


```

# $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
# Editable line 'B1' (only one-time per installation) - see line below [CATALOGUE path (for NUV)]
database_namepc,s,h,"/data2/swarna/uvit/CATALOG2/USNOA2_VIS_GALEX_NUV_FUV_catalogu
e.db",,,,"path of Catalogue Database"
# $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

# $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
# Editable line 'C2' (only one-time per installation) - see line below [output TAR path (for FUV)]
pathToOutputTarpfuv,s,h,"/data2/swarna/uvit/udata1/tarout1/L2_Driver_tar_outF",,,,"Enter the PATH
for Output TAR file (for FUV)"
# $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

# $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
# Editable line 'B2' (only one-time per installation) - see line below [CATALOGUE path (for FUV)]
database_namepcfuv,s,h,"/data2/swarna/uvit/CATALOG2/USNOA2_VIS_GALEX_NUV_FUV_catal
ogue.db",,,,"path of Catalogue Database"
# $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

```

The above 5 lines (which are to be **one-time** edited) provide the directory paths to :

- 'A' : CALDB (base directory of the Calibration Database)
- 'B1' & 'B2' : location of Star Catalogue (both paths could be identical)
- 'C1' & 'C2' : directories to keep output 'tar' product (two directories must be **DIFFERENT;**
& THEY MUST EXIST !)

5) At this stage UL2P is ready to run, provided you have proper UVIT Level-1 data file
(e.g. '/data2/swarna/uvit/udata2/z8202_56/LEVL1AS1UVT20170404A03_103T01_9000001132_08202.zip').

PLEASE NOTE THE INPUT DATA CAN BE “TAR” OR “ZIP” FORMAT !
ALSO, ALL UNIX SHELLS ARE SUPPORTED IN VERSION 6.3 !

Running the pipeline :

Interactive mode :

Type : UVIT_DriverModule (& then 'Enter' key),
The UL2P process initiates and asks the following interactive inputs :

- i) input data format 'zip' or 'tar' [usually data downloaded from ISSDC is 'zip'];
- ii) complete path & file-name of the input (Level-1) data that is to be processed;
- iii) do you want to **force** NUV tracking (even if VIS is present) ? (default : 'n' = NO);
- iv) the base directory address where all intermediate & final results will be written
(in a well defined sub-directory structure);
- v) do you want to **MANUALLY SELECT** stars for drift tracking ? (default : 'n');
Before running in **MANUAL** mode, it is mandatory to run first an in the **DEFAULT (AUTO)**
mode !! (see other documents);
- vi) in case of **MANUAL SELECTION** of stars, base directory of earlier RA_IM run output;

Many messages / logs will continue to scroll on your screen, which is normal.
The processing time can be large (depends on size of the dataset), hence one way to release the

terminal without hampering the execution of the UL2P job [particularly useful if running via remote login (“ssh”) over network / internet] :
Type “Ctrl-Z”, “bg”, “disown -h”.
Now one may close the terminal (logout).

Batch mode : [STRONGLY RECOMMENDED !]

