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## Euclid FGS Input Star Catalogue Verification Test Report

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### **1. SCOPE**

The objective of the verification testing is to assess to what degree the delivered third version of the ISC (ISC.R3) satisfy the requirements defined in EUCL-TAST-RS-2-056 [AD 2]. This document presents the results of the executed verification test cases, described in the ISC Verification Test Specifications (VTS) [AD 3], as part of the requirement verification phase described in the DDVP [RD 1].

### **2. REFERENCES**

#### **2.1 Applicable documents**

- [AD 1] Bosco A., *Euclid FGS Star Catalogue Statement of Work*, 21 April 2016, EUCL-TAST-SOW-2-028, issue 3
- [AD 2] Bosco A., *Euclid FGS Input Star Catalogue Requirement Specifications*, 21 April 2016, EUCL-TAST-RS-2-056, issue 1
- [AD 3] Drimmel R., *Euclid FGS Input Star Catalogue Verification Test Specifications*, 27 Nov 2016, EUCL-OATO-PL-2-002, issue 2

#### **2.2 Reference documents**

- [RD 1] Drimmel, R., *Euclid FGS Star Catalogues Design Development and Verification Plan*, EUCL-OATO-PL-2-001
- [RD 2] Morbidelli, R., *Release Note for Input Star Catalogue Release 3*, EUCL-OATO-NOTE-2-009
- [RD 3] Smart, R., *Euclid FGS Star Catalogue Database Description*, EUCL-OATO-TN-2-002
- [RD 4] Perina, S. et al, *Euclid FGS Input Star Catalog Generation Approach of Release ISC.R3*, EUCL-OATO-TN-2-006
- [RD 5] Taylor, M., *STILTS: Starlink Tables Infrastructure Library Tool Set*, Astrophysics Source Code Library, record ascl:1105.001, <http://ascl.net/1105.001>





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### **3. DEFINITIONS AND ACRONYMS**

#### **3.1 Definitions**

In accordance with the SoW [AD 1], the following definitions shall be used.

- **Input Star Catalogue (ISC)**  
Representative of the whole sky. Collecting all the FGS possible targets after a process of target selection driven by the FGS star catalogue requirements. Used as input for the On-ground Algorithm to generate the FGS On-board Catalogue and Triad Database.
- **Reference Star Catalogue (RSC)**  
Representative of the real sky. Limited to selected portions of the sky, collecting all available information in the current databases. Used for pixel-by-pixel simulation, FGS simulator validation and Relative Tracking Mode (RTM) performance analysis.

#### **3.2 Acronyms**

<b>Acronym</b>	<b>Definition</b>
<b>2MASS</b>	Two Micron All Sky Survey, Extended source catalogue
<b>AD</b>	Applicable Document
<b>ASCII</b>	American Standard Code for Information Interchange
<b>ATM</b>	Absolute Tracking Mode
<b>CCD</b>	Charged Couple Device
<b>DB</b>	DataBase
<b>DDVP</b>	Design Development and Verification Plan
<b>DPAC</b>	Data Processing and Analysis Consortium
<b>DR</b>	Data Release
<b>ESA</b>	European Space Agency
<b>FGS</b>	Fine Guidance Sensor
<b>FOV</b>	Field of View
<b>HEALPix</b>	Hierarchical Equal Area Iso Latitude Pixelation
<b>ICD</b>	Interface Control Document
<b>IDL</b>	Interactive Data Language
<b>INAF</b>	Istituto Nazionale di Astrofisica
<b>ISC</b>	Input Star Catalogue
<b>NGC</b>	New General Catalog
<b>Ns</b>	Number of stars
<b>OATo</b>	Osservatorio Astrofisico di Torino
<b>RD</b>	Reference Document
<b>RSC</b>	Reference Star Catalogue
<b>RTM</b>	Relative Tracking Mode
<b>SDSS</b>	Sloan Digital Sky Survey
<b>SoW or SOW</b>	Statement of Work
<b>SW</b>	Software
<b>TASI</b>	Thales Alenia Space Italy







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<b>TAST</b>	Thales Alenia Space Torino
<b>TN</b>	Technical Note
<b>VTR</b>	Verification Test Report

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## 4. TEST CONFIGURATION

### 4.1 Documentation

Relevant applicable documents are listed in section 2.1. Description of the procedures of each test case in the VTS [AD 3], is copied as italicized text in the procedure section of each test case below for convenience.

### 4.2 Input Data

The input data for all of the tests cases executed as a Test (Verification method T) were the delivered third version of the ISC (ISC.R3) itself, realized as 192 ascii files covering specific areas of the sky HEALPix. On production, all ISC files were placed on a common ftp depository dedicated to the FGS Euclid project, accessible to all the testers. All test cases were executed on copies of these ISC files generated via ftp get.

### 4.3 Software

Specific verification tests cases employing verification method T were performed by executing test specific software, written in various software languages, or via the acceptance test campaign, which was performed using IDL code.

### 4.4 Personnel

The Test Team are identified below, identified either as a Tester (executing SW and compiling results of test cases with verification method T) or as a Reviewer (performing test cases using verification method R or A). Each test case reports the Testers or Reviewers performing the test case.

Roberto Morbidelli
Sibilla Perina
Paola Re Fiorentin
Richard Smart
Alessandro Spagna
Beatrice Bucciarelli
Ronald Drimmel





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#### **4.5 Tests not run**

All tests specified in the VTS [AD 3] were executed.





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### 5. OVERVIEW OF THE TEST RESULTS

#### 5.1 Test Case Overview

Test Case	Requirement tested	Status
ISC-TST-REQ-0010-01	EUCL-ISC-REQ-0010	PASS
ISC-TST-REQ-0010-03	EUCL-ISC-REQ-0010	PASS
ISC-TST-REQ-0020-01	EUCL-ISC-REQ-0020	FAIL
ISC-TST-REQ-0030-01	EUCL-ISC-REQ-0030	PASS
ISC-TST-REQ-0040-01	EUCL-ISC-REQ-0040	FAIL
ISC-TST-REQ-0050-01	EUCL-ISC-REQ-0050	PASS
ISC-TST-REQ-0060-01	EUCL-ISC-REQ-0060	PASS
ISC-TST-REQ-0070-01	EUCL-ISC-REQ-0070	PASS
ISC-TST-REQ-0080-01	EUCL-ISC-REQ-0080	PASS
ISC-TST-REQ-0090-01	EUCL-ISC-REQ-0090	PASS
ISC-TST-REQ-0100-01	EUCL-ISC-REQ-0100	PASS
ISC-TST-REQ-0110-01	EUCL-ISC-REQ-0110	PASS
ISC-TST-REQ-0120-01	EUCL-ISC-REQ-0120	PASS
ISC-TST-REQ-0130-01	EUCL-ISC-REQ-0130	PASS
ISC-TST-REQ-0140-01	EUCL-ISC-REQ-0140	PASS

#### 5.2 Overall Assessment

As expected for this final version of the ISC, based on Gaia DR2, not all the ISC requirements are verified.

All tests specified in the ISC VTS [AD3] were tested, and two ISC requirements are not satisfied on test. (See Test Case Overview above.) The two requirements that have not been met are:

1. **EUCL-ISC-REQ-0020** (All-sky coverage)
2. **EUCL-ISC-REQ-0040** (No extended sources larger than 2.9")

The first test, to verify requirement **EUCL-ISC-REQ-0020** (minimum number of objects per FGS FOV) was expected to fail due to astrophysical reasons, as warned by OATo on numerous occasions. However, we note that the fraction of the sky lacking ISC sources is extremely small, namely 0.0323% of the sky.

The reasons for failure have three principle causes:

1. Lack of sources in small sky areas due to the patchy completeness of the Gaia DR2 subset containing complete astrometry, most likely due to a smaller number of observations for a





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specific area on the sky. This affects an area on the sky of about 30 sq. degrees at galactic coordinates of (225°, 40°). Future data releases of Gaia will very likely be more complete in this part of the sky.

2. Lack of sources in small, contiguous sky areas due to interstellar extinction. This is an inherent limitation of the real distribution of stars in the sky, and cannot be resolved. There will always be areas within 20° of the Galactic plane with extremely high foreground extinction, and thus very few stars. These sky areas will be identified during the Performance Assessment phase of the ISC, so that they can be appropriately avoided during Operations. In any case, being restricted to small sky areas near the Galactic plane, this problem will have no impact on the primary science objectives of Euclid.
3. Occasional lack of sources due to sparse number counts of stars at high galactic latitude ( $|b| > 60^\circ$ ). Here the FGS fields affected are not contiguous, and so cannot be easily mapped and avoided. Being a problem for fields at high galactic fields, this problem potentially has an impact in Euclid science fields. Again, this is likely due to an intrinsic lack of stars in the sky, and not due to incompleteness in Gaia. We stress that this problem only affects a small number of FGS fields, so will essentially lead to a relatively small failure rate in FGS pointings.

It is also worth noting that there are some effective mitigation strategies that can be used to address the problem of sparse number of sources at high galactic latitude:

1. Treatment of sources with neighbor flag = 3 (unknown) as isolated sources. In the ISC all sources fainter than magnitude 18 with no neighbors were assigned a neighbor flag = 3, due to the incompleteness of Gaia at magnitudes fainter than 20. Due to the steep gradient of the magnitude distribution, this causes more than a third of the ISC sources to have a neighbor flag = 3 (see [RD 4]). However, based on the very low instances of ISC sources actually having a neighbor (neighbor flag = 1 or 2), we expect that nearly all sources with neighbor flag = 3 will in fact be isolated. Indeed, after neighbor flag = 0 sources, neighbor flag = 3 sources should be in any case preferred. Accepting these sources as “isolated” will significantly decrease the failure rate of FOV fields not meeting requirement **EUCL-ISC-REQ-0020** for this reason.
2. Thanks to the all-sky coverage of the ISC, FGS failure due to lack of ISC sources for specific target fields can be avoided during the observation planning phase, which can specify which FGS CCDs should be used. In this case the probability of failure will also decrease dramatically, even assuming no re-orientation of the Euclid satellite via rotation. For instance, if the probability of insufficient sources for one set of two FGS fields is  $p$ , the chance of both the other two FGS fields also failing is  $p^2$ .

*During the Performance Analysis of the ISC, the probability of failure for lack of ISC sources will be mapped at an angular resolution of approximately 1 square degree, and characterized as a function of galactic latitude.*

Finally, we also found that requirement **EUCL-ISC-REQ-0040** is not satisfied in ISC.R3. This was not foreseen, as it was expected that the onboard detection algorithm used by the Gaia satellite would filter out such large extended sources, as per design. However, as already noted in the STR of ISC.R2, published studies indicate that galaxies with a highly peaked luminosity profile could indeed be detected by Gaia.

Due to the failure of this test on the previous delivered version of the ISC, significant effort was made on the classification of the ISC sources (not done for ISC.R2), and on the identification and filtering of the potentially large extended sources. Both of these tasks are very non-trivial, as Gaia is not an imaging survey, and so cannot (yet) produce any direct morphological classification of sources, let





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alone any estimate of the size of a source. (This may be addressed in future Gaia data releases by reconstructing an image of each source based on the multiple scan directions over the source during the course of Gaia observations.)

