PS1 Exposure detrending

The first step of the image processing with the IPP pipeline is the **CHIP** stage processing, which performs the image detrending (e.g., bias subtraction, dark current correction, flat fielding, defringing, masking), as well as a single epoch photomety.

The following information is taken from Magnier et al. and Waters et al., which should be cited appropriately.

Ensuring a consistent and uniform detector response across the three-degree diameter field of view of the GPC1 camera is essential to a well calibrated survey. Many standard image detrending steps are done for GPC1, with overscan subtraction removing the detector bias level, dark frame subtraction to remove temperature and exposure time dependent detector glows, and flat field correction to remove pixel to pixel response functions. We also construct fringe correction for the reddest data in the y filter, to remove the interference patterns that arise in that filter due to the variations in the thickness of the detector surface.

These corrections, however, assume that the detector response is linear across the full range of values. This is not universally the case with GPC1, and this requires an addi- tional set of detrending steps to remove these non-linear responses. The first of these is the burntool correction, which removes the persistence trails caused by the incomplete transfer of charge along the readout columns. This bright-end nonlinearity is generally only evident for the brightest stars, as only pixels that are at or beyond the saturation point of the detec- tor have this issue. More widespread is the non-linearity at the faint end of the pixel range. Some readout cells and some readout cell edge pixels experience a sag relative to linear at low illumination, such that faint pixels appear fainter than expected. The correction to this requires amplifying the pixel values in these regions to match the expected model.

The final non-linear response issue has no good option for correction. Large regions of some Orthogonal Transfer Array (OTA) cells experience significant charge transfer issues, making them unusable for science observations. These regions are therefore masked in processing, with these CTE regions making up the largest fraction of masked pixels on the detector. Other regions are masked for other regions, such as static bad pixel features or temporary readout masking caused by issues in the camera electronics that make these regions unreliable. These all contribute to the detector mask, which is augmented in each exposure for dynamic features that are masked based on the astronomical features within the field of view.

For the PV3 processing, the detrending is applied to the individual cells, and then an OTA level mosaic is constructed for the science image, the mask image, and the variance map image. The single epoch photometry is done at this stage as well.