

PS1 Sample queries

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Get high-fidelity stars in given area

Goal/Description

We want to get all objects with R degrees of a given position that are high fidelity stellar-like objects.

We get all objects within 0.2 degree of RA=334.0 and Dec=0.0 which have mean magnitudes in griz (i.e. at least 1 detection in each band that can be used for the mean mag). In addition, we require QfPerfect>0.85 in all bands. We select stars with the difference between Kron and PSF magnitude as described [here](#).

Note that **the search radius is in arcminutes**. This is a recent change in the interface to make the PS1 database functions consistent with those used for SDSS, GALEX, Kepler, the HSC, and other MAST catalogs.

Tables used

- MeanObjectView
- [StackObjectAttributes](#)

Query

```
SELECT o.objID,
o.raMean, o.decMean, o.raMeanErr, o.decMeanErr,
o.qualityFlag,
o.gMeanPSFMag, o.gMeanPSFMagErr, o.gMeanPSFMagNpt,
o.rMeanPSFMag, o.rMeanPSFMagErr, o.rMeanPSFMagNpt,
o.iMeanPSFMag, o.iMeanPSFMagErr, o.iMeanPSFMagNpt,
o.zMeanPSFMag, o.zMeanPSFMagErr, o.zMeanPSFMagNpt,
o.yMeanPSFMag, o.yMeanPSFMagErr, o.yMeanPSFMagNpt,
o.rMeanKronMag, o.rMeanKronMagErr,
o.nDetections, o.ng, o.nr, o.ni, o.nz,o.ny,
o.gFlags, o.gQfPerfect,
o.rFlags, o.rQfPerfect,
o.iFlags, o.iQfPerfect,
o.zFlags, o.zQfPerfect,
o.yFlags, o.yQfPerfect,
soa.primaryDetection, soa.bestDetection
INTO mydb.[HighFidelityStarsDR2]
FROM dbo.fGetNearbyObjEq(334, 0.0, 0.2*60.0) as x
JOIN MeanObjectView o on o.ObjID=x.ObjId
LEFT JOIN StackObjectAttributes AS soa ON soa.objID = x.objID
WHERE o.nDetections>5
AND soa.primaryDetection>0
AND o.gQfPerfect>0.85 and o.rQfPerfect>0.85 and o.iQfPerfect>0.85 and o.zQfPerfect>0.85
AND (o.rmeanpsfmag - o.rmeankronmag < 0.05)
```

Results

696 objects, here are the first 10:

107763340 006509592	334.00 067427	-0.19 2394 01	0.0 0192	0.0 0245	60	19.00 6313 7621	14	18.36 53	0.0 065 28	15	17.24 44	0.0 023 47	26	16.72 25	0.0 024 55	12	16.48 51	0.0 158 98	13	18.46 99	0.0 097 61	93	16	17	34	12	14	11 50 00	0.0 99 73	11 50 00	0.0 92 91	11 50 00	0.0 99 34	11 50 00	0.0 99 44	11 50 00	0.0 99 50	1	1
107763340 149672418	334.01 502523	-0.19 8394 02	0.0 0518	0.0 0285	52	21.08 9751 3929	3	20.79 48	0.0 316 93	15	19.64 86	0.0 130 22	17	19.11 14	0.0 128 57	12	18.80 21	0.0 265 64	14	20.98 95	0.0 536 47	65	3	15	20	13	14	11 50 00	0.0 99 62	11 50 00	0.0 99 46	11 50 00	0.0 99 03	11 50 00	0.0 99 28	11 50 00	0.0 99 82	1	1
107763340 365446394	334.03 656773	-0.19 51062	0.0 2425	0.0 2707	52	21.06 8092 2935	6	21.32 68	0.0 751	12	21.09 11	0.0 276 63	24	20.51 95	0.0 4418	10	19.35 65	0.0 003 43	1	21.41 59	0.0 682 16	63	8	14	29	10	2	16 89 22	0.0 99 25	11 50 00	0.0 99 06	11 50 00	0.0 99 03	11 50 00	0.0 99 32	16.00 96	0.0 22 82	1	1
107773339 339718616	333.93 399766	-0.18 4857 65	0.0 0422	0.0 0798	60	21.05 0967 7864	12	19.896	0.0 112 42	12	18.614	0.0 0688	29	18.02 34	0.0 046 13	10	17.77 39	0.0 225 77	9	20.01 17	0.0 311 77	85	12	12	37	12	12	11 50 00	0.0 99 04	11 50 00	0.0 99 15	11 50 00	0.0 99 00	11 50 00	0.0 99 15	11.00 95	0.0 99 26	1	1
107773339 418197028	333.94 187857	-0.18 6141 46	0.0 1971	0.0 3959	52	21.05 5705 2027	2	20.981	0.0 080 91	6	20.586	0.0 2858	27	20.32 25	0.0 494 34	8	20.32 66	0.0 430 02	1	20.97 79	0.1 531 02	60	4	9	35	11	1	11 50 00	0.999	11 50 00	0.0 99 29	11 50 00	0.0 99 28	11.00 96	0.0 92 53	0.0 99 92	11.49 77 65	1	1
107773339 602519327	333.96 026447	-0.18 4273 45	0.0 0452	0.0 079	60	21.07 979	6	19.76 09	0.0 144 22	6	18.456	0.0 046 37	21	17.86 12	0.0 060 05	10	17.60 79	0.0 353 27	6	19.82 38	0.0 158 97	65	8	11	25	10	11	11 50 00	0.0 99 68	11 50 00	0.0 99 58	11 50 00	0.0 99 13	11.00 99	0.0 92 12	11.50 99	0.0 91 33	1	1
107773339 666312601	333.96 664968	-0.18 98753	0.0 0262	0.0 0237	60	18.00 3317 5523	14	17.77 11	0.0 027 63	14	17.531	0.0 031 37	27	17.42 43	0.0 063 55	7	17.36 89	0.0 168 66	8	17.85 09	0.0 0506	77	14	16	29	8	10	11 50 00	0.0 99 94	11 50 00	0.0 99 42	11 50 00	0.0 99 05	11.00 99	0.0 868 00	11.50 99	0.0 91 06	1	1
107773339 901521365	333.99 016194	-0.19 0867 22	0.0 0392	0.0 0732	52	21.06 9495 7887	9	20.83 39	0.0 248 21	13	19.37 54	0.0 051 45	33	18.642	0.0 1119	12	18.29 68	0.0 151	12	20.87 94	0.0 820 54	81	9	14	33	13	12	11 50 00	0.0 99 90	11 50 00	0.0 99 07	11 50 00	0.0 99 04	11.00 99	0.0 97 06	11.50 99	0.0 91 11	1	1
107773339 922175058	333.99 225189	-0.18 78471	0.0 0356	0.0 2173	60	17.00 8118 5868	12	17.05 28	0.0 025 85	12	16.75 43	0.0 022	26	16.62 07	0.0 0568	12	16.50 89	0.0 097 86	12	17.11 91	0.0 033 35	87	14	14	31	14	14	11 50 00	0.0 99 04	11 50 00	0.0 99 42	11 50 00	0.0 99 00	11.00 99	0.0 95 77	11.00 99	0.0 92 38	1	1
107773340 107508029	334.01 078438	-0.18 5362 36	0.0 057	0.0 057	60	17.00 1406 1898	12	16.58 37	0.0 029 45	13	16.33 75	0.0 018 91	22	16.22 93	0.0 022 24	13	16.146	0.0 082 95	9	16.64 36	0.0 011 66	87	16	15	30	14	12	11 50 00	0.0 99 84	11 50 00	0.0 99 64	11 50 00	0.0 99 00	11.00 99	0.0 94 35	11.00 99	0.0 90 00	1	1

Query

```

SELECT  o.objID,
ot.raStack, ot.decStack, ot.raMean, ot.decMean,
ot.ng,   o.gMeanPSFMag,o.gMeanPSFMagErr,o.gMeanKronMag,o.gMeanKronMagErr,
ot.nr,   o.rMeanPSFMag,o.rMeanPSFMagErr,o.rMeanKronMag,o.rMeanKronMagErr,
ot.ni,   o.iMeanPSFMag,o.iMeanPSFMagErr,o.iMeanKronMag,o.iMeanKronMagErr,
ot.nz,   o.zMeanPSFMag,o.zMeanPSFMagErr,o.zMeanKronMag,o.zMeanKronMagErr,
ot.ny,   o.yMeanPSFMag,o.yMeanPSFMagErr,o.yMeanKronMag,o.yMeanKronMagErr,
o.gQfPerfect,o.rQfPerfect,o.iQfPerfect,o.zQfPerfect,o.yQfPerfect,
ot.qualityFlag,ot.objInfoFlag,
sp.gpetRadius,sp.rpetRadius,sp.ipetRadius,sp.zpetRadius,sp.ypetRadius,
sp.gpetR50,sp.rpetR50,sp.ipetR50,sp.zpetR50,sp.ypetR50,
soa.primaryDetection, soa.bestDetection
      INTO mydb.[C14]
FROM MeanObject AS o
JOIN fgetNearbyObjEq(160.68333, 6.85167 , 8.5*60.0) cone ON cone.objid = o.objID
JOIN ObjectThin AS ot ON ot.objID = o.objID
LEFT JOIN StackPetrosian AS sp ON sp.objID = o.objID
LEFT JOIN StackObjectAttributes AS soa ON soa.objID = o.objID
WHERE ot.ni >= 3
      AND ot.ng >= 3
      AND ot.nr >= 3
      AND soa.primaryDetection>0
      AND (o.rMeanKronMag > 0 AND o.rMeanKronMag <= 19.5 )
      AND (o.gQfPerfect >= 0.95)
      AND (o.rQfPerfect >= 0.95)
      AND (o.iQfPerfect >= 0.95)
      AND (o.zQfPerfect >= 0.95)
      AND (o.rmeanpsfmag - o.rmeankronmag > 0.05)