Essentially a classification of the sources must be made indirectly using machine-learning techniques, based on the various astrometric and photometric quality indicators made available in Gaia DR2, as described in [RD 4]. Being probabilistic in nature, neither the classification nor the filtering of large objects is perfect, as shown in test **ISC-TST-REQ-0040-01**, which used size estimates from an external catalogue (the Sloan Digital Sky Survey, SDSS). However, also the classifications in the SDSS are not perfect. In fact, our inspection of a random set of large SDSS extended objects remaining in the ISC revealed that many are resolved by Gaia as multiple sources, suggesting that these are blends of multiple point sources and not truly extended sources at all. Nevertheless, the presence of a few large extended sources in the ISC, in particular at fainter magnitudes, that have only a single DR2 counterpart has motivated us to mark this test as FAIL.

In any case, we stress that objects larger than 2.9" in the ISC will be extremely rare, and in any case will be characterized by a very peaked flux distribution, as required by the Gaia onboard detection algorithm.

*During the Performance Analysis of the ISC, the probable number of ISC sources larger than 2.9" will be estimated as a function of galactic latitude. Also a sample of such large ISC sources, as identified by the SDSS catalogue, will be visually verified (as in test **ISC-TST-REQ-0040-01**) and cross-matched with HST archived images to verify their extended nature.*





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### 5.3 Verification Status Summary

Status column reports the verification status of each ISC requirement based on the results of the associated Test Cases.

- V: Verified
- N: Not verified

Requirement	Test Cases	Status
EUCL-ISC-REQ-0010	ISC-TST-REQ-0010-01 ISC-TST-REQ-0010-03	V
EUCL-ISC-REQ-0020	ISC-TST-REQ-0020-01	N
EUCL-ISC-REQ-0030	ISC-TST-REQ-0030-01	V
EUCL-ISC-REQ-0040	ISC-TST-REQ-0040-01	N
EUCL-ISC-REQ-0050	ISC-TST-REQ-0050-01	V
EUCL-ISC-REQ-0060	ISC-TST-REQ-0060-01	V
EUCL-ISC-REQ-0070	ISC-TST-REQ-0070-01	V
EUCL-ISC-REQ-0080	ISC-TST-REQ-0080-01	V
EUCL-ISC-REQ-0090	ISC-TST-REQ-0090-01	V
EUCL-ISC-REQ-0100	ISC-TST-REQ-0100-01	V
EUCL-ISC-REQ-0110	ISC-TST-REQ-0110-01	V
EUCL-ISC-REQ-0120	ISC-TST-REQ-0120-01	V
EUCL-ISC-REQ-0130	ISC-TST-REQ-0130-01	V
EUCL-ISC-REQ-0140	ISC-TST-REQ-0140-01	V





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### 6. DETAILED TEST RESULTS

#### 6.1 ISC-TST-REQ-0010-01

##### 6.1.1 Requirements tested: EUCL-ISC-REQ-0010

##### 6.1.2 Test Items

- All ISC files
- Local database containing Gaia DR2
- Software to execute procedure.

##### 6.1.3 Test Personnel

Sibilla Perina, Richard Smart

##### 6.1.4 Procedure

###### **Verification method: T**

*List of all Gaia sources not in the ISC brighter than the magnitude limit of the ISC shall be produced using the ISC/Gaia source IDs. A check on each of these sources will be made to confirm missing data (incomplete astrometry, etc.), or that the source is outside the magnitude limit of the ISC. Sources with complete data and brighter than the ISC limiting magnitude will be counted.*

**Pass criteria:** *Count of missing Gaia sources with complete astrometry and photometry, and brighter than Euclid instrumental magnitude of 19, is zero.*

ISC has been generated from a local DB containing Gaia-DR2. The completeness of the local DB was checked by comparing the total count of the sources in the DB with the total number of sources in the Gaia Archive.

Starting from files generated from the Gaia-DR2 local DB (192 files),  $R_{\text{FGS}}$  magnitudes for all the Gaia-DR2 sources were calculated during the ISC generation. From this file of  $R_{\text{FGS}}$  magnitudes we selected from the local DB sources NOT in the ISC having 5-parameter astrometry and  $R_{\text{FGS}} < 18.99995$ . We then checked that the selected subset is equal to the subset of large extended sources removed from ISC.

The 18.99995 value was used because the ISC production software worked with magnitudes approximated to the fourth significant digit.

The above test has been implemented in python 3.6.

##### 6.1.5 Test Results

The local DB was found to have 1 692 919 135 objects, which agrees with the number of sources in Gaia DR2.







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The test shows that no sources with five-parameters astrometry within the ISC magnitude range are missing respect to the local DB (except for the big-extended ones).

The test result shows that no Gaia sources were inappropriately excluded from the ISC.

Based on the test results the test status is: **PASS**





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### 6.2 ISC-TST-REQ-0010-03

#### 6.2.1 Requirements tested EUCL-ISC-REQ-0010

#### 6.2.2 Test Items

- All ISC files
- Local input files.
- Software to execute procedure.

#### 6.2.3 Test Personnel

Sibilla Perina

#### 6.2.4 Procedure

##### **Verification method: T**

*ISC production should report the number of rejected sources and reasons for rejection (for instance, those fainter than the ISC magnitude limit). Number of rejected sources should equal to the difference in the number of sources in the local input files and the number of sources in the ISC. These numbers will be reported in the VTR.*

**Pass criteria:** *Difference between the number of sources in the ISC and the local input files is equal to the number of rejected sources reported by the production SW.*

Rejected sources are:

- sources in the local input files with two-parameters astrometry and fainter than the ISC magnitude limit ( $R_{\text{fgs}} \geq 18.99995$  &  $\text{astrometric\_params\_solved} \neq 31$ ): **966887054**
- sources with ( $R_{\text{fgs}} < 18.99995$  &  $\text{astrometric\_params\_solved} == 31$ ) excluded from the ISC as likely being too large, as per requirement **EUCL-ISC-REQ-0040** (big-extended sources): **1194963**

The 18.99995 value was used because the ISC production software worked with magnitudes approximated to the fourth significant digit.

Total number of rejected sources: **968082017**

#### 6.2.5 Test Results

The following table reports the healpix number identifier and the difference between the number of sources in the local input file with ( $R_{\text{fgs}} < 18.99995$  &  $\text{astrometric\_params\_solved} == 31$ ) and the number of sources in the ISC file, minus the number of sources excluded from the ISC as likely being too large, as per requirement **EUCL-ISC-REQ-0040** (big-extended sources):

$(\text{len}(\text{local\_DB}[R_{\text{fgs}} < 18.99995 \ \& \ \text{astrometric\_params\_solved} == 31]) - \text{len}(\text{ISC})) - \text{len}(\text{big-extended})$





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0	0	48	0	96	0	144	0
1	0	49	0	97	0	145	0
2	0	50	0	98	0	146	0
3	0	51	0	99	0	147	0
4	0	52	0	100	0	148	0
5	0	53	0	101	0	149	0
6	0	54	0	102	0	150	0
7	0	55	0	103	0	151	0
8	0	56	0	104	0	152	0
9	0	57	0	105	0	153	0
10	0	58	0	106	0	154	0
11	0	59	0	107	0	155	0
12	0	60	0	108	0	156	0
13	0	61	0	109	0	157	0
14	0	62	0	110	0	158	0
15	0	63	0	111	0	159	0
16	0	64	0	112	0	160	0
17	0	65	0	113	0	161	0
18	0	66	0	114	0	162	0
19	0	67	0	115	0	163	0
20	0	68	0	116	0	164	0
21	0	69	0	117	0	165	0
22	0	70	0	118	0	166	0
23	0	71	0	119	0	167	0
24	0	72	0	120	0	168	0
25	0	73	0	121	0	169	0
26	0	74	0	122	0	170	0
27	0	75	0	123	0	171	0
28	0	76	0	124	0	172	0
29	0	77	0	125	0	173	0
30	0	78	0	126	0	174	0
31	0	79	0	127	0	175	0
32	0	80	0	128	0	176	0
33	0	81	0	129	0	177	0
34	0	82	0	130	0	178	0
35	0	83	0	131	0	179	0
36	0	84	0	132	0	180	0
37	0	85	0	133	0	181	0
38	0	86	0	134	0	182	0
39	0	87	0	135	0	183	0





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40	0	88	0	136	0	184	0
41	0	89	0	137	0	185	0
42	0	90	0	138	0	186	0
43	0	91	0	139	0	187	0
44	0	92	0	140	0	188	0
45	0	93	0	141	0	189	0
46	0	94	0	142	0	190	0
47	0	95	0	143	0	191	0

Based on the test results the test status is: **PASS**





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### 6.3 ISC-TST-REQ-0020-01

#### 6.3.1 Requirements tested EUCL-ISC-REQ-0020

#### 6.3.2 Test Items

- All ISC files
- SW to execute the procedure.

#### 6.3.3 Test Personnel

Richard Smart, Beatrice Bucciarelli

#### 6.3.4 Procedure

##### **Verification method: T**

*The FGS FoV (43.5 arcmin sq) corresponds approximately to a HEALPix level nine (47 arcmin sq). Proving that the ISC meets this requirement is equivalent to mapping the entire sky at this HEALPix level, and verifying that there are no HEALPixes with less than the required number of sources.*

*Procedure: count number of sources, per level 9 HEALPix, and the number of ISC sources with no neighbors, with a stated positional accuracy of better than 0.4" per coordinate. Then count the number of HEALPixes with less than five sources, and the number of HEALPixes with less than three sources with no neighbors.*

***We note that this requirement may not be possible to satisfy: there may be regions on the sky with insufficient sources to meet the requirement.***

*We note also that there is a related performance assessment activity planned, namely to identify all areas on the sky not meeting this requirement. (For us this also indicates that TASI and ESA understand and expect that the ISC will fail this requirement.)*

***Pass criteria:*** *The count of the number of HEALPixes with insufficient sources equals zero.*

We examined each of the 192 ISC files covering resolution level 2 HEALPix areas, compiling counts of the objects in each resolution level 9 HEALPix area. At this resolution the HEALPixes have an area of 0.013114 square degrees, which corresponds well to the 0.0121 square degrees of the FGS FOV. There are 16384 level 9 HEALPixes in each level 2 HEALPix file. For each level 9 HEALPix we counted the number of sources in the HEALPix, as well as the number of sources with specific Neighbor flag values. Then, for each file, we count the total number of level-9 HEALPixes (i.e. FOVs) with less than 5 objects, those with less than 5 objects or with less than 3 objects with neighbour flag of zero (i.e. the number of FGS FOVs not satisfying the requirement being verified), and the number of HEALPixes with zero objects. In the table below we report these counts as well as the totals and the percentage of the total number of level 9 HEALPixes in the sky (3145728). The procedure above was implemented using a combination of STILTS and custom Idl programs.





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### 6.3.5 Test Results

Based on this test the ISC does not meet the requirement ( $N > 5$  AND  $N(\text{flag}=0) > 3$ ) in 0.03% of the sky.

The following table reports the statistics on the number of sources per FOV inside each of the 192 level-2 healpix, numbered from 0 to 191 (column 1). The second column gives the number of FOVs with less than 5 sources, and the third the number of FOVs with less than 5 sources or with less than 3 objects with no neighbor (neighbor flag = 0). The last column gives the number of FOVs with zero sources.

