VISTA Science Verification Report II

Science Verification run observations and the Science Verification vs. Survey Management Plan requirements matrix

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1 Introduction

The VISTA Science Verification (SV) run observations were successfully executed between October 15 and November 02, 2009. The first report summarized the status of VISTA and the overall telescope and instrument performance during the SV run. This report provides the summary of the data that were taken during the SV run and a cross-check with the matrix of Survey Management Plans, that was discussed at the Public Surveys Phase 2 workshop in September 2008.

2 A short description of the two SV programmes

Since VISTA is conceived to be primarily a survey telescope, the SV of VISTA consisted of two self-contained mini-surveys (one galactic and one extra-galactic), which have been defined by teams of astronomers from ESO and the community. The execution of these two mini-surveys not only provided the necessary end-to-end test and means to optimize the survey operations and to gain experience in supporting and processing of survey data, but it also at the same time fulfilled the goals of the science verification policy by providing the community with a complete and scientifically exciting set of new data.

2.1 The Galactic mini-survey: A wide area survey in Orion PI: M. G. Petr-Gotzens

The Orion star forming region had been identified as an ideal VISTA SV target to study several aspects of star formation, the early stellar evolution, and the interplay between OB stars and their immediate environment. In particular, a $\sim 30\mathrm{deg}^2$ area in the region of the Orion Belt stars, roughly centered at RA=05h32m, DEC= $-00°10'$, was chosen for a deep photometric VISTA survey making use of all VISTA broad-band filters (Z,Y,J,H,K_s). The survey area includes a number of known stellar populations of different age, which are: Very young ($\leq$ 1Myr) stellar clusters, sometimes still embedded in the molecular cloud material (NGC 2024, 2023, 2068, 2071), the intermediate-age cluster σ Ori ($\sim$3 Myr), parts of the older stellar associations Ori OB1b ($\sim$5 Myr) and Ori OB1a ($\sim$10 Myr), as well as the recently identified stellar group of almost 200 pre-main-sequence (PMS) stars around the B-star 25 Ori ($\sim$10 Myr). The older groups, but also the σ Ori cluster, are essentially free of gas.
The goal of this SV project is to study the young stellar and substellar populations in the survey area down to brown dwarf masses of $\sim 8 - 12\mathrm{M}_{\mathrm{Jup}}$. The actual limits in terms of mass mainly depend on brown dwarf age and extinction (beside the weather conditions). The targeted detection limits per filter (in Vega magnitudes) are given in Table 1, and are based on the goal to detect a $\sim 12\mathrm{M}_{\mathrm{Jup}}$ object with an age of 10Myr at the distance of 400 pc and A_V=1.0mag. In terms of $\mathrm{T}_{\mathrm{eff}}$ the observations will be sensitive

to young Orion members as cold as $T_{eff} \approx 1800$K, which corresponds to a spectral type of ∼L4. The final survey data shall allow observational comparative studies across the groups/populations of differing age and will enable investigations of e.g. the timescales for circumstellar (protoplanetary) disk evolution, or the environmental effects and possible non-universality on the low-mass end of the Initial Mass Function (IMF). The full SV proposal can be found at:
`http://www.eso.org/sci/activities/vltsv/vista/index.html`.

Table 1: Targeted sensitivity limits (in Vega mag, 5σ) of the Orion survey in each filter.

Filter	Mag limit (Vega)
Z	22.7
Y	21.0
J	20.2
H	19.2
K_s	18.4

The observing strategy for the Orion mini-survey has been as follows:

1. Deep imaging of the whole survey area

   The survey area is observed with 20 contiguous tiles (pointings) that are arranged as shown in Figure 1. Each tile overlaps by 60″ in x and by 100″ in y with its neighbouring tile. Furthermore, each tile consists of 6 pawprint positions defined by the Tile pattern *tile6zz*, such that stacking them results in a filled tile. Each tile is observed with all VISTA broad-band filters as close in time as possible, because young low-mass objects are known to be possibly variable on time scales of days. Therefore, for each tile, 2 OBs are planned to be executed in consecutive order: one OB that defines KsJZ imaging with DIT×NDIT = 2×12 (Ks), 4×8 (J), 30×5 (Z) and a second OB that defines HYZ imaging with DIT×NDIT = 2×12 (H), 6×4 (Y), 30×2 (Y), 6×4 (Z). Since the large majority of tiles observe regions of Orion that do not show strong nebulous background and little crowding, the sky shall be estimated from the science exposures of a tile itself. Tile 4, however, contains NGC 2024 which has extended nebulosity. Therefore for this tile the sky subtraction is done using the concatenated observations of an offset sky field to the east of NGC 2024 and Tile 8 observations to the north of Tile 4.

2. Shallower, repeated imaging of Tile19 (25 Ori group)

   In order to detect variability of sources (an additional indicator of youth) in the 25 Ori group, an observation at J- and H-band (one short OB with alternating H,