Edit “UVIT_DriverModule.par” file (located in the directory : ../AS1UVITLevel2DataPipeline-L2DIST-6.3/as1/uvit/paramfiles) by replacing the following **SIX** lines (to change the 'query-learn' [ql] mode to 'hide' [h] mode for all interactive inputs; Parameter Interface Library, PIL language) :

```
#ZipFlag,b,ql,y,,,"Input level1 is in Zip format or not?('y' for ZIP format/'n' is for TAR format)"  
ZipFlag,b,h,y,,,"Input level1 is in Zip format or not?('y' for ZIP format/'n' is for TAR format)"
```

```
#level1indir,f,ql,"/data2/swarna/uvit/udata2/z8202_63/LEVL1AS1UVT20170404A03_103T01_90000  
01132_08202.zip",,,,"Enter Level-1 data (merged or orbit-wise) directory path"  
level1indir,f,h,"/data2/swarna/uvit/udata2/z8202_63/LEVL1AS1UVT20170404A03_103T01_9000001  
132_08202.zip",,,,"Enter Level-1 data (merged or orbit-wise) directory path"
```

```
#NUVOnNUVflag,b,ql,n,,,"RAS from NUV data?('y' for YES,'n' for NO)"  
NUVOnNUVflag,b,h,n,,,"RAS from NUV data?('y' for YES,'n' for NO)"
```

```
#level2outdir,f,ql,"/data2/swarna/uvit/udata2/z8202_63/driver_out/",,,,"Enter level2 directory"  
level2outdir,f,h,"/data2/swarna/uvit/udata2/z8202_63/driver_out/",,,,"Enter level2 directory"
```

```
#ManualMode,b,ql,n,,,"Auto mode('n') or Manual selection of stars for generating RAS('y')?"  
ManualMode,b,h,n,,,"Auto mode('n') or Manual selection of stars for generating RAS('y')?"
```

```
#previousOutputL2,f,ql,"otuput_6740",,,,"Base directory of RAIM output in Auto mode"  
previousOutputL2,f,h,"otuput_6740",,,,"Base directory of RAIM output in Auto mode"
```

Now use the following command to submit as a batch job :

```
nohup UVIT_DriverModule >log1_target1 2>log2_target1 &
```

The two files 'log1_target1' & 'log2_target1' will contain all the text that would have scrolled on terminal screen if it was used in interactive mode.

- 6) The sky image outputs from individual sub/orbits as well as from combining all orbits for each unique combinations of : (i) channel (NUV/FUV), (ii) UV Filter & (iii) selected Window-size, will be generated as FITS files (4800x4800).
In addition, Exposure & Uncertainty images are also generated (again FITS).

TYPICAL OUTPUT DIRECTORY STRUCTURE & SOME DETAILS :

```
[swarna@swarna driver_out]$ pwd  
/data2/swarna/uvit/udata2/z8202_63/driver_out
```

```
[swarna@swarna driver_out]$ ls -lt  
drwxrwxr-x. 3 swarna swarna 32 Aug 17 00:20 FUV_FullFrameAst_F3_W511
```

drwxrwxr-x. 2 swarna swarna 89 Aug 17 00:20 FUV_Final_F3_W511
drwxrwxr-x. 3 swarna swarna 32 Aug 17 00:18 FUV_FullFrameAst_F2_W511
drwxrwxr-x. 2 swarna swarna 89 Aug 17 00:18 FUV_Final_F2_W511
drwxrwxr-x. 3 swarna swarna 32 Aug 17 00:14 NUV_FullFrameAst_F6_W511
drwxrwxr-x. 2 swarna swarna 89 Aug 17 00:14 NUV_Final_F6_W511
drwxrwxr-x. 3 swarna swarna 32 Aug 17 00:14 NUV_FullFrameAst_F5_W511
drwxrwxr-x. 2 swarna swarna 89 Aug 17 00:14 NUV_Final_F5_W511
drwxrwxr-x. 3 swarna swarna 32 Aug 17 00:13 NUV_FullFrameAst_F3_W511
drwxrwxr-x. 2 swarna swarna 89 Aug 17 00:13 NUV_Final_F3_W511
drwxrwxr-x. 3 swarna swarna 32 Aug 17 00:13 NUV_FullFrameAst_F2_W511
drwxrwxr-x. 2 swarna swarna 89 Aug 17 00:13 NUV_Final_F2_W511
drwxrwxr-x. 3 swarna swarna 32 Aug 17 00:11 NUV_FullFrameAst_F1_W511
drwxrwxr-x. 2 swarna swarna 89 Aug 17 00:11 NUV_Final_F1_W511
drwxrwxr-x. 2 swarna swarna 6 Aug 17 00:09 _RAPC_FUV_1
drwxrwxr-x. 3 swarna swarna 17 Aug 17 00:08 _RAPC_NUV_1
drwxrwxr-x. 3 swarna swarna 17 Aug 17 00:08 _RAPC
drwxrwxr-x. 3 swarna swarna 17 Aug 17 00:06 _FUV_10
drwxrwxr-x. 3 swarna swarna 17 Aug 17 00:04 _NUV_10
drwxrwxr-x. 3 swarna swarna 17 Aug 17 00:03 _FUV_9
drwxrwxr-x. 3 swarna swarna 17 Aug 17 00:01 _NUV_9
drwxrwxr-x. 3 swarna swarna 17 Aug 17 00:00 _FUV_8
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:57 _NUV_8
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:54 _FUV_7
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:50 _NUV_7
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:46 _FUV_6
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:43 _NUV_6
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:38 _FUV_5
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:34 _NUV_5
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:28 _FUV_4
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:24 _NUV_4
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:19 _FUV_3
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:15 _NUV_3
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:14 _FUV_2
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:12 _NUV_2
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:08 _FUV_1
drwxrwxr-x. 3 swarna swarna 17 Aug 16 23:06 _NUV_1
drwxrwxr-x. 3 swarna swarna 18 Aug 16 22:58 uvit

