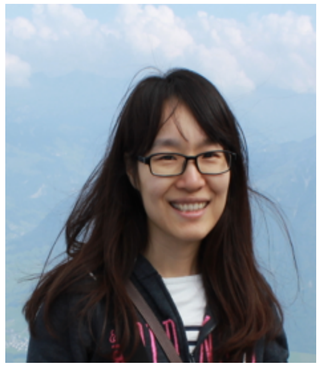

Star Formation and Gas Accretion in Nearby Galaxies

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Abstract

It has been suggested that gas accretion in galaxies enhances star formation. In order to quantify the relationship between gas accretion and star formation, we analyze a sample of nearby galaxies from the WHISP survey which contains galaxies with and without evidence for recent gas accretion. We compare combined radial profiles of FUV (GALEX) and IR 24 μm (Spitzer) characterizing distributions of recent star formation with radial profiles of CO (IRAM, BIMA, or CARMA) and HI (WSRT) tracing molecular and atomic gas contents to examine star formation efficiencies in symmetric (quiescent), asymmetric (accreting), and interacting (tidally disturbed) galaxies. In addition, we investigate the relationship between star formation rate estimated by FUV and HI in the outer disks for the three groups of galaxies.

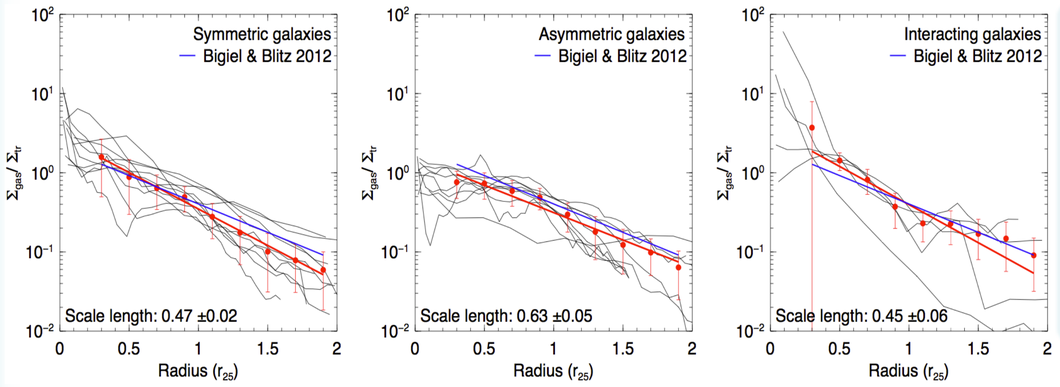
Observational Data are obtained from archives of the projects indicated below. HI, FUV, and IR 24 μm maps are available for all 24 galaxies; only 7 galaxies have CO maps.

* **H I:** WHISP archive (Westerbork observations of neutral Hydrogen in Irregular and SPiral galaxies Project; Kamphuis et al. 1996; van der Hulst et al. 2001)
* **CO**: u1913 & u5079 - IRAM Heracles (Lerory et al. 2009)
  u3334 - IRAM PdBI (Combes et al. 2009)
  u5557, u6856, & u7353 - BIMA SONG (Helfer et al. 2003)
  u5532 - CARMA STING (PI: Alberto Bolatto; Rahman et al 2012,2011; Wong et al. 2013)
* **FUV**: GALEX archive (mostly NGS and few galaxies from AIS or DIS)
* **24 μm**: Spitzer archive

Sample of Galaxies

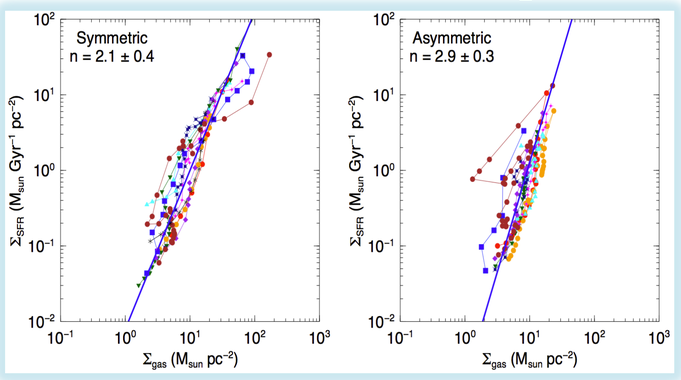
Galaxy	Distance (Mpc)	HI total flux (Jy km s^{-1})	R_{25} (arcsec)	Inclination (degree)	Kinematical Type
UGC 1913 (NGC 925)	9.3	326	314	54	Asymmetric
UGC 2455 (NGC 1156)	6.5	64	99	52	Symmetric
UGC 3334 (NGC 1961)	56.0	75	137	47	Interacting
UGC 3426	57.8	2	55	45	Interacting
UGC 3851 (NGC 2366)	3.9	274	244	68	Asymmetric
UGC 4165 (NGC 2500)	9.8	36	87	28	Symmetric
UGC 4274 (NGC 2537)	8.1	20	52	33	Symmetric
UGC 4305	5.0	253	238	40	Asymmetric
UGC 4862 (NGC 2782)	39.5	7	104	30	Interacting
UGC 5079 (NGC 2903)	7.3	277	378	64	Symmetric
UGC 5532 (NGC 3147)	43.0	32	117	35	Symmetric
UGC 5557 (NGC 3184)	10.1	123	222	21	Symmetric
UGC 5789 (NGC 3319)	13.3	94	185	62	Asymmetric
UGC 5840 (NGC 3344)	6.9	186	212	18	Symmetric
UGC 6856 (NGC 3938)	15.5	86	161	24	Symmetric
UGC 7256 (NGC 4203)	22.4	49	102	51	Asymmetric
UGC 7323 (NGC 4242)	8.8	49	150	52	Asymmetric
UGC 7353 (NGC 4258)	8.0	509	559	66	Symmetric
UGC 7524 (NGC 4395)	3.8	310	395	47	Asymmetric
UGC 7766 (NGC 4559)	9.8	331	321	67	Asymmetric
UGC 7853 (NGC 4618)	8.8	67	125	36	Interacting
UGC 7989 (NGC 4725)	26.8	145	321	44	Asymmetric
UGC 8900 (NGC 5395)	56.0	23	87	57	Interacting
UGC 12754 (NGC 7741)	12.5	53	131	49	Symmetric

