Comparison of Catalogs

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The data

In this script we will compare out 2 catalogs Kovlakas et al. (2021) and Karachentsev and Kaisina (2013)

- The data have been joined based on their position in the sky (Ra, Dec, Distance).
- We use TOPCAT to create two joins, an inner and an outer join
- We will use the inner join for 1-1 comparisons
- If we see that the data are similar we can use the outer join

The dataset we are going to use consists of 296 galaxies and 168 columns.

How are we going to compare the data?

Scatter plots and R^2 calculation

1. R^2: Measures the proportion of variance explained by the linear model.
2. Slope of the Fitted Line: Should be close to 1 for a 1-1 correlation.[1]
3. Pearson Correlation ρ: Measures the strength and direction of the linear relationship between two variables, ranging from -1 to 1. [2]

4. Scatter plots: Scatter plots are essential for visually assessing the relationship between two datasets, identifying correlations, trends, and outliers, and evaluating the fit of linear models.

Some data seem to have a very good linear correlation but they have many outliers. This is why we will clip the outliers whith $sigma > 3$

- Histograms

- Deviation

Comparable data

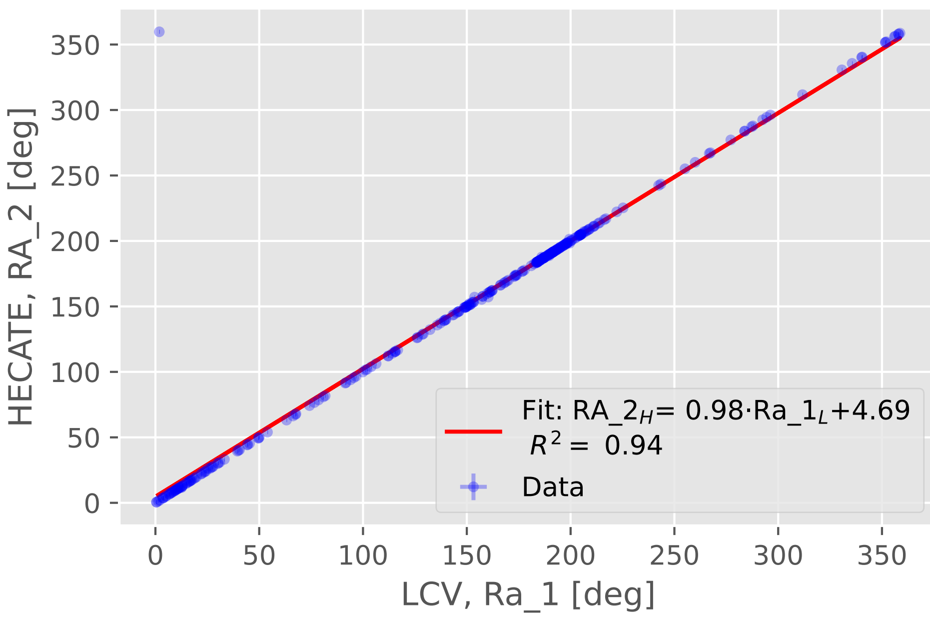
Coordinates

[1]Fitting can be done using the uncertainties as weights. To get the standard weighting of 1/unc^2, assuming Gaussian errors, the weights to pass to the fitting are 1/unc.

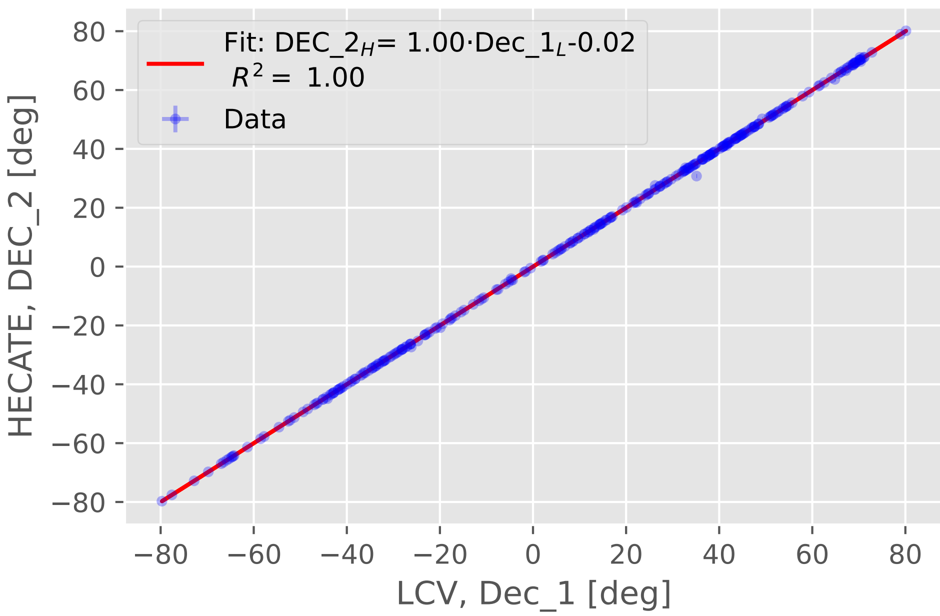
[2]In simple linear regression, R^2 is the square of the Pearson correlation coefficient ρ.

LCV	HECATE	Description	Pearson Correlation [-1,1]
Ra_1	RA_2	Right Ascension	0.972
Dec_1	DEC_2	Declination	1.0
Dis	D	Distance	1.0