The directories '_NUV_1', '_FUV_1', etc hold outputs from processing of individual orbits using VIS tracking and '_RAPC_NUV_1', '_RAPC_FUV_1' etc using NUV tracking (when no VIS data was found with any time-overlap with the NUV / FUV data) .

The directories “NUV_Final_F3_W511” & “NUV_FullFrameAst_F3” hold multi-orbit combined sky image results (for each specific combination of selected UV Filter & Window size).

The most users may need only the multi-orbit combined sky image products (unless there are some special needs). Typical examples of contents and locations of astronomer ready products are presented below for both cases (multi-orbit-final or single-orbit).

MULTI ORBIT CASE :

Example of “NUV_Final_F3_W511” directory [NUV channel, Filter 'F3' & 512x512 Window]

```
[swarna@uvitserv NUV_Final_F3_W511]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/NUV_Final_F3_W511
```

```
[swarna@uvitserv NUV_Final_F3_W511]$ ls -lt
total 270120
-rw-rw-r--. 1 swarna swarna 92200320 Mar 22 19:24 F3_W511_FinalImage_NoiseMap.fits
-rw-rw-r--. 1 swarna swarna 92200320 Mar 22 19:24 F3_W511_FinalImage_Exp.fits
-rw-rw-r--. 1 swarna swarna 92200320 Mar 22 19:24 F3_W511_FinalImage_Sig.fits
```

The above three FITS files refer to NUV image (“F3_W511_FinalImage_Sig.fits”; unit : photon/second), Statistical Error (“F3_W511_FinalImage_NoiseMap.fits”; unit : photon/second), and Sky Exposure (“F3_W511_FinalImage_Exp.fits”; unit : number of Frames) in RA-Dec (J2000) coordinate system.

Example of “NUV_FullFrameAst_F3_W511” directory

```
[swarna@uvitserv uvtFullFrameAst_6.3]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/NUV_FullFrameAst_F3_W511/uvtFullFrameAst_6.3
```

```
[swarna@uvitserv uvtFullFrameAst_6.3]$ ls -lt
total 270112
-rw-rw-r--. 1 swarna swarna 92191680 Mar 22 19:24 AS1G06_157T01_9000000772uvtNIIPC00F3_l2_as_Exp.fits
-rw-rw-r--. 1 swarna swarna 92191680 Mar 22 19:24 AS1G06_157T01_9000000772uvtNIIPC00F3_l2_as_NoiseMap.fits
-rw-rw-r--. 1 swarna swarna 92191680 Mar 22 19:24 AS1G06_157T01_9000000772uvtNIIPC00F3_l2_as_Sig.fits
-rw-rw-r--. 1 swarna swarna 465 Mar 22 19:24 star_raDec_frmOptics_catalogueWith_5Stars.txt
-rw-rw-r--. 1 swarna swarna 2278 Mar 22 19:24 star_raDec_frmOptics_catalogueWith_10Stars.txt
-rw-rw-r--. 1 swarna swarna 6115 Mar 22 19:24 star_radec.txt
```

Above, the FITS file “AS1G06_157T01_9000000772uvtNIIPC00F3_l2_as_Sig.fits” holds the NUV Filter F3 & 512x512 Window final sky image in RA-Dec coordinates. The other FITS files ‘*_Exp.fits’ & ‘_NoiseMap.fits’ contain the sky exposure & uncertainty maps respectively.