Healpix	N<5	N(F=0)<3 OR N<5	N=0
0	0	1	0
1	0	0	0
2	1	2	0
3	4	7	0
4	17	23	0
5	0	0	0
6	1	1	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	51	45	6
17	91	84	14
18	0	0	0
19	0	0	0
20	14	29	0
21	12	56	0
22	0	1	0
23	3	11	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	1	0
29	0	0	0
30	0	0	0
31	0	0	0
32	0	0	0
33	0	0	0
34	0	3	0
35	0	0	0
36	0	0	0
37	0	0	0
38	0	0	0





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39	0	0	0
40	2	28	0
41	0	3	0
42	18	74	0
43	12	25	0
44	0	1	0
45	0	0	0
46	0	4	0
47	0	0	0
48	0	0	0
49	0	0	0
50	0	0	0
51	0	0	0
52	0	0	0
53	0	0	0
54	0	0	0
55	0	0	0
56	0	0	0
57	0	0	0
58	0	0	0
59	0	0	0
60	0	0	0
61	0	0	0
62	0	0	0
63	0	0	0
64	3	13	0
65	3	30	0
66	1	3	0
67	0	7	0
68	4	22	0
69	1	6	0
70	0	11	0
71	0	4	0
72	20	18	3
73	0	0	0
74	2	1	1
75	3	3	0
76	0	1	0
77	0	1	0
78	0	0	0
79	0	0	0
80	0	0	0
81	0	0	0
82	0	0	0
83	6	8	0
84	0	0	0
85	0	0	0
86	0	0	0
87	0	0	0
88	0	1	0
89	1	3	0
90	0	1	0
91	2	2	0





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92	0	0	0
93	0	0	0
94	0	0	0
95	0	0	0
96	0	0	0
97	0	0	0
98	0	0	0
99	0	0	0
100	0	0	0
101	0	0	0
102	0	2	0
103	0	2	0
104	1	1	0
105	0	2	0
106	102	85	18
107	51	54	4
108	5	18	0
109	3	26	0
110	31	62	0
111	28	100	0
112	0	0	0
113	0	0	0
114	0	0	0
115	0	0	0
116	0	0	0
117	0	0	0
118	3	3	0
119	0	0	0
120	0	0	0
121	0	0	0
122	2	2	0
123	0	0	0
124	0	0	0
125	0	0	0
126	0	0	0
127	0	0	0
128	0	0	0
129	0	0	0
130	0	0	0
131	0	1	0
132	0	0	0
133	0	0	0
134	0	1	0
135	0	0	0
136	0	4	0
137	1	8	0
138	1	8	0
139	5	27	0
140	2	12	0
141	0	1	0
142	5	37	0
143	1	5	0
144	0	0	0







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145	0	0	0
146	0	0	0
147	0	0	0
148	0	0	0
149	0	0	0
150	0	0	0
151	0	0	0
152	0	0	0
153	0	0	0
154	0	0	0
155	0	0	0
156	0	0	0
157	0	0	0
158	0	0	0
159	0	0	0
160	0	0	0
161	0	0	0
162	0	0	0
163	0	0	0
164	0	0	0
165	0	0	0
166	0	0	0
167	11	16	2
168	0	0	0
169	0	0	0
170	0	0	0
171	0	0	0
172	0	0	0
173	0	0	0
174	0	0	0
175	0	0	0
176	0	0	0
177	0	0	0
178	0	0	0
179	0	0	0
180	0	0	0
181	2	2	0
182	0	0	0
183	0	0	0
184	0	0	0
185	0	0	0
186	1	1	0
187	0	0	0
188	0	0	0
189	2	3	0
190	0	0	0
191	0	0	0
<b>Total</b>	529 (0.0168%)	1017 (0.0323%)	48 (0.0015%)

Based on the test results the test status is: **FAIL**





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### 6.4 ISC-TST-REQ-0030-01

#### 6.4.1 Requirements tested EUCL-ISC-REQ-0030

#### 6.4.2 Test Items

- ISC production software
- Document describing color transformations

#### 6.4.3 Test Personnel

Alessandro Spagna

#### 6.4.4 Procedure

##### **Verification method: R**

*Issued document describing the color transformation will be identified.*

*ISC production software will be visually inspected to confirm that the color transformations implemented in the code are as specified.*

**Pass criteria:** Reviewer sign-off on test case.

#### 6.4.5 Test Results

The code `mag_transformation.py` includes four polynomial functions ( $p_1$ ,  $p_2$ ,  $p_3$ ,  $p_4$ ) that apply the seven cases of photometric transformations from the Gaia photometric system to  $R_{\text{FGS}}$  described in Sect. 5.3 of [RD 4].

The code implements properly the prescribed algorithm for calculating  $R_{\text{FGS}}$  magnitudes, however we note a minor discrepancy in the estimation of the  $R_{\text{FGS}}$  uncertainties that produces underestimated errors of the extrapolated  $R_{\text{FGS}}$  magnitudes (case 2, 4, and 6) with respect to the nominal photometric transformations. This affects a small number of extremely red objects.

Based on the analysis presented here, the test status is **PASS**.

Sign-off:





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### 6.5    **ISC-TST-REQ-0040-01**

#### 6.5.1   **Requirements tested    EUCL-ISC-REQ-0040**

#### 6.5.2   **Test Items**

- Gaia DPAC documentation

#### 6.5.3   **Test Personnel**

Sibilla Perina, Paola ReFiorentin

#### 6.5.4   **Procedure**

##### **Verification method: A**

*We note that the Gaia source catalogue does not contain image sizes. However, the on-board detection algorithm may already exclude sources larger than 2.9 arcsec.*

*An assessment of possibility that such large extended sources might be in the ISC will be done starting from the extant Gaia DPAC technical notes that evaluate the efficiency of the Gaia on-board detection algorithm to detect such large extended sources.*

**Pass criteria:** Reviewer sign-off on test case.

#### 6.5.5   **Test Results**

The aim of this test is to assess the performance of the selection criterion used to remove from ISC sources larger than the FGS tracking window (big-extended sources).

Following the adopted criterion, sources with Classification = 1 AND  $P1 > 0.95$  AND  $phot\_bp\_rp\_excess\_factor > 1.8$  have been rejected from ISC, i.e. extended sources with a high probability to be extended and a high excess of flux in the BP and RP Gaia integrated photometry with respect to the G band.

The reference sample of big-extended sources is a subset of 120154 ISC sources located in a sky stripe covering all latitudes (SDSS stripe 1188,  $l=94$ ,  $\delta_l=2.52$ ), classified as extended sources in the SDSS-DR9 catalog and with size greater than 2.9 arcsec (SDSS\_big\_ext). The size is given by  $(4 * deVrad\_g)$  where deVrad\_g is the de Vaucouleurs radius parameter provided in SDSS-DR9, (a measure of the half-light radius).

For these sources we have the ISC classification flag computed by the machine learning algorithm Random Forest (predicted class) and the correspondent probability to be extended (P1). Relying on Gaia-DR2 data we defined as big-extended the sources with  $phot\_bp\_rp\_excess\_factor > 1.8$  AND  $P1 > 0.95$ . (See [RD7] for details.)

Comparing the two classifications (SDSS / ISC) we have:

SDSS\_big\_ext AND NOT ISC\_filtered = 74 744 sources

SDSS\_big\_ext AND ISC\_point-like = 27 836 sources



In Fig.1 the galactic latitude ( $b$ ) is plotted versus  $\text{phot\_g\_mean\_mag}$  for the two sets above (left panel: SDSS\_big\_ext AND NOT ISC\_filtered; right panel: SDSS\_big\_ext AND ISC\_point-like)

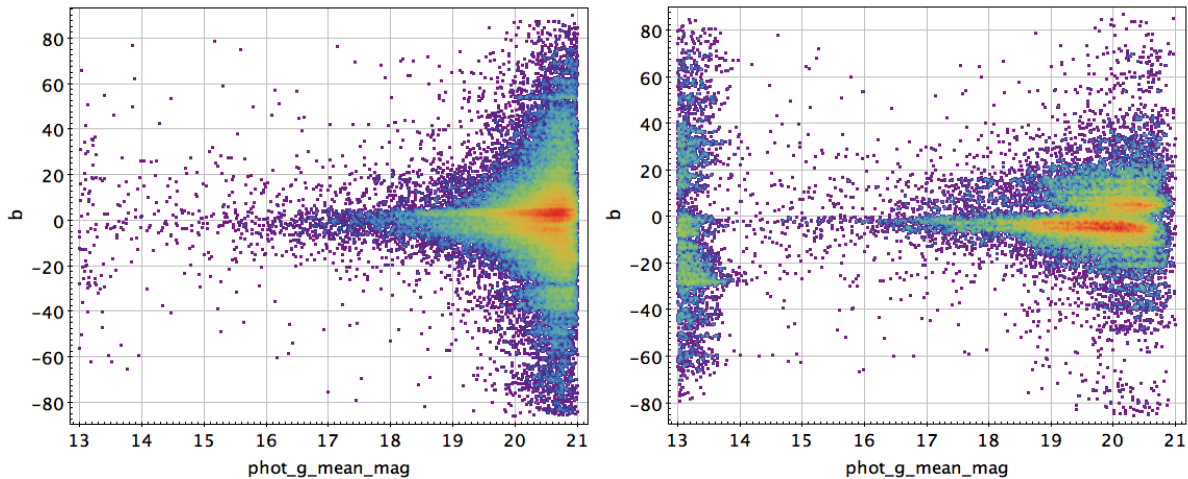


Fig 1.

For the two sets we performed a visual inspection of a random selection of SDSS images in order to verify the morphology/size of the sources.

Some of the inspected images of sources located at high and low  $b$  and with different magnitude are reported in the appendix of this document. While most of the images seem to be blends in SDSS (not true extended objects), a few of the images at fainter magnitudes indeed seem to be large extended objects.

Based on the analysis presented here, the test status is **FAIL**.

Sign-off:



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### 6.6 ISC-TST-REQ-0050-01

#### 6.6.1 Requirements tested EUCL-ISC-REQ-0050

#### 6.6.2 Test Personnel

Roberto Morbidelli

#### 6.6.3 Test Items

- All ISC files
- Acceptance testing SW
- ISC Release Note

#### 6.6.4 Procedure

##### **Verification method: T**

*This test case is effectively executed during Acceptance Testing, which reports the range of the magnitudes in each ISC file in the Release Note associated with ISC. The VTR is to report this range for each ISC file for this test case. However, note that the ISC will contain stars brighter 10<sup>th</sup> magnitude.*

**Pass criteria:** No ISC files with a maximum instrumental magnitude  $m_i > 19$ , nor a minimum magnitude  $m_i > 10$ .

The table below summarizes the relevant acceptance test results, as reported in the ISC.R3 Release Note [RD 2].

#### 6.6.5 Test Results

The following table reports the minimum and maximum values for the magnitude for each ISC HEALPix file, while the last column reports the check that the maximum magnitude is  $< 19$ .

