The Bluedisk project: searching for footprints of gas accretion

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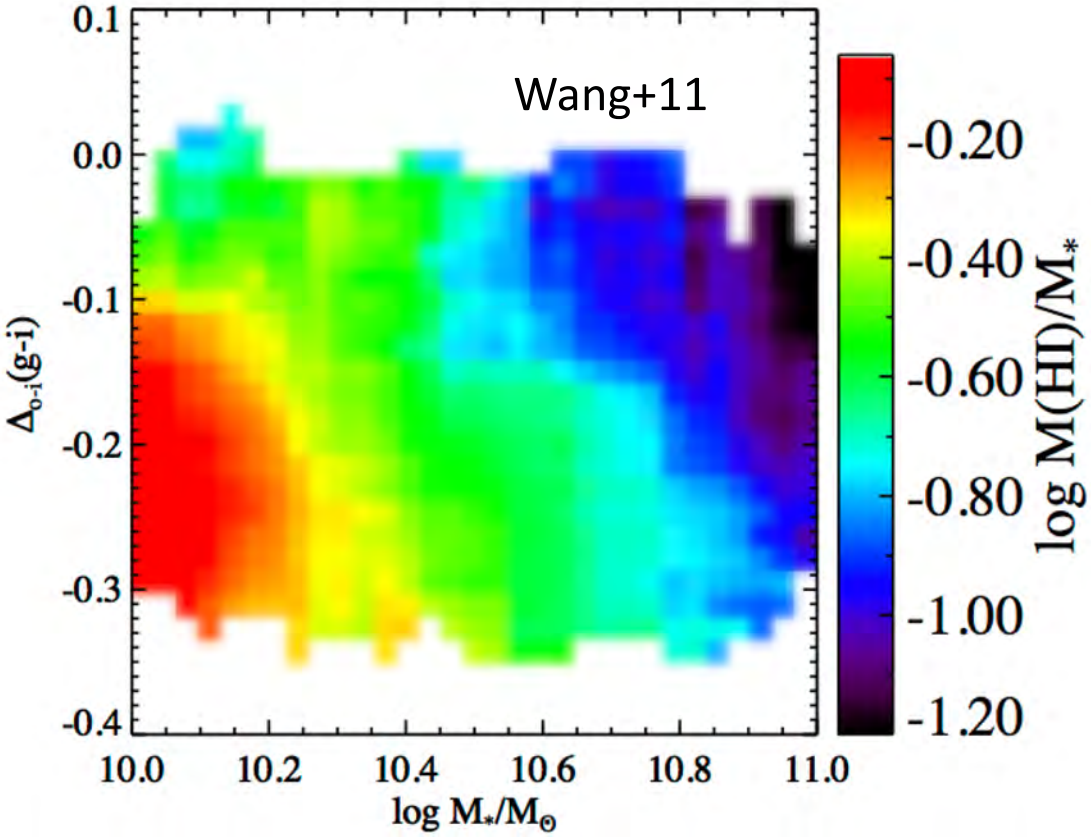
The Bluedisk project

Goal: searching for signs of gas accretion in and around HI-rich galaxies

The origin of "Bluedisk": HI-rich galaxies are on average bluer on their outer regions



HI images (PI: G. Kauffmann)
CO images (PI: F. Bigiel)
Optical long-slit spectrum (PI: J. Brinchmann)

Collaborators:

F. Bigiel (ITA/Heidelberg Univ.)
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D. Carton (Leiden)
D. Cormier (Heidelberg Univ.)
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J. Fu (SHAO)
K. Gereb (ASTRON)
G. Kauffmann (MPA)
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G. Jozsa (ASTRON)
C. Li (THU)
T. Oosterloo (ASTRON)
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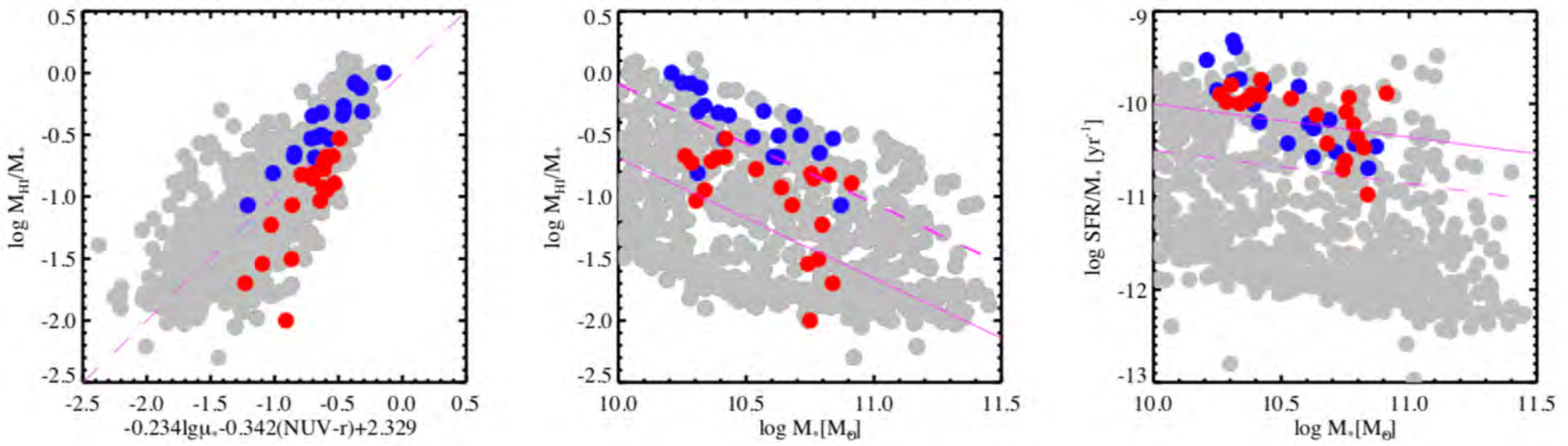
P. Serra (INAF)
T. van der Hulst (RUG)
M. Verheijen (RUG)
E. Wang (UZH)
J. Wang (KIAA)