SINGLE ORBIT CASE :

Example of “_NUV_3” directory

```
[swarna@uvitserv uvtN.19]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/_NUV_3/uvit/05962/uvtN/uvtN.19
```

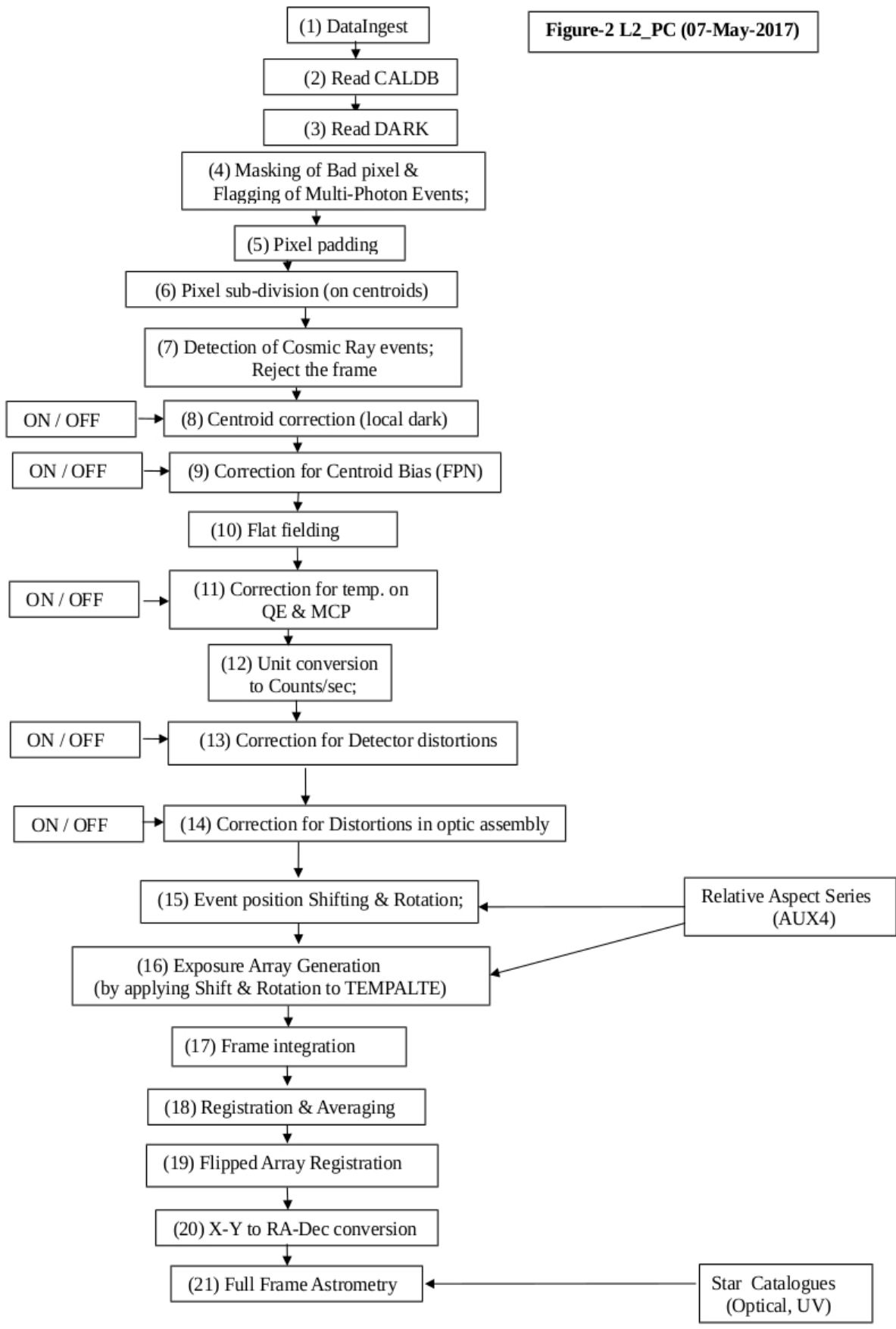
```
[swarna@uvitserv uvtN.19]$ ls -lt
total 24
drwxrwxr-x. 2 swarna swarna 4096 Mar 22 18:16 uvtFullFrameAst_6.3
drwxrwxr-x. 2 swarna swarna 4096 Mar 22 18:13 uvtRADECImage_6.3
drwxrwxr-x. 2 swarna swarna 4096 Mar 22 18:13 uvtShiftRot_6.3
```

