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ASTRO 3334, Spring 2018

Hertzsprung-Russell Diagram of the Omega Centauri Globular Cluster

For this lab, observation data of the globular cluster Omega Centauri was obtained from the Hubble Legacy Archive. The FITS data included three filters: F275W, F336W, and F814W. The ultraviolet and infrared filters were extracted, and then their photometry was analyzed using the DAO Star Finder algorithm from the photutils package. The two images were registered with respect to sky coordinates, so it was possible to use one set of apertures for both images. This approach was taken for two diagrams (aperture set found on the F275W and the F814W datasets respectively) in addition to finding apertures on both datasets and point matching apertures between the two images. The linear flux obtained from the photometry and aperture functions in photutils was converted to instrumental magnitude and calibrated using the zero point magnitude and inverse sensitivity data from the FITS file.

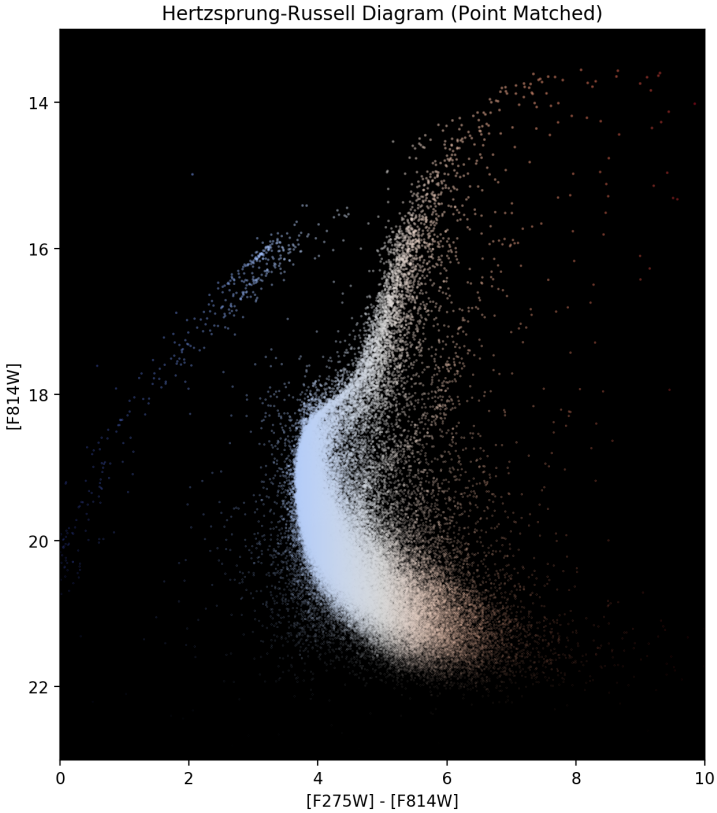
The point matched diagram naturally contains fewer data points than the same apertures diagrams (93,602 points compared to 97,572 and 125,940 points) most noticeably absent from the region between $6 < M_{[F275W]-[F814W]} < 10$ and $15 < M_{[F814W]} < 20$. The use of the infrared filter to select apertures biases toward predominantly red or mixed spectra stars while the use of the ultraviolet filter to select apertures biases toward predominantly blue or mixed spectra stars. The point matched diagram is the intersection of these two diagrams.

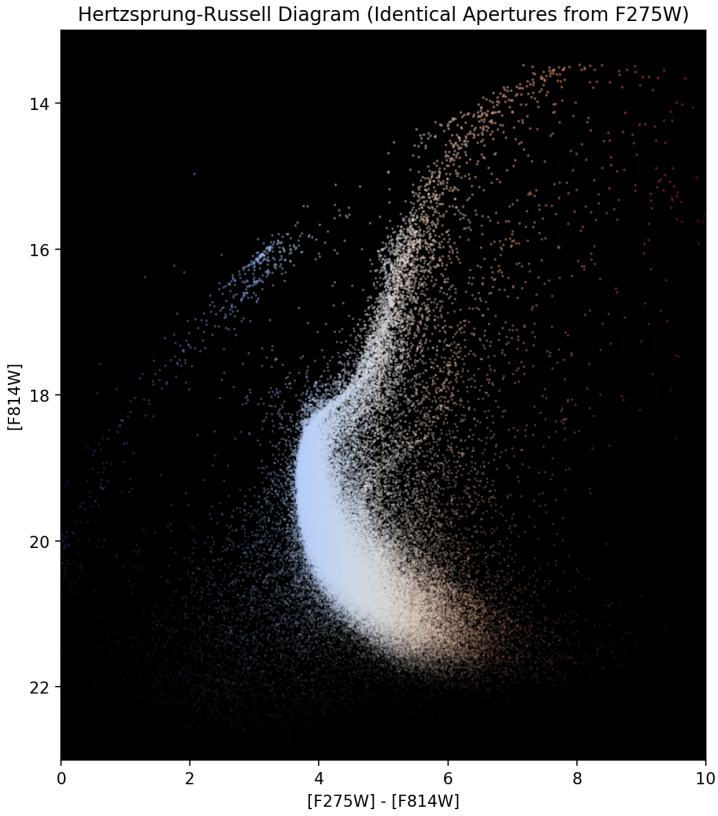
F814W Source Catalog Sample:

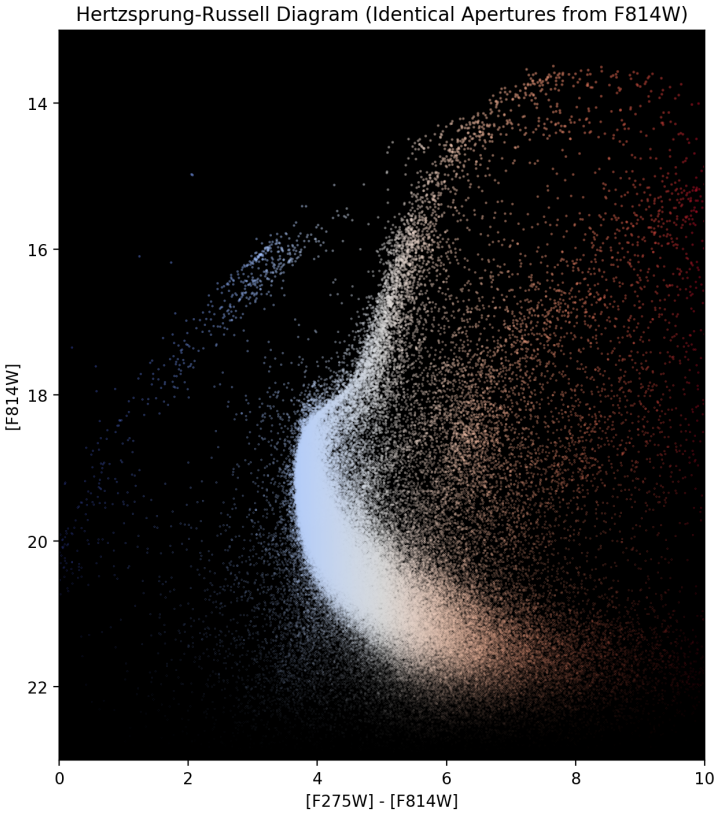
id	xcentroid	ycentroid	sharpness	...	sky	peak	flux	mag
1	1512.1227315	1104.83930888	0.549319571596	...	0.0	123.931854248	30.5939153051	-3.71408765018
2	1551.14113291	1109.49815835	0.530882719646	...	0.0	10.8572816849	2.62837336785	-1.04921764507
3	1521.24602533	1111.26238218	0.571649594146	...	0.0	4.65400409698	1.15870040257	-0.159927894629
4	1560.66841362	1113.75583709	0.566952588624	...	0.0	29.7614707947	7.26300775006	-2.15279126895
5	1544.6855923	1115.66237098	0.52567705108	...	0.0	22.9940643311	5.11285473087	-1.77165863374
6	1533.21437858	1116.85655923	0.592338597962	...	0.0	40.2426147461	10.1896267004	-2.52039568452
7	1592.42358419	1119.23047791	0.579372088158	...	0.0	8.25618267059	1.94462158297	-0.72208775398
8	1504.16514013	1119.95515048	0.783588934322	...	0.0	8.60087871552	1.94184162406	-0.720534515269
9	1581.11071308	1120.15918529	0.570990423435	...	0.0	17.035577774	4.32609798647	-1.59024088005
10	1609.34738728	1119.86951808	0.602880881306	...	0.0	9.98400020599	2.9133381305	-1.16097723259
...	...	...	...	...	...	...	...	...
138495	6021.51524429	6880.47476915	0.569874460262	...	0.0	69.1649169922	16.697395929	-3.05662186322
138496	6113.41556845	6885.51009086	0.572696811183	...	0.0	5.64790153503	1.5429891368	-0.470907171211
138497	5980.4427481	6886.40016478	0.561542043502	...	0.0	12.2390594482	3.10928970494	-1.2316529722
138498	6103.53562792	6888.75765272	0.536147387142	...	0.0	9.37109565735	2.52438615067	-1.00538947219
138499	6045.91248149	6889.59362494	0.595809736368	...	0.0	22.14427948	5.6301831594	-1.87630630854
138500	6118.2510819	6889.6920937	0.609230691591	...	0.0	9.55469417572	2.17094897795	-0.8416240417
138501	6122.10729553	6890.58601168	0.581132809395	...	0.0	24.1375923157	5.81876998181	-1.91207797427
138502	6004.7572858	6891.04024476	0.618404748619	...	0.0	12.2795562744	3.20154786596	-1.26339999823
138503	6062.87601596	6901.01822172	0.666224239722	...	0.0	5.04948759079	1.11731984421	-0.120443780356
138504	6066.56329249	6901.97900016	0.601414864841	...	0.0	44.6440200806	11.1923036405	-2.62229870949