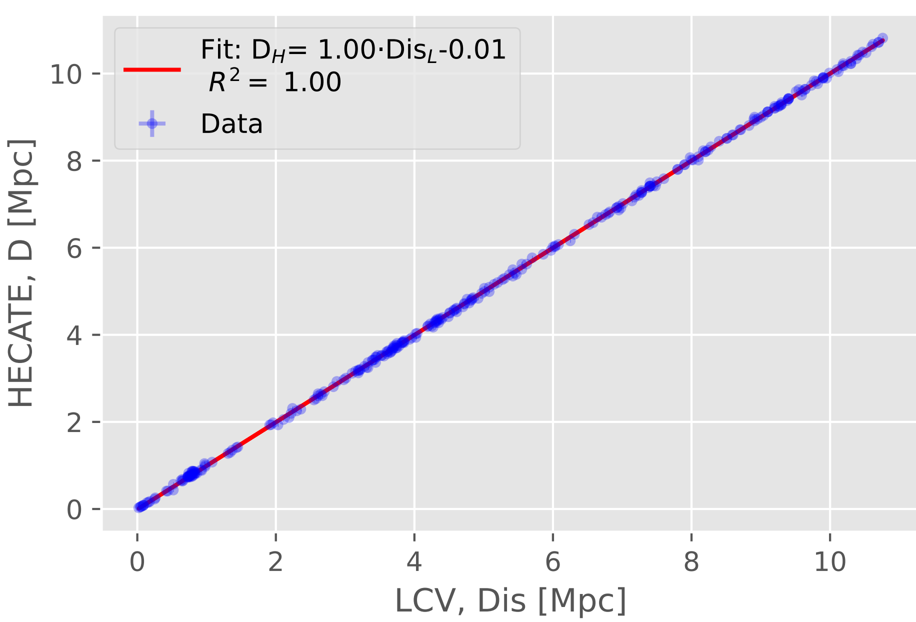
Right Ascnsion



Declination



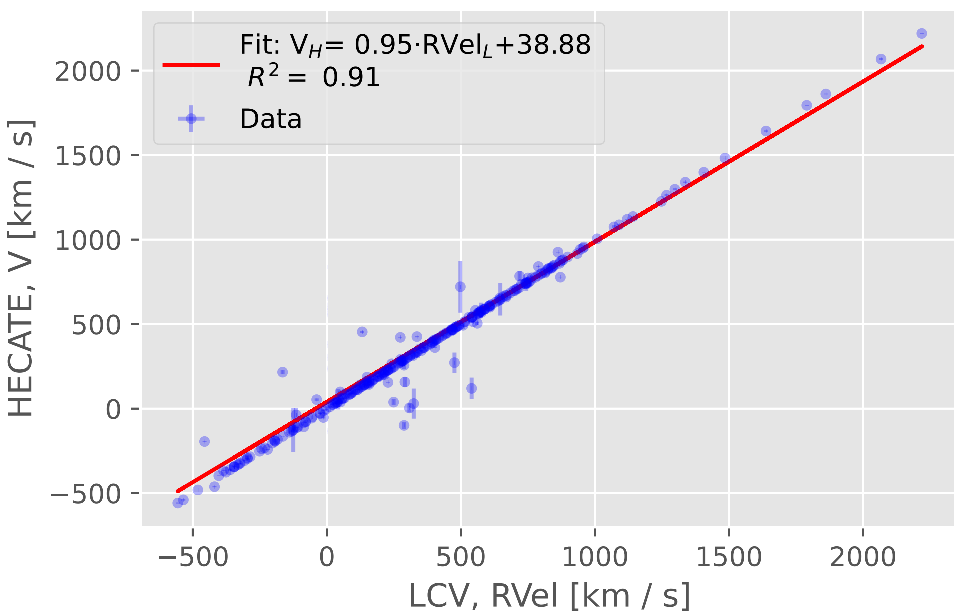
Distance



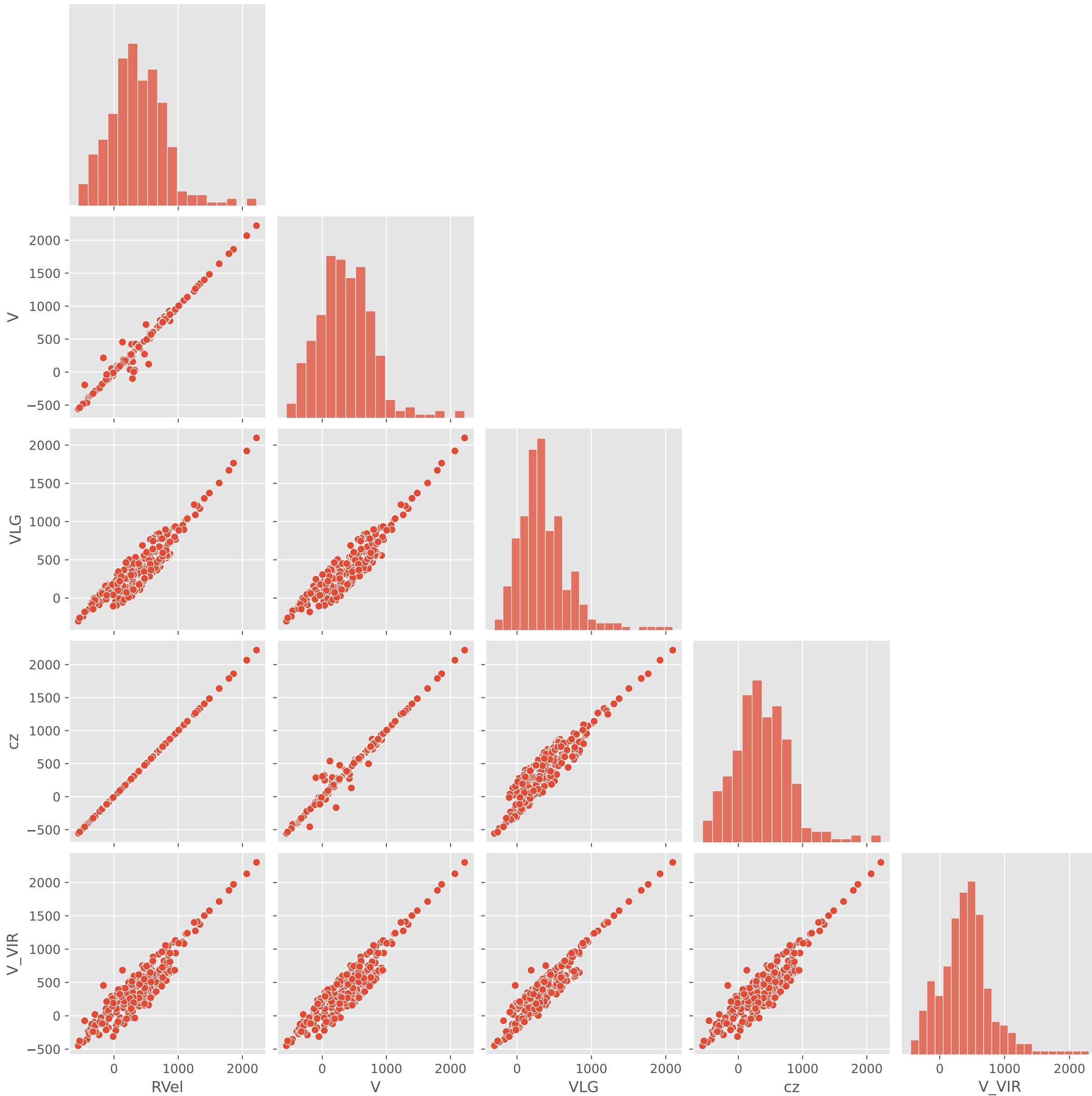
Velocities

LCV	HECATE	Description	Linear Correlation
RVel (km/s)	V (km/s)	Heliocentric radial velocity	0.952
VLG (km/s)		Radial velocity	
cz (km/s)		Heliocentric velocity	
	V_VIR (km/s)	Virgo-infall corrected radial velocity	