Healpix	FGSGmag_min	FGSGmag_max	FGSMag_result
000	2.8654	18.9999	T
001	2.7025	18.9999	T
002	4.0322	18.9999	T
003	3.2667	18.9999	T
004	2.5075	18.9999	T
005	2.3545	18.9999	T
006	2.7977	18.9999	T
007	3.3141	18.9999	T
008	2.8644	18.9999	T
009	3.6335	18.9999	T
010	3.6707	18.9999	T
011	2.4466	18.9999	T





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012	2.1795	18.9999	T
013	2.5382	18.9999	T
014	2.2790	18.9999	T
015	3.3552	18.9999	T
016	2.3270	18.9999	T
017	2.1791	18.9999	T
018	3.1192	18.9999	T
019	1.9095	18.9999	T
020	3.0011	18.9999	T
021	2.0016	18.9999	T
022	1.6854	18.9999	T
023	1.8414	18.9999	T
024	2.7477	18.9999	T
025	3.0103	18.9999	T
026	3.4109	18.9999	T
027	3.0673	18.9999	T
028	2.3234	18.9999	T
029	2.4678	18.9999	T
030	3.7193	18.9999	T
031	3.0791	18.9999	T
032	3.6000	18.9999	T
033	2.6928	18.9999	T
034	2.7701	18.9999	T
035	2.5645	18.9999	T
036	3.7268	18.9999	T
037	2.0946	18.9999	T
038	1.9997	18.9999	T
039	1.9807	18.9999	T
040	3.0548	18.9999	T
041	2.6938	18.9999	T
042	3.2549	18.9999	T
043	3.1102	18.9999	T
044	2.3982	18.9999	T
045	2.1978	18.9999	T
046	2.8438	18.9999	T
047	2.7127	18.9999	T
048	3.4074	18.9999	T
049	3.1452	18.9999	T
050	2.1463	18.9999	T
051	1.3727	18.9999	T
052	2.1762	18.9999	T
053	2.8317	18.9999	T
054	3.2825	18.9999	T





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055	2.8972	18.9999	T
056	1.9911	18.9999	T
057	2.6806	18.9999	T
058	2.4894	18.9999	T
059	3.0439	18.9999	T
060	2.4278	18.9999	T
061	1.7287	18.9999	T
062	2.2677	18.9999	T
063	2.3445	18.9999	T
064	3.1253	18.9999	T
065	2.9573	18.9999	T
066	2.7600	18.9999	T
067	2.5639	18.9999	T
068	2.5994	18.9999	T
069	3.3484	18.9999	T
070	3.5160	18.9999	T
071	2.8226	18.9999	T
072	2.1544	18.9999	T
073	2.7992	18.9999	T
074	1.9903	18.9999	T
075	2.9086	18.9999	T
076	2.4695	18.9999	T
077	3.2367	18.9999	T
078	3.2433	18.9999	T
079	2.3215	18.9999	T
080	2.2355	18.9999	T
081	2.3694	18.9999	T
082	1.7394	18.9999	T
083	2.9672	18.9999	T
084	3.1848	18.9999	T
085	2.4257	18.9999	T
086	3.4829	18.9999	T
087	3.1944	18.9999	T
088	3.0474	18.9999	T
089	3.4473	18.9999	T
090	4.0555	18.9999	T
091	2.6775	18.9999	T
092	3.3058	18.9999	T
093	1.8838	18.9999	T
094	2.4248	18.9999	T
095	3.1334	18.9999	T
096	2.0087	18.9999	T
097	1.6013	18.9999	T





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098	2.3592	18.9999	T
099	3.5092	18.9999	T
100	3.0852	18.9999	T
101	3.0880	18.9999	T
102	1.6894	18.9999	T
103	1.9895	18.9999	T
104	2.6458	18.9999	T
105	3.0603	18.9999	T
106	2.8872	18.9999	T
107	3.0910	18.9999	T
108	2.6833	18.9999	T
109	3.3314	18.9999	T
110	3.9780	18.9999	T
111	3.5852	18.9999	T
112	1.3737	18.9999	T
113	1.9009	18.9999	T
114	2.4727	18.9999	T
115	2.5652	18.9999	T
116	3.4431	18.9999	T
117	3.0651	18.9999	T
118	2.4675	18.9999	T
119	1.5802	18.9999	T
120	1.8209	18.9999	T
121	3.2314	18.9999	T
122	1.6877	18.9999	T
123	2.3095	18.9999	T
124	1.7200	18.9999	T
125	2.9409	18.9999	T
126	2.8937	18.9999	T
127	2.7675	18.9999	T
128	1.7721	18.9999	T
129	2.5574	18.9999	T
130	2.1916	18.9999	T
131	3.8691	18.9999	T
132	3.7131	18.9999	T
133	3.0053	18.9999	T
134	3.0059	18.9999	T
135	2.7835	18.9999	T
136	2.0569	18.9999	T
137	2.4859	18.9999	T
138	3.0899	18.9999	T
139	4.3379	18.9999	T
140	2.4673	18.9999	T







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141	1.5710	18.9999	T
142	2.6275	18.9999	T
143	2.7397	18.9999	T
144	2.7838	18.9999	T
145	2.2167	18.9999	T
146	2.8917	18.9999	T
147	1.9124	18.9999	T
148	1.7128	18.9999	T
149	3.5247	18.9999	T
150	3.4459	18.9999	T
151	3.1343	18.9999	T
152	1.9822	18.9999	T
153	2.2065	18.9999	T
154	3.0031	18.9999	T
155	1.4769	18.9999	T
156	3.0299	18.9999	T
157	3.4162	18.9999	T
158	2.3596	18.9999	T
159	3.6360	18.9999	T
160	2.6117	18.9999	T
161	2.0059	18.9999	T
162	1.9501	18.9999	T
163	2.4432	18.9999	T
164	1.7139	18.9999	T
165	2.3760	18.9999	T
166	2.2897	18.9999	T
167	2.8807	18.9999	T
168	2.1704	18.9999	T
169	2.6441	18.9999	T
170	3.7272	18.9999	T
171	1.8627	18.9999	T
172	1.5788	18.9999	T
173	2.7970	18.9999	T
174	2.3485	18.9999	T
175	3.4492	18.9999	T
176	2.5764	18.9999	T
177	1.7848	18.9999	T
178	2.3778	18.9999	T
179	2.7594	18.9999	T
180	2.2606	18.9999	T
181	3.1195	18.9999	T
182	2.3043	18.9999	T
183	3.4675	18.9999	T





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184	3.1964	18.9999	T
185	2.3252	18.9999	T
186	3.1931	18.9999	T
187	2.3609	18.9999	T
188	2.7764	18.9999	T
189	3.0320	18.9999	T
190	2.3346	18.9999	T
191	2.7652	18.9999	T

Based on the results above the test status is: **PASS**





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### **6.7    ISC-TST-REQ-0060-01**

#### **6.7.1   Requirements tested   EUCL-ISC-REQ-0060**

#### **6.7.2   Test Items**

- All ISC files
- Software to execute procedure.
- Local input files

#### **6.7.3   Test Personnel**

Ricky Smart, Beatrice Bucciarelli

#### **6.7.4   Procedure**

##### **Verification method: T**

For each ISC source, the difference in the ISC coordinates with the Gaia source coordinates in the local input files. The coordinate difference divided by the difference in the ISC and Gaia catalogue epochs should just be equal to the proper motion used to infer the ISC coordinates, namely the proper motion from the Gaia source catalogue, as contained in local input files, within a tolerance of 1 mas/yr. Count sources not satisfying this condition.

**Pass criteria:** Count of sources not meeting the criteria is equal to zero.

#### **6.7.5   Test Results**

The 192 ISC.R3 files were uploaded into a local DB, and Gaia-DR2 positions were recovered and uploaded from the local DR2 DB using the sourceId. The procedure was then performed on each ISC source as a DB operation.

For each ISC source, we found the proper motion from the difference in the ISC and Gaia coordinate positions and divided that by 9.5yr, the epoch difference between the ISC and the Gaia DR2, allowing for the cosine declination term. Comparing these proper motions with the Gaia DR2 proper motions by taking the difference, we found the largest absolute proper motion difference to be 0.97 mas/yr.

Based on the results above the test status is: **PASS**





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### 6.8 ISC-TST-REQ-0070-01

#### 6.8.1 Requirements tested EUCL-ISC-REQ-0070

#### 6.8.2 Test Items

- All ISC files
- Software to execute procedure.
- Local input files

#### 6.8.3 Test Personnel

Ricky Smart, Beatrice Bucciarelli

#### 6.8.4 Procedure

##### Verification method: T

For each ISC source, back propagating the ISC coordinates to the Gaia source catalogue epoch using the ISC proper motions, should recover the Gaia source catalogue positions in the local input files with a tolerance 10 mas.

**Pass criteria:** Count of sources not meeting the above criteria is equal to zero.

#### 6.8.5 Test Results

The 192 ISC.R3 files were uploaded into a local DB, and Gaia-DR2 positions were recovered and uploaded from the local DR2 DB using the sourceId. The procedure was then performed on each ISC source as a DB operation.

We propagated the ISC position from 2025 to 2015.5 using the *epochProp* routine in the Starlink Tables Infrastructure Library Tool Set [RD 5] assuming a parallax of zero and radial velocity of zero. Using the package this way is an independent implementation of the procedure defined in [RD 4]. The largest positional difference between the Gaia DR2 position and our propagated position was 0.022 mas.

Based on the results above the test status is: **PASS**





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### 6.9 ISC-TST-REQ-0080-01

#### 6.9.1 Requirements tested EUCL-ISC-REQ-0080

#### 6.9.2 Test Items

- ISC Release Note

#### 6.9.3 Test Personnel

Roberto Morbidelli

#### 6.9.4 Procedure

##### **Verification method: T**

*This test case is effectively executed during Acceptance Testing, which reports in the Release Note associated with ISC the number of sources in each ISC file with no classification flag or with flag values out-of-range. The VTR is to report these numbers for each ISC file for this test case.*

**Pass criteria:** All ISC files shall have zero sources missing a classification flag, and zero sources with classification flags out of range.

The table below summarizes the relevant acceptance test results, as reported in the ISC.R3 Release Note [RD 2].

#### 6.9.5 Test Results

The following table reports the result of the check, for each ISC HEALPix file, that the range of values for the Classification flag falls within the acceptable range ([0,1]), as reported in the ISC.R3 Release Note.

000	T	048	T	096	T	144	T
001	T	049	T	097	T	145	T
002	T	050	T	098	T	146	T
003	T	051	T	099	T	147	T
004	T	052	T	100	T	148	T
005	T	053	T	101	T	149	T
006	T	054	T	102	T	150	T
007	T	055	T	103	T	151	T
008	T	056	T	104	T	152	T
009	T	057	T	105	T	153	T
010	T	058	T	106	T	154	T
011	T	059	T	107	T	155	T
012	T	060	T	108	T	156	T
013	T	061	T	109	T	157	T
014	T	062	T	110	T	158	T
015	T	063	T	111	T	159	T





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016	T	064	T	112	T	160	T
017	T	065	T	113	T	161	T
018	T	066	T	114	T	162	T
019	T	067	T	115	T	163	T
020	T	068	T	116	T	164	T
021	T	069	T	117	T	165	T
022	T	070	T	118	T	166	T
023	T	071	T	119	T	167	T
024	T	072	T	120	T	168	T
025	T	073	T	121	T	169	T
026	T	074	T	122	T	170	T
027	T	075	T	123	T	171	T
028	T	076	T	124	T	172	T
029	T	077	T	125	T	173	T
030	T	078	T	126	T	174	T
031	T	079	T	127	T	175	T
032	T	080	T	128	T	176	T
033	T	081	T	129	T	177	T
034	T	082	T	130	T	178	T
035	T	083	T	131	T	179	T
036	T	084	T	132	T	180	T
037	T	085	T	133	T	181	T
038	T	086	T	134	T	182	T
039	T	087	T	135	T	183	T
040	T	088	T	136	T	184	T
041	T	089	T	137	T	185	T
042	T	090	T	138	T	186	T
043	T	091	T	139	T	187	T
044	T	092	T	140	T	188	T
045	T	093	T	141	T	189	T
046	T	094	T	142	T	190	T
047	T	095	T	143	T	191	T

Based on the results above the test status is **PASS**.