F275W Source Catalog Sample:

id	xcentroid	ycentroid	sharpness	...	sky	peak	flux	mag
1	592.268844865	12.5168571455	0.542379066709	...	0.0	1.41476464272	33.9165634505	-3.82602960379
2	600.009191427	12.9604625252	0.696112544943	...	0.0	3.04042983055	63.197242166	-4.50174531682
3	593.569494459	18.3448111706	0.634796506156	...	0.0	0.0829453542829	1.58487629247	-0.499988422543
4	583.401190923	20.0469541526	0.856683460028	...	0.0	0.167490407825	3.26001485475	-1.2830489475
5	620.123227216	29.6561472514	0.580533005603	...	0.0	3.11870384216	68.790634065	-4.59382328124
6	627.401323724	31.2118407591	0.724471715074	...	0.0	0.641059100628	13.7384936422	-2.84484779273
7	703.428247865	30.9485836098	0.62650712807	...	0.0	0.066293425858	1.45429054557	-0.406627951888
8	577.114276374	32.8457594805	0.68829625347	...	0.0	1.42741525173	32.3096006596	-3.77332897564
9	621.058033119	37.1167284031	0.917784926195	...	0.0	0.859966218472	16.2561115273	-3.02754167538
10	737.285473659	36.8297216929	0.6291086983	...	0.0	0.847478568554	20.2915980229	-3.26829062586
...	...	...	...	...	...	...	...	...
138921	6081.77099844	6885.0558463	0.952026252086	...	0.0	0.768852174282	14.8250865139	-2.92749309108
138922	5980.38496245	6886.47878792	0.488279712195	...	0.0	0.115134716034	2.66841098143	-1.06563179814
138923	6033.64181896	6886.04467199	0.784519452067	...	0.0	0.626653313637	12.5654405612	-2.74794430036
138924	5963.60026198	6887.33344192	0.621064224484	...	0.0	0.770358741283	16.5028534855	-3.04389760991
138925	6033.46790746	6888.88322469	0.696034641573	...	0.0	0.407298117876	8.47159665248	-2.31991317518
138926	6045.68051749	6889.42023432	0.548116134478	...	0.0	0.405976891518	8.68377055986	-2.34677085032
138927	6079.54781075	6889.1554284	0.754415624654	...	0.0	0.408699840307	9.02519187128	-2.38864110892
138928	6104.85357024	6890.28461044	0.658851054696	...	0.0	0.687518179417	15.5411441839	-2.97870747414
138929	6004.61615548	6890.92171763	0.5438818208	...	0.0	0.12195237726	2.63440806307	-1.05170761735
138930	6121.93916395	6890.35570977	0.586928621094	...	0.0	0.673352003098	14.3608472427	-2.89295015652


Hertzsprung-Russell Diagram (Point Matched)
[F814W]
14
16
18
20
22
0
2
4
6
8
10
[F275W] - [F814W]


Hertzsprung-Russell Diagram (Identical Apertures from F275W)
[F814W]
14
16
18
20
22
0
2
4
6
8
10
[F275W] - [F814W]


Hertzsprung-Russell Diagram (Identical Apertures from F814W)
[F814W]
14
16
18
20
22
0
2
4
6
8
10
[F275W] - [F814W]