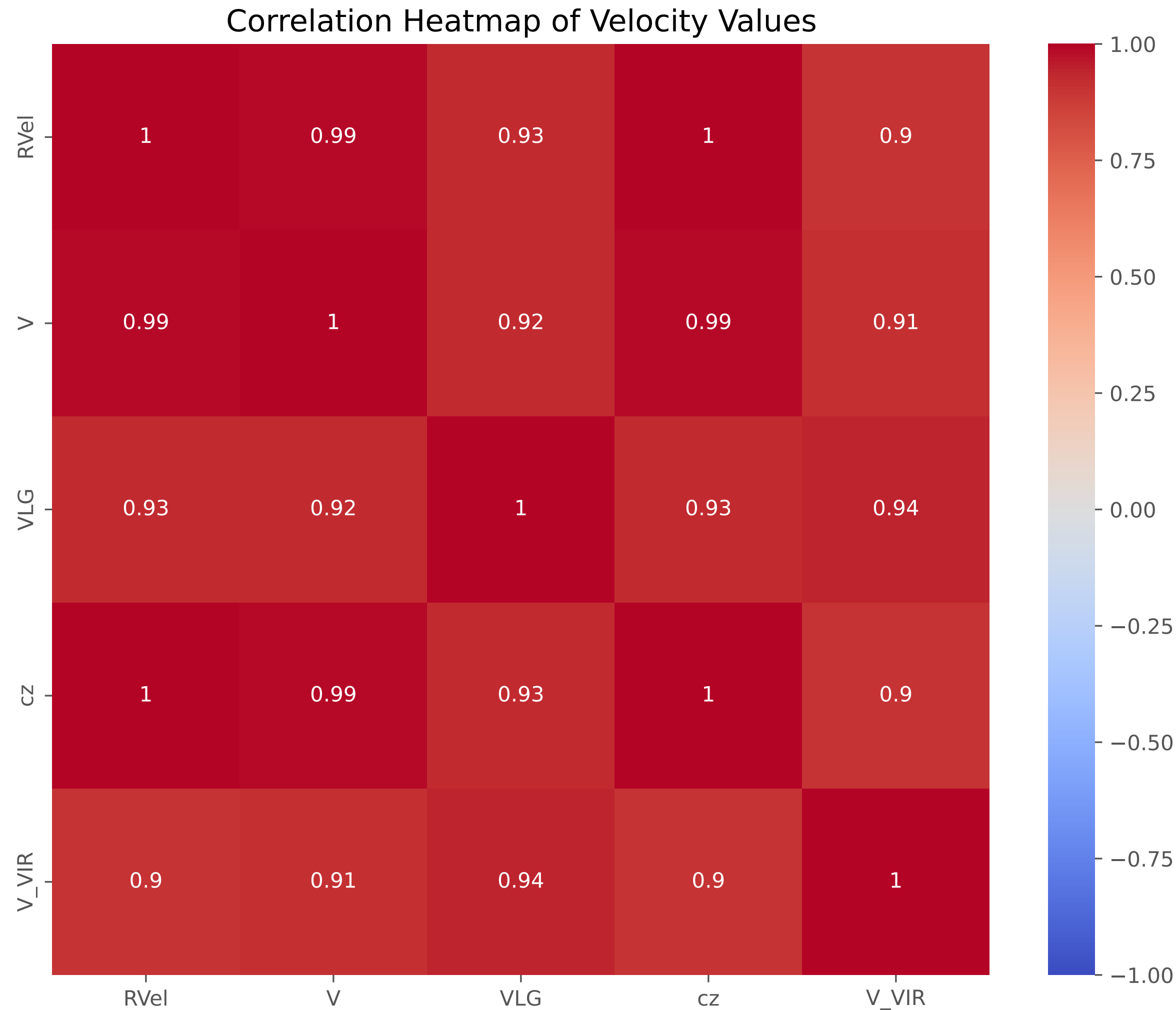
Heliocentric radial Velocity



Scatter Grid



Heatmap

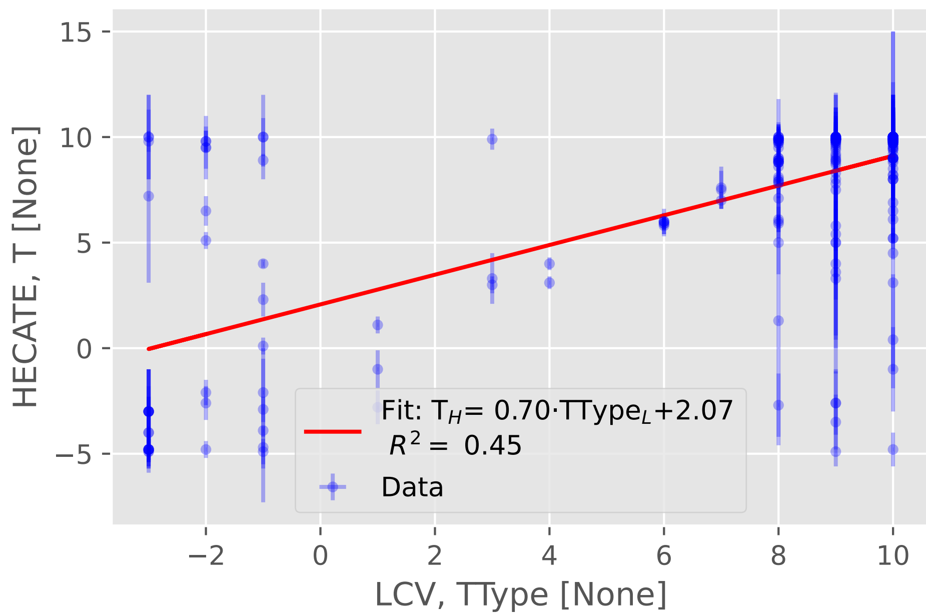


Morphology and Geometry

LCV	HECATE	Description	Pearson Correlation [-1,1]
TType	T (with errors)	Numerical Hubble type following the de Vaucouleurs system	0.6685
inc	INCL	Inclination (deg)	0.663

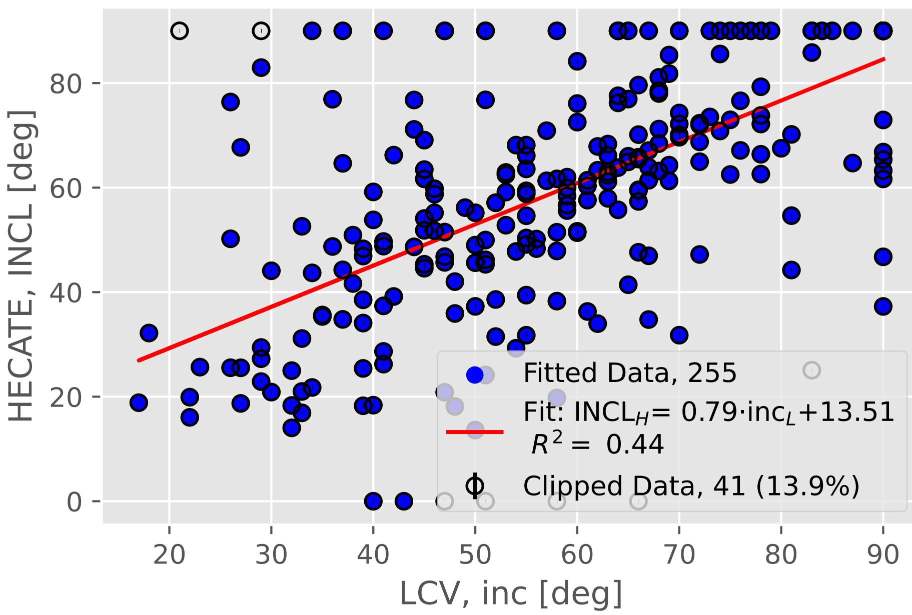
LCV	HECATE	Description	Pearson Correlation [-1,1]
a26_1 (Major)	R1 (Semi-major axis)	angular diameter (arcmin)	0.992

Galaxy Types

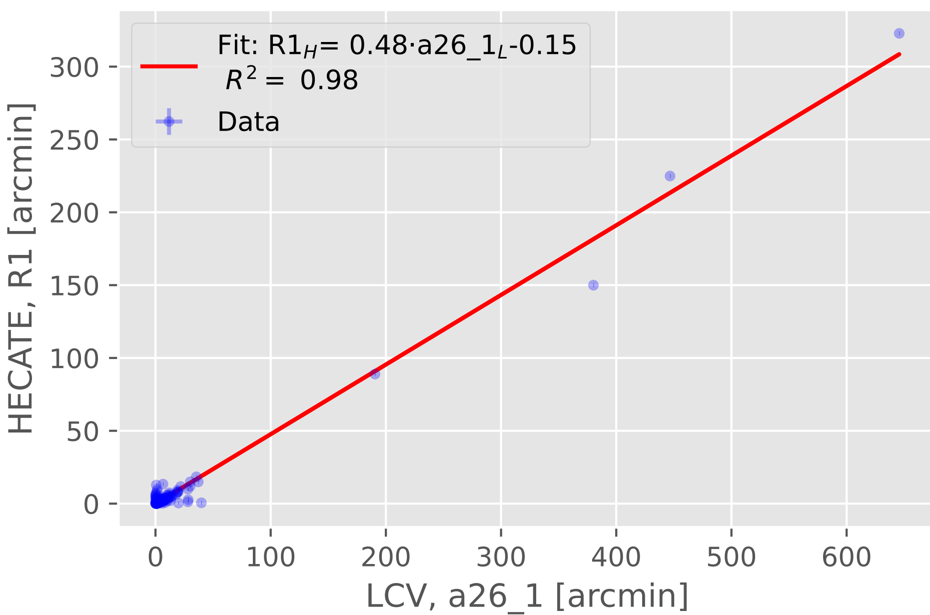


As we can see we don't have any significant correlation between the Types of galaxies and thus the correlation of the inclanations are 0