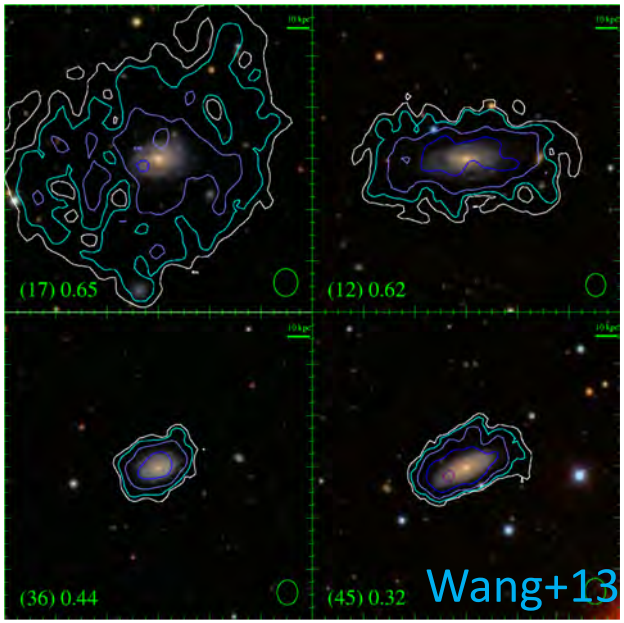
The sample

Sample: log M_*/M_{sun}~10-11, z~0.023-0.03 (Dis>100 Mpc)

- 23 HI-rich and 19 control galaxies that are relatively isolated (no major merger companion within 100 kpc)
- 8 interacting systems.



Wang+13

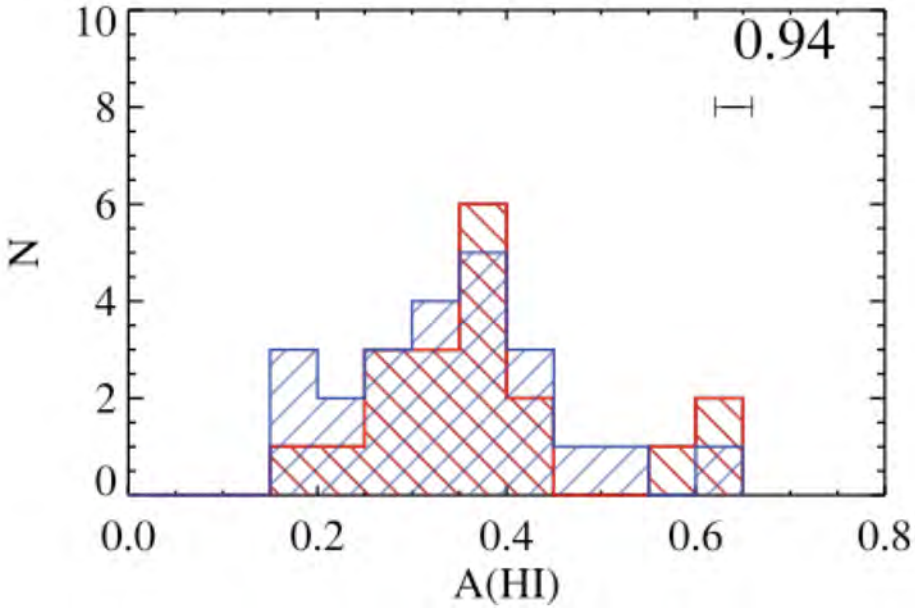


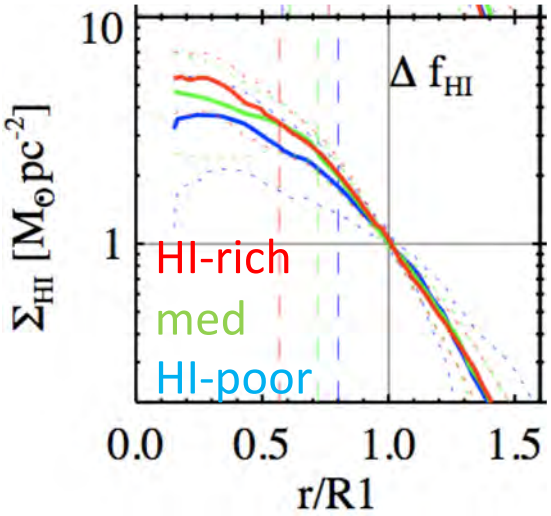
Comparing HI-rich with control galaxies

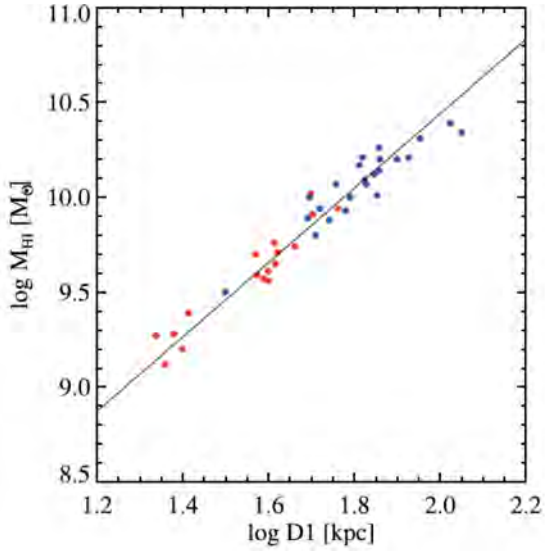
Signatures of gas accretion

Structure of the HI-rich galaxies

We compare HI-rich to control:

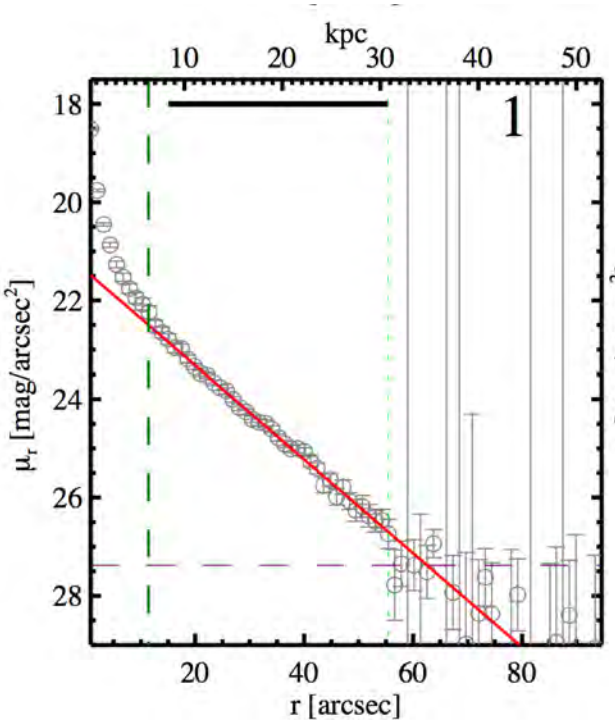




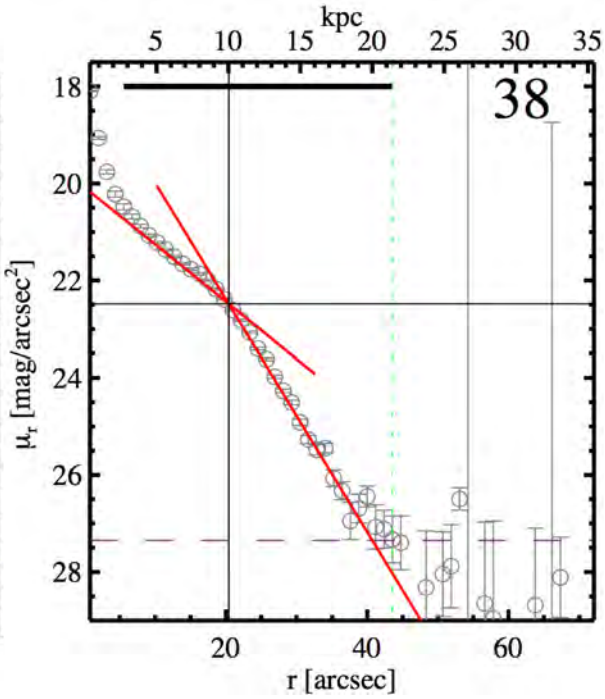


The HI-rich galaxies are similar to or even less disturbed than the control galaxies (Wang+13, 14)

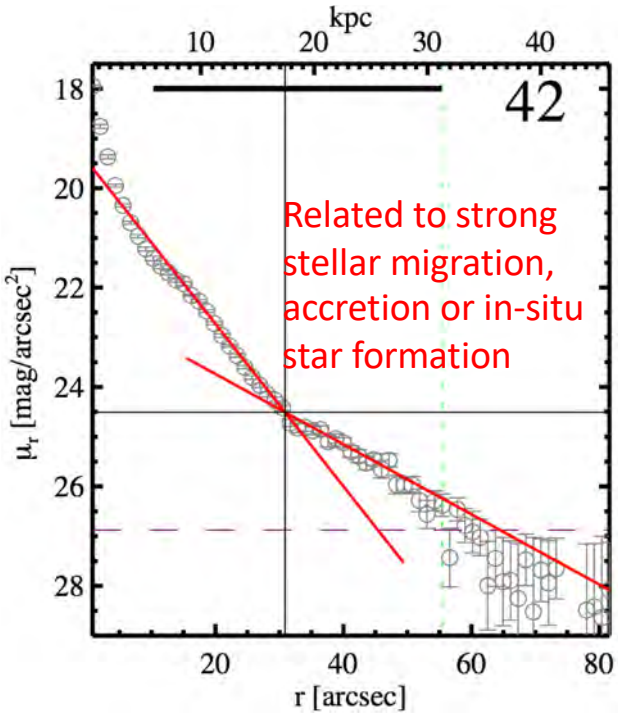
The optical outer disk breaks



Pure exponential



down-bending



up-bending

Sample		HI rich			control		
	total	exponential	down-bending	up-bending	exponential	down-bending	up-bending
Bluedisk	27	5	1	6	0	13	2