```

Results

First 10 out of 161,920 Rows of MyDB Table C14

12 53 91 63 32 03 08 96 97	14 32 49 03 41	14 32 49 03 41	16 32 49 02 88 30 92	14 49 88 30 92	10	21 00 93	20 03 89	20 67 31	0 07 48 27	14	19 77 03	0 02 66 01	19 25 63	10 01 528	10	19 26 81	0 01 15 38	18 63 97	0 02 14 55	14	18 99 57	18 01 69 01	0 01 37 29	0 01 564	13	18 69 68	0 03 06 42	18 12 66	0 03 75 91	0 09 95 66	0 09 96 35	0 09 92 13	0 09 92 09	0 09 93 49	61	51 20 24 576	8 61 66	2 71 981	2 66 062	2 67 084	2 77 483	1 25 887	1 192	1 08 737	1 06 83	1 02 985	1 1	1 1
12 53 91 63 49 58 62 49 64	16 32 49 54 64 29	14 49 54 13 62	16 32 49 58 36 02	14 49 54 36 125	10	20 33 36	0 03 00	19 55 83	0 02 04 55	14	19 79 66	0 03 558	18 92 14	0 02 23 74	15	19 53 16	0 02 58 72	18 62 78	0 00 93 25	13	19 367 95	0 03 37 21	18 56 29 86	0 03 29	14	19 12 71	0 03 82 72	18 38 29	0 05 11 01	0 09 96 19	0 09 94 57	0 09 89 65	0 09 90 23	0 09 93 77	53	44 49 15 712	5 27 407	5 04 787	4 27 913	4 71 588	5 21 124	2 08 763	1 80 538	1 59 33	1 46 589	3 27 605	1 1	1 1
12 53 91 63 52 82 55 92 55	16 32 52 89 65 27	14 49 89 91 41	16 32 52 89 39 41	14 49 89 95 27	8	20 95 98	0 06 20 91	0 17 41	0 02 67 35	14	20 39 23	0 06 29 02	19 417 90	0 02 90 26	15	20 07 27	0 03 63 66	19 01 68	0 02 44 43	11	19 86 52	0 02 52 11	18 82 08	0 03 12 21	8	19 24 06	0 09 26 35	18 77 78	0 14 11 02	0 09 97 26	0 09 94 35	0 09 92	0 09 91 13	0 09 91 85	53	44 49 15 712	4 60 435	5 28 031	4 94 089	5 31 433	4 20 82	2 20 738	2 36 504	2 07 939	2 09 779	1 98 962	1 1	1 1
12 53 91 63 61 22 61 52 71	16 31 49 22 48 01	14 49 61 22 07	16 31 49 22 12	14 49 56 375	10	21 01 58	0 04 75	20 31 79	0 07 33 74	16	20 08 38	0 03 90 24	19 361 20	0 03 20 28	23	19 67 38	0 02 45 72	18 96 32	0 01 44 86	13	19 44 87	0 02 07	18 70 97	0 02 42 55	12	19 21 02	0 06 31 86	18 59 49	0 07 46	0 09 31 43	0 09 97 63	0 09 96 56	0 09 88 14	0 09 95 92	53	44 49 15 712	3 83 093	3 52 666	3 35 348	4 64 719	3 17 508	1 43 311	1 691	1 44 687	1 24 055	1 13 158	1 1	1 1

11 87 91 64 36 48 70 43 45	16 4 36 48 99 64 27	8 99 48 99 54 87 29	16 4 36 48 99 20 64 73 07 11	8 99 49 07 11	12	19 14 29	0 05 26 52	18 22 54	0 01 775	10	18 15 85	0 04 72 54	17 19 06 84	0 01 03	24	17 83 59	0 01 45 82	16 73 99	0 00 64 93	15	17 529 42 07	0 03 475 63 07	16 0 01	12	17 38 21	0 03 26 85	16 52 17	0 01 99 99 06 25	0 09 99 99 27	0 09 99 99 27	0 09 99 99 27	0 09 99 99 27	0 09 99 99 27	61	51 20 24 576	9 41 188	7 51 037	8 15 557	6 79 108	6 69 249	3 239 89	2 972 712	2 98 567	2 58 303	1 1	1	
11 87 91 64 41 19 20 47 24	16 4 41 20 68 31	8 99 41 804 73 11	16 4 41 20 64 73 07	8 99 51 23 11	11	20 44 82	0 04 99 55	19 09 99 32	0 03 12 26	10	19 45 95	0 05 50 58	19 06 36	0 03 49 54	21	19 13 87	0 00 99 42	18 69 94	0 01 29 18	18	18 90 02	0 02 81 31	18 42 24	16	18 75 51	0 03 906 34 53	18 04 84 06	0 09 99 24	0 09 99 25	0 09 99 36	0 09 99 98	0 09 99 67	53	44 49 15 712	3 239 36 407	3 36 128	3 61 715	2 58 874	5 26 149	1 32 37	1 90 188	1 78 232	1 067 54 819	1 1	1		
11 87 91 64 46 39 08 91 17	16 4 46 39 088 58	8 99 48 65 88 893 95	16 4 46 38 23 95	8 99 88 38 95	12	20 58 45	0 01 39 54	20 52 22	0 02 51 29	9	19 53 92	0 01 41 82	19 46 73	0 02 80 32	25	19 22 91	0 00 95 82	19 09 12	0 01 04 08	8	18 98 44	0 01 93 72	18 86 21 95	10	18 86 94	0 03 332 72 61	18 05 99 69	0 09 99 24	0 09 99 27	0 09 99 52	0 09 99 58	0 09 99 909	53	44 49 15 712	1 71 052	2 17 727	1 84 635	1 71 799	1 60 121 05 68	0 81 24 24	0 78 62 21	0 69 683 57 71	1 1	1			
11 23 11 67 39 03 61 25 57	16 7 39 03 65 82	3 59 34 22 92 43	16 7 39 03 26 79	3 59 34 26 79	10	20 61 91	0 02 88 19	20 08 52	0 03 47 35	13	19 22 42	0 01 54 24	18 60 72	0 01 99 27	30	18 65 17	0 02 91 03	18 03 81	0 01 02 67	15	18 69 67	0 02 44 08	17 833 64 86	15	18 27 45	0 05 08 07	17 59 22	0 02 94 65	0 09 99 42	0 09 99 52	0 09 99 18	0 09 99 68	0 09 99 59	61	51 20 24 576	4 49 931	5 25 92	5 84 203	6 45 203	9 71 826 36	1 71 471	1 89 116	2 12 382	2 27 50 151	1 1	1	
11 23 11 67 39 03 61 25 57	16 7 39 03 65 82	3 59 34 22 92 43	16 7 39 03 26 79	3 59 34 26 79	10	20 61 91	0 02 88 19	20 08 52	0 03 47 35	13	19 22 42	0 01 54 24	18 60 72	0 01 99 27	30	18 65 17	0 02 91 03	18 03 81	0 01 02 67	15	18 69 67	0 02 44 08	17 833 64 86	15	18 27 45	0 05 08 07	17 59 22	0 02 94 65	0 09 99 42	0 09 99 52	0 09 99 18	0 09 99 68	0 09 99 59	61	51 20 24 576	5 75 997	6 37 828	5 77 622	5 69 946	6 93 83 143 11 87	1 83 295	2 14 678	1 96 195	1 13 665	1 98 887	1 1	1
11 23 11 67 39 27 39 51 35	16 7 39 27 613 97	3 59 56 27 44 75	16 7 39 27 13 68	3 59 56 27 13 68	8	21 29 23	0 07 54 64	20 53 47	0 03 857	12	19 88 38	0 034 27 46	19 02 05 44	0 02 05 44	37	19 35 58	0 02 37 52	18 79 83	0 01 36 54	14	19 31 37	0 03 55 08	18 55 01	12	18 91 65	0 03 51 19	18 329 96 55	0 09 99 03	0 09 99 06	0 09 99 07	0 09 99 66	53	44 49 15 712	2 69 325	3 55 384	2 87 281	3 02 684	13 9 143 11 87	0 82 09 999	1 06 384	1 13 938	-9 99	1 1	1			

Obtain lightcurves for a given set of objects

Goal/Description

The goal is to obtain light curves for a list of objects. The list of objects with their RA/Dec position is uploaded into Mydb, the PS1 objects are identified, and then the light curves are obtained. Here we upload a list of 13 RR Lyrae stars from the Catalina sky survey into mydb.[RRLcatalina]

Query #1: Match Catalina RR Lyrae stars to PS1 objects

We search for objects in the PS1 DB that are within 3 arcsec of the Catalina positions. Most of the parameters (mean mags, # of detections, etc) we get from the MeanObjectView table. We also join the StackObjectAttributes table in order to get [primaryDetection](#) and [bestDetection](#) (BestDetection is corrupted in DR2, but will be fixed in DR2.1, see the description of [StackObjectThin](#) table for a more detailed description). These RR Lyrae stars are bright, thus we can expect many detections, and we therefore require o.nDetections>5. We only want to use objects for which the majority of pixels were not masked, thus the cut on QFperfect>=0.95. In order to select only stars (and exclude galaxies), we require (o.rmeanpsfmag - o.rmeankronmag)< 0.05, as described [here](#).

```

SELECT d.CSS_ID, d.RA as CSSRA, d.Dec as CSSDec, d.V, d.Period, d.Amp, d.Npts, d.Dist, d.Red, d.CSIDnum,
o.objID,
o.raMean, o.decMean, o.raMeanErr, o.decMeanErr,
o.qualityFlag,
o.gMeanPSFMag, o.gMeanPSFMagErr, o.gMeanPSFMagNpt,
o.rMeanPSFMag, o.rMeanPSFMagErr, o.rMeanPSFMagNpt,
o.iMeanPSFMag, o.iMeanPSFMagErr, o.iMeanPSFMagNpt,
o.zMeanPSFMag, o.zMeanPSFMagErr, o.zMeanPSFMagNpt,
o.yMeanPSFMag, o.yMeanPSFMagErr, o.yMeanPSFMagNpt,
o.rMeanKronMag, o.rMeanKronMagErr,
o.nDetections, o.ng, o.nr, o.ni, o.nz,o.ny,
o.gFlags, o.gQfPerfect,
o.rFlags, o.rQfPerfect,
o.iFlags, o.iQfPerfect,
o.zFlags, o.zQfPerfect,
o.yFlags, o.yQfPerfect,
soa.primaryDetection, soa.bestDetection
  INTO mydb.[RRLPS1]
  FROM mydb.[RRLcatalina] d
CROSS APPLY dbo.fGetNearbyObjEq(d.RA, d.Dec, 3.0/60.0) as x
JOIN MeanObjectView o on o.objID=x.objID
LEFT JOIN StackObjectAttributes AS soa ON soa.objID = x.objID
WHERE o.nDetections>5
AND soa.primaryDetection>0
AND o.gQfPerfect>0.85 and o.rQfPerfect>0.85 and o.iQfPerfect>0.85 and o.zQfPerfect>0.85
AND (o.rmeanpsfmag - o.rmeankronmag < 0.05)

```

Results (25 minutes)

