

Cluster 163

March 5, 2025

1 Identifying Genuine cluster members with 3D Monte-Carlo simulation and HDBSCAN

This is an auto generated report for Cluster 163.

It shows methodology for identifying genuine cluster members with 3D Monte-Carlo Simulation and HDBSCAN*. Similar reports have been generated for all analyzed clusters.

1.1 Determination of membership cut-off from membership distribution

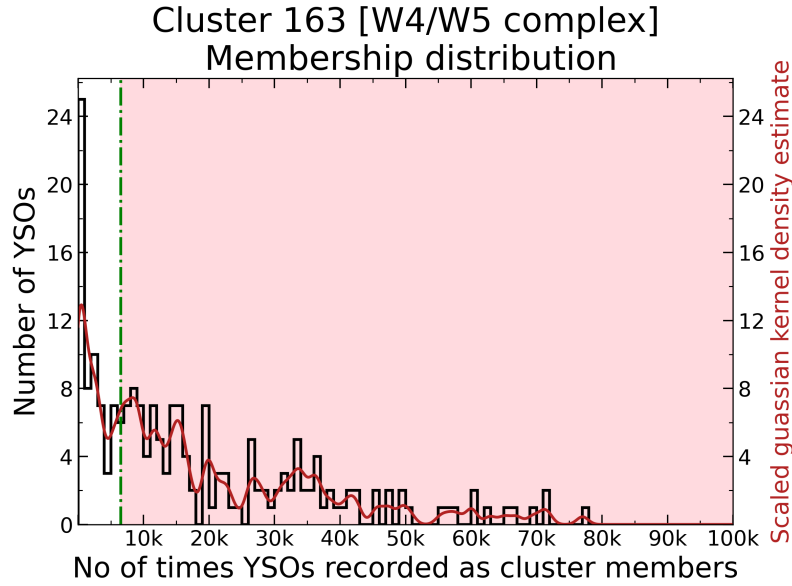


Figure 1: Distribution of YSO membership for 100,000 iterations of HDBSCAN* for 163

Monte-Carlo threshold (green dash-dotted line): 6500

Number of members above threshold in run 6 of HDBSCAN-MC: 140

1.2 Identifying common members across 10 runs HDBSCAN-MC

Figure 2 shows stability of HDBSCAN-MC across 10 runs. The common members across all runs will be considered for further analysis

HDBSCAN-MC Stability Test: Cluster 163 [W4/W5 complex]

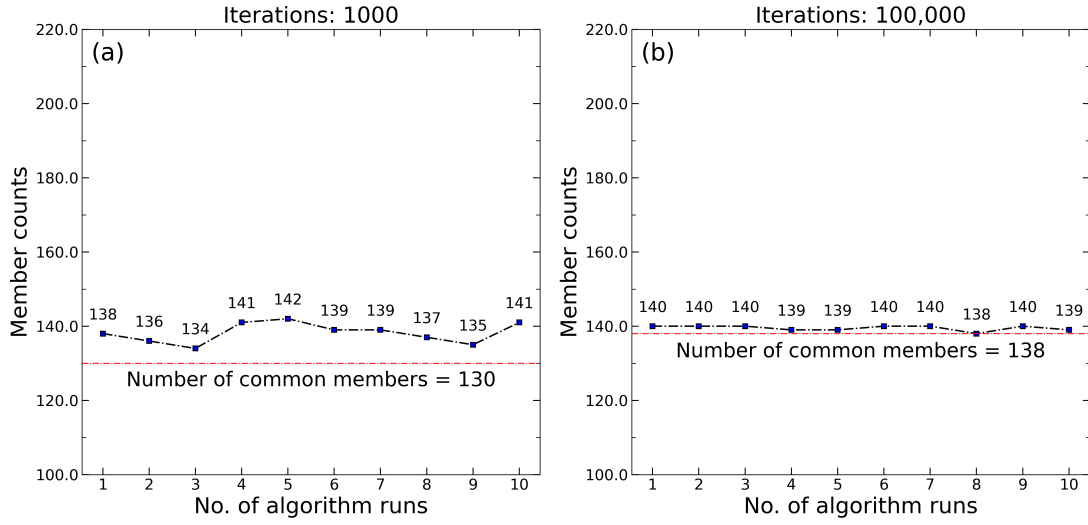


Figure 2: Stability Test for identification of HDBSCAN-MC algorithm across 10 runs. Common members across various runs are taken as final members

1.3 Viewing identified genuine cluster members in astrometric space.

Figure 3 shows final identified members in astrometric space along with Gaia color-color diagram.