drwxrwxr-x. 2 swarna swarna 4096 Mar 22 18:13 uvtFlippedRegImage_6.3
drwxrwxr-x. 2 swarna swarna 4096 Mar 22 18:13 uvtRegAvg_6.3
drwxrwxr-x. 5 swarna swarna 96 Mar 22 18:13 uvtFrameIntegration_6.3
drwxrwxr-x. 2 swarna swarna 83 Mar 22 18:13 uvtExposureFrames_6.3
drwxrwxr-x. 3 swarna swarna 4096 Mar 22 18:12 DataIngest_6.3

The above set of directories hold outputs from *selected* intermediate processing blocks, as per DEFAULT setting (user selection of writing on disk ON or OFF). A complete list of all intermediate blocks (one needs to turn ON all the disk writing switches in 'UVIT_DriverModule.par' file; see the enclosed block diagram below) is presented below :

DataIngest_6.3 : Block '1'
uvtMaskBadPix_6.3 : Block '4'
uvtPixPadding_6.3 : Block '5'
uvtSubDivision_6.3 : Block '6'
uvtCosmicRayCorrection_6.3 : Block '7'
uvtFlatFieldCorr_6.3 : Block '10'
uvtUnitConversion_6.3 : Block '12'
uvtDetectDistCorr_6.3 : Block '13'
uvtOpticDistCorr_6.3 : Block '14'
uvtShiftRot_6.3 : Block '15'
uvtExposureFrames_6.3 : Block '16'
uvtFrameIntegration_6.3 : Block '17'
uvtRegAvg_6.3 : Block '18'
uvtFlippedRegImage_6.3 : Block '19'
uvtRADECIImage_6.3 : Block '20'
uvtFullFrameAst_6.3 : Block '21'

Figure-2 L2_PC (07-May-2017)



Contents of *selected* intermediate directories are described below.

Example of “uvtFullFrameAst_6.3” directory

```
[swarna@uvitserv uvtFullFrameAst_6.3]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/_NUV_3/uvit/05962/uvtN/uvtN.19/uvtFullFrameAst_6.3
```

```
[swarna@uvitserv uvtFullFrameAst_6.3]$ ls -lt
total 270432
-rw-rw-r--. 1 swarna swarna 92188800 Mar 22 18:16 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_as_Exp.fits
-rw-rw-r--. 1 swarna swarna 92188800 Mar 22 18:16 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_as_NoiseMap.fits
-rw-rw-r--. 1 swarna swarna 92188800 Mar 22 18:16 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_as_Sig.fits
-rw-rw-r--. 1 swarna swarna 465 Mar 22 18:16 star_raDec_frmOptics_catalogueWith_5Stars.txt
-rw-rw-r--. 1 swarna swarna 6606 Mar 22 18:16 star_raDec_frmOptics_catalogueWith_10Stars.txt
-rw-rw-r--. 1 swarna swarna 328413 Mar 22 18:16 star_radec.txt
```

Above, the FITS file “AS1G06_157T01_9000000772uvtNIIPC00F4_l2_as_Sig.fits” holds the NUV sky image in RA-Dec coordinates generated using the single data collection episode “*NUV_3*”. The other FITS files ‘*_Exp.fits’ & ‘_NoiseMap.fits’ contain the sky exposure & uncertainty maps respectively for the single data collection episode “*NUV_3*”.