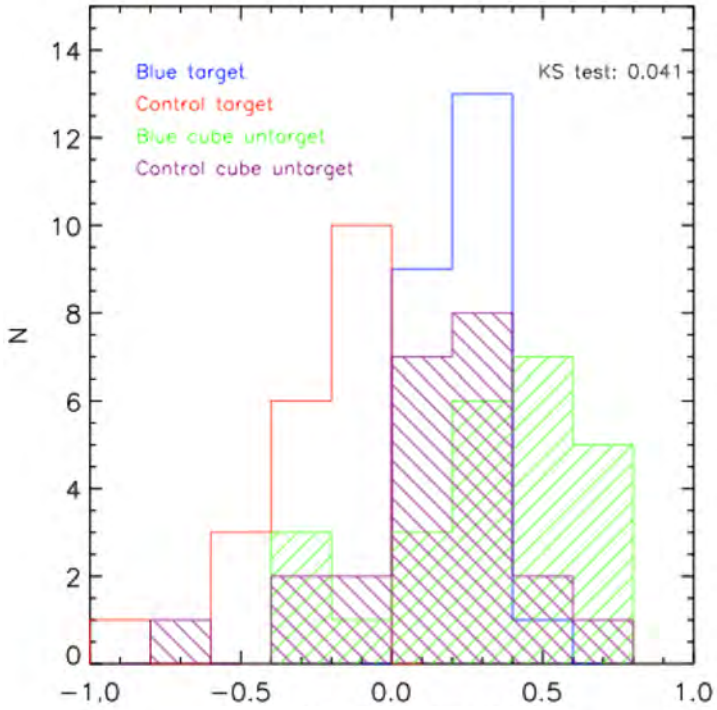
Wang+17

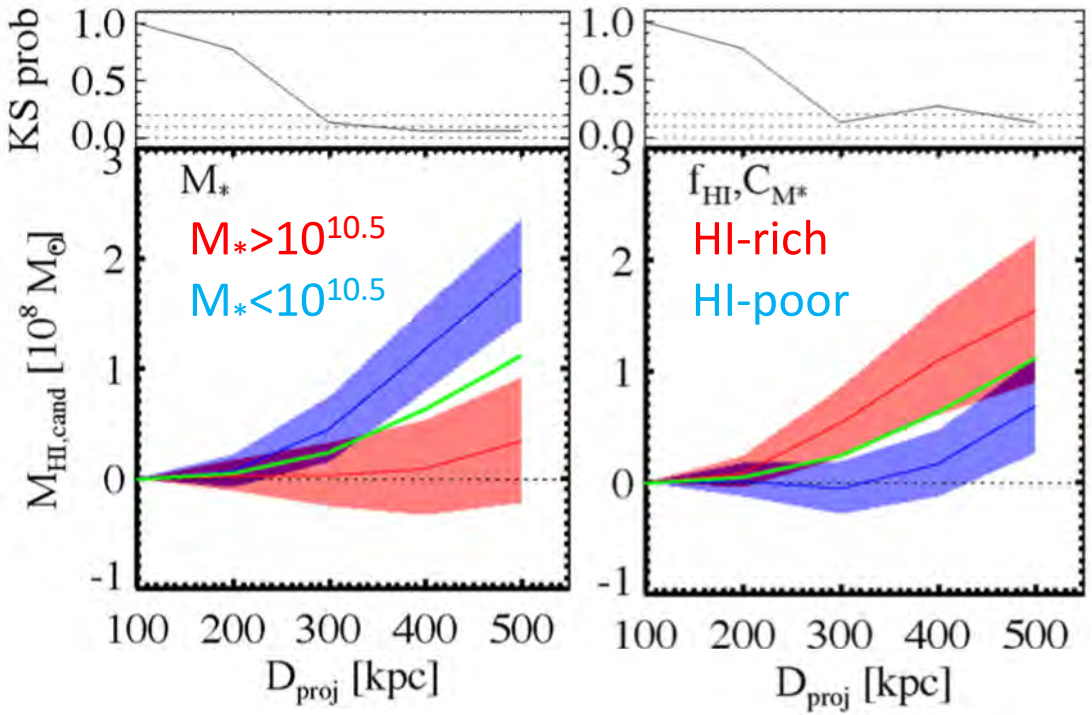
Conformity in HI-richness

In satellites(E. Wang+15)
(M_{HI} >10^8 $M_\odot$)

HI-rich central
Control central
Satellites around HI-rich central
Satellites around control central

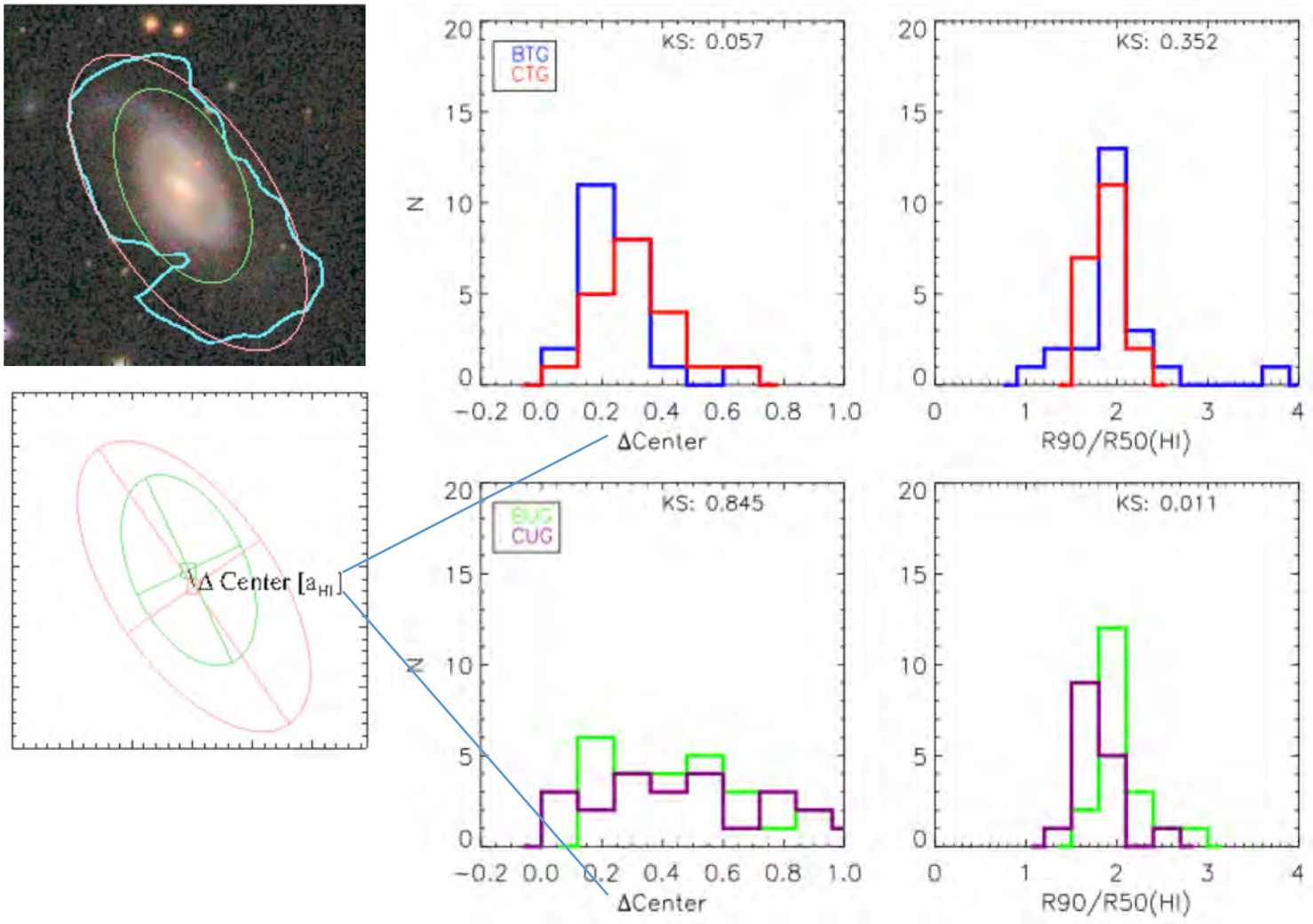
Signal cumulated outside detectable sources (J. Wang+15) (M_{HI} <10^8 $M_\odot$)





