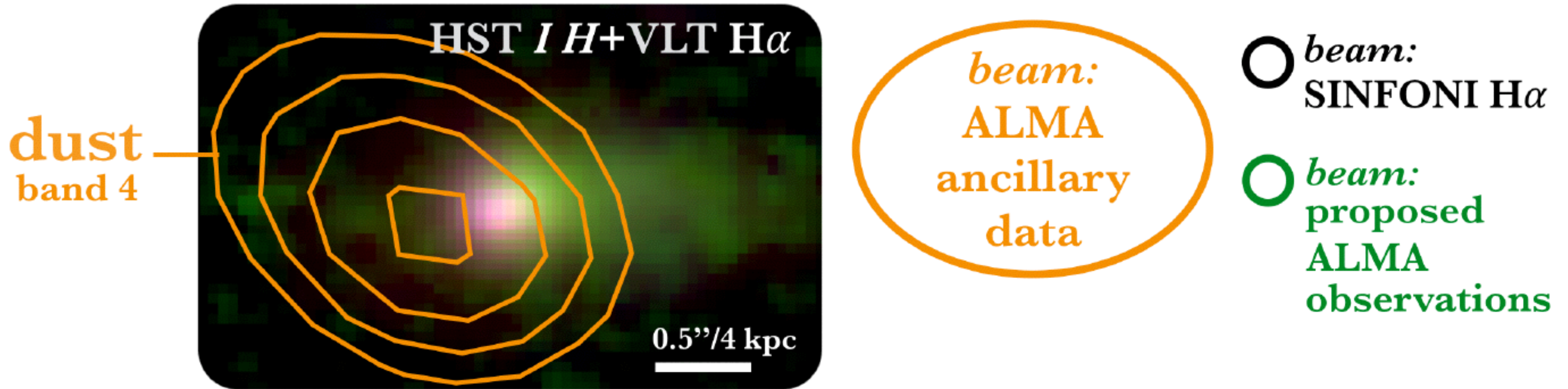
molecular gas depletion timescale

$$\tau_{\text{outflow}} \sim \tau_{\text{SF}}/2$$

Project II

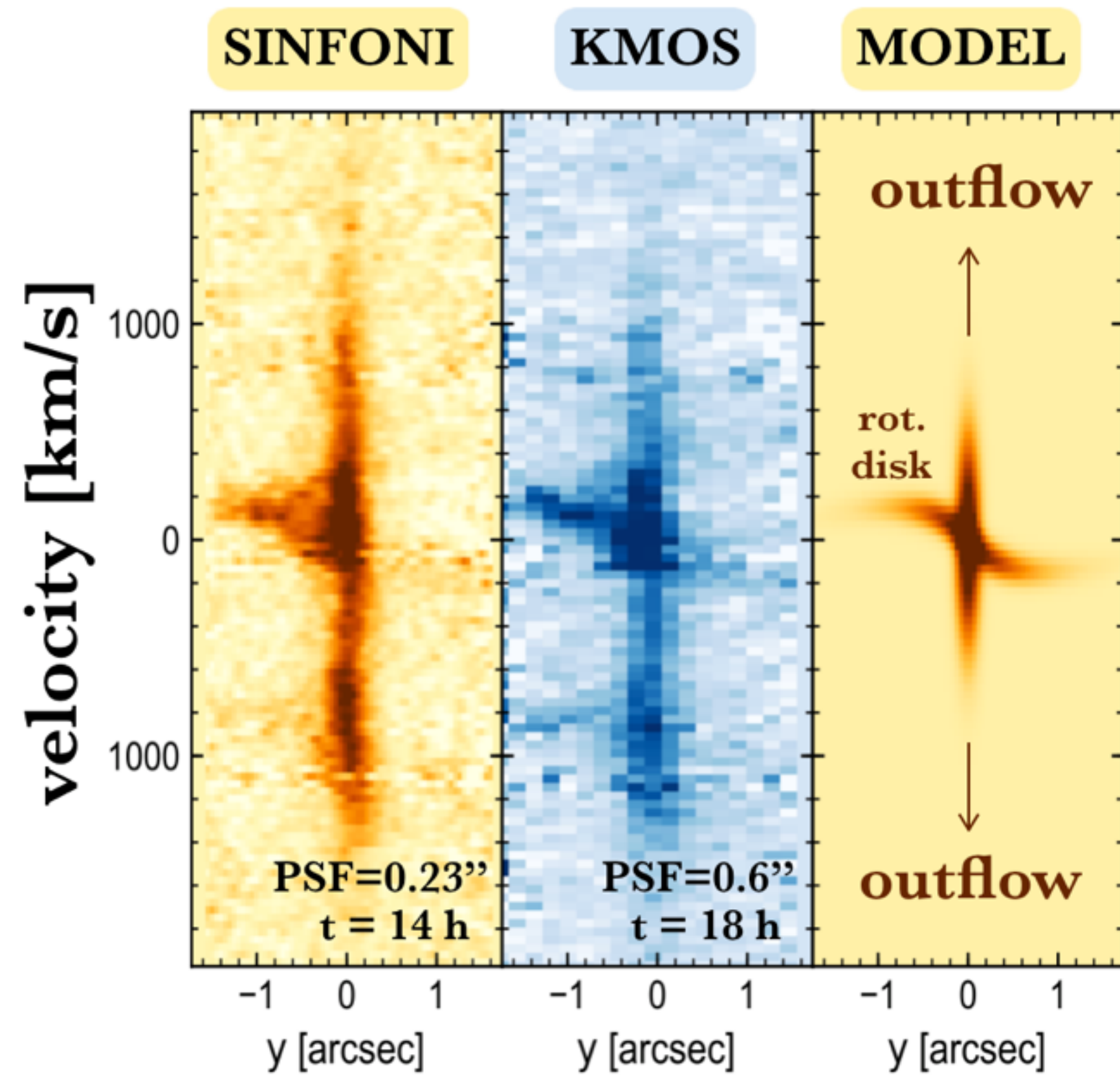
AGN + stellar driven molecular
outflow at $z \approx 2$

GS30274 at $z \approx 2$



Warning: 4 different names in the ALMA archive!

CASA simulation



Project III

Kinematics of a typical $z \approx 5$ galaxy