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### 6.10 ISC-TST-REQ-0090-01

#### 6.10.1 Requirements tested EUCL-ISC-REQ-0090

#### 6.10.2 Test Items

- ISC Release Note

#### 6.10.3 Test Personnel

Roberto Morbidelli

#### 6.10.4 Procedure

##### **Verification method: T**

*This test case is effectively executed during Acceptance Testing, which reports in the Release Note associated with ISC the number of sources in each ISC file with no neighborhood flag or with flag values out-of-range. The VTR is to report these numbers for each ISC file for this test case.*

**Pass criteria:** All ISC files shall have zero sources missing a neighborhood flag, and zero sources with neighborhood flags out of range.

The table below summarizes the relevant acceptance test results, as reported in the ISC.R3 Release Note [RD 2].

#### 6.10.5 Test Results

The following table reports the result of the check, for each ISC HEALPix file, that the range of values for the Neighbor flag falls within the acceptable range ([0,3]), as reported in the ISC.R3 Release Note.

000	T	048	T	096	T	144	T
001	T	049	T	097	T	145	T
002	T	050	T	098	T	146	T
003	T	051	T	099	T	147	T
004	T	052	T	100	T	148	T
005	T	053	T	101	T	149	T
006	T	054	T	102	T	150	T
007	T	055	T	103	T	151	T
008	T	056	T	104	T	152	T
009	T	057	T	105	T	153	T
010	T	058	T	106	T	154	T
011	T	059	T	107	T	155	T
012	T	060	T	108	T	156	T
013	T	061	T	109	T	157	T
014	T	062	T	110	T	158	T
015	T	063	T	111	T	159	T
016	T	064	T	112	T	160	T





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017	T	065	T	113	T	161	T
018	T	066	T	114	T	162	T
019	T	067	T	115	T	163	T
020	T	068	T	116	T	164	T
021	T	069	T	117	T	165	T
022	T	070	T	118	T	166	T
023	T	071	T	119	T	167	T
024	T	072	T	120	T	168	T
025	T	073	T	121	T	169	T
026	T	074	T	122	T	170	T
027	T	075	T	123	T	171	T
028	T	076	T	124	T	172	T
029	T	077	T	125	T	173	T
030	T	078	T	126	T	174	T
031	T	079	T	127	T	175	T
032	T	080	T	128	T	176	T
033	T	081	T	129	T	177	T
034	T	082	T	130	T	178	T
035	T	083	T	131	T	179	T
036	T	084	T	132	T	180	T
037	T	085	T	133	T	181	T
038	T	086	T	134	T	182	T
039	T	087	T	135	T	183	T
040	T	088	T	136	T	184	T
041	T	089	T	137	T	185	T
042	T	090	T	138	T	186	T
043	T	091	T	139	T	187	T
044	T	092	T	140	T	188	T
045	T	093	T	141	T	189	T
046	T	094	T	142	T	190	T
047	T	095	T	143	T	191	T

Based on the results above the test status is: **PASS**







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### 6.11 ISC-TST-REQ-0100-01

#### 6.11.1 Requirements tested EUCL-ISC-REQ-0100

#### 6.11.2 Test Items

- ISC Release Note

#### 6.11.3 Test Personnel

Roberto Morbidelli

#### 6.11.4 Procedure

##### **Verification method: T**

*This test case is effectively executed during Acceptance Testing, which reports in the Release Note associated with ISC the number of sources in each ISC file with no variability flag or with flag values out-of-range. The VTR is to report these numbers for each ISC file for this test case.*

**Pass criteria:** All ISC files shall have zero sources missing a variability flag, and zero sources with variability flags out of range.

The table below summarizes the relevant acceptance test results, as reported in the ISC.R3 Release Note [RD 2].

#### 6.11.5 Test Results

The following table reports the result of the check, for each ISC HEALPix file, that the range of values for the Variability flag falls within the acceptable range  $([0,1])$ , as reported in the ISC.R3 Release Note.

000	T	048	T	096	T	144	T
001	T	049	T	097	T	145	T
002	T	050	T	098	T	146	T
003	T	051	T	099	T	147	T
004	T	052	T	100	T	148	T
005	T	053	T	101	T	149	T
006	T	054	T	102	T	150	T
007	T	055	T	103	T	151	T
008	T	056	T	104	T	152	T
009	T	057	T	105	T	153	T
010	T	058	T	106	T	154	T
011	T	059	T	107	T	155	T
012	T	060	T	108	T	156	T
013	T	061	T	109	T	157	T
014	T	062	T	110	T	158	T
015	T	063	T	111	T	159	T
016	T	064	T	112	T	160	T





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017	T	065	T	113	T	161	T
018	T	066	T	114	T	162	T
019	T	067	T	115	T	163	T
020	T	068	T	116	T	164	T
021	T	069	T	117	T	165	T
022	T	070	T	118	T	166	T
023	T	071	T	119	T	167	T
024	T	072	T	120	T	168	T
025	T	073	T	121	T	169	T
026	T	074	T	122	T	170	T
027	T	075	T	123	T	171	T
028	T	076	T	124	T	172	T
029	T	077	T	125	T	173	T
030	T	078	T	126	T	174	T
031	T	079	T	127	T	175	T
032	T	080	T	128	T	176	T
033	T	081	T	129	T	177	T
034	T	082	T	130	T	178	T
035	T	083	T	131	T	179	T
036	T	084	T	132	T	180	T
037	T	085	T	133	T	181	T
038	T	086	T	134	T	182	T
039	T	087	T	135	T	183	T
040	T	088	T	136	T	184	T
041	T	089	T	137	T	185	T
042	T	090	T	138	T	186	T
043	T	091	T	139	T	187	T
044	T	092	T	140	T	188	T
045	T	093	T	141	T	189	T
046	T	094	T	142	T	190	T
047	T	095	T	143	T	191	T

Based on the results above the test status is: **PASS**





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### 6.12 ISC-TST-REQ-0110-01

#### 6.12.1 Requirements tested EUCL-ISC-REQ-0110

#### 6.12.2 Test Items

- ISC Release Note

#### 6.12.3 Test Personnel

Roberto Morbidelli

#### 6.12.4 Procedure

##### **Verification method: T**

*This test case is effectively executed during Acceptance Testing, which reports in the Release Note associated with ISC the number of sources with missing parameters (i.e. number of records with non-nominal record length). The VTR is to report these numbers for each ISC file for this test case.*

**Pass criteria:** All ISC files shall have zero sources missing a required parameter, and zero sources with variability flags out of range.

The table below summarizes the relevant acceptance test results, as reported in the ISC.R3 Release Note [RD 2].

#### 6.12.5 Test Results

The following table reports the result of the check, for each ISC HEALPix file, that each line was correctly read with a formatted read statement, that all parameters fell within the acceptable range of values, and that no parameters had a no numeric value, as reported in the ISC.R3 Release Note.

000	T	048	T	096	T	144	T
001	T	049	T	097	T	145	T
002	T	050	T	098	T	146	T
003	T	051	T	099	T	147	T
004	T	052	T	100	T	148	T
005	T	053	T	101	T	149	T
006	T	054	T	102	T	150	T
007	T	055	T	103	T	151	T
008	T	056	T	104	T	152	T
009	T	057	T	105	T	153	T
010	T	058	T	106	T	154	T
011	T	059	T	107	T	155	T
012	T	060	T	108	T	156	T
013	T	061	T	109	T	157	T
014	T	062	T	110	T	158	T





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015	T	063	T	111	T	159	T
016	T	064	T	112	T	160	T
017	T	065	T	113	T	161	T
018	T	066	T	114	T	162	T
019	T	067	T	115	T	163	T
020	T	068	T	116	T	164	T
021	T	069	T	117	T	165	T
022	T	070	T	118	T	166	T
023	T	071	T	119	T	167	T
024	T	072	T	120	T	168	T
025	T	073	T	121	T	169	T
026	T	074	T	122	T	170	T
027	T	075	T	123	T	171	T
028	T	076	T	124	T	172	T
029	T	077	T	125	T	173	T
030	T	078	T	126	T	174	T
031	T	079	T	127	T	175	T
032	T	080	T	128	T	176	T
033	T	081	T	129	T	177	T
034	T	082	T	130	T	178	T
035	T	083	T	131	T	179	T
036	T	084	T	132	T	180	T
037	T	085	T	133	T	181	T
038	T	086	T	134	T	182	T
039	T	087	T	135	T	183	T
040	T	088	T	136	T	184	T
041	T	089	T	137	T	185	T
042	T	090	T	138	T	186	T
043	T	091	T	139	T	187	T
044	T	092	T	140	T	188	T
045	T	093	T	141	T	189	T
046	T	094	T	142	T	190	T
047	T	095	T	143	T	191	T

Based on the results above the test status is: **PASS**





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### **6.13 ISC-TST-REQ-0120-01**

#### **6.13.1 Requirements tested EUCL-ISC-REQ-0120**

#### **6.13.2 Test Items**

- ISC ICD

#### **6.13.3 Test Personnel**

Ronald Drimmel

#### **6.13.4 Procedure**

##### **Verification method: R**

*VTR shall state the document reference to the ISC ICD.*

**Pass criteria:** *Reviewer sign-off on test case.*

#### **6.13.5 Test Results**

The ICD for the ISC, describing its format and contents, is specified in [RD 3].

Test status is **PASS**.

Sign-off:





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### 6.14 ISC-TST-REQ-0130-01

#### 6.14.1 Requirements tested EUCL-ISC-REQ-0130

#### 6.14.2 Test Items

- ISC Release Note

#### 6.14.3 Test Personnel

Ronald Drimmel

#### 6.14.4 Procedure

##### **Verification method: R**

*The successful execution of the Acceptance Tests (done by software) essentially verifies that the ISC is in ASCII format, as the read statement of the SW running the acceptance tests assumes ASCII format. The VTR shall report the read statement and make reference to the ISC Release Note that reports the result of the acceptance tests.*

**Pass criteria:** Reviewer sign-off on test case.

#### 6.14.5 Test Results

As noted in the Release Note of the ISC.R3 [RD 2], the execution of the acceptance tests required the ISC input files be in ascii format, as the acceptance tests were executed by SW using ASCII read statements, so the successful execution of these tests on all ISC files demonstrates that the ISC is in ASCII format.

Test status is **PASS**.