There are 12 out of 13 matches, and below are the first 10 entries

C S S _J 22 03 09 . 8+ 05 16 33	33 0. 79 097	5. 27 593	16 68 86 98	0. 63 86 98	0. 38	294 15 62	0. 057	11 04 11 80 64 018	11 43 33 30 79 10 21 16 43	33 0. 27 59 125	5. 27 59 626	0. 00 217 427	0. 00	60	17 06 65	0. 00 33 94	5 16 73	0. 00 20 55	3 55	16 59 98	0. 01 256	17 49 21	16 01 88 82	8 54 24	16 01 22 65	12 72 16	16 00 79 11	75	12	7	28	11	17	11 50 00	0. 99 94 97	11 50 00	0. 99 92 65	11 50 00	0. 99 96 39	0. 99 96 00	0. 99 96 97	11 50 00	0. 99 89 78	1	
C S S _J 22 19 49 . 2- 02 40 20	33 4. 95 521	-2 67 224	16 51 94 91	0. 70 94 91	0. 37	249 14 12	0. 085	10 01 12 00 04 060	10 47 93 34 95 46 54 43 34 47	33 4. 95 51 25 015	-2 67 25 015	0. 03 063 043	0. 02	60	16 74 44	0. 00 61 59	5 16 46 11	0. 00 67 58	6 58	16 47 71	0. 00 44 79	13 37 52	16 00 56 38	7 35 94	16 01 81 96	7 50 58	16 00 37 76	63	8	11	23	10	11	11 50 00	0. 99 96 46	11 50 00	0. 99 98 25	11 50 00	0. 99 96 72	0. 99 96 00	11 50 00	0. 99 87 27	11 50 00	0. 99 93 31	1
C S S _J 22 05 59 . 8- 02 39 49	33 1. 49 951	-2 66 365	18 11 365	0. 53 717	0. 89	234 27 82	0. 152	10 01 11 80 04 001	10 48 31 96 49 69 23 67 71 38 60	33 1. 96 38 05 67	-2 66 38 05 67	0. 00 559 857	0. 00	52	18 65 98	0. 03 43 48	7 18 44 56	0. 00 26 74	8 74	18 08 95	0. 03 00 17	19 92 96	17 04 67 95	10 99 23	0. 00 375	9 48 06	18 02 48 47	67	12	12	21	12	10	11 50 00	0. 99 91 29	11 50 00	0. 99 93 10	11 50 00	0. 99 96 38	11 50 00	0. 99 92 17	11 50 00	0. 99 98 00	0. 99 87 98	1
C S S _J 22 04 57 . 2- 05 14 11	33 1. 23 867	-5 23 656	15 64 643	0. 53 643	0. 75	173 9. 67	0. 06	10 04 11 80 10 930	10 17 13 31 23 88 80 82 78 63 86	33 1. 23 23 55 94	-5 67 88 55 94	0. 00 469 529	0. 00	60	16 27 17	0. 02 75 81	6 15 59 56	0. 03 394	6 56	15 88 79	0. 03 06	12 89 23	15 01 70 74	3 85 42	15 00 46	5 73 68	15 07 63 47	73	16	14	24	10	9	11 50 00	0. 99 96 81	11 50 00	0. 99 93 84	11 50 00	0. 99 95 01	11 50 00	0. 99 87 61	11 50 00	0. 99 79 96	1	

C S S _J 21 56 02 . 1- 05 20 21	32 9. 00	-5 . 33	16 . 51	0. 75 58	0. 47	218 . 14	17 . 77	0. 036	10 04 11	10 15 93	32 9. 33	-5 . 01	0. 01 67	0. 01 841	60	16 . 84	0. 00 78	6	16 . 42	0. 02 20	15	16 . 37	0. 00 80	15	16 . 34	0. 00 35	8	16 . 37	0. 01 80	11	16 . 48	0. 02 34	72	10	16	22	12	12	11 50 00	0. 99 99	11 50 00	0. 99 96	11 50 00	0. 99 94	11 50 00	0. 99 91	11 50 00	0. 99 94	1
C S S _J 22 08 20 . 9- 02 02 22	33 2. 08	-2 . 03	17 . 01	0. 56 16	0. 95	263 . 17	17 . 61	0. 092	10 01 11	10 55 03	33 2. 08	-2 . 21	0. 00 27	0. 01 02	60	17 . 75	0. 00 38	8	17 . 382	0. 00 89	13	17 . 16	0. 03 364	23	17 . 17	0. 00 74	4	16 . 94	0. 01 34	4	17 . 38	0. 00 94	80	14	21	29	8	8	11 50 00	0. 99 96	11 50 00	0. 99 92	11 50 00	0. 99 98	11 50 00	0. 99 88	11 50 00	0. 99 96	1
C S S _J 22 27 07 . 9+ 05 12 59	33 6. 78	5. 21 646	16 . 19	0. 55 25	0. 73	275 . 11	11 . 29	0. 173	11 04 12	11 42 03	33 6. 78	5. 21 64	0. 00 177	0. 00 188	60	16 . 33	0. 00 62	6	16 . 22	0. 11 75	7	16 . 27	0. 01 69	25	16 . 16	0. 02 45	9	16 . 084	0. 02 85	9	16 . 28	0. 13 48	87	13	15	36	12	11	11 50 00	0. 99 95	11 50 00	0. 99 89	11 50 00	0. 99 96	11 50 00	0. 99 92	11 50 00	0. 99 85	1
C S S _J 21 54 35 . 8- 00 54 50	32 8. 64	-0 . 91	17 . 75	0. 57 52	0.9	257 . 24	24 . 14	0. 126	10 01 11	10 69 03	32 8. 64	-0 . 91	0. 00 219	0. 00 138	52	18 . 14	0. 07 48	7	17 . 87	0. 05 72	10	17 . 61	0. 04 20	17	17 . 76	0. 11 41	9	17 . 669	0. 01 11	10	17 . 90	0. 06 23	75	12	12	26	13	12	11 50 00	0. 99 96	11 50 00	0. 99 93	11 50 00	0. 99 92	11 50 00	0. 99 96	11 50 00	0. 99 90	1
C S S _J 22 29 42 . 0- 04 05 19	33 7. 42	-4 . 08	18 . 08	0. 47 56	1. 19	230 . 29	29 . 63	0. 067	10 04 12	10 30 03	33 7. 42	-4 . 08	0. 00 245	0. 00 194	52	18 . 838	0. 02 24	9	18 . 552	0. 01 008	8	18 . 50	0. 01 38	14	18 . 23	0. 11 88	8	18 . 34	0. 01 94	10	18 . 63	0. 01 17	82	14	16	26	12	14	11 50 00	0. 99 95	11 50 00	0. 99 95	11 50 00	0. 99 94	11 50 00	0. 99 96	11 50 00	0. 99 935	1
C S S _J 22 31 05 . 2+ 00 05 38	33 7. 77	0. 09 404	16 . 97	0. 67 02	0.4	278 . 17	17 . 7	0. 071	11 01 12	10 81 13	33 7. 77	0. 09 39	0. 01 024	0. 01 061	60	17 . 19	0. 01 30	7	16 . 98	0. 00 65	14	16 . 87	0. 01 28	30	16 . 84	0. 01 55	8	16 . 74	0. 01 12	9	17 . 02	0. 00 59	94	14	22	35	10	13	11 50 00	0. 99 95	11 50 00	0. 99 96	11 50 00	0. 99 97	11 50 00	0. 99 91	11 50 00	0. 99 96	1

Query #2: Get the detections

Now we get all detections associated with these objIDs

```

SELECT
o.objID, o.raMean, o.decMean,
d.ra, d.dec, d.raErr, d.decErr,
d.detectID, d.obstime, d.exptime, d.airmass, d.psfflux, d.psffluxErr, d.psfQf, d.psfQfPerfect, d.psfLikelihood,
d.psfChiSq, d.extNSigma, d.zp, d.apFlux, d.apFluxErr,
d.imageID, d.filterID,
d.sky, d.skyerr, d.infoflag, d.infoflag2, d.infoflag3,
o.qualityFlag,
o.gMeanPSFMag, o.gMeanPSFMagErr, o.gMeanPSFMagNpt,
o.rMeanPSFMag, o.rMeanPSFMagErr, o.rMeanPSFMagNpt,
o.iMeanPSFMag, o.iMeanPSFMagErr, o.iMeanPSFMagNpt,
o.zMeanPSFMag, o.zMeanPSFMagErr, o.zMeanPSFMagNpt,
o.yMeanPSFMag, o.yMeanPSFMagErr, o.yMeanPSFMagNpt,
o.rMeanKronMag, o.rMeanKronMagErr,
o.nDetections, o.ng, o.nr, o.ni, o.nz,o.ny,
o.gFlags, o.gQfPerfect,
o.rFlags, o.rQfPerfect,
o.iFlags, o.iQfPerfect,
o.zFlags, o.zQfPerfect,
o.yFlags, o.yQfPerfect,
o.primaryDetection, o.bestDetection
INTO mydb.[RRLPS1det]
FROM mydb.[RRLPS1] o
JOIN Detection d on d.objID = o.objID

```

Results (30 seconds)

There are 946 detection entries for the 12 objects, and below are the first 10 entries

10	17	13	31	23	88	88	78	63	86	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82	94	33	1.	23	23	88	82
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[illegible]

Query #1: Get the ObjID for the star

```

SELECT
o.objID,
o.raMean, o.decMean, o.raMeanErr, o.decMeanErr,
o.qualityFlag,
o.gMeanPSFMag, o.gMeanPSFMagErr, o.gMeanPSFMagNpt,
o.rMeanPSFMag, o.rMeanPSFMagErr, o.rMeanPSFMagNpt,
o.iMeanPSFMag, o.iMeanPSFMagErr, o.iMeanPSFMagNpt,
o.zMeanPSFMag, o.zMeanPSFMagErr, o.zMeanPSFMagNpt,
o.yMeanPSFMag, o.yMeanPSFMagErr, o.yMeanPSFMagNpt,
o.rMeanKronMag, o.rMeanKronMagErr,
o.nDetections, o.ng, o.nr, o.ni, o.nz,o.ny,
o.gFlags, o.gQfPerfect,
o.rFlags, o.rQfPerfect,
o.iFlags, o.iQfPerfect,
o.zFlags, o.zQfPerfect,
o.yFlags, o.yQfPerfect
  INTO mydb.[RRL_584630948352256_PS1]
FROM dbo.fGetNearbyObjEq(46.341468915923, 1.54199810825252, 1.0/60.0) as x
JOIN MeanObjectView o on o.ObjID=x.ObjID

```

Results (1 entry, < 1 min)

objID	ra Mean	dec Mean	raMeanErr	decMeanErr	quality Flag	gMeanPSF Mag	gMeanPSF MagErr	gMeanPSF Mag Npt	rMeanPSF Mag	rMeanPSF MagErr	rMeanPSF Mag Npt	iMeanPSF Mag	iMeanPSF MagErr	iMeanPSF Mag Npt	zMeanPSF Mag	zMeanPSF MagErr	zMeanPSF Mag Npt	yMeanPSF Mag	yMeanPSF MagErr	yMeanPSF Mag Npt	rMeanKron Mag	rMeanKron MagErr	n Detections	ng	nr	ni	nz	ny	g Flags	g Qf Perfect	r Flags	r Qf Perfect	i Flags	i Qf Perfect	z Flags	z Qf Perfect	y Flags	y Qf Perfect
109850463414820867	46.5434141467	1.190000216806	0.0030303920	0.00392000004649162	60	17.63999899075195	0.029890021999438405	12	17.1961994171143	0.044886000454258	13	17.481199264	0.049341000604165504	23	17.5072889	0.05795700151304451	10	17.52680019992556396	0.0218180010159303	10	17.2178001403809	0.0414300002157688	92	14	18	30	17	13	11500004029750824	0.999500197378845	1150009700	0.99970032997608185	1150009500	0.999901197052	1150008900	0.9995007301708913		