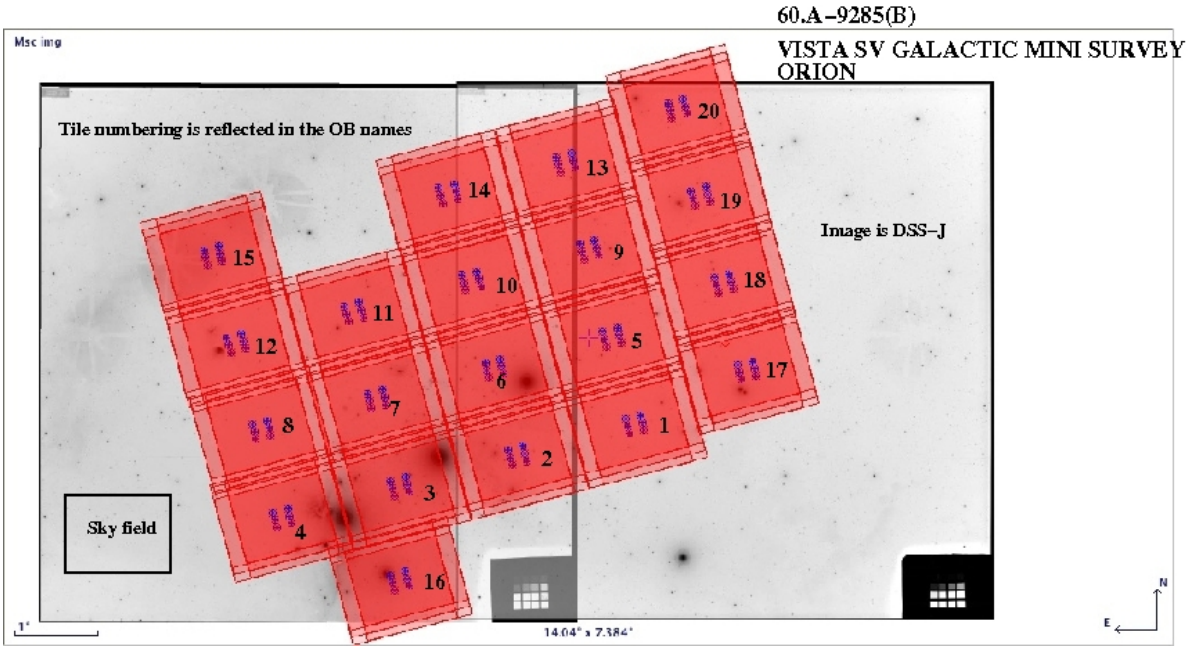

Figure 1: The arrangement of Tiles $1-20$ in the Orion survey area. The tiles' position angle is PA= 15°. The small blue dots visible in the centers of each tile indicate the pointings of each of the 6 pawprint positions.

J observation with DIT×NDIT = 4×3 (H), 8×2 (J)) is executed at least once per night for tile19. In the case that 2 epochs of JH observations are carried out per night, the minimum separation in time between these two is 1hour.

3. Additional observations at Z- and J-band of Tile 16 (σ Ori)

   Some additional OBs at Z- and J-band are prepared to improve the sensitivity limits of Tile16, which contains the well studied cluster σ Orionis. These observations, are carried out only in case there is additional time available, e.g. a few minutes (or tens of minutes) at the end of the observing night, when it is not reasonable to start deep observations on a new tile. The settings used for these observations are DIT×NDIT = 30×3 (Z), 4×8 (J), number of jitters per pawprint position = 3.

In Sec. 3, we list the actual total integration times per filter and tile and provide a description of the actually carried observations.

2.2 The extragalactic mini-survey: deep survey of NGC 253 PI: M. Arnaboldi

The scientific goals of this project are the studies of the stellar halo in a nearby edge-on spiral galaxy:

- Detect the faint stellar halo;
- luminosity function of satellites;
- detection of GCs/UCDs – their luminosity function and distribution;
- detection of stellar streams outside the disk;
- determination of the dust distribution orthogonal to the disk by mapping the 2D distribution of background emitters;
- study of the dynamics of the disk and the nuclear regions.

The scientific proposal for the VISTA SV extragalactic mini-survey is available at
`http://www.eso.org/sci/activities/vltsv/vista/VISTA_Extragalactic.pdf`
The target selected for the VISTA science verification is NGC 253 located at RA(J2000)= 00 : 47 : 33 DEC(J2000)=−25 : 17 : 18 (J2000) , a Southern starburst edge-on spiral galaxy in the Sculptor group at a distance of 3.9 Mpc (m−M = 27.62). At such distance, the tip of the RGB stars is at J = 22.4, H=21.6 mag. The total area covered by the VISTA FoV is 75 kpc × 100 kpc, and we should be able to detect stellar streams like those in NGC 5907 and M31. Additional data available in the ESO archive for such galaxy are B, V, Rc, Ic + H_α from MPI-2.2 WFI, FORS2 I (1.75 hrs),R (3.6hrs). All data are available to the public.
The definition of the mini survey geometry via SADT, and the phase 2 OBs are available at the following webpage:
`http://www.eso.org/sci/observing/policies/PublicSurveys/VISTA_SV.html`
The following observing strategies were adopted:

1. **The Phase 2 deep observing strategy** included 5.8 hrs in NB118 (NDIT × DIT = 1 × 300), 9.6hrs in Z (NDIT × DIT=60 × 3) and 24 hrs in J band (NDIT × DIT=45 × 5) to reach the tip of the RGBs with S/N = 10. We used tile6zz with a sequence of pawprint offsets and the jitter exposures (FJPME). Such strategy was adopted to ensure the best sky subtraction: the presence of an extended disk covering several detectors would prevent the simple sky subtraction using images from different jitter exposures, because the disk is extended. Having adjacent pawprints made it possible to subtract the sky, at the expense of editing manually the reduction blocks with the precise indication of the pawprints where the disk is not present.

2. **The Phase 2 shallow observing strategy** included short observations in Y, J, H and Ks to study the morphology of the disk, in the nuclear regions and the mapping of the thick disk. Here the implemented strategy tested a possible sky-offset sequence. A concatenation was made with three OBs, the first and the third were centred on the galaxy, with the VIRCAM template tile3px and tile3nx. The

assumption is that they would cover two parallel stripes, as in the sequence of the tile6zz template. The second OB was a tile1_00 (e.g. single pawprint) observation of an offset sky. This approach did not work because of a bug in the SADT definition of tile3px and tile3nx.

2.3 Additional observations carried upon request from some public survey PIs

Public survey PIs Minniti (VVV), Jarvis and Dunlop (VIDEO and UltraVISTA) and Cioni (VMC) requested to have short (up to two hour long) observations taken during the SV run for their testing purposes.
The data taken for the VMC survey consisted of single exposures with the same DIT/NDIT values as described in the VMC survey management plan (SMP). This was requested as a test of the S/N and non-linearity limit due to different results being given by the ESO ETC and ETC from VISTA consortium web pages.
The data taken for the VVV survey consisted of 12 OBs on a single field in the Bulge, aiming to provide a test dataset for the variability analysis and for the setup of the data processing procedures. In addition, a test of the sky subtraction strategy was done by observing one tile with all 5 broad-band filters as expected by the SMP, and then immediately before and after that observing adjacent and more distant tiles in only one filter (K-band). With this dataset the team aims to test how frequently the sky has to be sampled in K-band, and whether in the crowded Bulge regions the adjacent tiles give sufficiently good offset sky images, or if one needs to go to less crowded external regions of the Bulge.
The data taken for the VIDEO and Ultra-VISTA surveys combined the strategy and maximized the return where the combination of the J-band $\sim$ 4h long exposure was taken on the field that has other public data - this tests the observing strategies of both these deep public surveys.

