PhoSim-NIRCam: CatalogFile

- CatalogFile specifies various observing parameters (e.g., filter, pointing coordinates, integration time), and includes a catalog of sources that will be used for image simulation.

- See "phosim_sw.cat" and "phosim_lw.cat" in the **phosim-nircam/nircam** directory for example CatalogFiles. The only difference between these two files is the filter specification (see below).

- The CatalogFile "phosim_sw.cat" looks like the following:

```
Opsim_filter 31
Unrefracted_RA_deg 53.117046
Unrefracted_Dec_deg –27.804967
Opsim_obshistid 0001
SIM_NSNAP 1
SIM_VISTIME 600.0
 object 0.0 53.092995 –27.954538 26.24 ../sky/nir_sed_flat.txt 0 0 0 0 0 0 sersic2d  1.42 0.46 –14.61 8.00
 object 0.0 53.102890 –27.959661 26.39 ../sky/nir_sed_flat.txt 0 0 0 0 0 0 sersic2d  0.22 0.03 –75.26 0.80
 object 0.0 53.10168  –27.958479 26.29 ../sky/nir_sed_flat.txt 0 0 0 0 0 0 sersic2d  0.46 0.11 –33.00 0.75
 object 0.0 53.102280 –27.958651 25.57 ../sky/nir_sed_flat.txt 0 0 0 0 0 0 sersic2d 23.58 9.19 –56.35 8.00
 object 0.0 53.090561 –27.958500 28.05 ../sky/nir_sed_flat.txt 0 0 0 0 0 0 sersic2d  0.16 0.09 –89.22 0.59
 .....
 .....
```

- The CatalogFile starts with the following lines:
  - Filter selection
    - `Opsim_filter 31 (F200W for SW)`
    - `Opsim_filter 19 (F356W for LW)`
    - See the table on the next page for the filter specification numbers (which is Table 6 in "Implementation of the James Webb Space Telescope Near-Infrared Camera (NIRCam) in PhoSim" by Colin Burke).
  - Pointing coordinates:
    - `Unrefracted_RA_deg 53.117046`
    - `Unrefracted_DEC_deg –27.804967`
  - Image ID number:
    - `Opsim_obshistid 0001`
    - This can be any integer ID number (with or without preceding 0's) that will be added to the image file name.
  - Number of exposures & total integration time (in seconds)
    - `SIM_NSAMP 1`
    - `SIM_VISTIME 600.0`
    - If `SIM_NSAP` is set to 6, PhoSim-NIRCam will create 6 images with an integration time of 100 sec each.

Number	NIRCam Filter
0	No filter
1	F070W_A
2	F070W_ABmean
3	F070W_B
4	F090W_A
5	F090W_ABmean
6	F090W_B
7	F115W_A
8	F115W_ABmean
9	F115W_B
10	F140M_A
11	F140M_ABmean
12	F140M_B
13	F150W_A
14	F150W_ABmean
15	F150W_B
16	F150W2_A
17	F150W2_ABmean
18	F150W2_B
19	F162M_A
20	F162M_ABmean
21	F162M_B
22	F164N_A
23	F164N_ABmean
24	F164N_B
25	F182M_A
26	F182N_ABmean
27	F182N_B
28	F187N_A
29	F187N_ABmean
30	F187N_B
31	F200W_A
32	F200W_ABmean
33	F200W_B
34	F210M_A
35	F210M_ABmean
36	F210M_B
37	F212N_A
38	F212N_ABmean
39	F212N_B

Number	NIRCam Filter
0	No filter
1	F250M_A
2	F250M_ABmean
3	F250M_B
4	F277W_A
5	F277W_ABmean
6	F277W_B
7	F300M_A
8	F300M_ABmean
9	F300M_B
10	F322W2_A
11	F322W2_ABmean
12	F322W2_B
13	F323N_A
14	F323N_ABmean
15	F323N_B
16	F335M_A
17	F335M_ABmean
18	F335M_B
19	F356W_A
20	F356W_ABmean
21	F356W_B
22	F360M_A
23	F360M_ABmean
24	F360M_B
25	F405M_A
26	F405M_ABmean
27	F405M_B
28	F410M_A
29	F410M_ABmean
30	F410M_B
31	F430M_A
32	F430M_ABmean
33	F430M_B
34	F444W_A
35	F444W_ABmean
36	F444W_B
37	F460M_A
38	F460M_ABmean
39	F460M_B
40	F466N_A
41	F466N_ABmean
42	F466N_B
43	F470N_A
44	F470N_ABmean
45	F470N_B
46	F480M_A
47	F480M_ABmean
48	F480M_B