Query #2: Get the detections

```

SELECT
o.objID, o.raMean, o.decMean,
d.ra, d.dec, d.raErr, d.decErr,
d.detectID,
  d.obstime, d.exptime, d.airmass, d.psfflux, d.psffluxErr, d.psfQf,
d.psfQfPerfect, d.psfLikelihood, d.psfChiSq, d.extNSigma, d.zp,
d.apFlux, d.apFluxErr,
d.imageID, d.filterID,
d.sky, d.skyerr, d.infoflag, d.infoflag2, d.infoflag3,
o.qualityFlag,
o.gMeanPSFMag, o.gMeanPSFMagErr, o.gMeanPSFMagNpt,
o.rMeanPSFMag, o.rMeanPSFMagErr, o.rMeanPSFMagNpt,
o.iMeanPSFMag, o.iMeanPSFMagErr, o.iMeanPSFMagNpt,
o.zMeanPSFMag, o.zMeanPSFMagErr, o.zMeanPSFMagNpt,
o.yMeanPSFMag, o.yMeanPSFMagErr, o.yMeanPSFMagNpt,
o.rMeanKronMag, o.rMeanKronMagErr,
o.nDetections, o.ng, o.nr, o.ni, o.nz,o.ny,
o.gFlags, o.gQfPerfect,
o.rFlags, o.rQfPerfect,
o.iFlags, o.iQfPerfect,
o.zFlags, o.zQfPerfect,
o.yFlags, o.yQfPerfect
  INTO mydb.[RRL_584630948352256_PS1det]
FROM mydb.[RRL_584630948352256_PS1] o
JOIN Detection d on d.ObjID = o.ObjID

```

Below are the first 10 entries out of 92 total entries

Query #3: Get the forced detections

```
SELECT
o.objID, o.raMean, o.decMean,
fwm.detectID,
    fwm.obstime, fwm.exptime, fwm.airmass, fwm.Fpsfflux, fwm.FpsffluxErr,
fwm.FpsfQf, fwm.FpsfQfPerfect, fwm.FpsfChiSq, fwm.zp, fwm.FapFlux,
fwm.FapFluxErr,
fwm.forcedWarpID, fwm.filterID,
fwm.Fsky, fwm.Fskyerr, fwm.Finfoflag, fwm.Finfoflag2, fwm.Finfoflag3,
o.qualityFlag,
o.gMeanPSFMag, o.gMeanPSFMagErr, o.gMeanPSFMagNpt,
o.rMeanPSFMag, o.rMeanPSFMagErr, o.rMeanPSFMagNpt,
o.iMeanPSFMag, o.iMeanPSFMagErr, o.iMeanPSFMagNpt,
o.zMeanPSFMag, o.zMeanPSFMagErr, o.zMeanPSFMagNpt,
o.yMeanPSFMag, o.yMeanPSFMagErr, o.yMeanPSFMagNpt,
o.rMeanKronMag, o.rMeanKronMagErr,
o.nDetections, o.ng, o.nr, o.ni, o.nz,o.ny,
o.gFlags, o.gQfPerfect,
o.rFlags, o.rQfPerfect,
o.iFlags, o.iQfPerfect,
o.zFlags, o.zQfPerfect,
o.yFlags, o.yQfPerfect
INTO mydb.[RRL__584630948352256_PS1forceddet]
FROM mydb.[RRL__584630948352256_PS1] o
JOIN ForcedWarpMeasurement fwm on fwm.ObjID = o.ObjID
```

Results (84 entries, <1 min)

Below are the first 10 entries out of 84 total entries

[illegible]

98	50	46	34	14	99	54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
98	50	46	34	14	99	54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
50	34	14	99	95	55	54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
46	34	14	99	95	55	54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
34	14	99	95	55	55	54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
14	86		06		211	54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
82			93			54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
08			52			54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
67			602			54	76	87	1.	43	1.	0.	0.	3.	0.	0.	0.	99	99	99	10	24	0.	0.	2.	42	52	16	57	1	1.	3.	1.	3.	17	16	0	10	60	17	0.	12	17	0.	13	17	0.	23	17	0.	10	17	0.	92	14	18	30	17	13	11	0.	0.	11	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

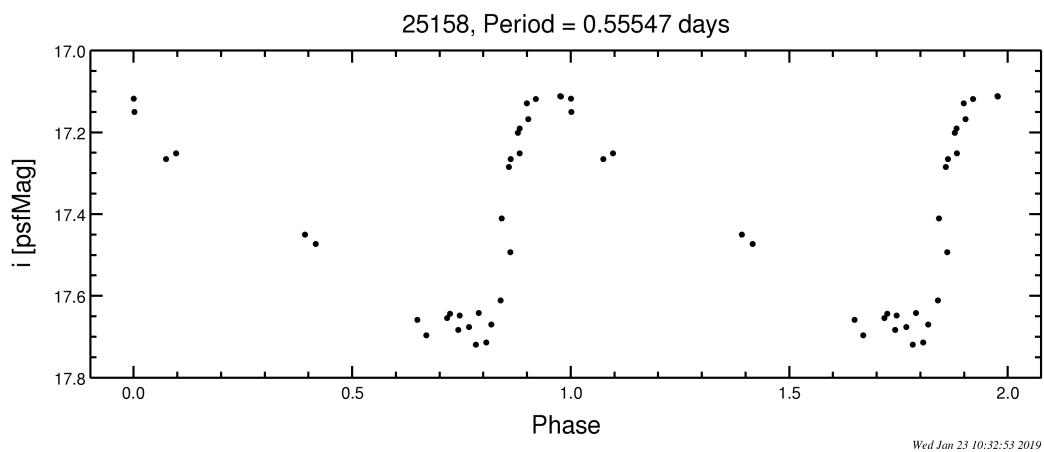
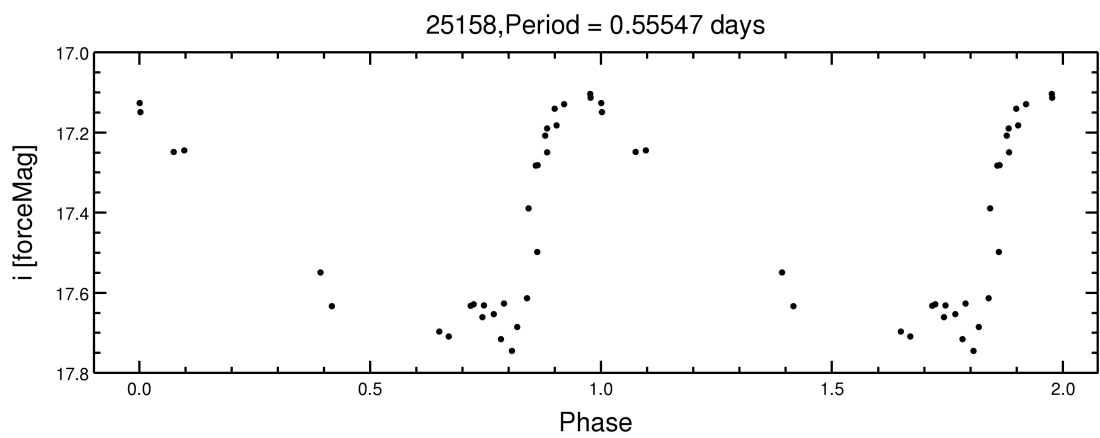


FIG. 1: PS1 i-band light curve for the RR Lyrae from aperture photometry (left panel) and PSF photometry (right) from the Detection table.

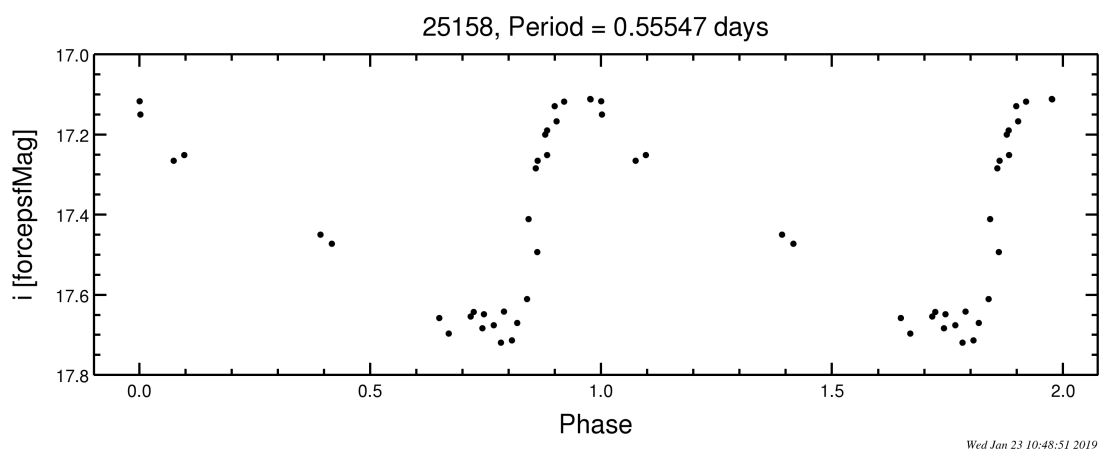
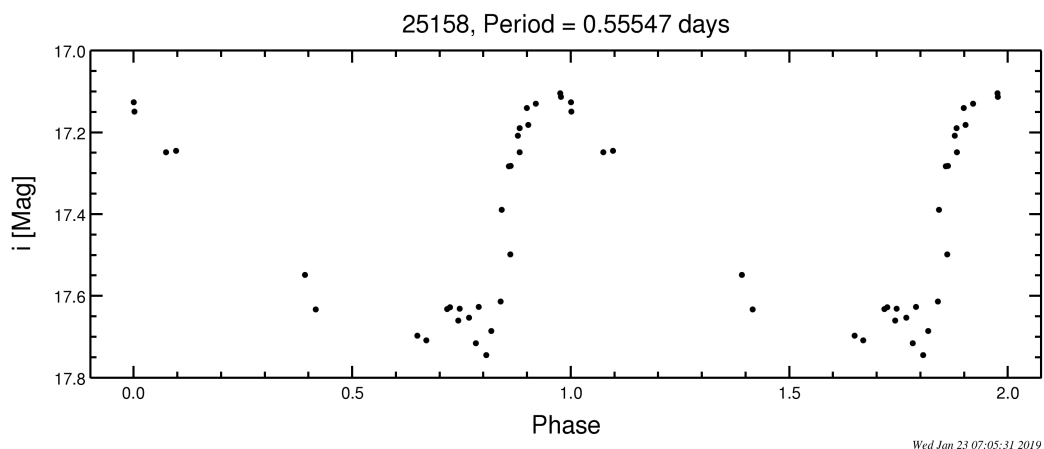
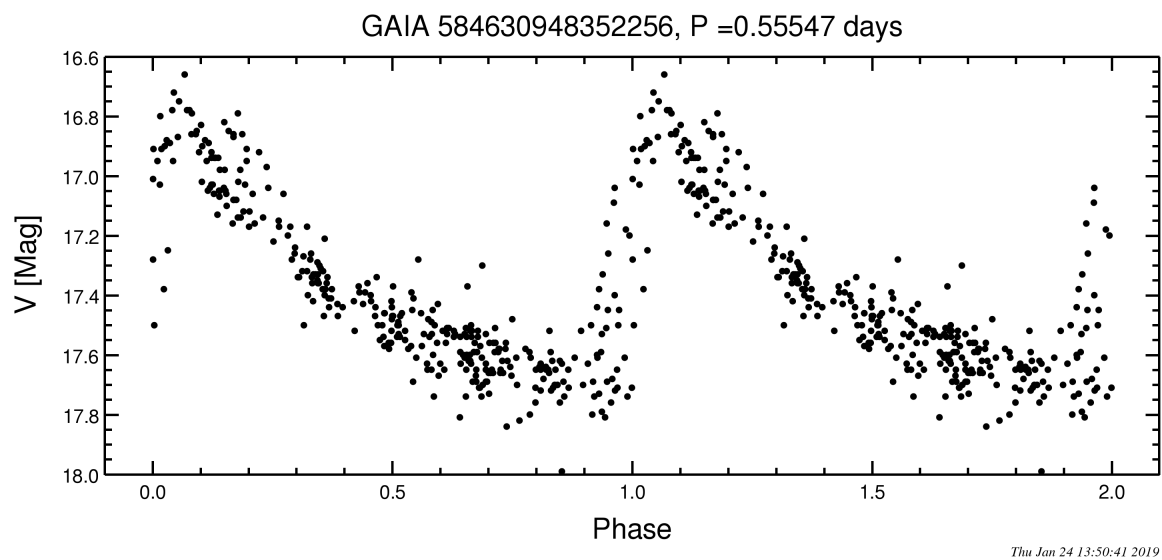