Example of “uvtExposureFrames_6.3” directory

```
[swarna@uvitserv uvtExposureFrames_6.3]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/_NUV_3/uvit/05962/uvtN/uvtN.19/uvtExposureFrames_6.3
```

```
[swarna@uvitserv uvtExposureFrames_6.3]$ ls -lt
total 90012
```

```
-rw-rw-r--. 1 swarna swarna 92171520 Mar 22 18:13 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_t0.0000_f1_exp_fi.fits
```

The file(s) in this directory contain Exposure array/(s) for individual Frame Integration sub-set/(s) (in DEFAULT setting, the entire data is put into one single “sub-set”).

Example of “uvtFrameIntegration_6.3” directory

```
[swarna@uvitserv uvtFrameIntegration_6.3]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/_NUV_3/uvit/05962/uvtN/uvtN.19/uvtFrameIntegration_6.3
```

```
[swarna@uvitserv uvtFrameIntegration_6.3]$ ls -lt
total 0
drwxrwxr-x. 2 swarna swarna 99 Mar 22 18:13 NOISE_MAP
drwxrwxr-x. 2 swarna swarna 104 Mar 22 18:13 SignalFrames_DividedWithExposure
drwxrwxr-x. 2 swarna swarna 88 Mar 22 18:13 SignalFrames
```


The directory “SignalFrames” contains individual stacked up UV images (2-D; X-Y) from selected number of Frames for the Frame_Integration stage. The corresponding Statistical Error arrays are held in the directory “NOISE_MAP”. The directory “SignalFrames_DividedWithExposure” contains sky images in 'photon/sec' units.

Example of “uvtRegAvg_6.3” directory

```
[swarna@uvitserv uvtRegAvg_6.3]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/_NUV_3/uvit/05962/uvtN/uvtN.19/uvtRegAvg_6.3
```

```
[swarna@uvitserv uvtRegAvg_6.3]$ ls -lt
total 270044
-rw-rw-r--. 1 swarna swarna 92180160 Mar 22 18:13 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_t0.0000_f1_sig_regAvg.fits
-rw-rw-r--. 1 swarna swarna 92171520 Mar 22 18:13AS1G06_157T01_9000000772uvtNIIPC00F4_l2_t0.0000_f1_noiseMap_regAvg.fits
-rw-rw-r--. 1 swarna swarna 92171520 Mar 22 18:13 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_t0.0000_f1_exp_regAvg.fits
```

The three FITS files refer to the final UV (*_sig_*), sky Exposure (*_exp_*) and Uncertainty (*_noiseMap_*) images of the sky in Detector (X-Y) coordinates after carrying out the Registration and Averaging process.

Example of “uvtShiftRot_6.3” directory

```
[swarna@uvitserv uvtShiftRot_6.3]$ pwd
/home/swarna/uvit2/m5962_v63/driver_out/_NUV_3/uvit/05962/uvtN/uvtN.19/uvtShiftRot_6.3
```

```
[swarna@uvitserv uvtShiftRot_6.3]$ ls -lt
total 176644
-rw-rw-r--. 1 swarna swarna 57389760 Mar 22 18:16 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_radec.fits
-rw-rw-r--. 1 swarna swarna 92185920 Mar 22 18:13 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_t9999.0000_f1_img_fi.fits
-rw-rw-r--. 1 swarna swarna 31299840 Mar 22 18:13 AS1G06_157T01_9000000772uvtNIIPC00F4_l2_snr.fits
```

The two files “AS1G06_157T01_9000000772uvtNIIPC00F4_l2_snr.fits” & “AS1G06_157T01_9000000772uvtNIIPC00F4_l2_radec.fits” contain the final photon event list with their centroid values corrected for all effects that have been selected (e.g. Drift, Distortions, ...etc). The latter also includes pixel-coordinates in RA-Dec (J2000) system for each photon event. **This product (*_radec.fits) is relevant for studies involving TIMING (each photon event has time stamp).**

The file “AS1G06_157T01_9000000772uvtNIIPC00F4_l2_t9999.0000_f1_img_fi.fits” provides a UV sky image in Detector X-Y coordinate system.

=====