A common underlying reservoir of gas for both central and satellite galaxies

Inconformity in HI disc structure



HI-rich central

Control central

Satellites around HI-rich central

Satellites around control central

Satellites around HI-excess and normal centrals show considerable difference in morphology of HI discs. (E. Wang+15)

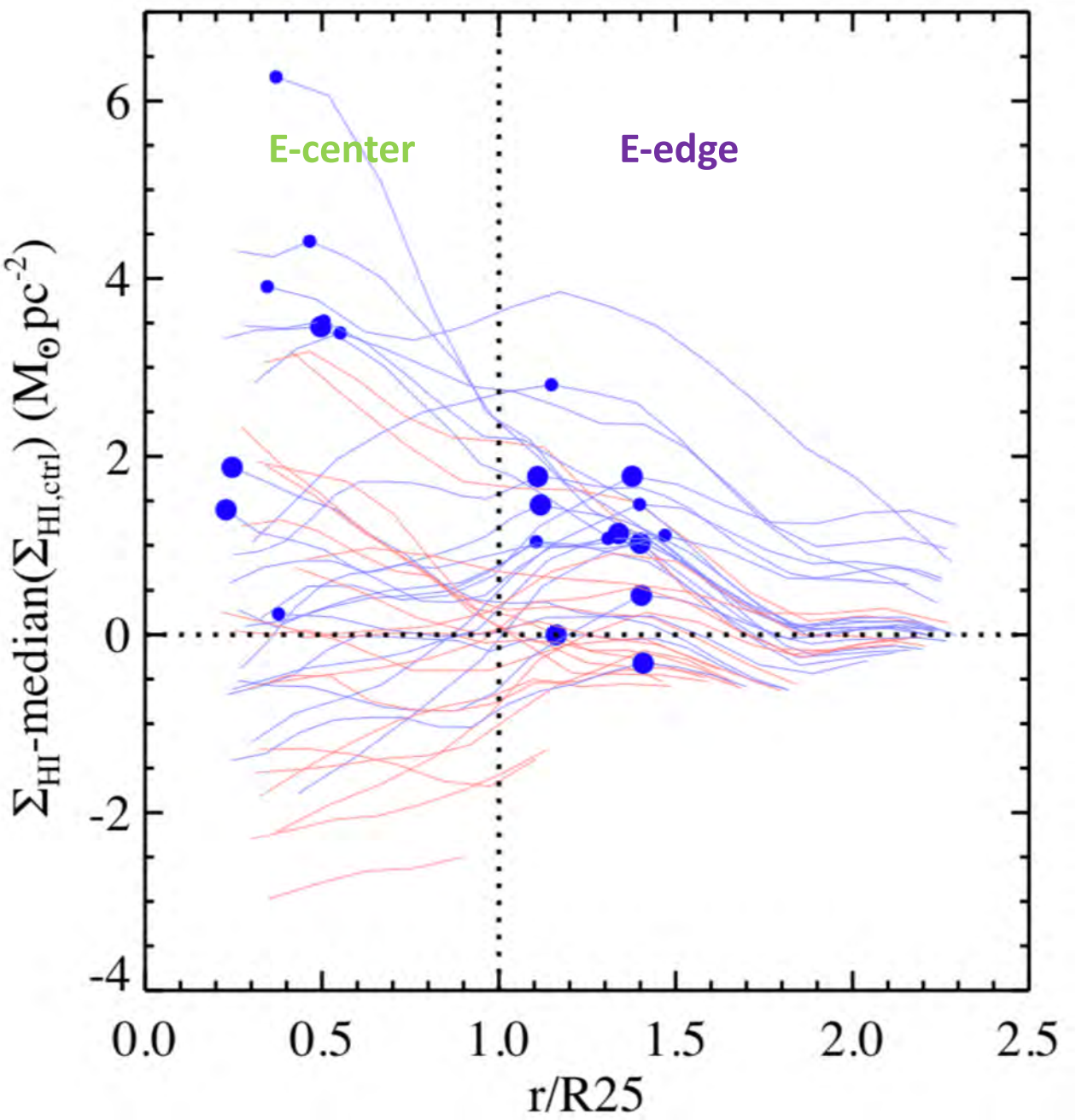
Possible signatures of gas accretion in low-redshift, high-M_* and HI-rich disc galaxies?