FIG. 2: PS1 i-band light curve for the same star from aperture photometry (left panel) and PSF photometry (right) from the force detection table.

As a comparison, the Catalina Sky Survey V-band light curve:



Select mean objects and associated detections within 3 deg of HDF; compare photometry and astrometry with Gaia DR2

This mini-project illustrates how to extract mean objects with predefined quality parameters and then the associated detections. The goal ultimately is to understand the astrometric properties of PanSTARRS **before** the Gaia adjustments, therefore we are interested in the original detections; forced measurements are not useful.

Step 1: Obtain mean objects in cone search, filtering for objects with a high probability of Gaia matches

We start with a cone search of ObjectThin within a 3 degree radius of the nominal HDF position (169.2,61.3). We select only mean objects with at least three detections and mean PSF magnitude $r < 21.0$ (Gaia sources are sparse at fainter magnitudes). The following search was run in CasJobs and took 8: 29, returning 192,611 objects.

```
select o.objID, o.raMean, o.decMean, o.raMeanErr, o.decMeanErr,
       o.raStack, o.decStack, o.raStackErr, o.decStackErr, o.epochMean,
       o.nDetections, o.ng, o.nr, o.ni, o.nz, o.ny, o.objInfoFlag, o.qualityFlag,
       m.gMeanPSFMag, m.rMeanPSFMag, m.iMeanPSFMag, m.zMeanPSFMag, m.yMeanPSFMag,
       m.gMeanPSFMagErr, m.rMeanPSFMagErr, m.iMeanPSFMagErr, m.zMeanPSFMagErr, m.yMeanPSFMagErr,
       m.gMeanKronMag, m.rMeanKronMag, m.iMeanKronMag, m.zMeanKronMag, m.yMeanKronMag,
       m.gFlags, m.rFlags, m.iFlags, m.zFlags, m.yFlags
into mydb.MyTable_HDF_3deg from fGetNearbyObjEq(169.20,62.30,180.0) nb
inner join ObjectThin o on o.objid=nb.objid and o.nDetections>3
inner join MeanObject m on o.objid=m.objid and o.uniquePsp0Bid=m.uniquePsp0Bid and m.rMeanPSFMag<21.0
```

The output table is 48,200 kb; here is a sample of the first few rows:

bigint [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	small int [2]	small int [2]	small int [2]	small int [2]	small int [2]	small int [2]	small int [2]	int [4]	tinyint [1]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	int [4]	int [4]	int [4]	int [4]	int [4]		
objID	raMean	decMean	raMeanErr	decMeanErr	raStack	decStack	decStackErr	epochMean	nDetections	ng	nr	ni	nz	ny	objInfoFlag	qualityFlag	gMeanPSFMag	rMeanPSFMag	iMeanPSFMag	zMeanPSFMag	yMeanPSFMag	gMeanPSFMagErr	rMeanPSFMagErr	iMeanPSFMagErr	zMeanPSFMagErr	yMeanPSFMagErr	gMeanKronMag	rMeanKronMag	iMeanKronMag	zMeanKronMag	yMeanKronMag	gFlags	rFlags	iFlags	zFlags	yFlags
179681712835753758	17.1.28373	59.5558	0.003650008	0.008299998	17.1.28373	59.5558	0.001000004	0.0000004	56887.0658912	72	6				13	503635968	60	19.638638	18.60969	17.447399	16.921699	16.674699	0.009003996	0.008698998	0.0044979105	0.004377998	0.008810998	19.653999	17.664829	17.511222	16.990400	16.762496	115000	115000	115000	115000
181881687299148148	16.8.7299	61.5758	0.013220008	0.014299992	16.8.7299	61.5758	0.001000004	0.0000004	56067.984236	75	11	12	27	16	9	444915712	53	21.253200	20.462699	20.115600	19.850500	19.507600	0.060488998	0.051541006	0.039379903	0.035339015	0.079178000	21.032400	19.982799	19.518299	19.316999	19.115800	168922	168922	168922	168922
1849016550524008966	16.5.0524	64.5209	0.008980039	0.016130052	16.5.0524	64.5209	0.001000004	0.001000004	56850.59731481	103	9				14	503635968	60	14.876468	14.498599	14.332295	14.295900	14.267800	0.003291999	0.002353999	0.002094999	0.004273998	0.004172998	14.931599	14.531388	14.100999	14.388100	14.297499	115000	115000	115000	115000
18320173235863225	17.3.262	62.4899	0.013013	0.016580051	17.3.262	62.4899	0.001000004	0.001000004	56170.7540278	68	9	10	26	13	10	444915712	53	19.226999	18.673600	18.729600	18.514299	18.356999	0.040097999	0.090009000	0.069587000	0.110015998	0.032370999	16.322999	15.967999	15.911300	15.893100	16109600	162222	161616	161616	
183961662062155429	16.6.223	63.30493	0.010169903	0.004960042	16.6.223	63.3049	0.001000004	0.001000004	57009.84126157	68	6	14	22	17	9	436527104	52	20.306100	19.95299	19.843599	19.815599	19.468700	0.018285999	0.011083000	0.013592000	0.01463236	0.095564877	20.402999	20.055999	19.945949	19.930299	19196300	115000	115000	115000	115000
1840916521321916264	16.5.213	63.41557	0.039659931	0.045710014	16.5.213	63.4155	0.001000004	0.001000004	56455.006773	31	4	4	8	10	5	444915712	53	21.010499	20.222122	20.280865	19.930212	19.354360	0.13004613876	0.038970010	0.014945997	0.137548997	0.037838008	19.569700	19.434600	18.955738	18.620800	18.292018	168922	168922	168922	168922

1822	16	61	0.009	0.008	16	61	0.001	0.001	568	71	9	6	24	17	15	50	60	18.	17.	17.	17.	16.	0.00	0.00	0.00	0.00	0.00	18.	17.	17.	17.	17.	11	11	11	11
9163	3.2	. 61	8700	1099	3.2	. 61	0.000	0.000	90.							36	60	520	598	183	025	903	7381	5032	3556	5563	6905	596	665	270	104	50	50	50	50	
2855	85	90	0018	9982	85	90	0004	0004	193							35		799	100	500	800	600	9998	9999	0000	9999	0001	000	100	200	600	00	00	00	00	
3910	44	85	3582	0590	51	85	7497	7497	043							968		636	662	289	704	692	6517	0668	6878	9186	9118	671	097	183	363	723				
25	234	46	31	02	981	84	07		98									8408	2314	917	9561	749	429	893	376	397	397	3867	6563	1055	1592	2666				
1817	16	61	0.006	0.014	16	61	0.001	0.001	567	83	13	14	22	18	16	50	60	15.	15.	15.	15.	15.	0.00	0.00	0.00	0.00	0.00	15.	15.	15.	15.	15.	11	11	11	11
8168	8.6	. 61	1499	5800	8.6	. 61	0.000	0.000	78.							36		682	307	175	163	149	3380	2305	3481	2041	2662	728	354	221	216	185	50	50	50	
296	29	48	9979	0019	29	48	0004	0004	062							36		700	100	800	599	399	9999	0000	9999	0000	199	700	699	699	899	00	00	00	00	
3386	67	98	7344	1927	64	99	7497	7497	1412							096		157	296	323	967	757	0040	8910	7097	4914	1351	958	088	714	600	734				
28	41	49	21		809	21	45	45										1655	0205	4863	9565	3853	064	894	254	234	535	8013	501	6606	2197	4971				
1849	16	64	0.014	0.016	16	64	0.001	0.001	562	86	12	14	35	21	4	44	53	21.	20.	20.	20.	19.	0.02	0.03	0.02	0.04	0.09	21.	20.	20.	19.	19.	16	16	16	11
0165	5.1	. 64	9800	2300	5.1	. 64	0.000	0.000	21.							49		161	583	248	026	577	8948	8169	3500	2869	5078	004	272	011	737	330	89	89	89	
1016	01	08	0044	0018	01	08	0004	0004	054							15		399	799	500	800	999	9999	9986	9994	0016	9973	199	499	800	300	299	22	22	22	
4085	63	98	37566	29863	59	98	7497	7497	085							712		841	362	823	155	114	41349	7558	3578	2696	1397	981	084	765	872	377	16	16	16	16
75	871	23	17		224	59	45	45	65									3086	1826	9746	6396	9902		48	24	84	63	6895	4727	9912	8027	4414				
1839	16	63	0.011	0.003	16	63	0.001	0.001	570	72	1	15	23	15	18	43	52	21.	20.	19.	19.	18.	0.13	0.02	0.01	0.01	0.03	21.	21.	19.	19.	18.	16	11	11	11
6166	6.0	. 63	1300	5399	6.0	. 63	0.000	0.000	10.							65		908	943	761	217	971	0292	8215	1008	6232	2907	248	038	878	340	977	89	50	50	
0492	49	30	0046	9994	49	30	0004	0004	880							27		599	899	199	399	300	9967	0004	0000	0006	0016	800	000	999	399	24	00	00	00	
3325	05	15	46182	6951	081	15	7497	7497	798							232		853	154	951	597	125	64183	0590	0131	6387	7417	277	106	441	603	826	72			
32	936	24	98		183	45	45	45	61									5156	6631	1719	168	1221		76	13	65	53	71	8115	2715	0498					
1817	16	61	0.027	0.031	16	61	0.001	0.001	558	48	5	10	16	11	6	44	53	21.	20.	20.	20.	19.	0.07	0.03	0.03	0.04	0.10	21.	20.	20.	19.	19.	11	16	16	11
8168	8.4	. 61	5999	3999	8.4	. 61	0.000	0.000	31.							49		674	805	468	066	652	8189	5766	7687	3595	3969	600	425	052	568	364	50	89	89	
4177	17	48	9968	9881	17	48	0004	0004	922							15		400	300	500	099	900	9988	0017	9982	0011	0002	400	699	600	700	299	00	22	22	00
2941	75	61	11152	38676	74	61	7497	7497	870							712		329	674	137	166	695	6512	9076	65028	0149	79903	924	234	860	790	774	16	16	16	
64	907	71	11		215	877	45	45	37									5898	4385	3291	8701	8008	76	19		38	6826	0088	5957	4053	1699					
1817	16	61	0.015	0.024	16	61	0.001	0.001	559	67	13	14	19	14	7	44	53	20.	20.	20.	20.	19.	0.01	0.02	0.03	0.04	0.10	20.	19.	19.	19.	19.	16	16	16	11
8168	8.5	. 61	7800	5299	8.5	. 61	0.000	0.000	96.							49		453	282	028	026	761	2954	6145	0764	3905	4230	248	958	795	628	558	89	89	89	
5428	42	48	0001	9912	42	48	0004	0004	658							15		500	100	499	199	899	9996	0000	0004	0011	9999	100	700	000	799	599	22	22	22	
0551	84	69	60933	20236	81	70	7497	7497	587							712		747	677	603	340	948	9273	1072	9030	3368	46594	280	076	438	472	16	16	16	50	
78	354	84	68		239	29	45	45	96									6807	4902	2715	8203	1201	81	88	78	03	7617	1807	0537	2939	4766	0459				