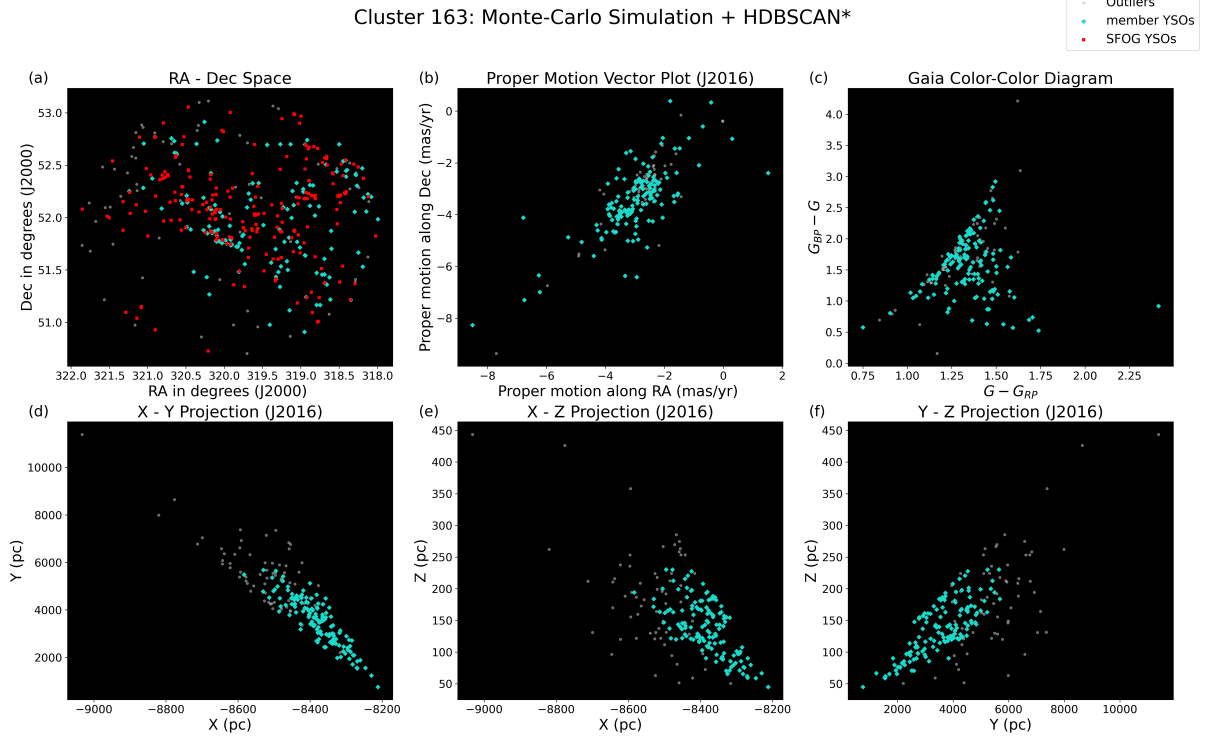


Figure 3: Astrometric analysis by application of HDBSCAN-MC for Cluster 163

1.4 Summarizing Cluster Statistics

Cluster Statistics	
Median Distance	3656 pc +/- 1230 pc
Mean Distance	3578 pc +/- 1230 pc
Kinematic Distance (Winston et.al. 2020)	9900 pc +/- 1980 pc
Simulation predicted distance estimate	3531 pc +/- 444 pc
No. of Gaia matched SFOG YSOs	134 out of 198
No. of Gaia only YSOs	1 out of 3
Total cluster members (with Gaia counterparts)	135 out of 201
Predicted false positives	108 out of 135
New Gaia-matches SFOG members	131
SFOG only YSOs in region	233
SFOG cluster members as reported in Winston et.al. (2020)	108
No. of outlier in Winston et.al. (2020) SFOG cluster members	2
Cluster β value	0.2547

1.5 Proper Motion Analysis

Figure 4 shows direction distribution of proper motion vectors for identified cluster members. The angle is measured from positive x-axis. The proper motion magnitude distribution is given by Figure 5.

