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

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P. Serra (INAF)
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HI images (PI: G. Kauffmann)
CO images (PI: F. Bigiel)
Optical long-slit spectrum (PI: J. Brinchmann)
The sample

Sample: $\log M_*/M_{\text{sun}} \sim 10-11$, $z \sim 0.023-0.03$ (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

Wang+13
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

Related to strong stellar migration, accretion or in-situ star formation

<table>
<thead>
<tr>
<th>Sample</th>
<th>total</th>
<th>exponential</th>
<th>down-bending</th>
<th>up-bending</th>
<th>exponential</th>
<th>down-bending</th>
<th>up-bending</th>
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<tbody>
<tr>
<td>Bluedisk</td>
<td>27</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>13</td>
<td>2</td>
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</table>

Wang+17
Conformity in HI-richness

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

- HI-rich central
- Control central

Satellites around HI-rich central
Satellites around control central

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

A common underlying reservoir of gas for both central and satellite galaxies
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-\(M_\ast\) and HI-rich disc galaxies?

- blue and up-bending optical outer disks.
- an HI-rich environment extending to \(\sim\)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
Unlikely two steps of gas accretion

Unlikely due to difference in atomic-to-molecular conversion

Likely just less accretion in the inner region of E-edge galaxies.

A sub-sample confirmed by CO images, Cormier+16

In prep
Other differences

<table>
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<tr>
<th>Parameter</th>
<th>M*</th>
<th>μ*</th>
<th>Σ1</th>
<th>R25</th>
<th>Δ g-i</th>
<th>SFR</th>
<th>sSFR</th>
<th>Δ f_{HI}</th>
<th>f_{HI}</th>
<th>t_{orbit}</th>
<th>Σ3</th>
<th>M_{halo}</th>
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<td><strong>Unit</strong></td>
<td>M☉</td>
<td>M☉ kpc⁻²</td>
<td>M☉ kpc⁻²</td>
<td>kpc</td>
<td>M☉ yr⁻¹</td>
<td>dex</td>
<td>yr⁻¹</td>
<td>dex</td>
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<td>Mpc⁻²</td>
<td>dex M☉</td>
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<td>0.20</td>
<td>0.38</td>
<td>0.20</td>
<td>0.21</td>
<td>0.96</td>
<td>0.38</td>
<td>0.13</td>
<td>1.00</td>
<td>0.12</td>
<td>0.02</td>
<td>0.92</td>
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<td><strong>Med (EC)</strong></td>
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<td>8.19</td>
<td>9.12</td>
<td>16.65</td>
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<td>2.37</td>
<td>-9.99</td>
<td>0.22</td>
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<td>8.80</td>
<td>0.88</td>
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<td><strong>Med (EE)</strong></td>
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<td>0.70</td>
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<td><strong>Control</strong></td>
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<tr>
<td><strong>P_{KS} (EE vs ctrl)</strong></td>
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E-center

No significant bars
E-edge

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 ($\sim 10^{12.5} M_\odot$)
- High frequency of hosting strong bars