Inclanation

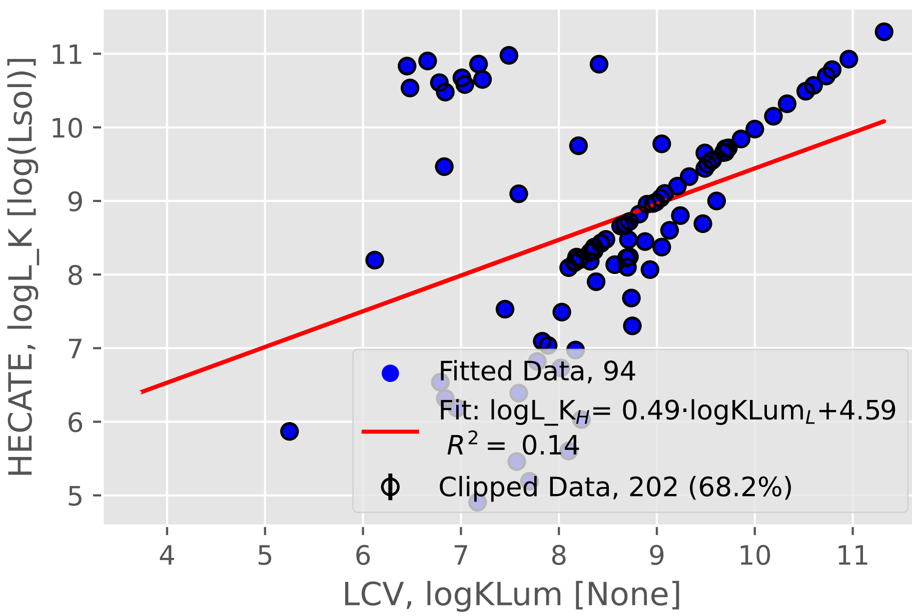


Major Axis



Luminosities

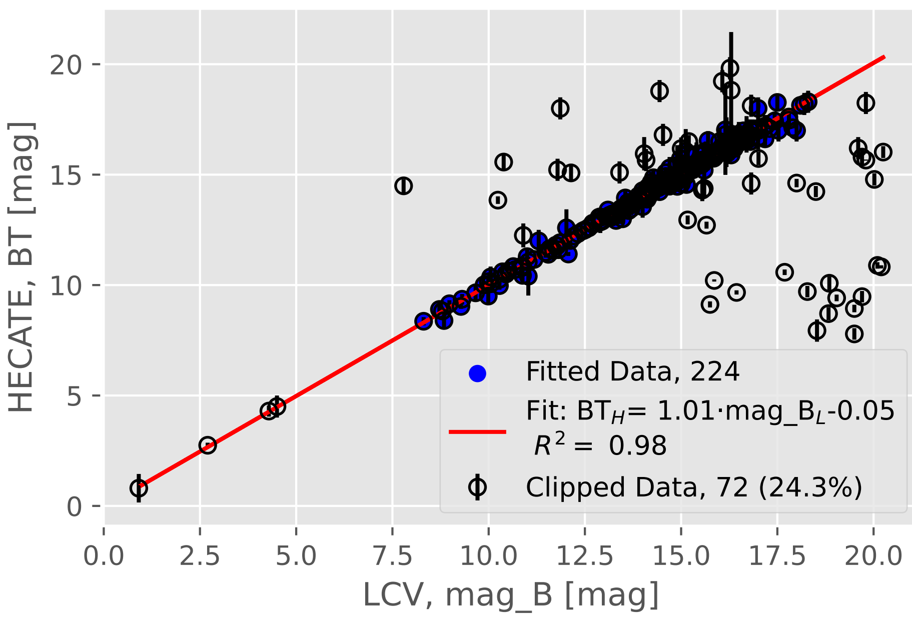
LCV	HECATE	Description	Pearson Correlation [-1,1]
logKLum	logL_K		0.379



Magnitudes

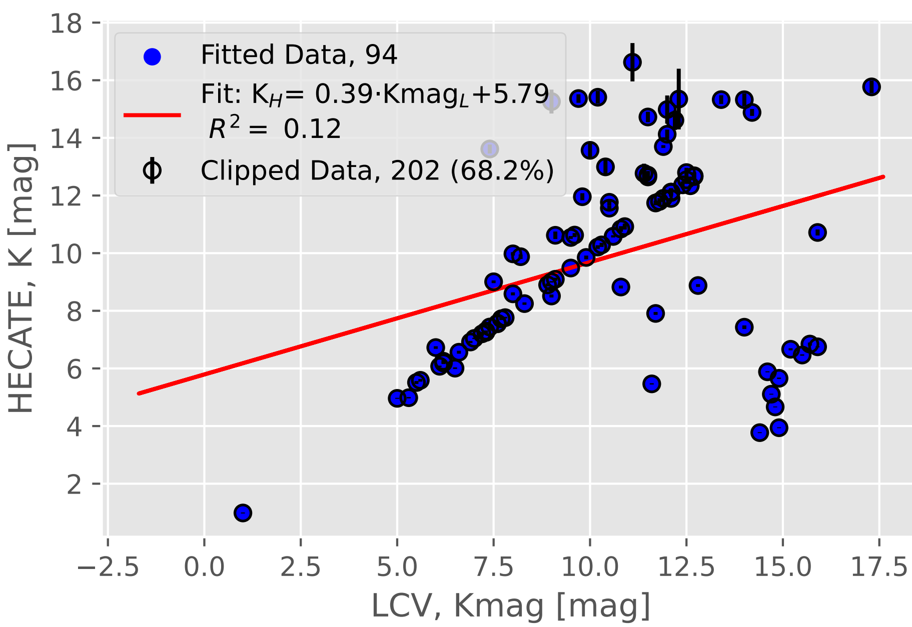
LCV	HECATE	Description	Pearson Correlation [-1,1]
mag_B (with errors)	BT (with errors)		0.992
Kmag	K	2MASS band magnitude (both)	0.348

B mag



Fitted Data, 224
Fit: BT_H= 1.01·mag_B_L-0.05
$R^2 =$ 0.98
Clipped Data, 72 (24.3%)
HECATE, BT [mag]
LCV, mag_B [mag]