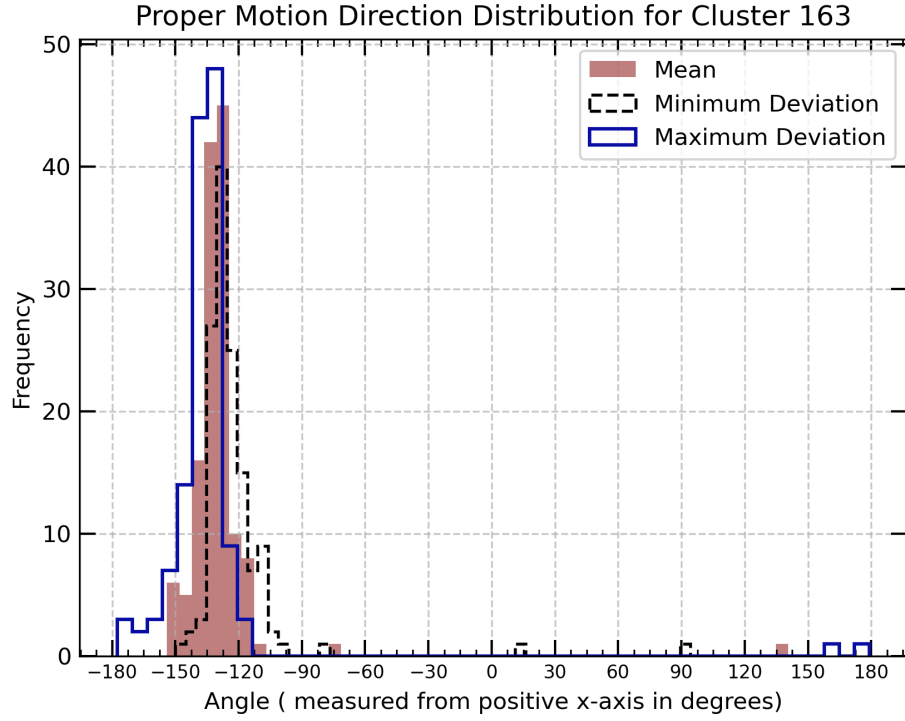


Figure 4: Proper motion direction distribution for Cluster 163

1.6 Cluster simulation

The table below gives weighted parameters and unbiased weighted standard deviation obtained from optimization process. The weighted parameters are calculated using optimized parameter sets having MSD less than three times best-fit solution.

Iteration	center_dist	mem_frac	noise_lower	noise_upper	c	pm_scale	MSD
	3531 pc +/- 444 pc	13.785 +/- 0.446	1902.329 +/- 207.514	6803.055 +/- 133.409	588.521 +/- 354.552	7027.015 +/- 1071.751	
3	4006.0	14.0	1680.0	6731.0	50.0	8368.0	14.2438
2	2988.0	14.0	2140.0	6754.0	862.0	6089.0	16.3881
17	3692.0	14.0	1679.0	6744.0	884.0	7740.0	20.1343
4	3116.0	14.0	2018.0	6669.0	535.0	6048.0	21.2587
26	3714.0	13.0	2107.0	6913.0	753.0	5844.0	27.3134
24	3990.0	13.0	1800.0	6911.0	366.0	7787.0	28.5672
5	3192.0	14.0	1986.0	7082.0	904.0	6746.0	29.403