3 Data, processing and SV data products

The Galactic survey on Orion has covered 20 contiguous tiles, with each tile exposed nearly-simultaneously in Y, Z, J, H, and Ks bands within two OBs. The J, H, and Ks observations used short detector integration times in order to stay well below the detector's non-linearity regime for the background and for moderately bright sources. For the Y- and Z-band observations short exposures were obtained in addition to the background limited long DIT exposures, in order to guarantee non-saturation of most of the 2MASS sources in the field-of-view. Typically, 2 jittered exposures were performed per pawprint, except for the short exposure Z-band observation (1 jitter) and the long exposure Z-band observation (3 jitters). In addition, tile19 was monitored 1-2 times each night in J and

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Z	2844	3294	2844	3144	2988	2844	2844	2844	2844	2844	2844	2844	2844	2844	2994	6084	2844	2844	2844	2844
Y	1128	1380	1008	1200	1788	1068	1008	1008	1032	1008	1008	864	1008	1008	1464	1008	1008	1008	1008	1008
J	544	608	384	384	768	384	384	384	384	384	384	384	384	384	384	2112	384	416	2528	384
H	416	288	288	288	288	312	288	288	288	288	288	288	288	288	456	288	288	288	1884	288
K_s	288	360	288	288	312	288	288	288	288	288	312	288	312	288	576	288	336	576	288	288

Figure 2: Total exposure time (in sec) per tile per filter for the Galactic mini-survey in Orion.

H-bands, resulting in a total of 19 epochs obtained between Oct 16 and Nov 02, 2009. Five additional OBs (3 at J-band and 2 at Z-band) were executed on the tile16 covering the σ Ori cluster. In Figure 2 we list the total exposure time that has been accumulated per tile and filter for the Galactic VISTA survey.
The extragalactic survey has accumulated 5.8h exposure time in NB118, 9.6h in Z, and 24h in J-band on a single tile on the field of NGC 253 galaxy in the Sculptor group. In addition to this deep and narrow-band part, the extragalactic mini-survey took also shallower images in Y, J, H and Ks bands, in which the aim was to investigate the bright galaxy disk, and therefore the exposure times were shorter, in order to keep the brightest part of the galaxy within the linearity regime of the array. In all cases, the galaxy was centered on detectors 10 and 11 in pawprints 2, 4, and 6, so that the other three pawprints (1, 3, and 5), and their jittered exposures could be used to create an offset sky image for data processing. The major axis of the galaxy was parallel to the shorter side of the tile.

Pawprint level data products for $\sim$ 60% of the observations of the extragalactic mini-survey, and $\sim$ 10% of the Galactic mini-survey were produced on Paranal, in parallel with the observations. The reductions were run on the offline machine with the pipeline version 0.9.6. The reduction blocks were manually adjusted in order to take the latest calibrations available, and to include the offset sky frames for sky subtraction. The pawprint level data products consist of stacked jittered images for each pawprint, confidence maps, offset sky images, and catalogues based on individual pawprints. These reductions enabled to gain experience with the VIRCAM pipeline and data processing, to investigate some parameters like de-striping and the best observational strategy for offset sky observations and to assess several items on the SV matrix. The next section provides detailed discussion on all the items from the SV matrix and where possible indicates the dataset that can be used to test and characterize the instrument.
Reductions of SV data beyond the pawprint level, production of tiles, mosaics and merging of the catalogues is an on-going activity that is coordinated in Garching by the SV team PIs, M. Arnaboldi and M. Petr-Gotzens.
At the time of writing of this report CASU has made reductions of all the SV data to the pawprint level. It is expected that CASU will also make tiles and final merged catalogues. These reductions, together with reductions done by SV teams, will be discussed in a meeting scheduled in Garching on 25-26 November. We expect to discuss and agree on the data publication policy at that time. All raw and reduced data should be published shortly after the official handover of the telescope to ESO.

4 Survey Management Plan requirements vs. Science Verification and Commissioning matrix

Here we list the items from the SV matrix and for each of them indicate the result of the test or if the result is not yet available, which data can be used for this. Note that

for some of the items, ESO will not provide the end result, as they are expected to be covered in the commissioning report from the VISTA consortium. However, if necessary to (re-)derive the results for these items, we provide the information on the available data.

1. **Tile overlaps** - data taken within the Orion SV mini-survey — Result: verify by measuring the overlap between the adjacent tiles and comparing that it corresponds to input in SADT

2. **Tile Orientation** — data for NGC 253 taken at PA=51° and for ORION taken at PA=15° — Result: definiton of PA and rotator angle is correct in SADT and OB templates

3. **Combine 6 pawprints into a tile** — SV data for Orion and NGC 253 — Result: tiling done successfully with Gaia and SWARP software packages; CASU will deliver also pipeline products at tile level

4. **Nesting** — OBs with nesting FPJME, PFJME, and FJPME prepared and executed — Result: nesting FPJME and FJPME give expected observing sequence, but some bugs were discovered for PFJME – these are reported in PPRS-033114

5. **Multiple filters in one template** — OBs prepared and executed — Result: expected behaviour, except for PFJME nesting when two equal filters are used – bug reported in PPRS-033114

6. **Different tile patterns**

   - OBs prepared and executed with Tile3nx + Tile3px pattern — Result: different initial point for tiling currently in SADT results in offset between the two tile patterns such that the full tile is not covered; this was reported in PPRS-033251 and was included in the SADT report for the tool acceptance
   - OBs prepared and executed with all combinations of Tile6 pattern — Result: expected behaviour

7. **Optimal filter sequences** — filter distribution re-shuffled during VISTA consortium commissioning — overheads measured by T. Szeifert and verified during the SV

8. **Overheads** — overheads were measured during the ESO commissioning run in July and implemented in the ETRM — Result: they were tested with the SV data and further verification is expected to be done with more statistics on larger number of OBs during the Dry Runs

9. **Cross-talk** — Orion mini-survey observed the Orion belt stars — How to measure: using data from tile 6 of the Orion mini-survey, measure the signal of the brightest star on other detectors. — Result: No detectable cross-talk was found.