- The remaining lines specify the properties of each source line by line with the following parameters:

```
object ID RA DEC MAG_NORM SED_NAME REDSHIFT GAMMA1 GAMMA2 KAPPA
DELTA_RA DELTA_DEC SOURCE_TYPE source_pars DUST_REST_NAME
dust_pars_1 DUST_LAB_NAME dust_pars_2
```
(dust parameters are not used in the examples)

  o PhoSim calculates filter magnitudes using the source SED (SED_NAME), normalization magnitude (MAG_NORM at 500 nm/(1+z), which is equivalent to observed V_{AB} or g_{AB}), and redshift (REDSHIFT). For the examples here, we used a flat f_ν SED (sed_flat_fnu.txt) and z=0 with the observed HST/WFC3 H_{160} magnitudes (in AB).
  o SED files (e.g., sed_flat_fnu.txt) should be saved in /data/SEDs.
  o SOURCE_Type specifies the name of the spatial model (i.e. morphology). Here, we used the 4-parameter sersic2D profile (SOURCE_TYPE, source_pars).
  o GAMMA1, GAMMA2, and KAPPA are parameters associated with weak-lensing effects, and are set to 0 here.
  o DELTA_RA, DELTA_DEC are also set to 0.
  o See the next page for a more detailed description of the catalog parameters (taken from https://confluence.lsstcorp.org/display/PHOSIM/Instance+Catalog).

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Astrophysical Data	
ID	A floating point number to keep track of the object, which is unused by phosim except for diagnostic source information
RA	The right ascension of the center of the object or image in decimal degrees.
DEC	The declination of the center of the object in decimal degrees
MAG_NORM	The normalization of the flux of the object in AB magnitudes at (500 nm)/(1+z) (which is roughly equivalent to V (AB) or g (AB)).
SED_NAME	The name of the SED file with a file path that is relative to the data directory
REDSHIFT	The redshift (or blueshift) of the object. Note that the SED does not need to be redshifted if using this
GAMMA1	The value of the shear parameter gamma1 used in weak lensing.
GAMMA2	The value of the shear parameter gamma2 used in weak lensing.
KAPPA	The value of the magnification parameter in weak lensing.
DELTA_RA	The value of the declination offset in radians. This can be used either for weak lensing or objects that moved from another exposure if you do not want to change the source position in the first two columns.
DELTA_DEC	The value of the declination offset in radians. This can be used either for weak lensing or objects that moved from another exposure if you do not want to change the source position in the first two columns.
SOURCE_TYPE	The name of the spatial model to be used as defined below.
spatial_pars	The associated parameters for each spatial model.There could be none or many. While the parser is reading the model it looks for more parameters based on the name of the model.
DUST_REST_NAME	Dust model name in the object's rest frame. This is either the ccm for the CCM model, or calzetti for the calzetti model. If no dust model is desired, then put none for this field.
dust_pars_1	The parameters for both the calzetti and CCM are the A_v followed by the R_v value. If no dust model is used, do not use parameters
DUST_LAB_NAME	Dust model name in the lab frame. This is either the ccm for the CCM model, or calzetti for the calzetti model. If no dust model is desired, then put none *for this field*.
dust_pars_2	The parameters for both the calzetti and CCM are the A_v followed by the R_v value. If no dust model is used, do not use parameters

Spatial Models		
point	No parameters	This is a model primarily used for stars, but also unresolved objects.
gauss	1 parameter: sigma in arcseconds	This is a model for a gaussian-shaped object.
movingpoint	2 parameters: the derivative of the velocity arcseconds per second along the ra direction, the derivative of the velocity in arcseconds per second along the dec direction	Moving object (e.g. asteroid)
sersic2D	4 parameters: (half-light radius of semi-major axis in arcseconds, half-light radius of semi-minor axis in arcseconds, position angle in degrees, sersic index	2-D elliptical Sersic model
sersic	6 parameters: size of axis 1 in arcseconds, size of axis 2 in arcseconds, size of axis 3 in arcseconds, sersic index, polar angle in radians, position angle in degrees	3-D ellipsoidal Sersic model
If the SOURCE_TYPE contains the word fits or fit,it will look for that file in the image directory	2 parameters: pixel size (in arcseconds) and rotation angle (in degrees). RA goes to the left and DEC goes up in physical coordinates Note that PhoSim will not use the header information, because you may want to use the same image in multiple field locations	Complex morphology spatial truth images