Sign-off:





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### 6.15 ISC-TST-REQ-0140-01

#### 6.15.1 Requirements tested EUCL-ISC-REQ-0140

#### 6.15.2 Test Items

- ISC Release Note
- ISC VTR

#### 6.15.3 Test Personnel

Ronald Drimmel

#### 6.15.4 Procedure

##### **Verification method: R**

*Reviewer confirms via document review that all ISC files are covered in the ISC Release Note, and that the VTR is complete.*

**Pass criteria:** *Reviewer sign-off on test case.*

#### 6.15.5 Test Results

The Reviewer has reviewed the ISC.R3 Release Note [RD 2], as well as this document (the ISC VTR), and certifies that both are complete.

The test status is **PASS**.

Sign-off:



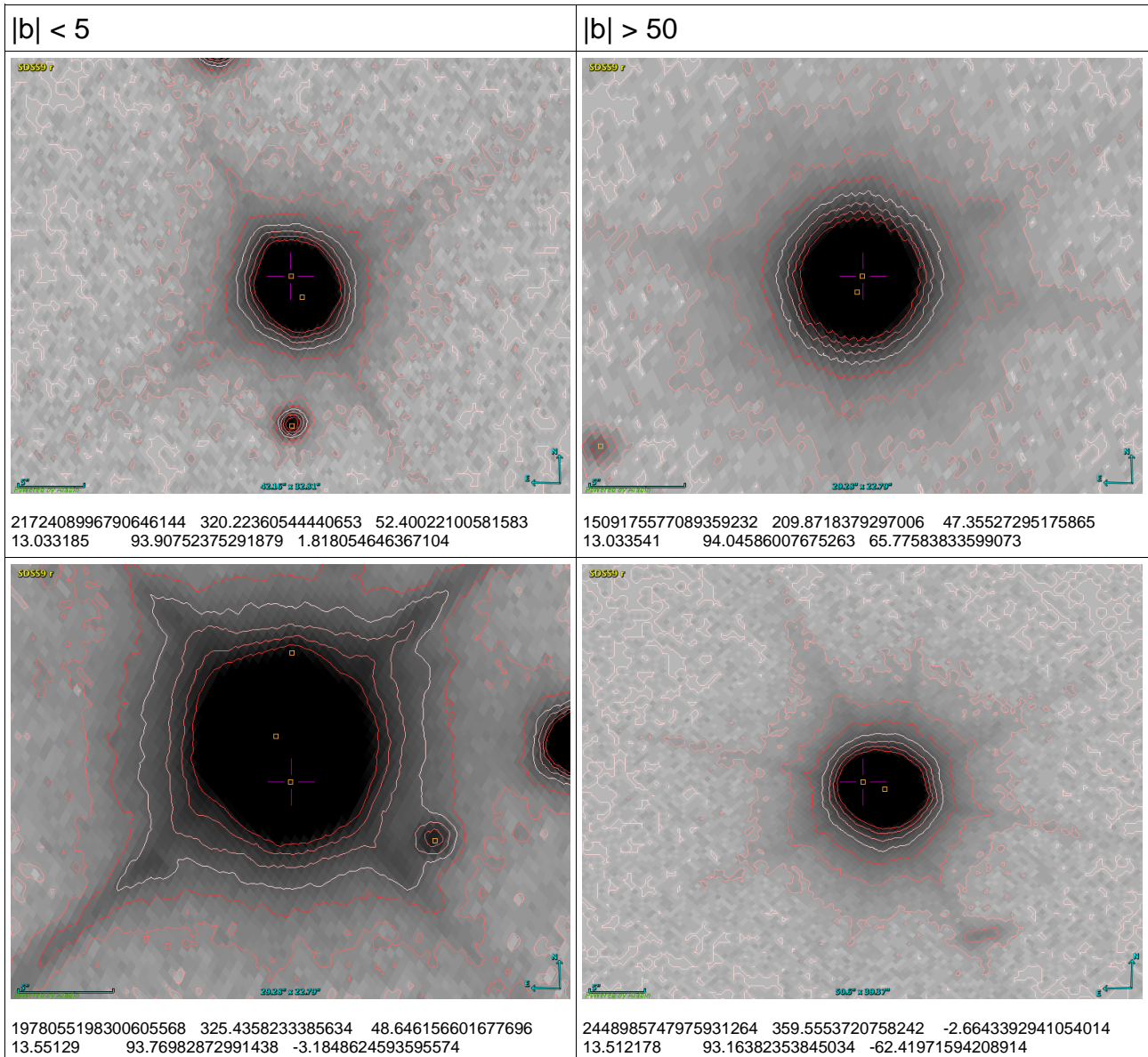
## 7. APPENDIX

Images of a selection of large extended sources in SDSS that are in the ISC.

Fig.A1 shows images of a set SDSS\_big\_ext classified as extended sources in the ISC.

Fig.A2 shows images of a set SDSS\_big\_ext classified as point sources in the ISC.

**Fig A1: Selection of ISC extended sources classified as large extended sources in SDSS.** first column are sources at low galactic latitude, and second column are sources at high galactic latitude. Red cross is centered on the ISC source of interest, yellow squares show the Gaia DR2 sources in the field, images are from the SDSS.

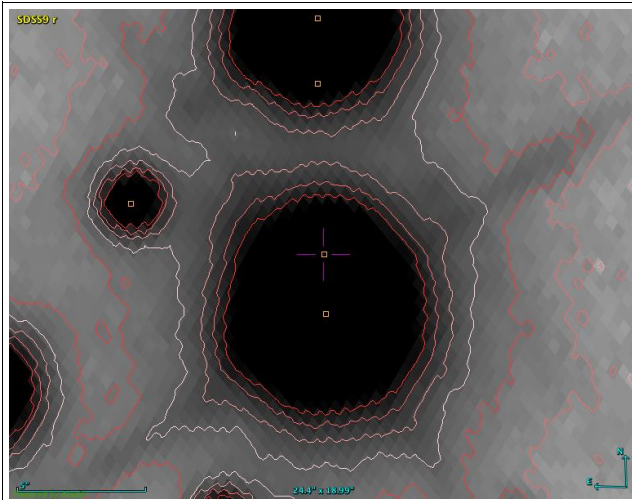




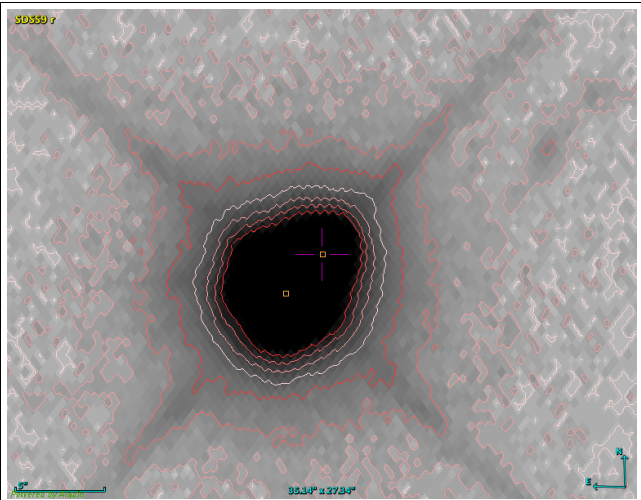


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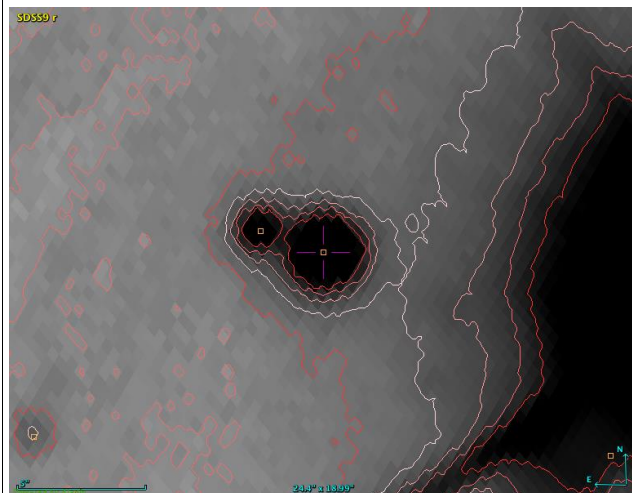
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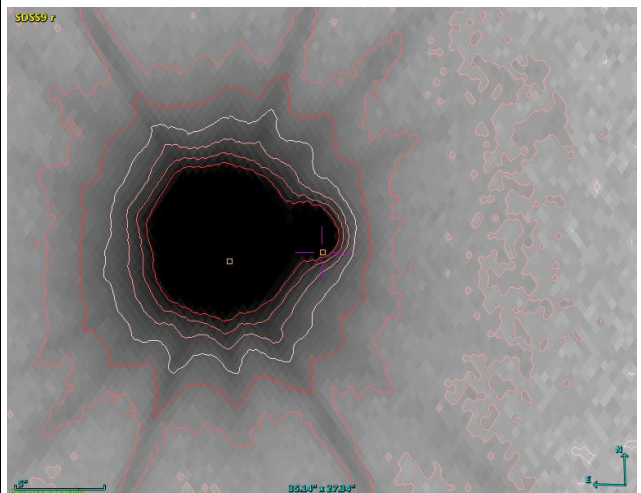
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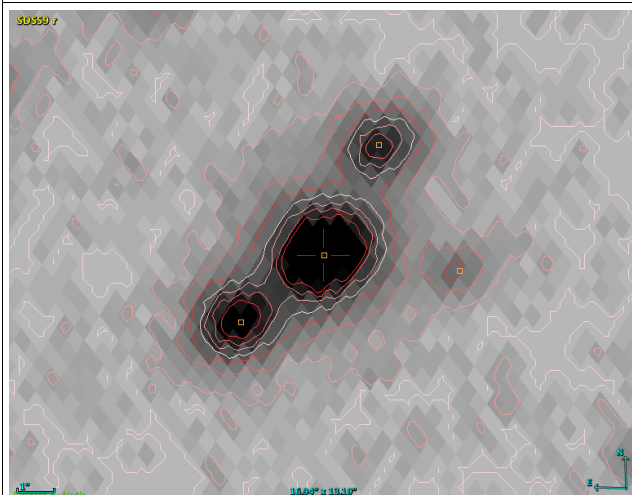
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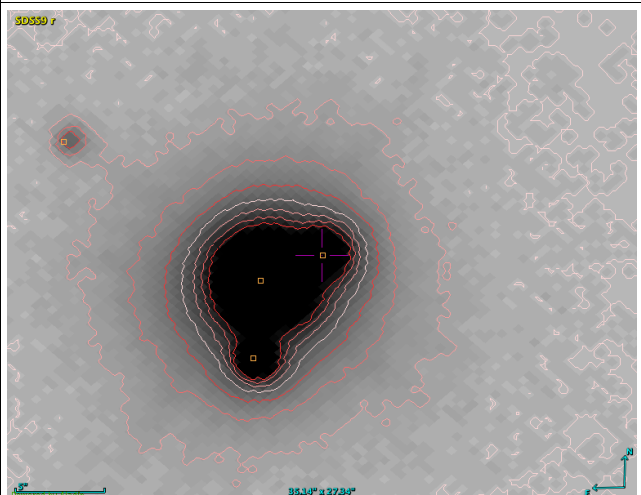
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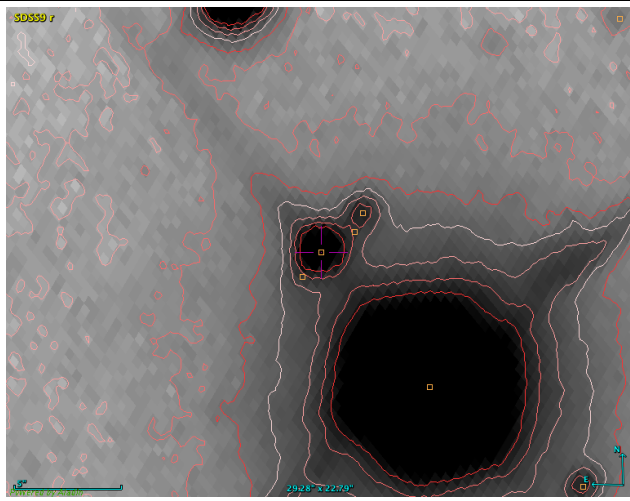