10. **Persistence** — Orion mini-survey observed the Orion belt stars — How to measure: using data from tile 6 of the Orion mini-survey which includes HD 36558 (K$\sim$2.2mag) and δ Ori (K$\sim$3.0mag), measure the signal on subsequent images — Preliminary result: only very low level of persistence measured on the image that was taken directly after the strong detector saturation caused by HD 36558. The DIT/NDIT used during these observations were DIT=2, NDIT=12. More precisely, a persistence signal of $\sim 1.5\sigma$ above the background was measured 1 minute after the saturation through HD 36558 occured. No images with shorter delay after the saturation event were taken. Two minutes after the saturation event, no persistence at all is detectable.

11. **Linearity and saturation** — done during the commissioning — Result: information available on CASU web pages:
`http://casu.ast.cam.ac.uk/surveys-projects/vista/technical/linearity-sequences`

12. **Light leaks** — done during the commissioning (day-time calibrations: darks/flats) — Result: instrument is light tight.

13. **Background vs. moon distance** — adequate data could not be taken during the SV run

14. **Background vs. twilight distance** — long sequences in J and Z-band taken for NGC 253 mini-survey — Result: the observations show strongly decreasing background as a function of time from the twilight for J-band, while the effect in Z-band is smaller (see Fig. 1) — Recommendation: for survey observation scheduling prefer redder filters close to twilights

15. **Large galaxy in the field** — NGC 253 (extragalactic SV mini-survey) has one of the largest southern galaxies in its field — Results: (i) sky subtraction works well if adjacent pawprints do not contain the extended object; (ii) automatic pipeline is not able to deal with the sky subtraction properly and the offset sky exposures need to be identified manually; (iii) *destriping* had to be switched off in pipeline reductions due to alignment of the galaxy with the detector rows. — Recommendation: do not align extended objects with detector axes.

16. **Crowded fields** — data taken for the VVV public survey in the Bulge to test the sky subtraction and photometry accuracy — Results: (i) the automatic pipeline has some problems with the sky subtraction and the image quality and zero-points are systematically worse than for less crowded fields; (ii) the astrometry is not good in the very crowded fields;

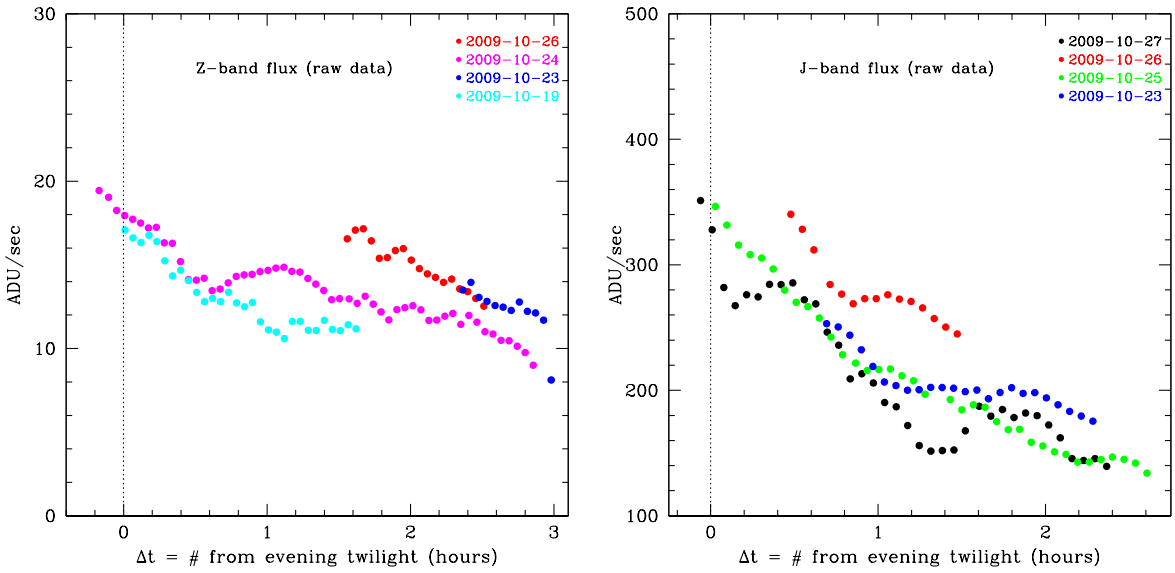

Figure 3: Background flux vs. twilight distance: J-band (right panel) shows quite a strong decrease in background flux within first $\sim$ 1h from the evening twilight, while this effect is smaller for Z-band (left panel). These measurements are made on raw images, but in all cases DIT and NDIT values were the same. Fluxes are normalized in ADU/sec by dividing the measured flux with (DIT*NDIT).

17. **Deep fields** — NGC 253 mini-survey — total of 5.8h in NB118, 9.6 in Z and 24h in J-band observed — Result: after making deep stacks verify that the expected sky subtraction and photometry accuracy are reached (to be done by the extragalactic SV team)

18. **Contiguous mapping** — Orion mini-survey — 20 contiguous tiles observed — Result: merge the photometric and astrometric catalogues and derive the errors on the global photometric and astrometric solution (to be done by the galactic SV team)

19. **Photometric calibration 2MASS → VIRCAM** — done during the commissioning — Result: implementation in the pipeline

20. **Illumination for broad-band filters** — if possible this should be done during commissioning through observation of Touchstone 2MASS fields in YZJHKs filters

21. **NB118 illumination and filter band-pass calibration accross the field** — some members of the UltraVISTA team were part of the extragalactic SV project, but did not ask to test this during the SV and in addition the Ultra-VISTA SV request for additional observations did not use NB filter — as it is not fully clear what this team wants no measurements were taken during the SV; this should probably be addressed during the GTO nights that are to be scheduled for Danish part of the Ultra-VISTA team that provided the filter

22. **NB118 photometry** — data taken in this filter for NGC 253 — also other filters observed, and this could be used in the extrapolation of the calibration — Result: photometric accuracy to be derived by the extragalactic mini-survey team

23. **NB118 and broad-band fringing** — SV data for NGC 253 — Result: no fringing

24. **Special calibrations** — no requests received from any public survey team — item dropped

25. **Repeat for variability** — variability monitoring sequences observed within the Orion mini-survey in J and H, and for VVV in the Bulge in Ks; in addition, the repetitive observation of the same field in NGC 253 over $\sim$ 15 nights allows for comparison of relative photometric stability and accuracy over many nights on both pawprint and tile level using NGC 253 dataset.