- blue and up-bending optical outer disks.

- an HI-rich environment extending to ~Mpc distances.

Among the HI-rich galaxies

Different ways of accretion?

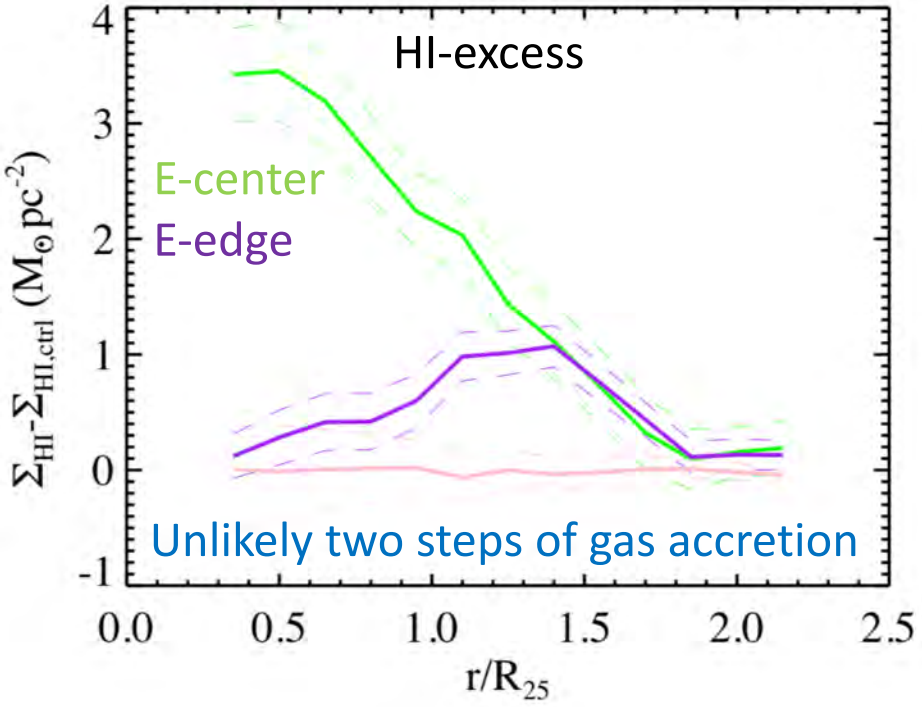


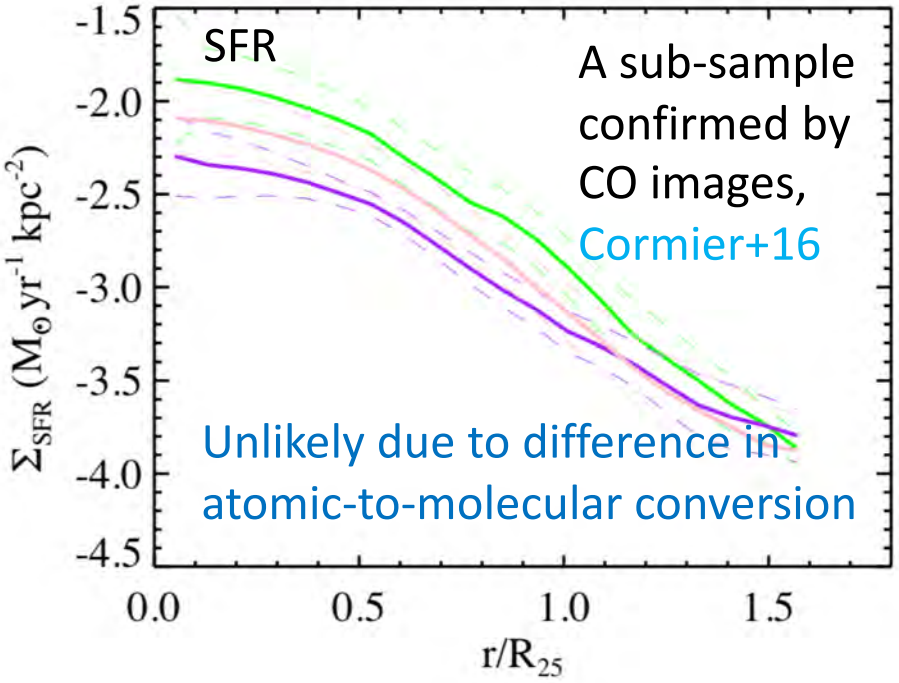
Two types of HI excess radial distributions in **HI-rich galaxies**