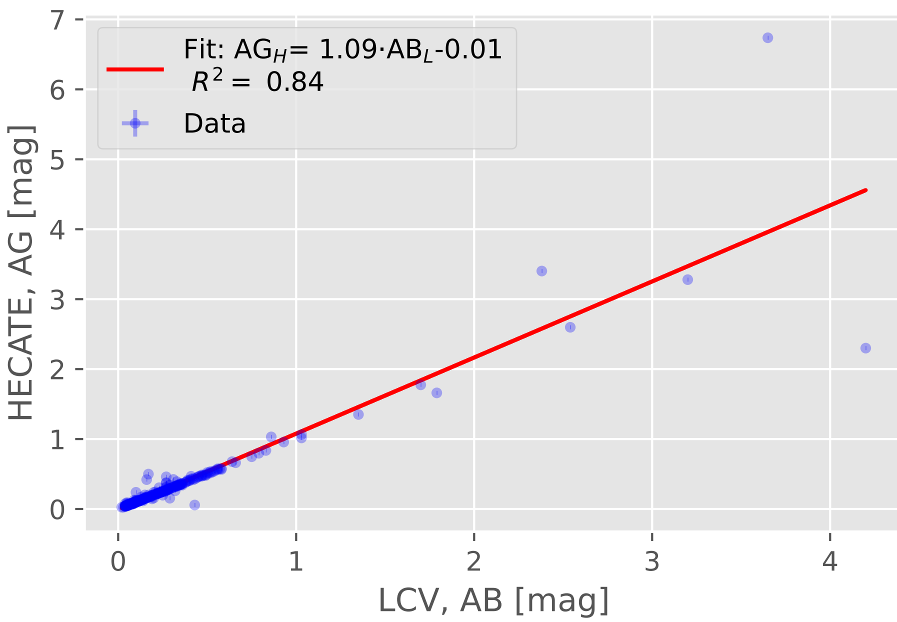
K mag



Fitted Data, 94
Fit: K_H= 0.39·$Kmag_L$+5.79
$R^2 =$ 0.12
Clipped Data, 202 (68.2%)
HECATE, K [mag]
LCV, Kmag [mag]

Absorbsion

LCV	HECATE	Description	Pearson Correlation [-1,1]
AB	AG	Galactic extinction/absorption in B band	0.914
AB_int	AI	Internal/Intrisic B band extinction/absorption	0