26. **Jitter patterns** — observations with essentially all jitter patterns available in the templates were taken during the SV run — Results: Observations and reductions are ok. One problem was found with the Random jitter pattern, as it always starts with 0 offset in the first exposure of the sequence; a change request was made to correct this.

27. **Containers** — OBs made including Time Link, Concatenation, and Group OBs — Result: the implementation at the level of P2PP is working well (under Linux; some problems found under Mac OSX). The ranking algorithm for the short term scheduling was tested, and some bugs were reported based on SV run. Further more detailed testing is ongoing during the dry runs.

5 Appendix A: Observation Logs

The full observation logs, listing the names and some header keywords of all images, will be available from the SV web pages. Here we only list a short summary of the observations taken each night, providing short comments as recorded during the observations. Only night-time observations are listed (day time darks are not listed here). More information is available in VISTA night reports.

```
15-16/10
**********
weather: clear, strong wind from the north preventing observations of Orion

Twilight flats:
OBID 423989 - TwilightFlatsKs
OBID 423991 - TwilightFlatsNB118
OBID 423997 - TwilightFlatsJ
OBID 423999 - TwilightFlatsZ

OBID 425414 - 203121.15-493851.9 - standard field

Observations NGC253:
OBID 428066 - NGC253_Zd_tile6zz_1_1_1 - qc grade B (seeing at the limit)
Concat_428606 - OBID 428607 - object1_K   - overall OK, but seeing constraint violated
                OBID 429050 - sky_K
                OBID 428613 - object2_K

OBID 425372 - 032654.43-395033.6 - standard field
```

16-17/10
****
weather: clear/photometric

Twilight flats:
OBID 423991 - TwilightFlatsNB118
OBID 423995 - TwilightFlatsH
OBID 423993 - TwilightFlatsY

OBID 425366 - 003315.89-392405.5 - standard field - M2 unstable: some elongated images

NGC253:
OBID 427986 - NGC253_NB_tile6zz_2exp_1 - qc grade A (not reduced by the pipeline
due to missing dark with this DIT)
OBID 428069 - NGC253_Jd_tile6zz_1_1_1-3 - qc grade A (IQ ~0.8")
OBID 428072 - NGC253_Jd_tile6zz_1_1-2 - good quality data but done 3 out of 4
jitters; thus needs to be repeated

OBID 425366 - 003315.89-392405.5 - standard field

Observations Orion:
OBID 428726 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_1_2 - TILE2 (IQ~0.9")

OBID 428729 - HYZshort_OB_FPJMEaPFJME_Orion_SV_tile6zz_gen_1_1_2 - TILE2 (IQ~0.8")
- several restarts of the OB due to problems with the technical CCD
of the wavefront sensor
OBID 428223 - HJ_monitor_25Ori_Epoch1_Orion_SV_tile6zz - TILE 19 executed twice

