24μm SUR-mode Saturation Flagging: SATMASK

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What SATMASK Does:

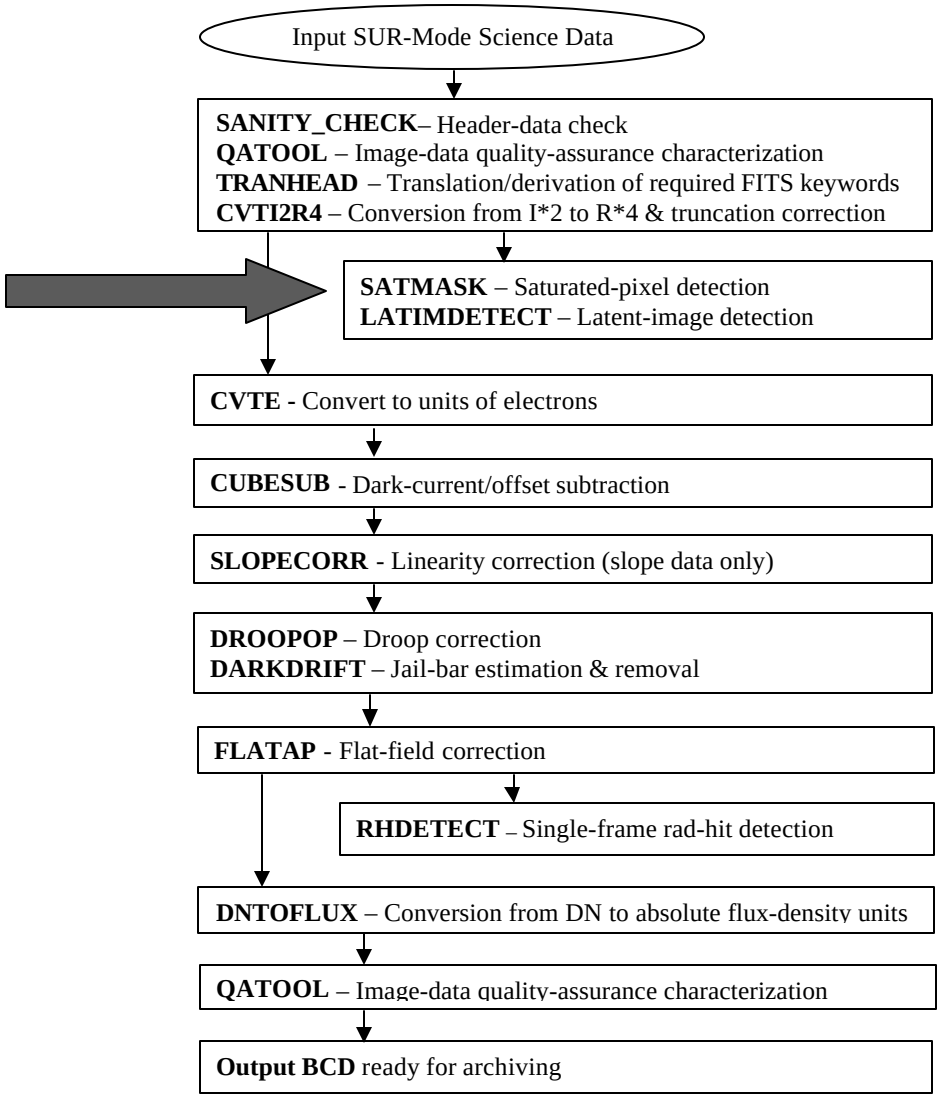
1. Flags slope values in SUR-mode data which have been fit to RAW-mode ramp data that goes into “immediate” saturation after the first non-destructive read sample (absolute saturation).

2. Flags unreliable slope values due to either “mid-ramp” saturation, cosmic ray hits or both.

3. **Optionally:** Can replace unreliable pixels (from anomalies in 2. above) in the *slope-plane* with those from the *difference-plane.*

4. Saturated pixels, discrepant slope/difference-plane pixel values and hence slope pixels needing replacement are flagged in a bit-mask image (D-mask).