Note that the mean object astrometric parameters (raMean, decMean) have been post-processed to match with corresponding Gaia sources, and therefore are not indicative of the underlying PanSTARRS astrometry.

Step 2: Obtain detections associated with objects selected in Step 1

The following query identifies all detections associated (i.e., having the same ObjID) as the mean objects obtained in Step 1, and extracts relevant parameters for each. The query ran for 3:18 and returned 8,560,632 rows (detections), or an average of over 40 per mean object.

```
select d.detectID, d.objid, d.obstime, d.exptime, d.airmass, d.psfflux, d.psffluxErr, d.psfQF,
d.imageID, d.filterID, d.sky, d.skyerr, d.infoflag, d.infoflag2, d.infoflag3, d.ra, d.dec, d.raerr, d.decerr
into mydb.MyTable_HDF_det2
from Detection d
inner join MyDB.MyTable_HDF_3deg mm on d.objid=mm.objid
```

The resulting table is about 1.3 GB, exceeding the standard limit in CasJobs. A sample of the first several rows follows.

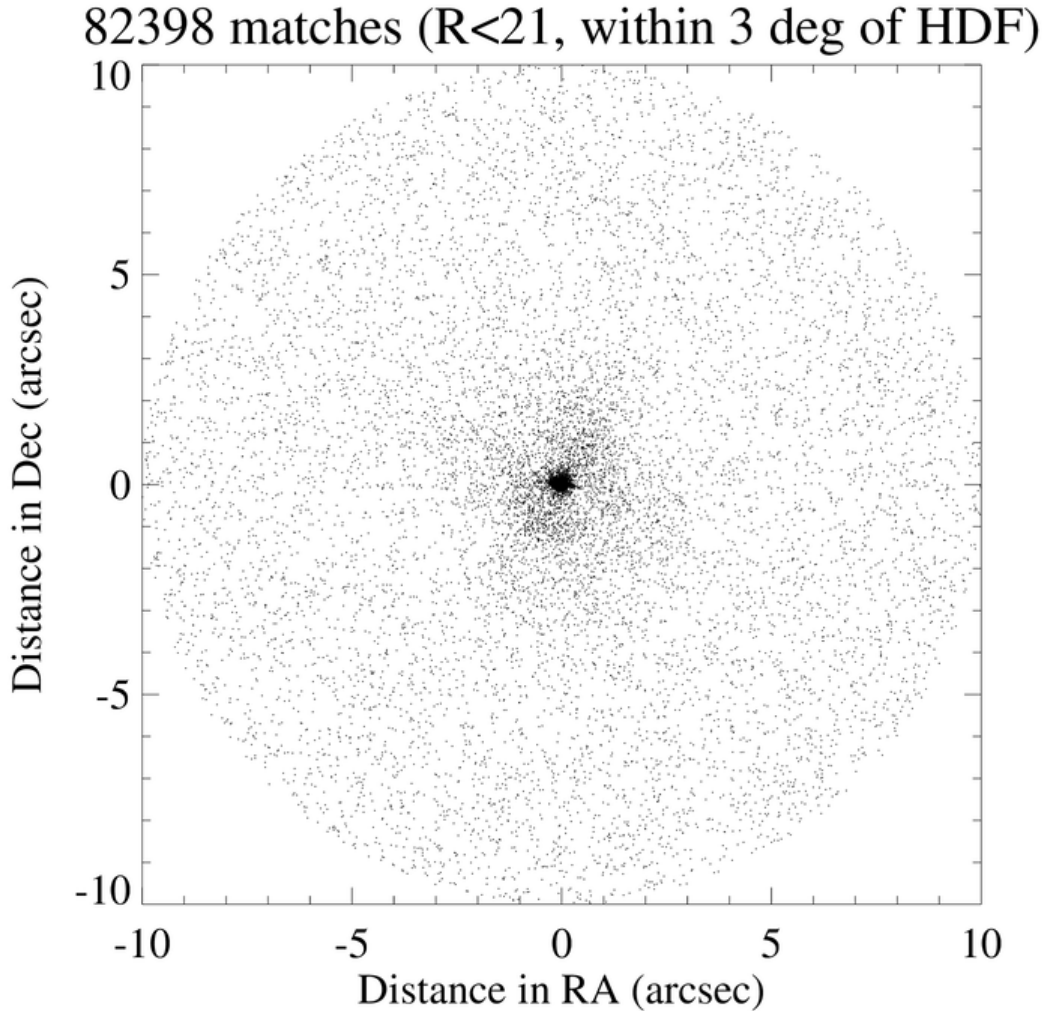
bigint [8]	bigint [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	float [8]	bigint [8]	tinyint [1]	float [8]	float [8]	bigint [8]	int [4]	int [4]	float [8]	float [8]	float [8]	float [8]
------------	------------	-----------	-----------	-----------	-----------	-----------	-----------	-----------	------------	-------------	-----------	-----------	------------	---------	---------	-----------	-----------	-----------	-----------

detectID	objid	obstime	exp time	airmass	psfflux	psffluxErr	psfQF	imag eID	flit erID	sky	skyerr	infofl ag	infofl lag2	infofla g3	ra	dec	raerr	decerr
1482500043 10000540	1791616884 98759335	55583.5 003176	45	1.3484499 4544983	1.919649912 45186E-05	1.327769950 87625E-06	0.99891799 6883392	2844 0031	3	5.785109897 26055E-05	3.173030108 88281E-06	3566 7969	0	7374 912	168.849 91255	59.307 20106	0.03775979 95102406	0.03775979 95102406
1482506663 10001421	1791616884 98759335	55583.5 069285	45	1.9347899 9137878	1.467039965 06403E-05	1.326140022 68383E-06	0.99880897 9988098	2844 1031	3	5.763780063 71669E-05	3.130639925 07523E-06	3566 7969	0	7374 912	168.849 81296	59.307 15457	0.04934319 85378265	0.04934319 85378265
1233257111 70000179	1791616884 98759335	55334.2 573031	30	1.2808400 3925323	4.310740041 54652E-05	3.706609959 40852E-06	0.99955701 8280029	1693 7517	4	5.736530147 26005E-05	4.783209988 09068E-06	3566 7969	0	1247 82656	168.849 84276	59.307 21012	0.04670640 08116722	0.04670640 08116722
1234266461 70000229	1791616884 98759335	55335.2 666525	30	1.2865400 3143311	4.953450115 86323E-05	5.493689968 71635E-06	0.99960201 9786835	1698 9317	4	7.647740130 7784E-05	5.548019998 96881E-06	3566 7969	0	1247 82656	168.849 82005	59.307 15227	0.06020810 08255482	0.06020810 08255482
1234253881 70000181	1791616884 98759335	55335.2 540732	30	1.2806999 6833801	2.964630039 05956E-05	3.380899897 8202E-06	0.99766701 4598846	1698 7017	4	7.845940126 5718E-05	5.753110144 72391E-06	3565 1585	0	7374 912	168.849 92647	59.307 14316	0.06189449 87654686	0.06189449 87654686
1167535461 70000094	1791616884 98759335	55268.5 356725	36	1.4778800 0106812	1.730350049 91107E-05	1.851779984 46306E-06	0.99884200 0961304	1477 4017	2	1.619840077 18274E-05	2.141709956 04945E-06	3565 1585	0	7374 912	168.849 95451	59.307 1895	0.05811170 11606693	0.05811170 11606693
1167544161 70000227	1791616884 98759335	55268.5 443795	36	1.5157899 8565674	1.998640072 99766E-05	2.026770062 00247E-06	0.99870902 299881	1477 5517	2	1.648020042 92142E-05	2.175879899 36874E-06	3565 1585	0	7374 912	168.849 78545	59.307 19865	0.05506790 05682468	0.05506790 05682468
1156446631 70000366	1791616884 98759335	55257.4 468208	32	1.2816599 6074677	2.900899926 31692E-05	4.257500222 59308E-06	0.99919897 3178864	1443 7617	3	9.262000094 16789E-05	4.894070116 27918E-06	3566 7969	0	1080 05440	168.850 06837	59.307 16401	0.07962950 31905174	0.07962950 31905174
1171512021 70000279	1791616884 98759335	55272.5 123379	52	1.4306000 4711151	7.238600119 3081E-06	1.122470052 90556E-06	0.95072901 2489319	1488 0017	1	6.346670033 96316E-06	1.662440013 20592E-06	3566 7969	0	7374 912	168.849 91705	59.307 26753	0.08420000 22530556	0.08420000 22530556
1156436651 70000161	1791616884 98759335	55257.4 368465	32	1.2868399 6200562	3.171090065 73446E-05	3.910809937 22426E-06	0.99926900 8636475	1443 5917	3	9.123959898 71584E-05	4.865430128 12035E-06	3566 7969	0	1080 05440	168.849 82811	59.307 24274	0.06699889 89830017	0.06699889 89830017
2235616606 50000401	1791616884 98759335	56336.6 168684	43	1.5010700 2258301	7.672029823 87971E-06	1.164579998 65816E-06	0.99800902 6050568	5808 7965	1	4.418679964 14658E-06	1.753550009 19083E-06	3566 7969	0	7374 912	168.849 59486	59.307 38858	0.08270119 87566948	0.08270119 87566948