Observation for VMC:
OBID 429185 - vmc_SV_lmcS_1_1_1

17-18/10
****
weather: clear/photometric

Twilight flats:
OBID 423997 - TwilightFlatsJ
OBID 423999 - TwilightFlatsZ

```
Observations NGC 253:
OBID 428081 - NGC253_Zd_tile6zz_1_1_1-2 - aborted: seeing >1.1" + OB too long (zenith)

Concat_428616 - OBID 428617 - object1_H - all together A - IQ~0.9"
                OBID 429055 - sky_H
                OBID 428623 - object2_H

Concat_428626 - OBID 428627 - object1-Y - grade C: did not manage to complete
                OBID 428060 - sky-Y       concatenation due to zenith passage

OBID 425366 - 003315.89-392405.5 - standard field

OBID 428072 - NGC253_Jd_tile6zz_1_1_1-2 - 2 out of 4 jitters; together with
                                          execution from previous night A (IQ~0.7-0.8")

Observations Orion:
OBID 428226 - JH_monitor_25Ori_Epoch2_Orion_SV_tile6zz  (IQ~0.7-0.8")

OBID 428803 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_4_4  - TILE15
                       - Ks has only moderate IQ (0.9-1.0")
                       - Ks repeated after end of the OB, now better IQ

OBID 428806 - HYZshort_OB_FPJMEaPFJME_Orion_SV_tile6zz_gen_1_4_4  - TILE15
                        -bug in the template and therefore many more exposure at the same
                         pawprint position for Y-observations taken than originally intended

OBID 428229 - HJ_monitor_25Ori_Epoch3_Orion_SV_tile6zz - grade A (IQ~0.7-0.8")

OBID 428785 - HYZshort_OB_FPJMEaPFJME_Orion_SV_tile6zz_gen_1_3_4  - grade A (IQ~0.55-0.7")
                         - TILE12
                         - again problems with template execution during Y observations

OBID 428232 - JH_monitor_25Ori_Epoch4_Orion_SV_tile6zz  - grade A (IQ~0.6-0.7")


18-19/10
**********
weather: clear/photometric

Twilight flats:
OBID 423989 - TwilightFlatsKs
OBID 423991 - TwilightFlatsNB118
OBID 423995 - TwilightFlatsH
OBID 423993 - TwilightFlatsY
```

```
Observations NGC253:
OBID 428075 - NGC253_Jd_tile6zz_1_1-3  - grade A (IQ~0.9")
OBID 428081 - NGC253_Zd_tile6zz_1_1_1-2 - grade B (seeing ~1.0-1.1)
OBID 428633 - NGC253_object2_Y - Aborted - could not find guide star;
                                 after this check pointing model

Observations Orion:
OBID 428831 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_3_3_1 - grade A
                          - TILE19 (Z-band IQ~0.8-0.9")
                          - OB crashed after 6th Z-band exp. re-started from pawprint 3

OBID 429627 - HYZshort_OB_FPJMEaPFJME_Orion_SV_tile6zz_gen_3_3_1  - grade A (IQ~0.8")
                          - TILE19

OBID 428733 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_1_3 - grade A
                                       (IQ K ~0.7", J~0.8", Z~0.85")
OBID 429633 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_1_3 - grade A
                                       (IQ H~0.6-0.7", Y~0.7-0.9")
OBID 428235 - HJ_monitor_25Ori_Epoch5_Orion_SV_tile6zz - grade A  (IQ ~0.8")


19-20/10
***********
weather: photometric!

Twilight flats:
OBID 423989 - TwilightFlatsKs
OBID 423997 - TwilightFlatsJ
OBID 423999 - TwilightFlatsZ

OBID 425410 - 185118.67-041629.6 - Touchstone std field (bulge - dark cloud in the center?)

Observation for VVV:
OBID 429991 - monitor-SV-1 - grade A (IQ ~0.65-0.7")

Observations NGC 253:
OBID 428047 - NGC253_Zdeep_tile6zz_1_1_1-2 - seeing ~1.4", grade C
                        strongly variable background; reductions done individually
                        for each image - no jitter stacks
OBID 427988 - NGC253_NB_tile6zz_3exp_1 - grade A (IQ~0.8")

Observation for Ultra-VISTA + VIDEO:
OBID 429969 - Dunlop-SV_xmm1_1_1_1 - grade A (IQ~0.75")
```

```
Observations Orion:
                        Very stable sky conditions!
OBID 429001 - Sky_Ylong_jitter5_singlepaw_0555_0200_1_1_1
OBID 429005 - Y_Tile4_Orion_SV_tile6zz_gen_1_1_4  - OB crashed many times; restarting
OBID 428715 - Y_Tile8_Orion_SV_tile6zz_gen_1_2_4 - grade A (IQ ~0.7")
OBID 428953 - Sky_Ks_jitter5_singlepaw_0555_0200_1_1_1
OBID 428957 - Ks_Tile4_Orion_SV_tile6zz_gen_1_1_4
OBID 428961 - Ks_Tile8_Orion_SV_tile6zz_gen_1_2_4
OBID 428238 - JH_monitor_25Ori_Epoch6_Orion_SV_tile6zz
OBID 428965 - Sky_J_jitter5_singlepaw_0555_0200_1_1_1
OBID 428969 - J_Tile4_Orion_SV_tile6zz_gen_1_1_4
OBID 428973 - J_Tile8_Orion_SV_tile6zz_gen_1_2_4
OBID 429642 - sigOri_Jextra_1 - QC grade A (IQ~0.7")


20-21/10
**********
weather: thin

OBID 425410 - 185118.67-041629.6 - Touchstone standard field (TSF)

Observation for VVV:
OBID 429994 - monitor-SV-2 - grade B (IQ ~0.7-0.8", but thin)

Observations NGC253:
Concat_428626 - OBID 428627  - object1-Y - seeing ~1.4", thin --> C
                     429060  - sky-Y
                     428633  - object2-y - noise in Det6/ readout #14

Observation for VVV:
OBID 429997 - monitor-SV-3 - grade B (IQ ~1.1", but thin)

Observations NGC 253:
OBID 429654 - NGC253_NB_tile6zz_1exp-2 - grade B due to thin ~0.1mag extinction
OBID 428047 - NGC253_Zdeep_tile6zz_1_1_1-2 - grade C: changed Jitter5n->3d, but still
                            finished only 15/18 exposures before zenith, IQ~0.9"
OBID 428078 - NGC253_Jd_tile6zz_1_1-4 - grade C: changed Jitter4u->2d,
                            IQ~0.7", thin; also additional noise appeared in
                            detector 6, readout 14; thus aborted after 3 exposures,
                            then re-started (ignore first 3 exposures)
```

```
Observations Orion:
OBID 428241 - HJ_monitor_25Ori_Epoch7_Orion_SV_tile6zz
OBID 428719 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_1_1 - Note: OB
                            crashed after J-band, but was re-started
OBID 428722 - HYZshort_OB_FPJMEaPFJME_Orion_SV_tile6zz_gen_1_ - Note: changed
                            DIT/NDIT/FILTER List to single entries and nesting
                            to FPJME, because otherwise OB would crash
OBID 428810 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_2_1_1 (IQ~0.6-0.8")
OBID 430072 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_2_1_1 (IQ~0.7-0.8")

21-22/10
***********
weather: thin in the beginning, then clear

OBID 425410 - 185118.67-041629.6 - TSF