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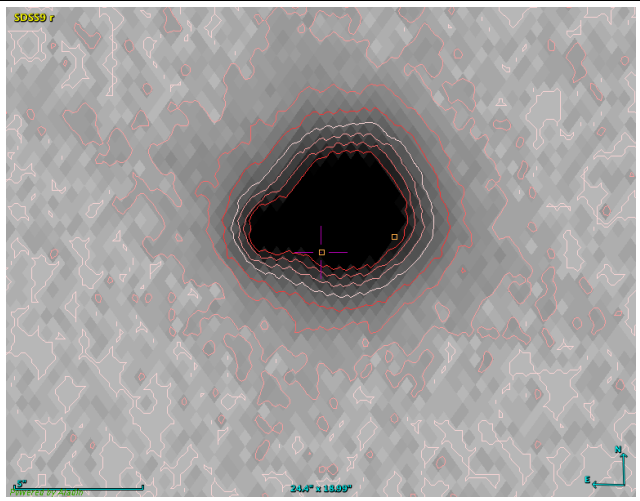


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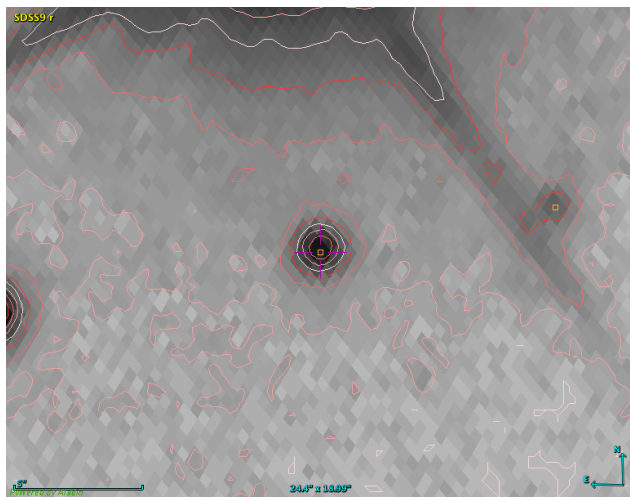




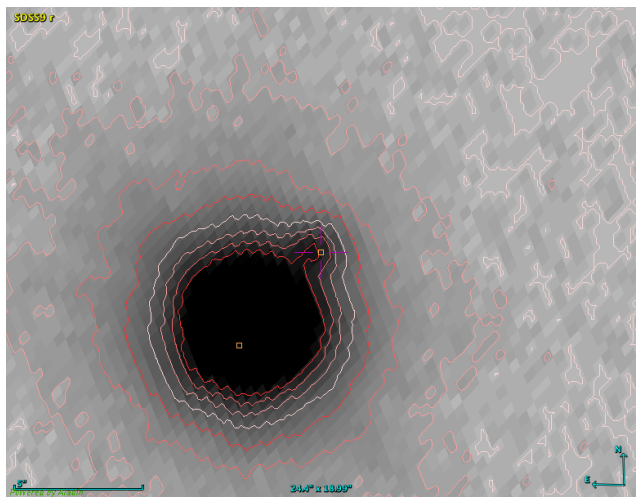
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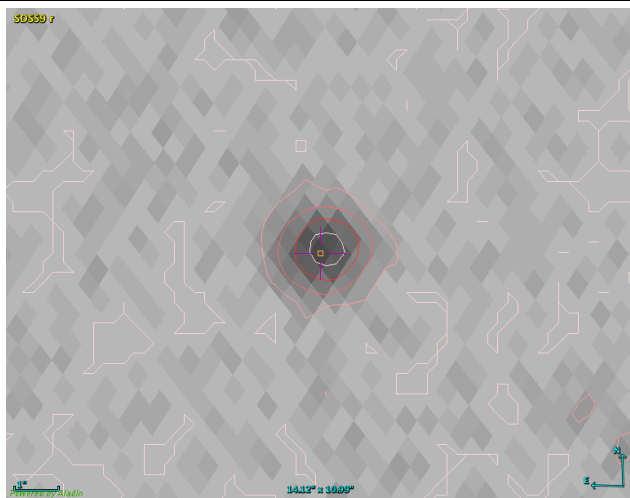
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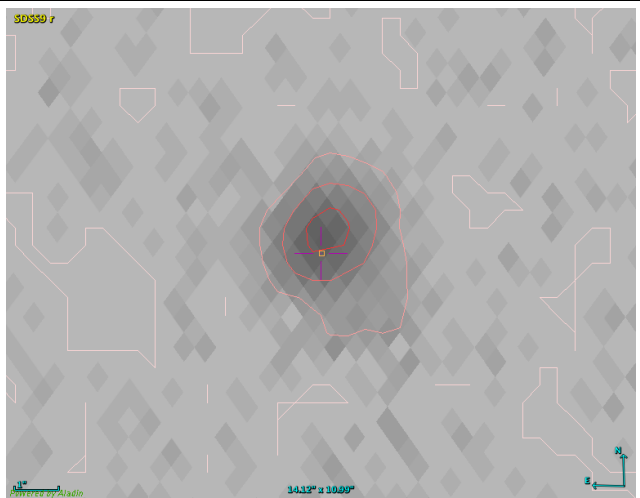
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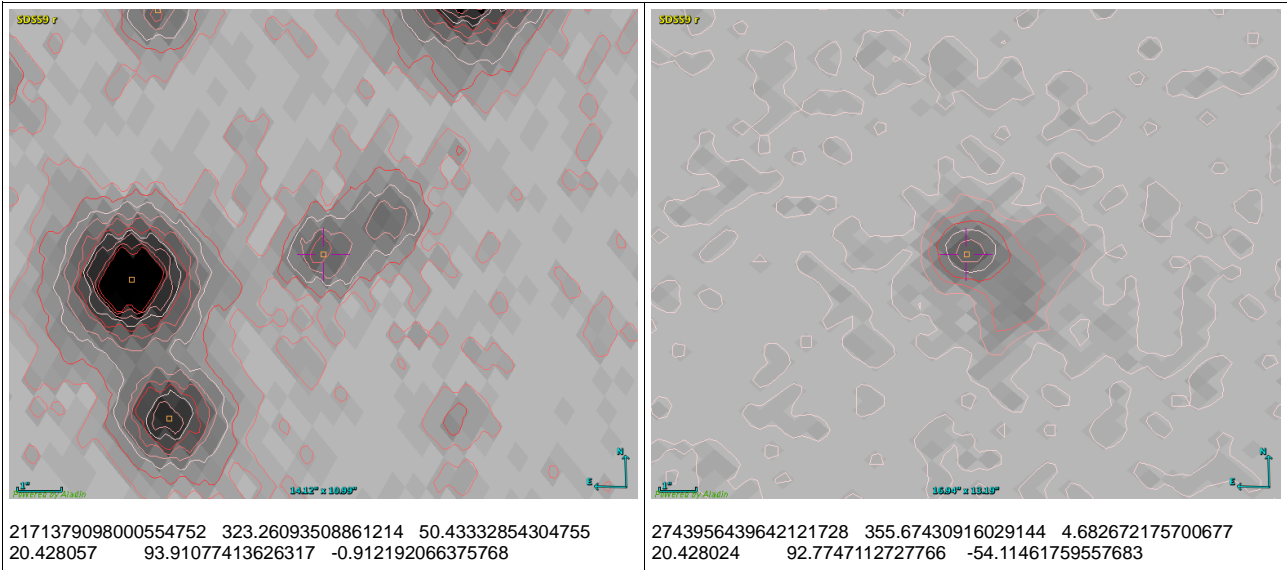
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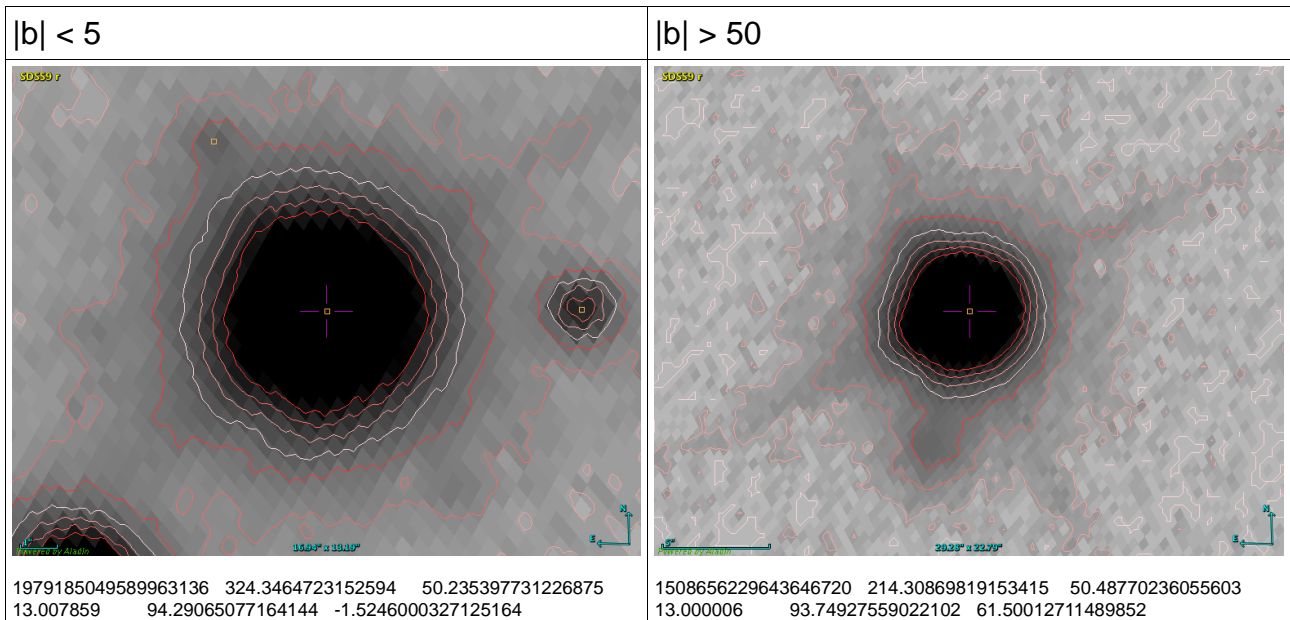
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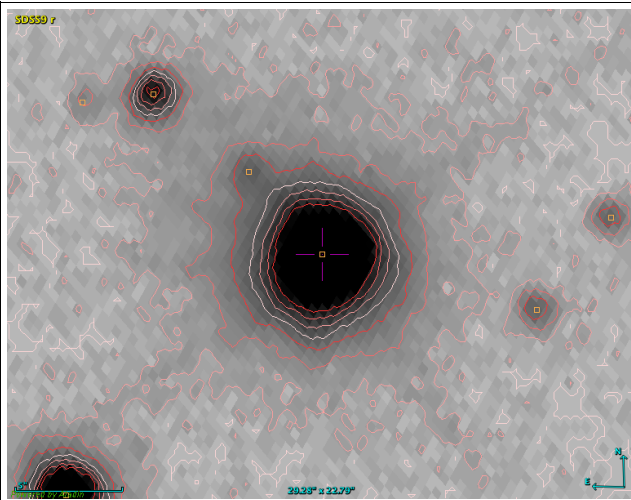


