Req 5.6.4

Title:

Photometric Calibration - Zeropoint - User bands

Objective:

Determine the zeropoint of the overall detector chain and the atmosphere by measuring standard stars in the **User passbands**.

The zeropoints of the photometric calibration in the User bands will only be determined for the nights that the User bands are actually used for scientific observations. The measurements will be done on one of the eight equatorial fields.

The atmospheric extinction will be determined in the keybands through **req. 562** *monitoring* on the polar field. The extinction results from **req. 562** *monitoring* are appended here, like in **req.**563, with a monolithic exposure at the equatorial field at midnight. The extinction curve will be used to transform the measured atmospheric extinction at the keybands to the User bands.

The transformation (colour term) of the user passband to the key passbands is determined for a limited set of filters and the ADC with the keybands in **req.**565.

By combining the extinction results in the keybands, the passband transformation coefficients and the direct zeropoint measurements in the User bands, the zeropoint corresponding to the DQE of each of the 32 CCD chips will be determined on an individual chip basis.

Trend analysis on these data is not required. The instrumental magnitudes of standard stars in each of the userbands will not be solved.

Fulfilling or fulfilled by:

Selfstanding, but uses data of **req.**562 at the middle of the night.

When performed/frequency:

Once in the middle of each night.

Sources, observations, instrument configurations:

All observations done with **Mode– Stare** N=1. **OmegaCAM** equatorial fields; always one exposure in composite key filter and additional exposures in User bands.

Inputs:

The inputs for deriving the photometry result tables are:
Fully calibrated image of equatorial standard field

CalFile– 569 *Secondary Standard Catalog*
CalFile– 565 *User -> key*

The inputs for deriving the zeropoints for the night are:
List of photometry result tables
CalFile– 562 *Extinction night report*
CalFile– 564E *Standard extinction curve*

Outputs:

The output from deriving a photometry result table is the same as for **req.** 562.

The outputs from deriving the zeropoints for the night are:
CalFile– 564 *Zeropoint - extinction - Userbands* (always)

Required accuracy, constraints:

2% on the photometric scale for broad bands and 5% for narrow band filters.

Estimated time needed:

2-3 minutes per User band. Reduction: 3 min./CCD/filter.

Priority:

essential

TSF:

Mode– Stare N=1
(**TSF– OCAM_img_obs_stare,** N=1, filter=userband)
= **TSF– OCAM_img_obs_zpuser**

Recipe:

The same recipes are used as for **req.**563. Only difference is the requirement of **CalFile– 565** *User -> key* as an extra input for deriving the photometry result tables.

Needed functionality:

catalog - source extraction (Sextractor)
catalog - associate (LDAC prephotom)
catalog - select stars (LDAC filter)

CA:

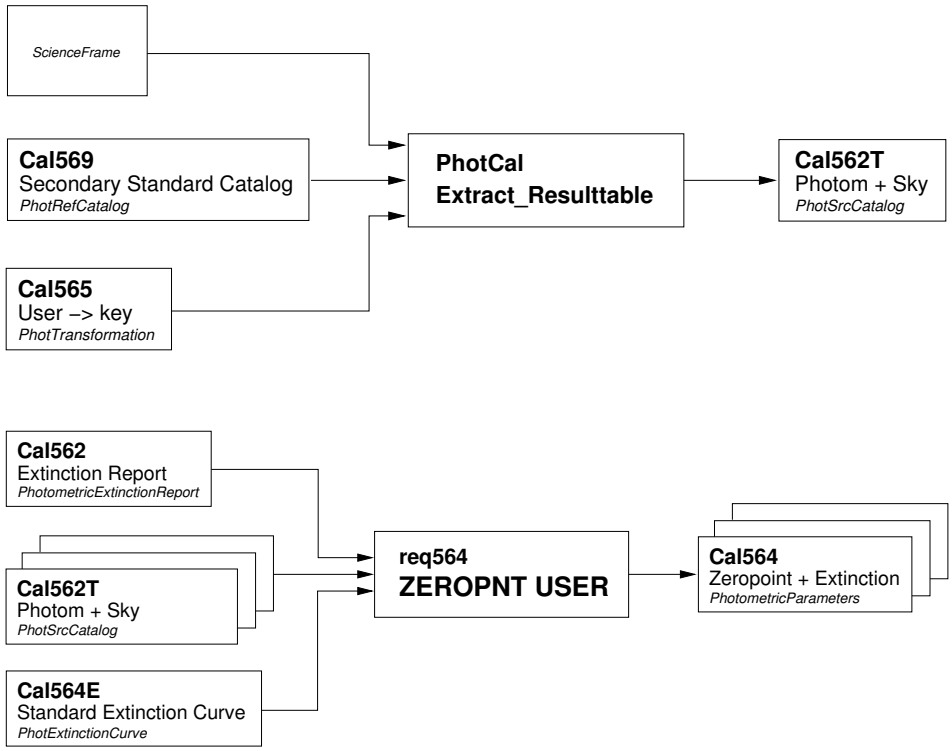

Fig 5.6.4 Dataflow and object class names for req564

The processing in the photometric part of the pipeline must be done for every **User band** separately and has two phases: 1) derive a photometry result table for every input chip, 2) calculate the extinction, and derive the zeropoint for every separate chip (i.e. from the information contained in every separate photometry result table). The photometry result tables are derived in the same way as described in steps 1-8 of the relevant section of the **CA** from **req.** 562; these have to be derived first before the zeropoints for the night. The zeropoints for the night are derived from these photometry result tables as described in the steps 1-6 below. These steps are repeated for every separate input photometry result table.

1. Retrieve from the input extinction report (**CalFile– 562**) the shift on the extinction curve as determined for the middle of the night (see **req.** 562).
2. Retrieve from the standard extinction curve the atmospheric extinction evaluated at the central wavelength of the User-band filter under consideration. Apply the shift as retrieved from the extinction report to this extinction. Note that this extinction is per unit airmass.

3. Multiply the extinction with the airmass from the photometry result table, and subtract the resultant value from the raw zeropoints contained in the photometry result table.
5. Derive the zeropoint from the extinction corrected raw zeropoints by deriving the weighted average.
6. Store the derived zeropoint and the input extinction per unit airmass, together with the name of the chip for which the zeropoint was derived and the name of the User-band.

CAP:

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Constants:
  DETECT_THRESH  : Sextractor processing parameter

/* Step 1 : make photometry result tables

(1)   create_empty_list_for_photometry_result_tables
(2)   for every frame in the list of science frames:
(2.1)   derive_source_catalog_from_frame:
          Sextractor.sextractor(frame_name)
(2.2)   remove_saturated_stars_from_the_catalog:
          LDAC.filter(catalog_name, filter_criterium_1)
(2.3)   associate_source_catalog_with_standard_star_catalog:
          LDAC.prephotom(catalog_name, refcat)
(2.4)   remove_not_associated_sources_from_catalog:
          LDAC.filter(catalog_name, filter_criterium_2)
(2.5)   create_empty_list_for_raw_zeropoints
(2.6)   for every source in the source catalog:
          mag = take_magnitude_of_source_from_standard_catalog
          apply_transformation_to_mag
          instmag = take_measured_magnitude_of_source
          raw_zeropoint = mag - instmag
          raw_zeropoint_err = sqrt(mag_err**2 + instmag_err**2)
          add_raw_zeropoint_and_error_to_list
(2.7)   save_the_photometry_result_table
(2.8)   add_photometry_result_table_to_list

/* Step 2 : make extinction
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cwl = central_wavelength_of_user_band
extinction  = value_from_extinction_curve_at_cwl
extinction += shift_from_input_report_at_middle_of_the_night

/* Step 3 : make zeropoints

(1)   for every table in list of photometry_result_tables:
(1.1)   ext = extinction * airmass_from_table
(1.2)   ext_err = extinction_error * airmass_from_table
(1.3)   create_empty_list_for_zeropoints
(1.4)   for every raw_zeropoint in catalog:
          zeropoint = raw_zeropoint + ext
          zeropoint_err = sqrt(raw_zeropoint_err**2 + ext_err**2)
          add_zeropoint_and_error_to_list
(1.5)   get_weighted_mean_and_error_of_zeropoint
(1.6)   save_zeropoint_and_extinction
```