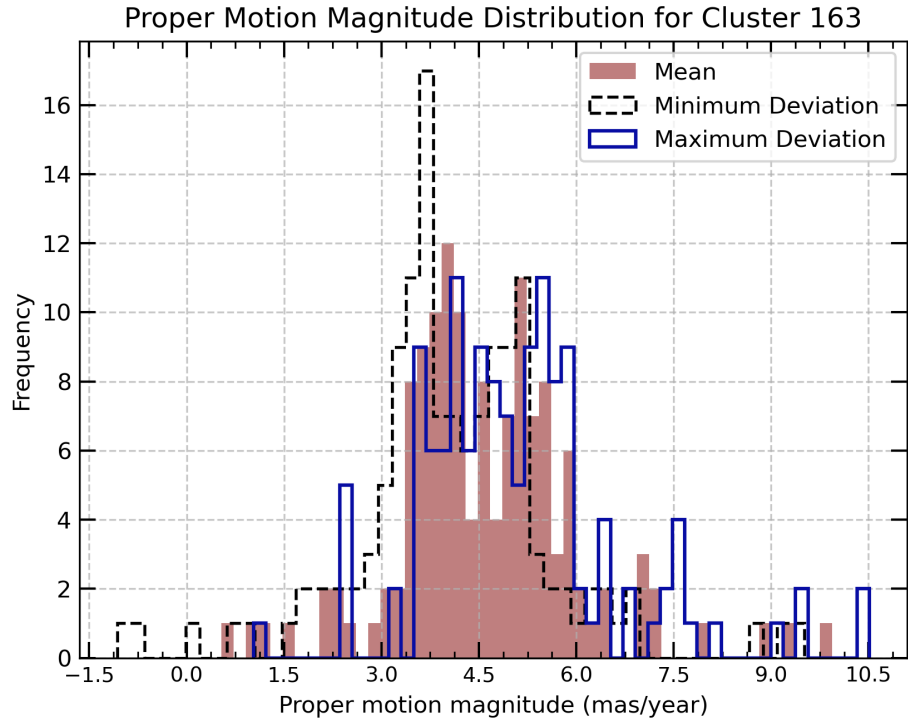


Figure 5: Proper motion magnitude distribution for Cluster 163

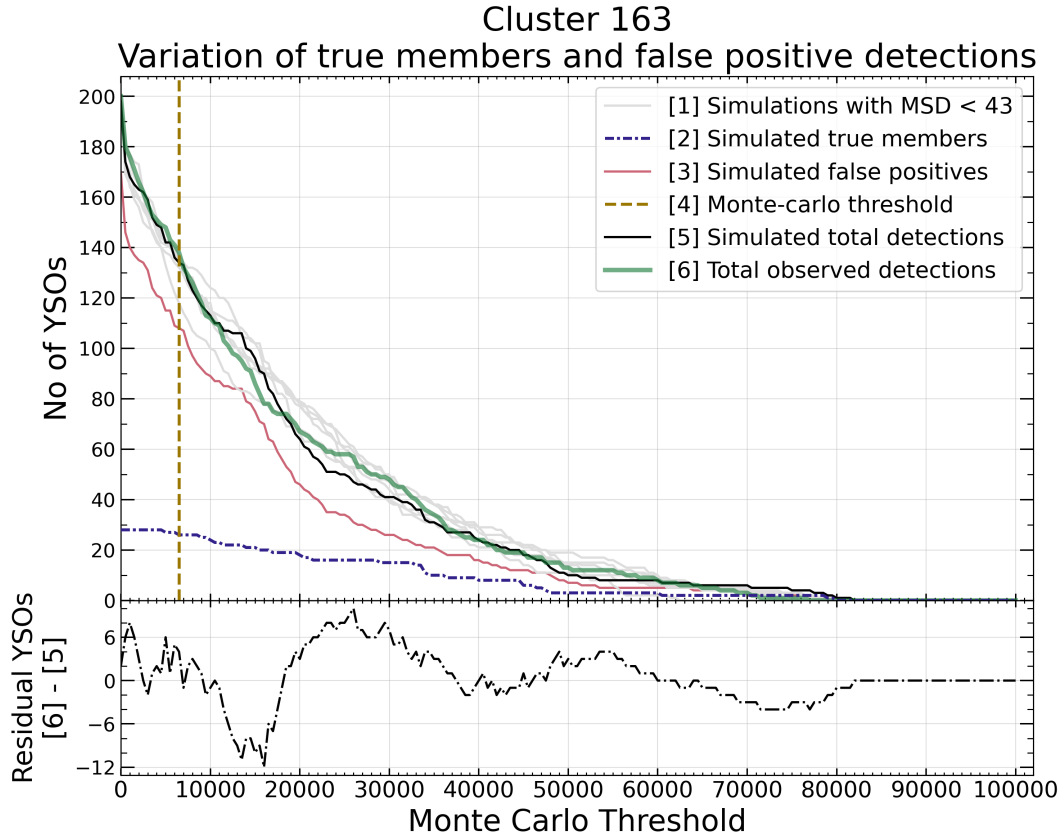


Figure 6: Monte Carlo spectra and simulation result for Cluster 163