Observation for VVV:
OBID 430000 - monitor-SV-4 - classified B due to possible thin, IQ~0.8"-0.9"

Observation NGC 253:
OBID 428078 - NGC253_Jd_tile6zz_1_1_4 - changed Jitter4u->2d, IQ~0.8-0.9",
                                        thin; together with previous execution B
Observation for VVV:
OBID 430003 - monitor-SV-5 - qc grade C

Observations NGC 253:
OBID 428053 - NGC253_Jdeep_tile6zz_1_1_1-3 - grade C: aborted after 12/24, IQ~1.2-1.3"
Concat_428596 - OBID 428597 - object1-sky-object2 J; seeing 1.2-1.3"
                OBID 429045
                OBID 428603
                --> tile 3 OBs do not cover the full tile!?
Concat_428626 - OBID 428627 - object1-sky-object2 Y; seeing 1.3-1.5"; object1
                OBID 429060                          exposure has some noise
                OBID 428603                          in det 6/paw6
                --> tile 3 OBs do not cover the full tile!?

OBID 425366 - 003315.89-392405.5 - TSF - noise in detector 6.

NGC 253:
Concat_428606 - OBID 428607 - object1-sky-object2 K; seeing 0.9-1.0"
                OBID 429050
                OBID 428613
                --> tile 3 OBs do not cover the full tile!?
OBID 428056 - NGC253_Jdeep_tile6zz_1_1-2 - grade C: aborted after 6 exposures
                                                    due to problem with TCCD nY
                                      - strong noise in detector 6!
```

```
Observations Orion:
OBID 428244 - JH_monitor_25Ori_Epoch8_Orion_SV_tile6zz - many crashes
OBID 429572 - BadSeeing_HJ_monit_Epoch1_Orion_SV_tile6zz_gen_
OBID 428244 - JH_monitor_25Ori_Epoch8_Orion_SV_tile6zz
OBID 428782 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_3_4 (IQ~0.7-0.8")
OBID 428247 - HJ_monitor_25Ori_Epoch9_Orion_SV_tile6zz
OBID 429630 - sigOri_Zextra_1 (IQ~0.8-0.9")
OBID 429636 - sigOri_Zextra_2 (IQ~0.8-0.9")

22-23/10
**********
weather: clear/photometric (some thin in twilight?)

Twilight flats: probably not useful!
OBID 423991 - TwilightFlatsNB118 - additional noise in detector 6 - do not use!
OBID 423995 - TwilightFlatsH - do not use (possible some thin clouds)

OBID 425412 - 190156.25-042916.6 - TSF

Observation for VVV:
OBID 430003 - monitor-SV-5 - IQ~1.3"

Observations NGC 253:
Concat_431254 - OBID 431255 - new_ngc253_shallow_object_1_1_1 - K band IQ~0.8"
                OBID 431258 - offset sky
                            - grade A; object OB was repeated twice. There are
                              problems with guide stars; only guiding in paw 4 & 5

OBID 428053 - NGC253_Jdeep_tile6zz_1_1_1-3 - grade C: good seeing (0.8-0.9"), but
                              done 2/4 jitters (Jitter 2u) to finish before zenith

Concat_431261 - OBID 431262 - new shallow H - Grade C: done jitter 2u instead of 4u
                OBID 431265 - offset sky

OBID 425366 - 003315.89-392405.5 - TSF while waiting for NGC253 to get through zenith

OBID 428053 - NGC253_Jdeep_tile6zz_1_1_1-3 - second part (IQ~0.9"); completed
                                        - noise in Detector 6

Concat_431261 - OBID 431262 - new shallow H - Grade B: second part - noise in
                OBID 431265 - offset sky                              det 6!
```

```
Observations Orion:
OBID 428740 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_2_1 - repeated J
                              due to worse IQ (~1") compared to Ks and Z (~0.8-0.9")
OBID 431225 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_2_1 - IQ~0.8" H
OBID 428747 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_2_2 - IQ~0.7-0.8"
OBID 431235 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_2_2 - IQ~0.6-0.8"

23-24/10
**********
weather: clear/photometric, good seeing

Twilight flats:
OBID 423991 - TwilightFlatsNB118 - ok
OBID 423995 - TwilightFlatsH - some noise in detector 6 occasionally

OBID 425412 - 190156.25-042916.6 -TSF

Observation for VVV:
OBID 430006 - monitor-SV-6 - IQ~1.0", some exposures affected by noise in detector 6
OBID 430028 - sky1
OBID 430031 - multi-color_Baade_SV, some exposures affected by noise in detector 6
OBID 430034 - sky2
              due to many aborts it looks like the OBID 430037 (sky3) was forgotten!
OBID 430009 - monitor-SV-7 - IQ~1.2", some exposures affected by noise in detector 6

Observations NGC 253:
OBID 428056 - J deep - seeing ~0.75", grade: A
OBID 428047 - Z deep - changed Jitter5n->2d but only 11/12 exposures
                       taken before zenith, IQ~0.9-1.0"

Observation for Ultra-VISTA + VIDEO:
OBID 429971 - Jarvis-SV_xmm1_1_1_1 - grade A; IQ~0.8"

Observations Orion:
OBID 430048 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_2_1 - IQ~1" in Y
OBID 428250 - JH_monitor_25Ori_Epoch10_Orion_SV_tile6zz
OBID 431500 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_2_3 - IQ~0.8"
OBID 431496 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_2_3 - IQ~0.8" in H
OBID 428673 - Sky_H_jitter5_singlepaw_0555_0200_1_1_1
OBID 428676 - H_Tile4_Orion_SV_tile6zz_gen_1_1_4 - IQ~0.8"
OBID 428679 - H_Tile8_Orion_SV_tile6zz_gen_1_2_4
OBID 428253 - HJ_monitor_25Ori_Epoch11_Orion_SV_tile6zz
OBID 429645 - sigOri_Jextra_2
```

```
24-25/10
**********
weather: clear/photometric

Twilight flats:
OBID 423989 - TwilightFlatsKs
OBID 423997 - TwilightFlatsJ
OBID 423993 - TwilightFlatsY

OBID 425410 - 185118.67-041629.6 - TSF

Observation for VVV:
OBID 430012 - monitor-SV-8 - IQ~1.0", grade A

Observations NGC 253:
OBID 428050 - Z deep - first time full execution seeing ~1.0"
                     - repeated with Jitter4u; IQ~0.95"

NGC 300 while NGC253 crosses zenith:
OBID 431565 - Z_NGC300_6z_1_1_1

Observation NGC 253:
OBID 428059 - J deep - 18/24 exposures; IQ~0.7"

Observations Orion:
OBID 428256 - JH_monitor_25Ori_Epoch12_Orion_SV_tile6zz
OBID 428700 - Sky_Zlong_jitter5_singlepaw_0555_0200_1_1_1
OBID 428703 - Z_Tile4_Orion_SV_tile6zz_gen_1_1_4
OBID 428706 - Z_Tile8_Orion_SV_tile6zz_gen_1_2_4 - IQ~0.75"
OBID 431509 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_3_2_1 (IQ~0.6-0.7")
OBID 431505 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_3_2_1 - Note: skipped
                       Y-band due to beginning of twilight!
```