2235623036 50000363	1791616884 98759335	56336.6 232838	43	1.5306700 4680634	6.949700036 78463E-06	1.121140030 59105E-06	0.99859702 5871277	5808 8865	1	4.630499915 94744E-06	1.780150000 74083E-06	3565 1585	0	7374 912	168.849 97658	59.307 14763	0.08789809 79323387	0.08789809 79323387
1865493883 60000546	1791616884 98759335	55966.4 940736	30	1.2878400 0873566	2.577539999 03798E-05	2.913579919 5501E-06	0.99768698 2154846	4519 1836	4	9.486859926 25542E-05	5.997790140 09982E-06	3566 7969	0	7374 912	168.849 95928	59.307 22864	0.06158199 90634918	0.06158199 90634918
1865485963 60000476	1791616884 98759335	55966.4 861404	30	1.2945699 6917725	3.006320002 89625E-05	3.192250005 66803E-06	0.99845999 4792938	4519 0336	4	9.636610047 89174E-05	6.030159966 03062E-06	3565 1585	0	7374 912	168.849 88062	59.307 17744	0.05784339 83027935	0.05784339 83027935
1948288613 60000399	1791616884 98759335	56049.2 888798	45	1.2796000 2422333	2.231690086 7736E-05	1.715460030 02732E-06	0.99719297 8858948	4833 9036	3	5.707910167 98466E-05	3.153030093 01715E-06	3566 7969	0	7374 912	168.849 7873	59.307 23566	0.04186490 17810822	0.04186490 17810822

Step 3: Match objects and detections with the closest Gaia DR2 source

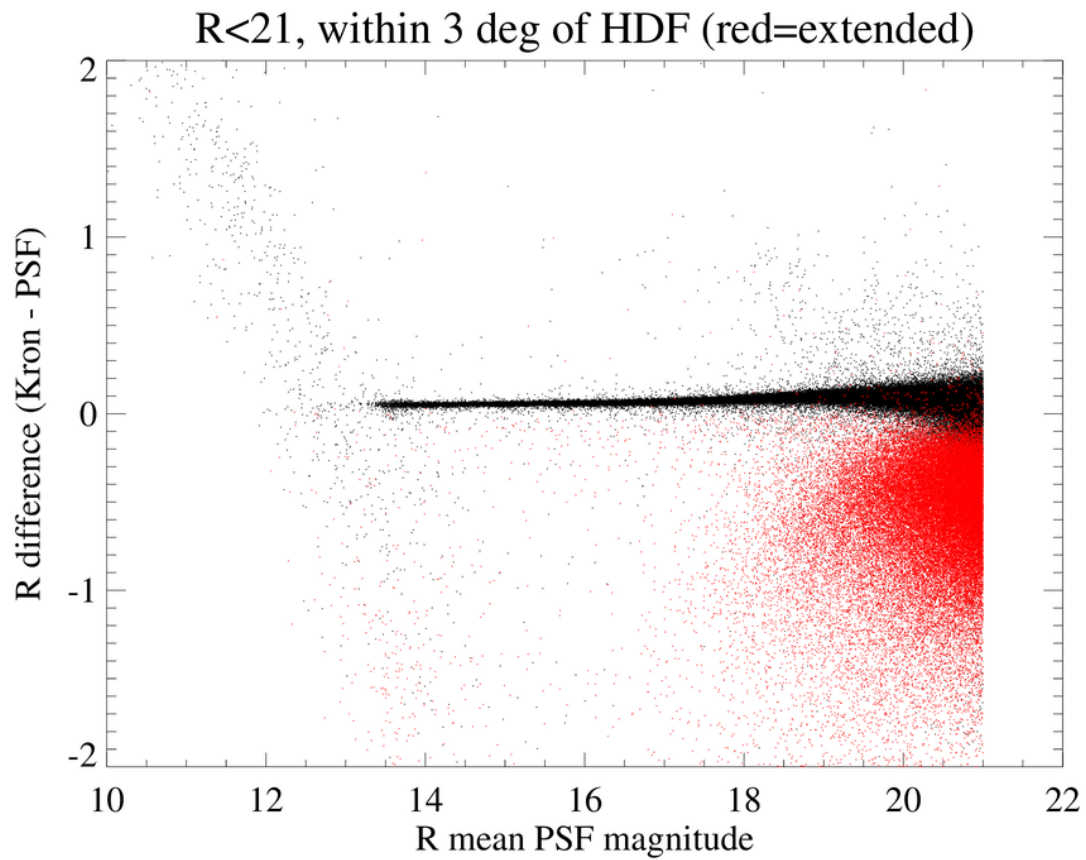
The same region of the sky contains 86,685 Gaia DR2 sources, of which 77448 have a valid five-parameter astrometric solution, and 68638 have also a valid G magnitude. For the first matching stage, we do not require valid magnitude or five-parameter astrometry; the direct positional match with a generous 10" radius finds 82,398 matches, with the vast majority well within 1":



In this comparison, it is useful to distinguish point sources from extended sources. The latter will likely be treated differently in Gaia vs. Pan-STARRS, and their astrometric and photometric accuracy is likely poorer. One way to distinguish point from extended sources is to use the difference between Kron and PSF magnitudes; another is encoded in the QF_OBJ_EXT bit (bit 1) from the qualityFlag parameter in ObjectThin (extracted from the query in Step 1):

ExtendedFlag = (qualityFlag AND 1)

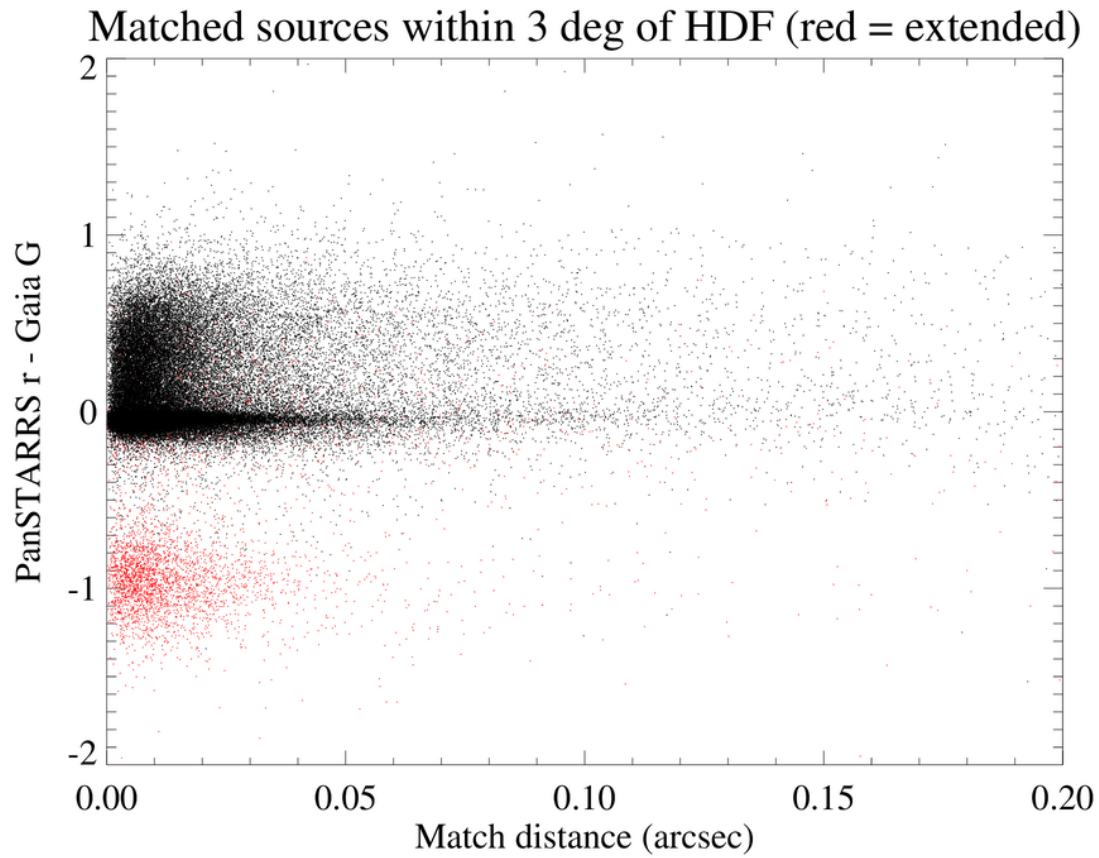
(this is a bitwise AND). The ExtendedFlag thus defined correlates well with the Kron vs. PSF magnitude difference (which presumably is part of the definition):