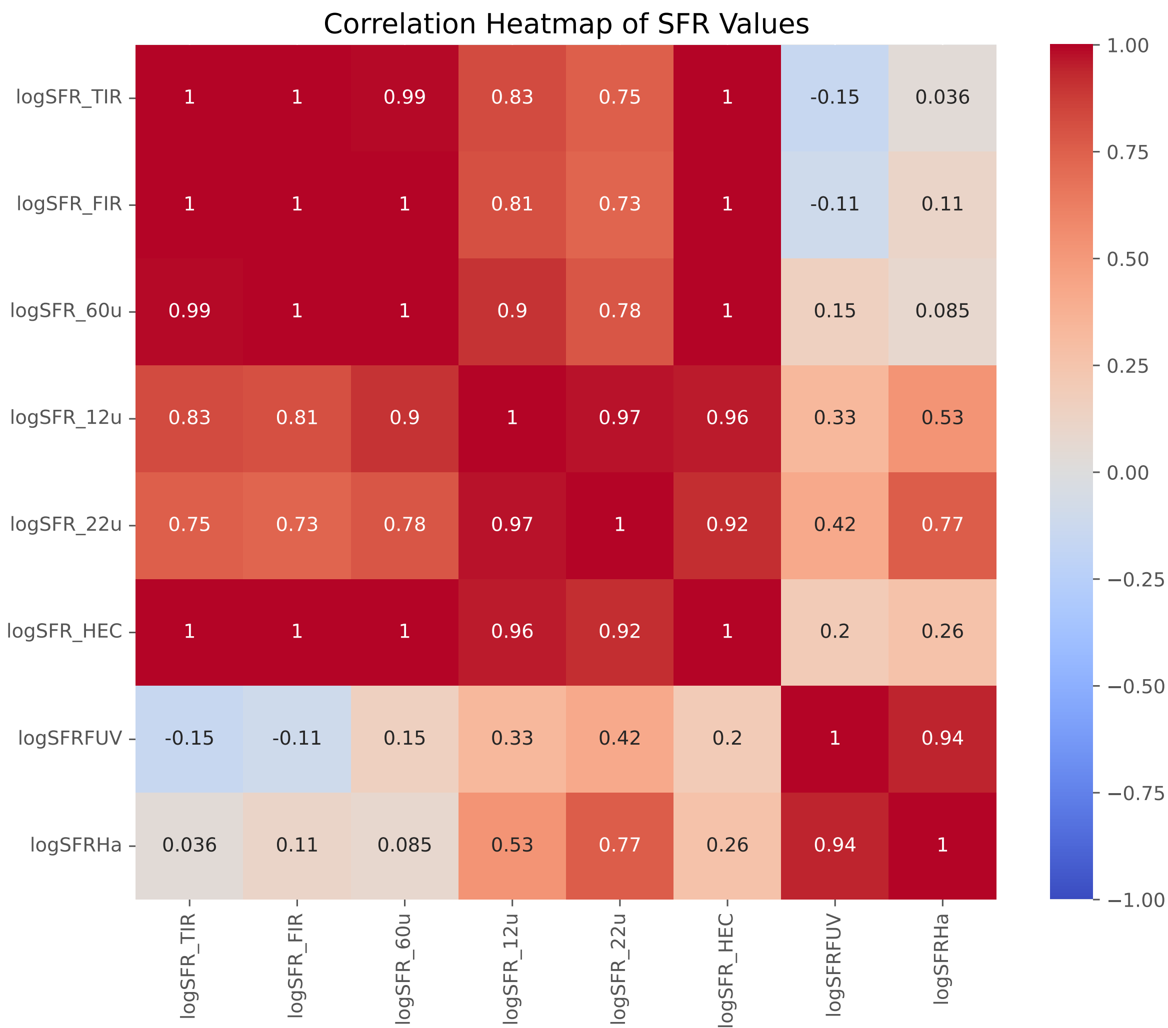


SFR

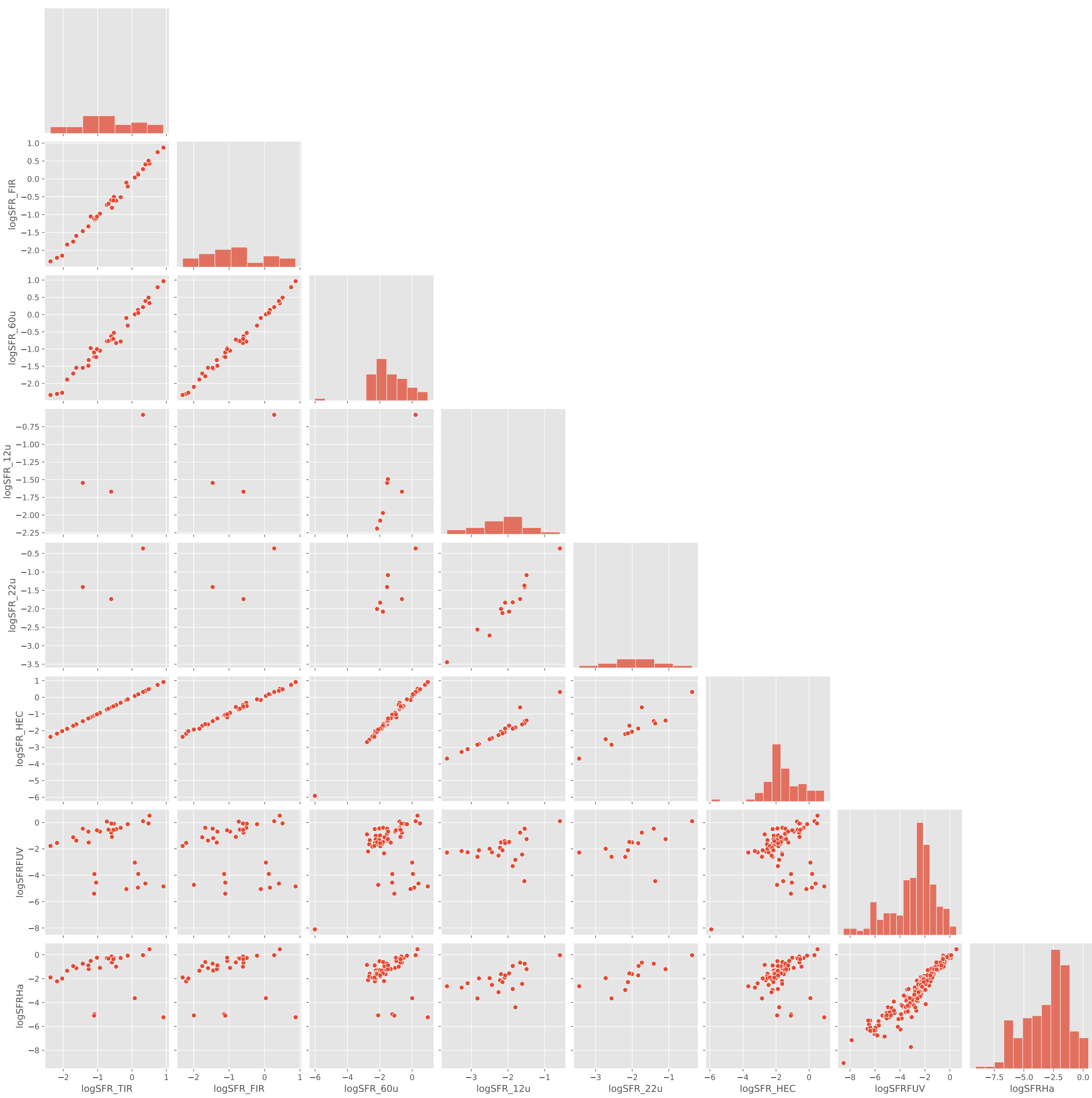
LCV	HECATE	Description	Count
	logSFR_TIR	Decimal logarithm of the total-infrared SFR estimate [Msol/yr]	35
	logSFR_FIR	Decimal logarithm of the far-infrared SFR estimate [Msol/yr]	38

LCV	HECATE	Description	Count
	logSFR_60u	Decimal logarithm of the 60um SFR estimate [Msol/yr]	64
	logSFR_12u	Decimal logarithm of the 12um SFR estimate [Msol/yr]	23
	logSFR_22u	Decimal logarithm of the 22um SFR estimate [Msol/yr]	14
	logSFR_HEC	Decimal logarithm of the homogenised SFR estimate [Msol/yr]	81
	logSFR_GSW	Decimal logarithm of the SFR in GSWLC-2 [Msol/yr]	0
SFRFUV		FUV derived integral star formation rate	257