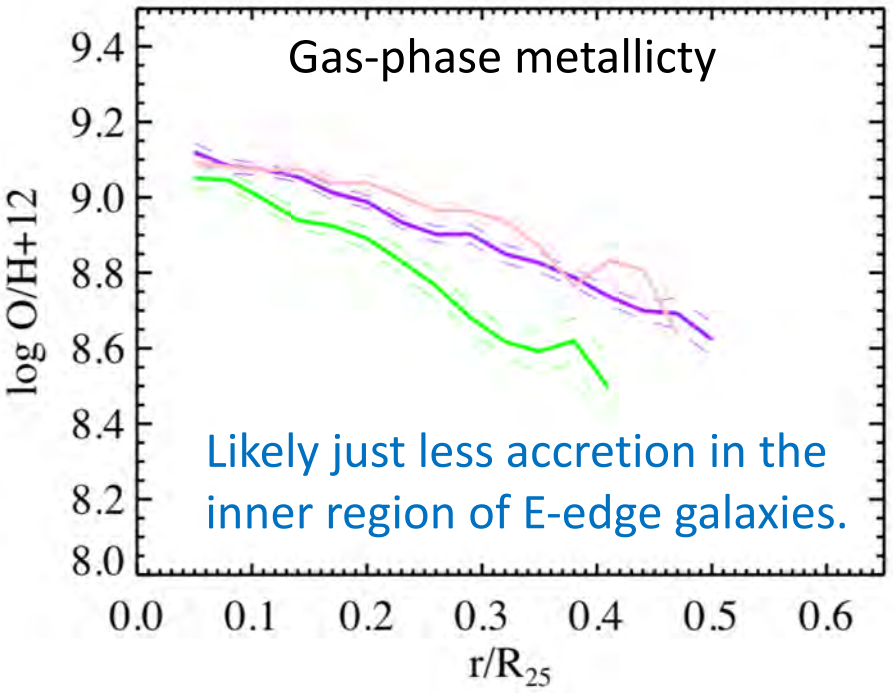
Excess HI at the center: E-center,
and at the edge: E-edge

- Two types of gas accretion?
- Two steps of gas accretion?
- Different efficiencies of converting to the molecular?

Wang+14, in prep


HI-excess
E-center
E-edge
Unlikely two steps of gas accretion
Σ_{HI}-$\Sigma_{HI,ctrl}$ ($M_\odot$ pc^{-2})
r/R_{25}


SFR
A sub-sample confirmed by CO images, Cormier+16
Unlikely due to difference in atomic-to-molecular conversion
Σ_{SFR} ($M_\odot$ yr^{-1} kpc^{-2})
r/R_{25}


Gas-phase metallicty
Likely just less accretion in the inner region of E-edge galaxies.
log O/H+12
r/R_{25}