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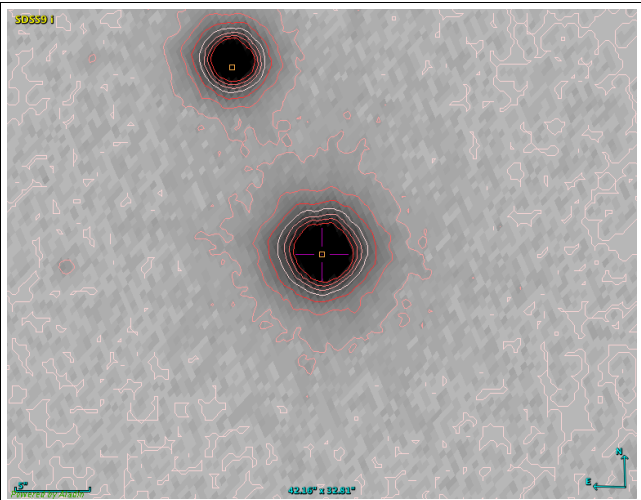


**Fig A2: Selection of ISC point sources classified as large extended sources in SDSS.** first column are sources at low galactic latitude, and second column are sources at high galactic latitude. Red cross is centered on the ISC source of interest, yellow squares show the Gaia DR2 sources in the field, images are from the SDSS.





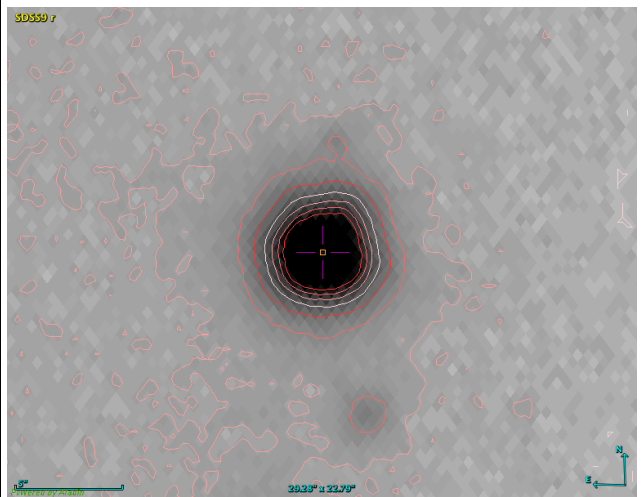
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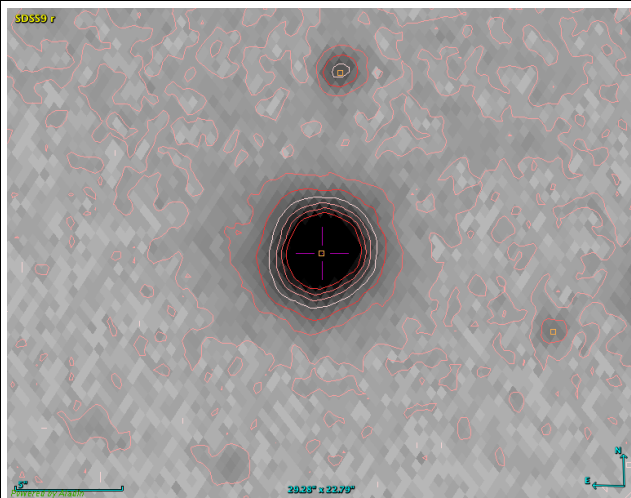
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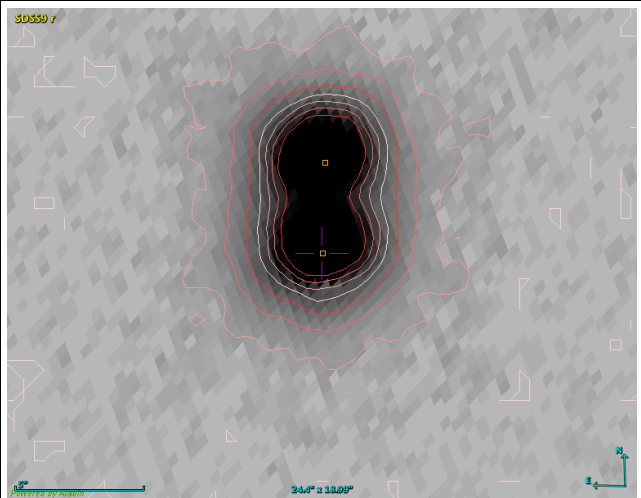
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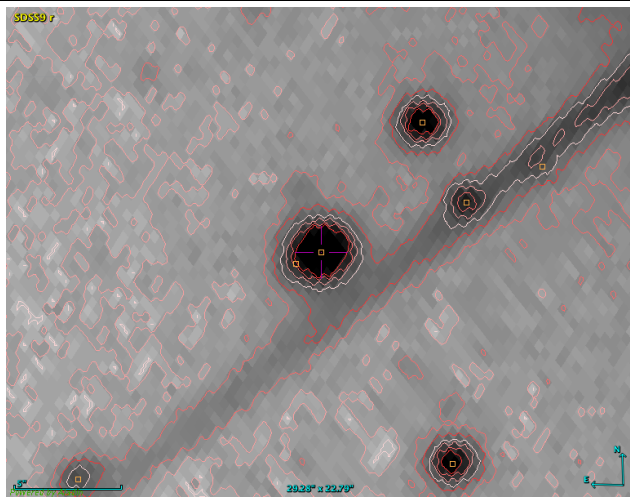
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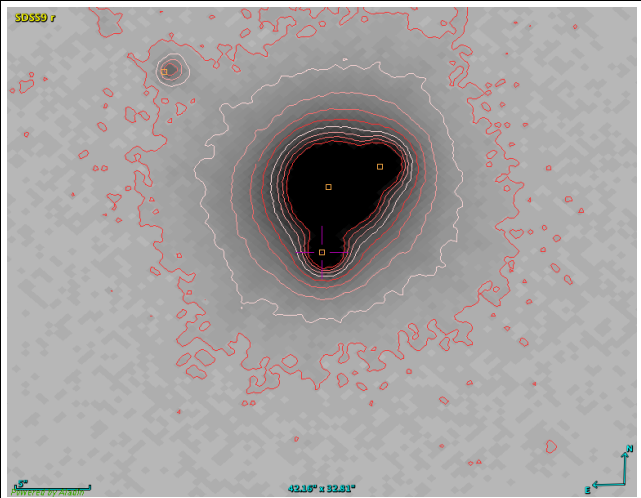
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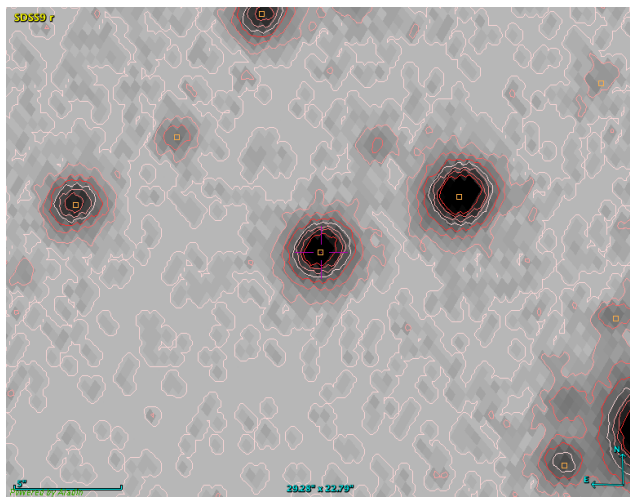
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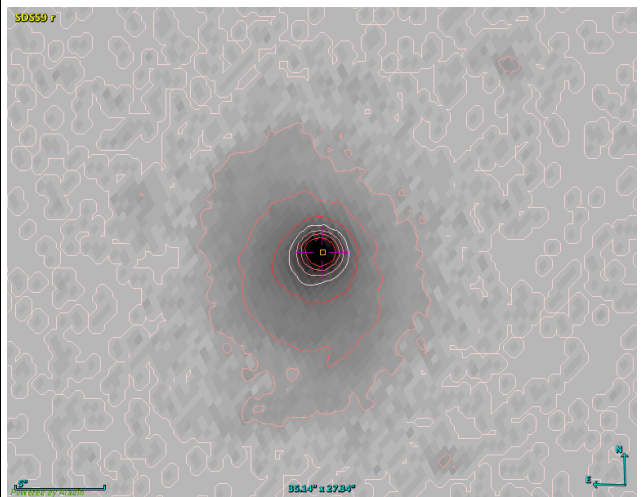
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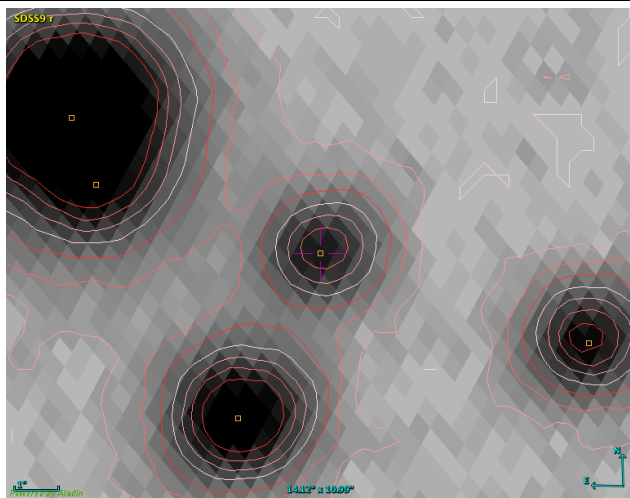
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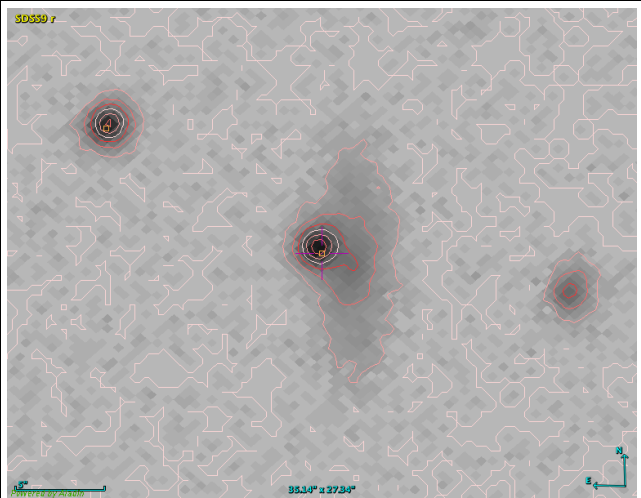
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Verification Test Report***

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