SFRHa		H{alpha} derived integral star formation rate	249

Heatmap


Correlation Heatmap of SFR Values
logSFR_TIR
logSFR_FIR
logSFR_60u
logSFR_12u
logSFR_22u
logSFR_HEC
logSFRFUV
logSFRHa
1 1 0.99 0.83 0.75 1 -0.15 0.036
1 1 1 0.81 0.73 1 -0.11 0.11
0.99 1 1 0.9 0.78 1 0.15 0.085
0.83 0.81 0.9 1 0.97 0.96 0.33 0.53
0.75 0.73 0.78 0.97 1 0.92 0.42 0.77
1 1 1 0.96 0.92 1 0.2 0.26
-0.15 -0.11 0.15 0.33 0.42 0.2 1 0.94
0.036 0.11 0.085 0.53 0.77 0.26 0.94 1
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00

Scatter Grid

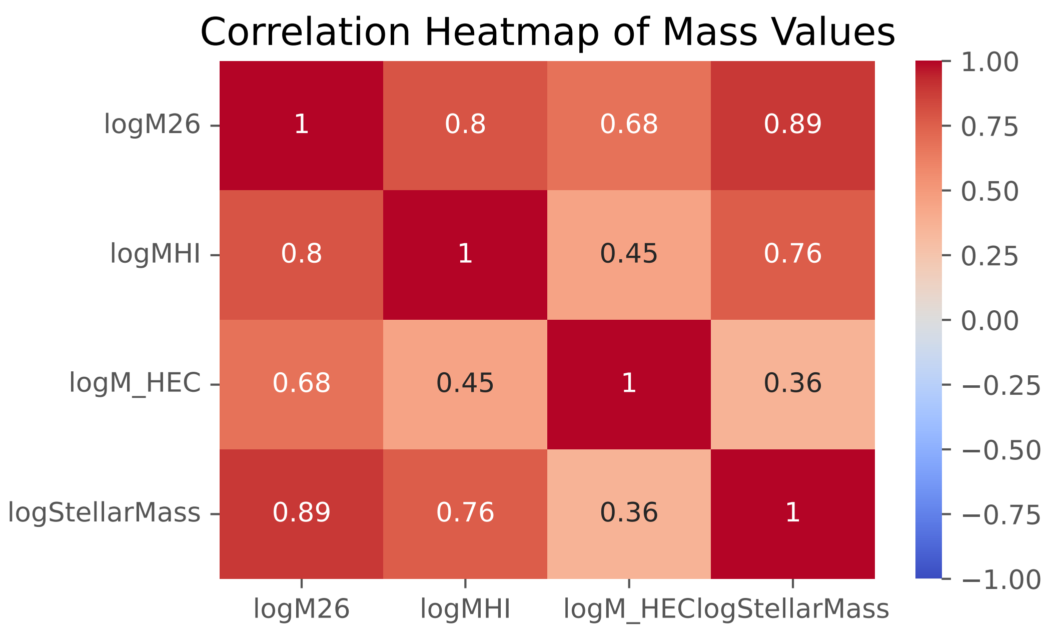


It is possible we dont see a good correlation because we dont have a big enough common sample