Processing in Pipeline



Inputs/Outputs

- **INPUTS:**
  - SUR-mode FITS image (plane 1: slope-value, plane 2: “first and second read” difference-value).
  - Mask images for hot/dead pixels, and for reporting saturated pixels and discrepancies between slope-to-difference values.
  - Threshold parameters (with acronyms used in this presentation):
    - Saturation Threshold (Sat_Threshold)
    - Minimum slope-to-difference ratio (SDrat_Min)
    - Maximum slope-to-difference ratio (SDrat_Max)
    - sky background in difference plane (DMin_Sky)

- **OUTPUTS:**
  - Optional, new SUR-mode image with anomalous slope-values replaced by those in the difference plane.
  - Log file containing processing statistics and error messages
  - Bit-mask image (d-mask) which flags discrepant and saturated pixels.

Algorithm

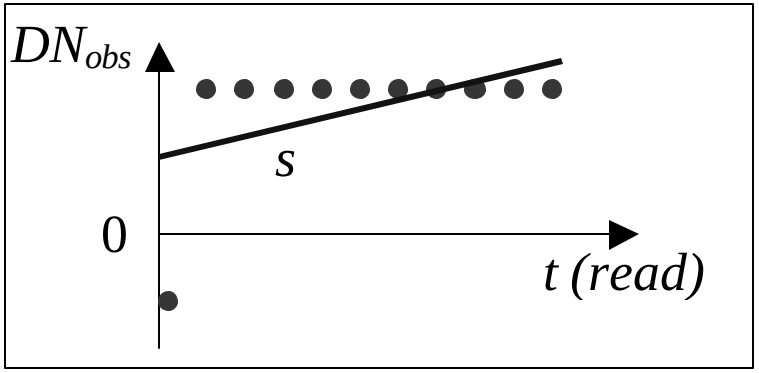
- The algorithm below is recommended by the instrument team (devised by Chad Engelbracht, University of Arizona).
- The ratio of pixel values in the slope and difference planes: *s/d (where s=slope value, d=difference value)* is used as a diagnostic with user-tunable thresholds.

- Case 1: "Absolute" saturation (Type 1: fatal):

If *d = Sat_Threshold* parameter, **OR**,

if number of initial frames to ignore (*Ignore_Frames* parameter) > 0 **AND**

d = 0, then flag slope-pixel as completely saturated.



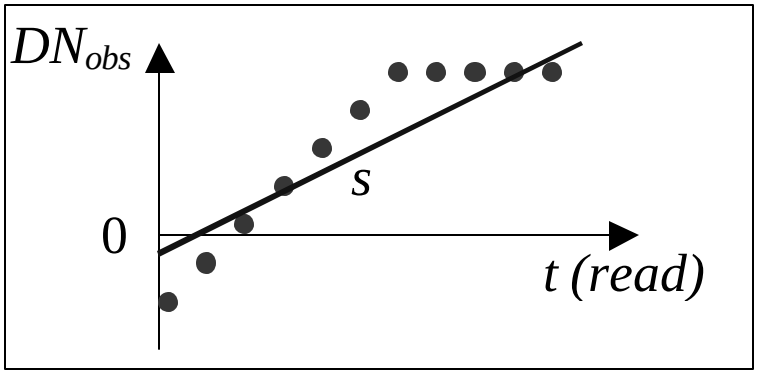
$$d = DN(t_2) - DN(t_1)$$

$$s = slope\ value$$

Algorithm continued...

- Case 2: “Mid-ramp” saturation after 2nd read sample (Type 2: non-fatal):

Here we expect *s/d < 1.* Or in general, if *s/d < minimum threshold* (*SDrat_Min parameter*) **AND** if *d* > lowest value of sky background expected (DMin_Sky parameter) then the difference value is more reliable and can ‘potentially’ replace the slope pixel.