25-26/10
****
weather: clear/photometric

Twilight flats: some exposures affected by additional noise in Det. 6!
OBID 423991 - TwilightFlatsNB118
OBID 423995 - TwilightFlatsH
OBID 423999 - TwilightFlatsZ

OBID 425410 - 185118.67-041629.6 - TSF

Observation for VVV:
OBID 430015 - monitor-SV-9 - IQ~0.8", grade A

Observations NGC 253:
OBID 428059 - J deep - 12/24 exposures; IQ~0.9"-1.0"; together with previous
                       execution grade A; quite strong sky background variation
                       (due to start of the night)
OBID 428062 - J deep - 7/24 exposures + 18 exposures (IQ~0.9")
                       Aborted after 7 exposures due to TCCD pY went into
                       LOADED/OFF due to failed readout.
                     - appearance of noise in the detector 6

NGC 300 observation while NGC 253 crosses zenith:
OBID 431561 - J_NGC300_1_1_1

NGC 253:
OBID 428085 - J deep - 12/24 exposures; IQ~0.6-0.7"

Observations Orion:
OBID 428817 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_3_1_1 - IQ~0.8-0.9"
OBID 431241 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_3_1_1 - IQ~0.55-0.6"
OBID 430078 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_3_2_1 - Only Y: IQ~0.6"
OBID 431518 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_3_1 - IQ~0.55-0.7"
OBID 431514 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_3_1 - IQ~0.7"
OBID 431509 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_3_2_1 - IQ K~0.6"

```
26-27/10
**********
weather: clear/photometric

Twilight flats: some exposures affected by additional noise in Det. 6!
OBID 423989 - TwilightFlatsKs
OBID 423997 - TwilightFlatsJ
OBID 423993 - TwilightFlatsY

OBID 425412 - 190156.25-042916.6 - TSF

Observation for VVV:
OBID 430018 - monitor-SV-10 - IQ~1.1"

Observations NGC 253:
OBID 428085 - J deep - 12/24 exposures; IQ~0.8" - with previous exec. grade A
                     - actually re-started after 3 exposures (3+12)
OBID 428047 - Z deep - Jitter3d instead of 5n; IQ~0.9" - completed with
                       previous execution

NGC 300 observation while NGC 253 crosses zenith:
OBID 431563 - K_NGC300_6u_1_1_1 - done without AO corrections, but IQ~0.6"

NGC 253:
OBID 428088 - J deep - all images affected by noise in detector 6
                     - Jitter2u instead of 4u; IQ~0.7"
                     - abort after 1 exposure to correct M2 tilt; then restarted
Observations Orion:
OBID 428259 - HJ_monitor_25Ori_Epoch13_Orion_SV_tile6zz
OBID 431527 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_3_2 - IQ~0.7-0.8"
OBID 431523 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_3_2 - IQ~0.65"
OBID 431536 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_3_3 - IQ~0.6-0.7"
OBID 431532 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_3_3 - IQ~0.7"
OBID 428262 - JH_monitor_25Ori_Epoch14_Orion_SV_tile6zz
```

```
27-28/10
**********
weather: clear

Twilight flats: some exposures affected by additional noise in Det. 6!
OBID 423991 - TwilightFlatsNB118
OBID 423995 - TwilightFlatsH
OBID 423999 - TwilightFlatsZ

OBID 425412 - 190156.25-042916.6 - TSF

Observation for VVV:
OBID 430021 - monitor-SV-11 - IQ~1.0", grade A

Observations NGC 253:
OBID 428091 - J deep - Jitter4u; grade B: IQ~0.75-0.85"
                     - noise appears between UT=01:29-01:42
OBID 428088 - J deep - Jitter2d; grade B: IQ~0.7", completed with previous
                       execution; noise between UT=02:20-02:36
OBID 431269 - new_ngc253_shallow Y - aborted after 10/12 - getting too close
                                     to zenith

NGC 300 observation while NGC 253 crosses zenith:
OBID 431567 -  Y_NGC300_6n_1_1_1

Observations NGC 253:
Concat_431268 - OBID 431272 + 431269 - new shallow Y; IQ~0.8" - ok
OBID 428182 - NGC253_NB_2exp2 - grade D: violated moon constraints, but this
                                         is the last chance to execute...

OBID 425366 - 003315.89-392405.5 - TSF

Observations Orion:
OBID 428265 - HJ_monitor_25Ori_Epoch15_Orion_SV_tile6zz
OBID 431541 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_4_1 - IQ~0.6-0.7"
OBID 431545 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_4_1 - IQ~0.6-0.7"
OBID 428268 - JH_monitor_25Ori_Epoch16_Orion_SV_tile6zz
OBID 429648 - sigOri_Jextra_3 - IQ~0.7"

OBID 425382 - 055708.27+000108.0 - TSF

28-29/10
**********
weather:  lost the whole night - too strong wind
```

```
29-30/10
**********
weather: clear
         Closed due to wind in the beginning. Opened at UT=00:33

Observation for VVV:
OBID 430024 - monitor-SV-12 - IQ~1.4"-2.0"

OBID 425420 - 220536.59-110429.2 - TSF
OBID 425364 - 002425.49-015822.6 - TSF

Observations NGC 253:
Concat_431247 - OBID 431248 + 431251 - new shallow J - grade C: IQ~1.2-1.4"

NGC 300 observation while NGC 253 crosses zenith:
OBID 431569 - H_NGC300_6ss_1_1_1

NGC 253:
Concat_431247 - OBID 431248 + 431251 - new shallow J - grade A
                repeated due to bad seeing first time; now: 0.7"
OBID 428094 - J deep - IQ~0.65-0.7" excellent data!

Concat_431254 - OBID 431255+431258 - new shallow K - IQ~0.6" excellent data!

Observations Orion:
OBID 428271 - HJ_monitor_25Ori_Epoch17_Orion_SV_tile6zz
OBID 431554 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_1_4_2 - IQ~0.6"-0.9"
OBID 431550 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_1_4_2 - IQ~0.8-0.9"
OBID 428274 - JH_monitor_25Ori_Epoch18_Orion_SV_tile6zz - repeated 2x by mistake?


02-03/11
**********
weather: clear

Twilight flats: some exposures affected by additional noise in Det. 6!
OBID 423989 - TwilightFlatsKs
OBID 423997 - TwilightFlatsJ
OBID 423993 - TwilightFlatsY

OBID 425420 - 220536.59-110429.2 - TSF
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```
Observations NGC 253:
OBID 428097 - NGC253_Jd1_tile6zz_1_1-5 - Jitter 4u->Jitter3d to complete before zenith
                    Excellent Image quality~0.6"
OBID 428100 - NGC253_Jd1_tile6zz_1_1_1-2 - IQ~0.7"
OBID 428103 - NGC253_Jd1_tile6zz_1_1_1-4 - IQ~1.0 - 1.1" (high airmass)
                    changed Jitter4u -> Jitter3d to finish before target sets

OBID 425376 - 042621.40+033724.3 - TSF

Observations Orion:
OBID 428277 - HJ_monitor_25Ori_Epoch19_Orion_SV_tile6zz
OBID 431778 - KsJZlong_OB_FPJME_Orion_SV_tile6zz_gen_3_4_1 - IQ~0.6-0.9"
OBID 431782 - HYZshort_OB_FPJME_Orion_SV_tile6zz_gen_3_4_1 - IQ~0.8-0.9"
```