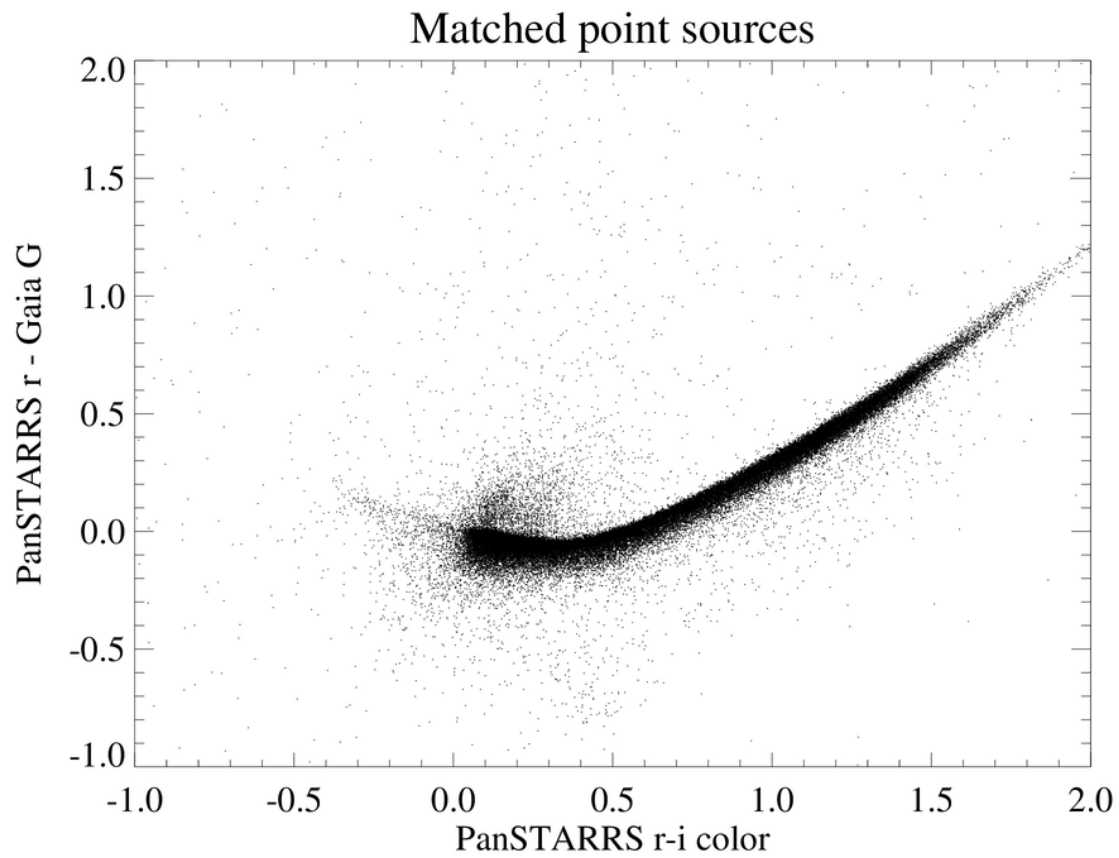
Red dots in this plot have `ExtendedFlag == true`. In the following, we use `ExtendedFlag` to identify extended objects.

Step 4: compare Gaia and PanSTARRS magnitudes for point sources

The match distance distribution shows clearly that "true" matches likely have match distances $\ll 1$ ". This plot shows that PanSTARRS r-band PSF magnitudes and Gaia G band magnitudes match very well for "true" point source matches (separation < 0.2):

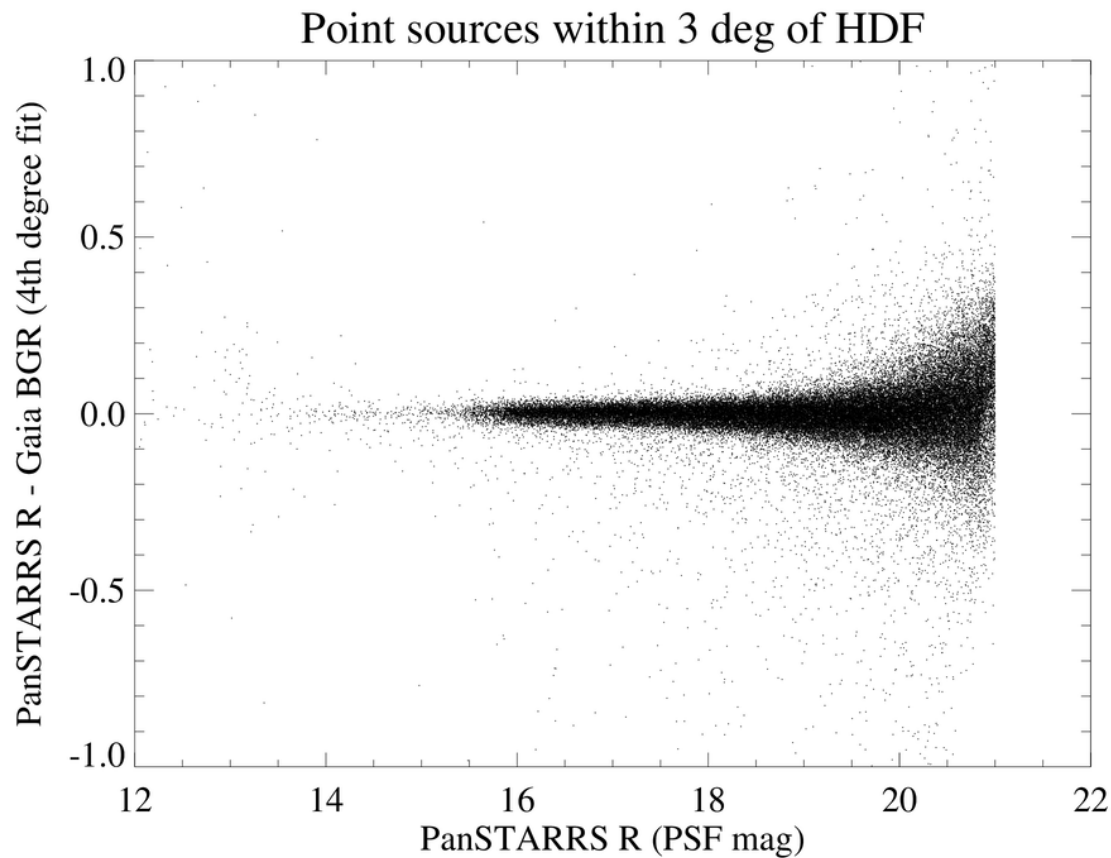


The plot shows two populations of point sources: a narrow band with $r-G \sim 0$, containing a majority of the matches, and a broader distribution at positive $r-G$ values (brighter in G than in r). Extended sources are mostly brighter in PanSTARRS r, as expected since Gaia, with its higher angular resolution, would only measure the core of the object. (We will neglect extended sources henceforth.) It turns out that the second population of point sources, at positive $r-G$, is constituted of very red stars, for which the extremely broad G passband is dominated by red photons. This becomes clear if the $r-G$ magnitude difference is plotted against PanSTARRS colors, e.g., $r-i$:



where the region of positive $r - G$ (Gaia brighter) corresponds with positive $r - i$ (red stars). The narrowness of the sequence testifies to the quality of Gaia and PanSTARRS magnitudes.

We can take one additional step and attempt to define a color transformation that maps Gaia magnitudes (G , B , and R) into PanSTARRS r . A degree 4 polynomial results in a very good match, albeit with large scatter at faint magnitudes, where Gaia B and R magnitudes lose precision:

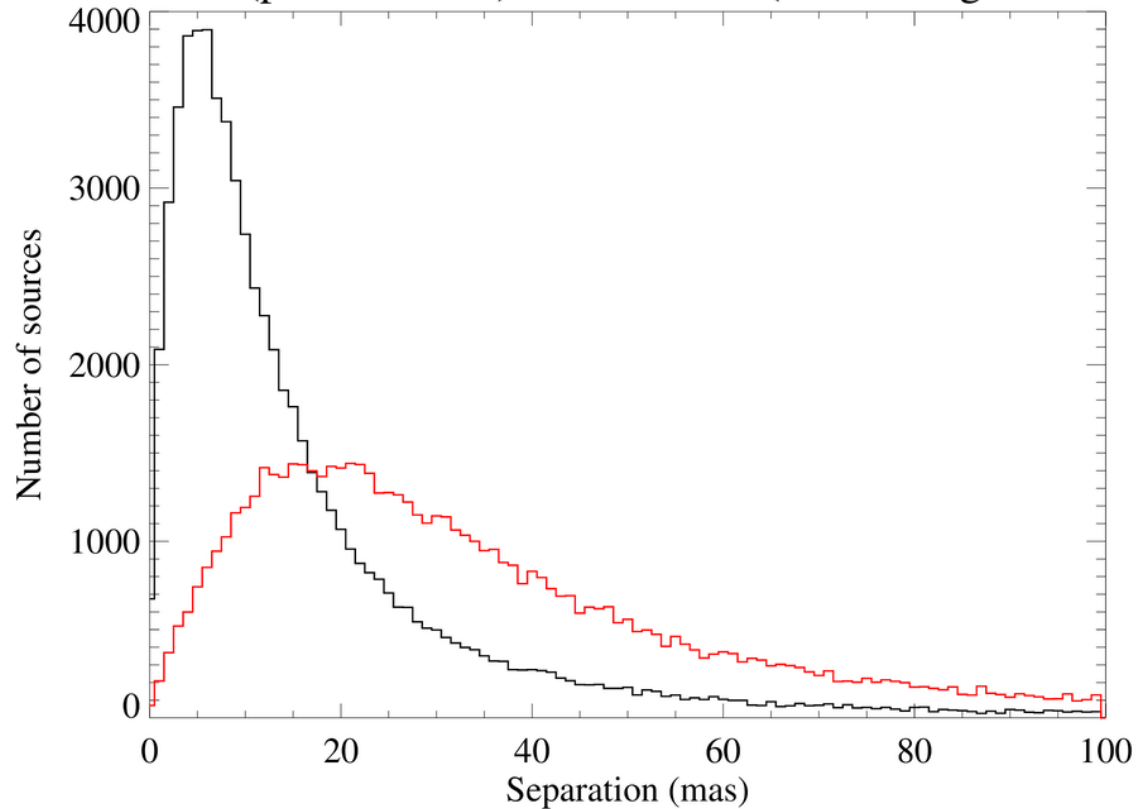


It would also be possible to define a combination of PanSTARRS magnitudes to map into Gaia G, but the above plots clearly show that magnitudes are well matched, so this has not been pursued further.

Step 5: Compute mean detection positions and compare to Gaia astrometry

Finally, we compare the astrometric match between Gaia and PanSTARRS using both mean object quantities and the average of detection positions. Mean object astrometry is obtained from the DR2 table `ObjectThin` and has been adjusted to Gaia. Detection positions are taken from the DR2 Detection table, and have **not** been adjusted to Gaia. Accordingly, if we assign to each matched object a "mean detection" position corresponding to the average of its detections (as indicated by `objID`), this position is a true indicator of the underlying quality of PanSTARRS astrometry **before** Gaia matching:

PanSTARRS (point sources) vs Gaia DR2 (red=average of detect



The black histogram shows the match distance for mean object (typically Gaia-adjusted) positions; it peaks at 5 mas, with a significant tail beyond 20 mas. The red histogram uses the mean position of detections; it peaks at 20 mas, with a significant tail beyond 50 mas. More analysis is in progress to better understand how proper motions might impact the relative astrometry for both matched and unmatched PanSTARRS sources. In particular, we plan to use detection positions to obtain proper motion estimates or bounds for sources that do not have Gaia proper motions. Note that separations based on mean detection positions have not been adjusted for the (known) proper motion of the corresponding Gaia source; this is ongoing.

In summary, we show that 1) most Gaia sources within the chosen area have PanSTARRS matches; 2) point-source photometry is very consistent between Gaia and PanSTARRS, with obvious deviations related to both extended sources and point sources of extreme colors; and 3) detection positions can be used to understand the validity of PanSTARRS astrometry after matching to Gaia, and potentially offer information of source proper motions.