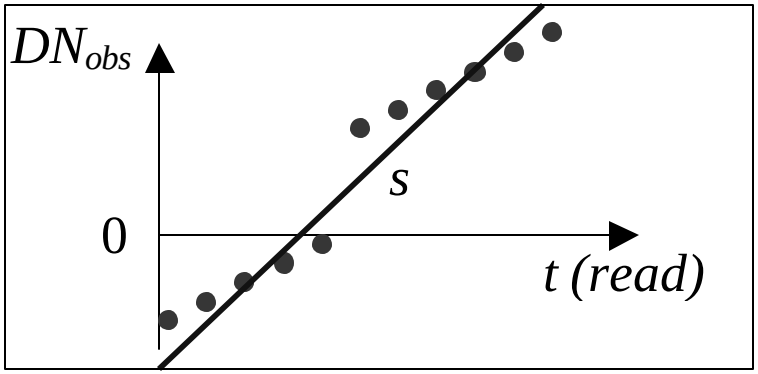
Note that *s/d < 1* is also expected for pixels with strong non-linearity in the ramp. This must be accounted for when assigning a suitable value for the minimum *s/d* threshold.

Algorithm continued...

- Case 3: Cosmic Rad Hits:

  (a) Mid ramp rad hits which occur after the 2nd read:

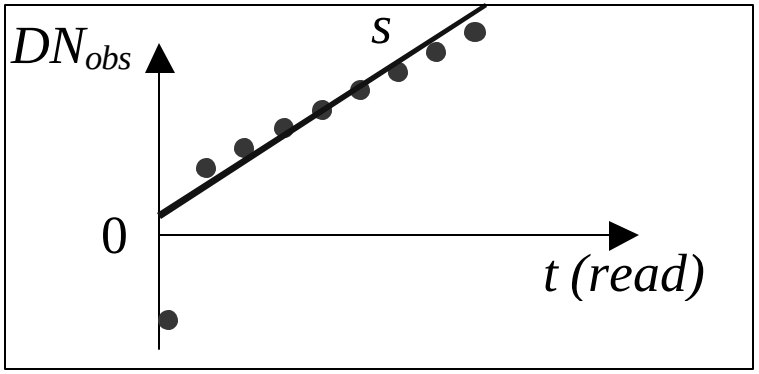
  This will always give *s/d > 1*. Or in general if *s/d >SDrat_Max* threshold parameter) **AND** if the difference value satisfies *DMin_Sky < d < Sat_Threshold,* then the difference value can replace the slope value.



Algorithm continued...

(b) Rad hits which occur **IN** the 2nd read:

The difference value will be (hugely) affected leading to s/d << 1. The difference value will therefore not be a good estimator of the slope. This case is to be resolved and may require a more sophisticated rad-hit detection algorithm, preferably in the difference plane.



Conclusions...

- The main task of SATMASK is to flag slope-plane pixels which are affected by saturation in the “ramp”.

- It flags (and optionally replaces) slope-plane pixels which differ (within user-specified thresholds) from corresponding difference-plane values due to cosmic rad-hits and/or saturation.

- Remaining Issues:
  - Rad-hits which occur exactly *in the second read sample up the ramp* need flagging by a more robust algorithm.

  - Since the difference values (*d*) can be noisier than the slope-values (*s*), further testing is needed to test the robustness of this algorithm for pixels near the sky-background. A single threshold may not work.

SATMASK

Back-up Slides

Inputs/Output: *Namelist parameter file*

INPUTS: "RED" *OUTPUTS: "BLUE"*

```
Ancillary_File_Path = './slopecorr',
FITS_Image_Filename = 'SUR_mode.fits',          (Input SUR-mode image)
FITS_Image_PMask_Filename = 'pmask.fits',       (mask for hot/dead pixels)
FITS_Image_DMask_Filename = 'dmask.fits',       (DCE-dependent processing mask)
FITS_Out_Filename = 'SUR_mode_new.fits',        (Optional, pixel replaced image)
Log_Filename = 'stdout',                        (for errors and processing stats)
PMaskFatal = 8192,                              } Fatal mask bits
DMaskFatal = 8192,                              }
Ignore_Frames = 2,                              (Number of initial frames to ignore)
Sat_Threshold = 30000,                          (Saturation threshold in diff. plane)
SDrat_Min = 0.7,                                (Min. threshold for slope/diff. ratio)
SDrat_Max = 1.5,                                (Max. threshold for slope/diff. ratio)
DMin_Sky = 100,                                 (sky background in difference plane)
DMask_discrep = 128,                            (mask bit for large discrepancy in
                                                 slope/difference pixel values)
DMask_replace = 256,                            (mask bit for slope pixel replacement)
```