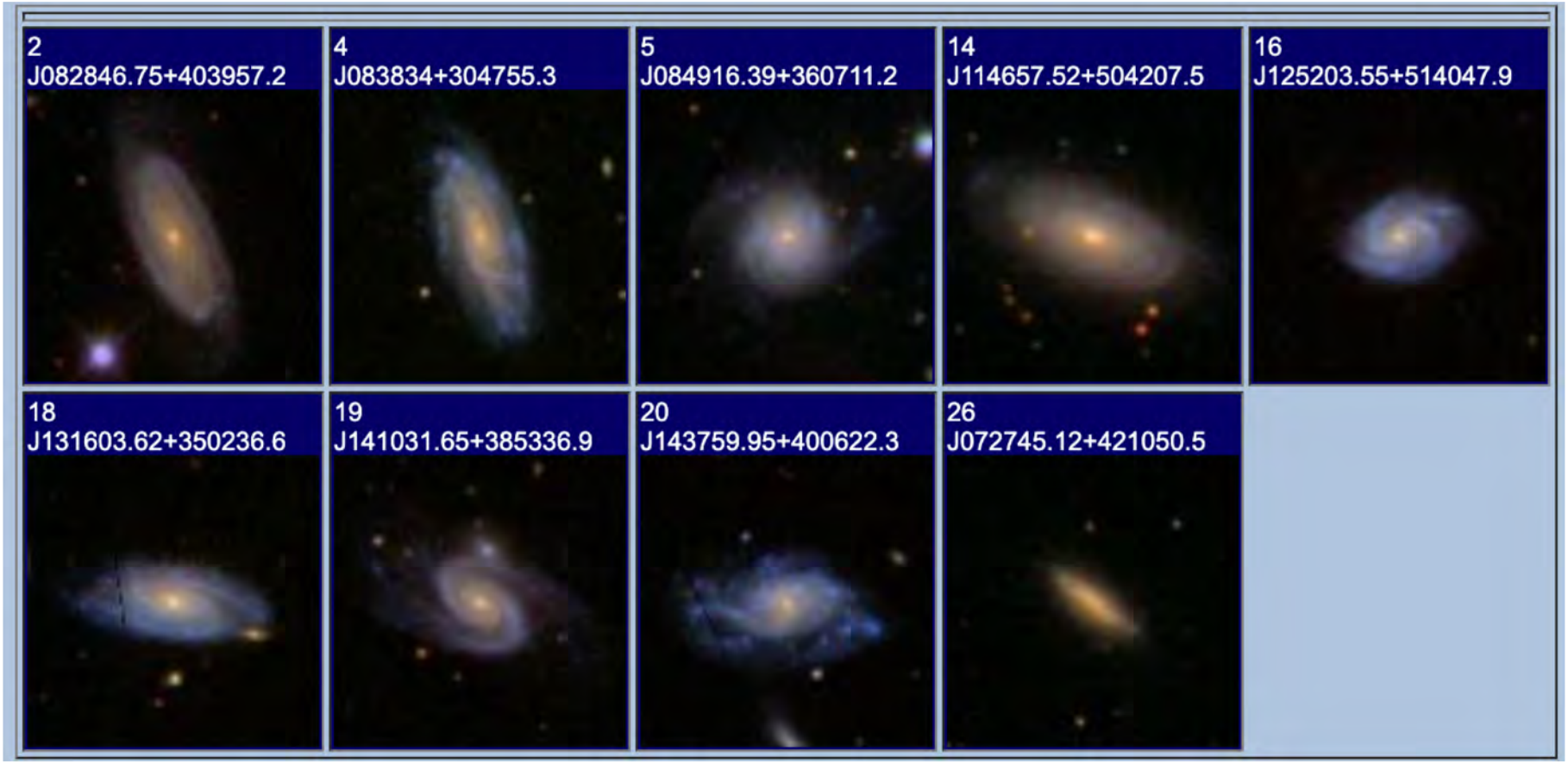
In prep

Other differences

	Stellar mass and distribution				SFR and distribution			HI mass and kinematics			Environment	
Param-eter	**M_***	**μ_***	**Σ_1**	**R_{25}**	**Δ g-i**	**SFR**	**sSFR**	**Δ f_{HI}**	**f_{HI}**	**t_{orbit}**	**Σ_3**	**M_{halo}**
Unit	$M_\odot$	$M_\odot$ kpc^{-2}	$M_\odot$ kpc^{-2}	kpc		$M_\odot$ yr^{-1}	dex yr^{-1}	dex	dex	dex yr	Mpc^{-2}	dex $M_\odot$
P_{KS} (EC vs EE)	0.20	0.38	0.20	0.21	0.96	0.38	0.13	1.00	0.12	0.02	0.92	0.08
Med (EC)	10.35	8.19	9.12	16.65	-0.25	2.37	-9.99	0.22	-0.25	8.80	0.88	12.08
Med (EE)	10.50	8.41	9.32	21.10	-0.26	2.06	-10.16	0.23	-0.38	8.91	0.70	12.55
Control							-9.98		-0.85	8.7		12.42
P_{KS} (EE vs ctrl)							0.06		0.00	0.00		0.77

In prep

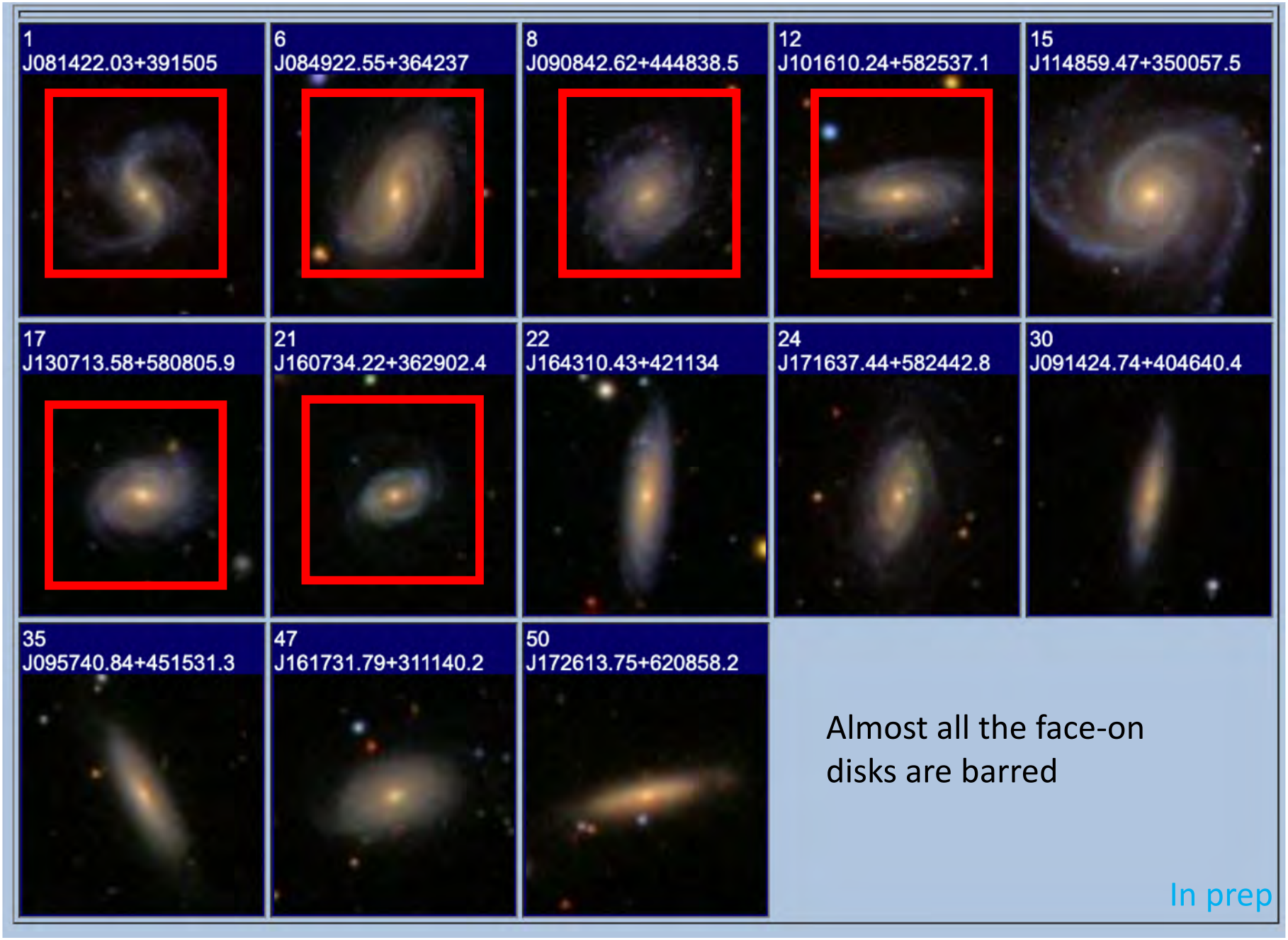
E-center



No significant bars

In prep

E-edge


1
J081422.03+391505
6
J084922.55+364237
8
J090842.62+444838.5
12
J101610.24+582537.1
15
J114859.47+350057.5
17
J130713.58+580805.9
21
J160734.22+362902.4
22
J164310.43+421134
24
J171637.44+582442.8
30
J091424.74+404640.4
35
J095740.84+451531.3
47
J161731.79+311140.2
50
J172613.75+620858.2
Almost all the face-on disks are barred
In prep

What might have produced the excess of HI at the optical disk edge?

- long orbital time.
- massive halos (~$10^{12.5}$ $M_{\odot}$)
- High frequency of hosting strong bars