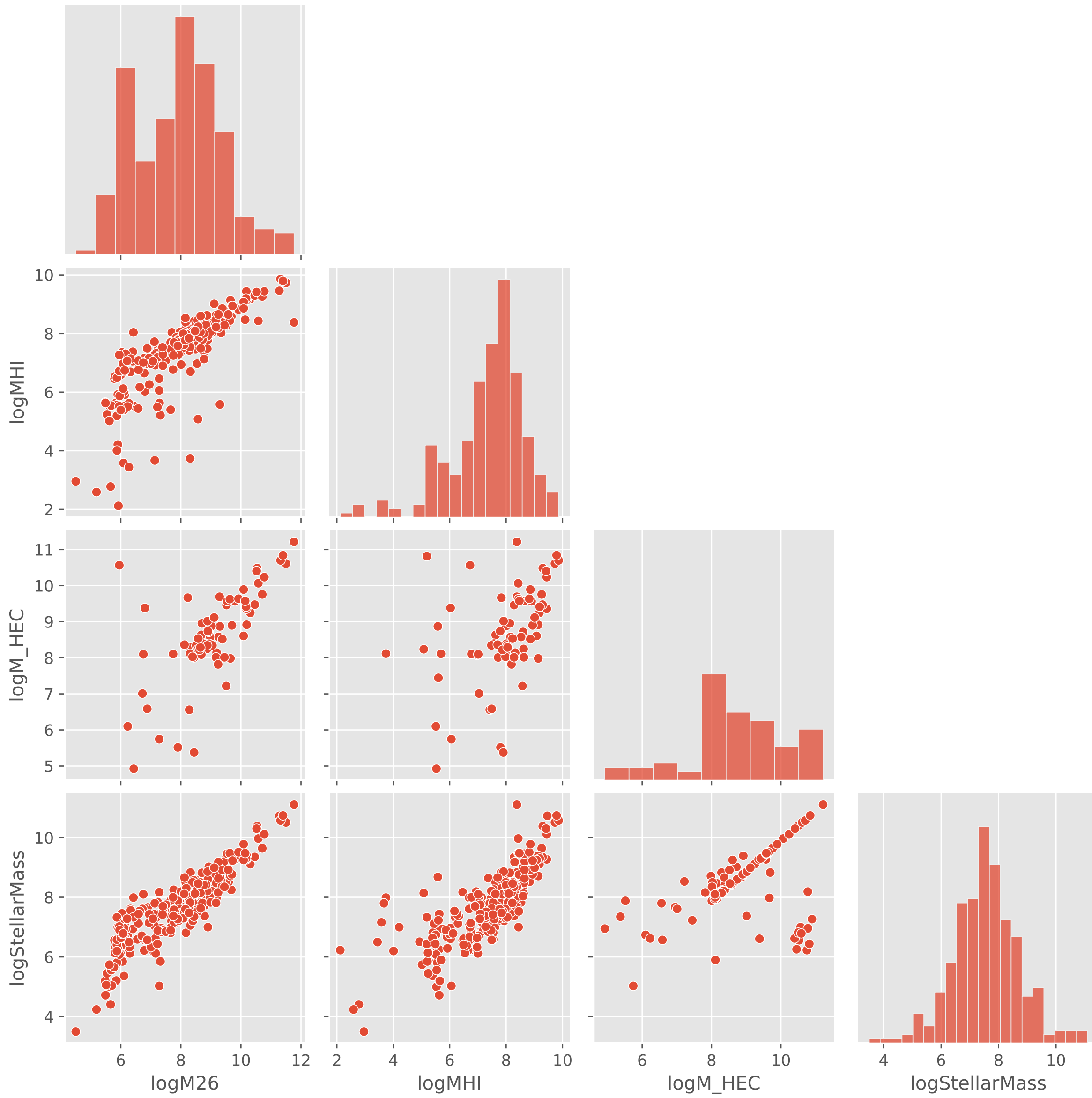
Masses

LCV	HECATE	Description	Count
logM26		Log mass within Holmberg radius	263
logMHI		Log mass within Holmberg radius	269
	logM_HEC	Decimal logarithm of the stellar mass [Msol]	87
	logM_GSW	Decimal logarithm of the stellar mass in GSWLC-2 [Msol]	0
logStellarMass		Stellar Mass from M_*/L=0.6	296

Heatmap



Plot Grid



Karachentsev, Igor D., and Elena I. Kaisina. 2013. "STAR FORMATION PROPERTIES IN THE LOCAL VOLUME GALAXIES VIA H AND FAR-ULTRAVIOLET FLUXES." *AJ* 146 (3): 46. https://doi.org/10.1088/0004-6256/146/3/46.

Karachentsev, Igor D., Dmitry I. Makarov, and Elena I. Kaisina. 2013. "UPDATED NEARBY GALAXY CATALOG." *AJ* 145 (4): 101. https://doi.org/10.1088/0004-6256/145/4/101.

Kovlakas, K., A. Zezas, J. J. Andrews, A. Basu-Zych, T. Fragos, A. Hornschemeier, K. Kouroumpatzakis, B. Lehmer, and A. Ptak. 2021. "The Heraklion Extragalactic Catalogue (HECATE): A Value-Added Galaxy Catalogue for Multimessenger Astrophysics." *Monthly Notices of the Royal Astronomical Society* 506 (September): 1896–1915. https://doi.org/10.1093/mnras/stab1799.