• Scaled Radial Profiles of the Total Gas

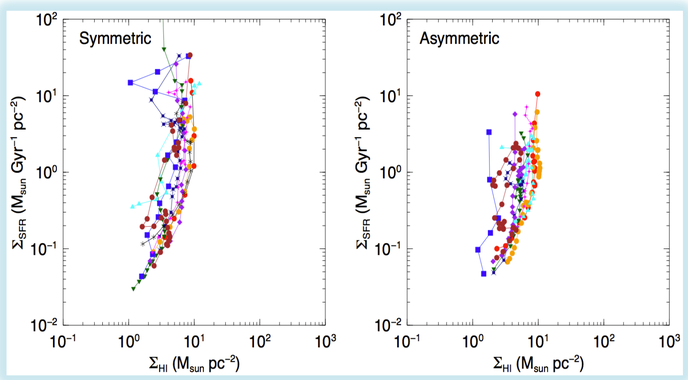


Radial profiles of 10 symmetric, 9 asymmetric, and 5 interacting galaxies have been fitted by an exponential function and compared with the result of Bigiel & Blitz (2012). The adopted Σ_{tr} ($\Sigma_{H2} = \Sigma_{HI}$) is 14 $M_\odot$ pc^{-2}. The red points are the average values in each bin ($0.2R_{25}$) and the red line is the fit to the points.

• Kennicutt-Schmidt Law (H_2+HI)



• SFR vs. Atomic Gas (HI)



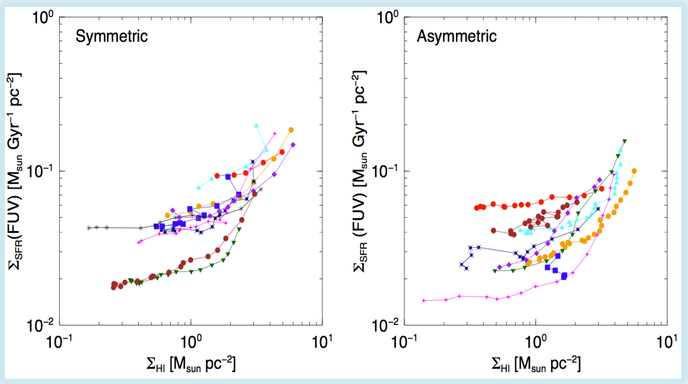
Σ_{SFR} [$M_\odot$ kpc^{-2} yr^{-1}] = 0.081 I_{FUV} [MJy sr^{-1}] + 0.0032 $I_{24\mu m}$[MJy sr^{-1}] (Leroy 2008); if CO data are unavailable, H_2 is inferred from the correlation $\Sigma_{SFR} = 10^{-2.1} (\Sigma_{H2}/10\ M_\odot pc^{-2})^{1.0}$ given by Bigiel et al. (2008)

✷ The asymmetric galaxy group shows a steeper slope of the K-S law than the symmetric galaxy group. Part of the difference is caused by the availability of CO data; only one of the asymmetric galaxies has the CO data. If we fit the same range for both groups ($\Sigma_{gas} < 20\ M_\odot\ pc^2$), the difference becomes smaller.

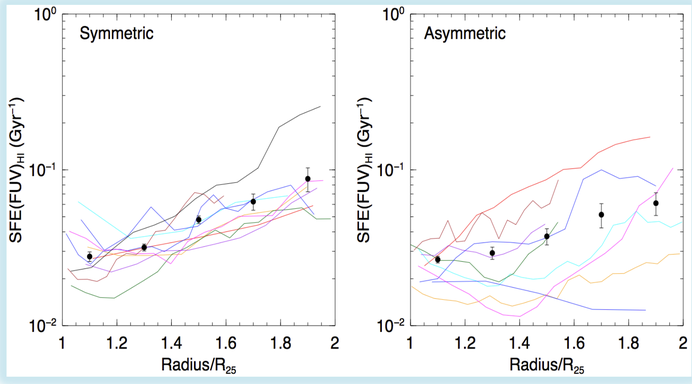
✷ The relation between Σ_{SFR} and Σ_{HI} suggests that both groups show very similar pattern even though the symmetric group extends to higher values in Σ_{SFR}.

• Star formation in the outer regions (1–2R_{25})

Star Formation Rate



Star Formation Efficiency



In the outer regions, we only have UV and HI data. Therefore, we obtain the star formation rate from FUV only, and define the star formation efficiency as: $SFE(FUV)_{HI} = \Sigma_{SFR}(FUV)/\Sigma_{HI}$

✷ There is no significant difference between symmetric and asymmetric groups in SFR and SFE although the asymmetric galaxies show a larger scatter.

Conclusions

✷ Radial profiles of all three groups (symmetric, asymmetric, and interacting galaxies) are well fitted by an exponential function and the fits are in good agreement with the result of Bigiel & Blitz (2012).

✷ The Kennicutt-Schmidt law for our sample (24 galaxies) is similar to that of the galaxies studied by Bigiel et al. (2008). The asymmetric group has a slightly steeper K-S relation.

References

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