Latent-Image Reporting: LATIMREPORT

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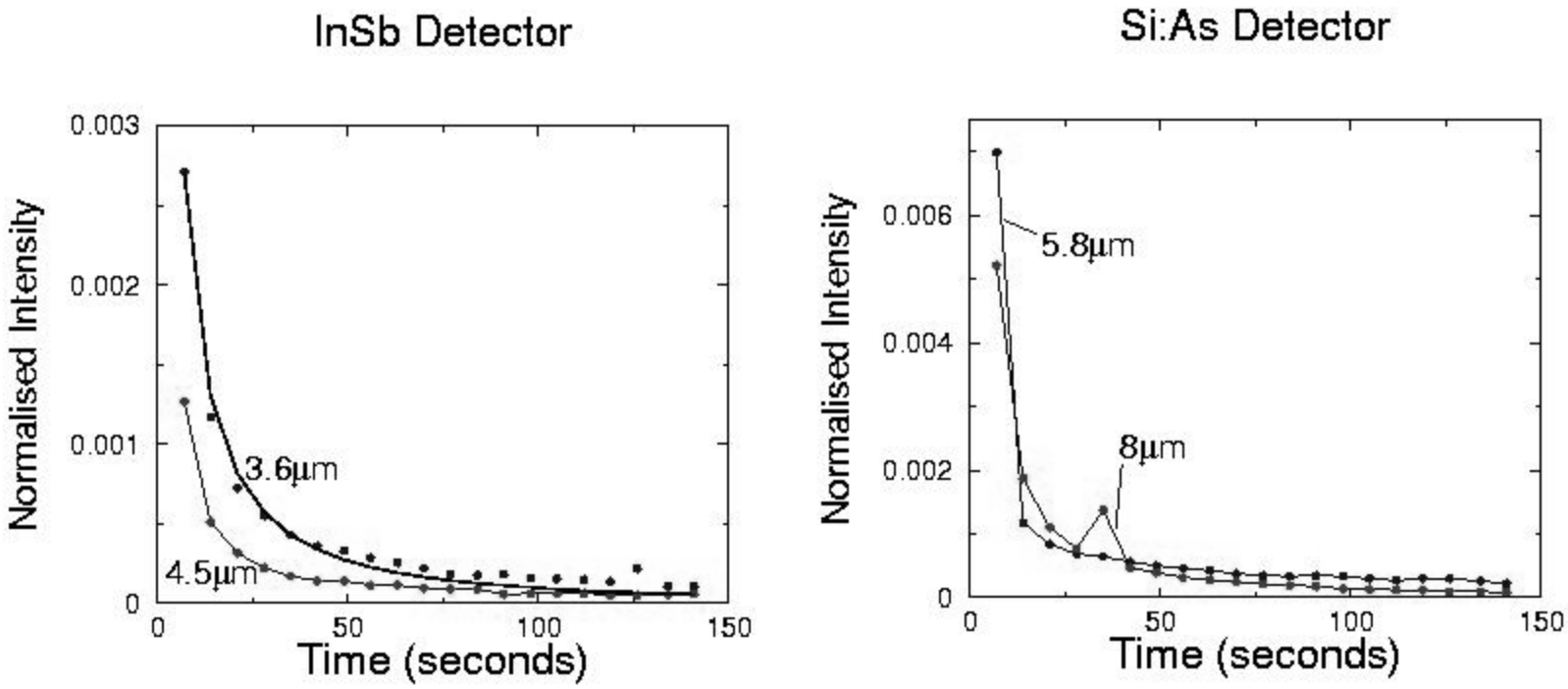
Introduction

- AIM: To self-consistently track and locate pixels containing latent (residual) intensities in DCEs.
- Part of final post-processing science data thread using two modules: LATIMDETECT and LATIMREPORT.
- LATIMDETECT (step 1): Converts pixel intensities that lie above a specified noise threshold into equivalent persistence-times using a latency model.
  - Inputs: FITS image, noise threshold in target DCE for which latent-image report is requested (σ), latency model coefficients, p- and d-masks (optional)
  - Primary product: 16-bit/pix persistence-time image in scaled units if seconds. Time that a pixel with given DN will persist as a latent above σ in target DCE.

Latency Models



- IRAC Latency model, derived from "Comprehensive Latent-Image Test" (08/16/00) using a median of pixel values in transmission calibrator images.
- For band 1 (3.6μm): $I(t) = I_0 \exp\left[-\left(\frac{t}{A}\right)^B\right] \quad A = 1.8E-04, \quad B = 0.17$
- when I(t) = σ, and invert ⇒ persistence time t = *f* (σ, I_0).

LATIMREPORT Input/Output:

INPUT:

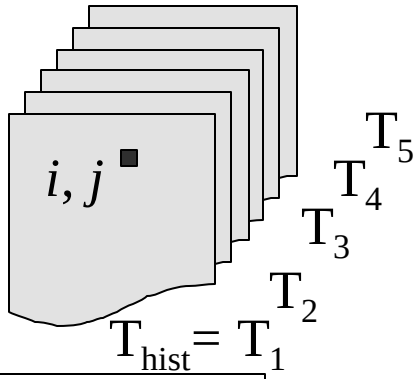
- Persistence-time (history) FITS image list of DCEs preceding DCE for which latent report is requested.
- Input DCE for which latent-image report is requested.
  - Image cube can also be read. In this case, latent-image reporting is done on each input-plane.
- All input FITS images must have UTCS-OBS, T_INT header keywords as generated by the TRANHEAD module.

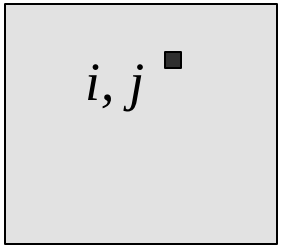
OUTPUT:

- Primary output: 8-bit/pixel FITS “flag” image which flags a pixel containing a latent with the value “1” and “0” otherwise.
- IPAC table which reports latent-pixel locations.

LATIMREPORT Module (step 2)

Step 1: LATIMDETECT - History list of persistence-time images from BQD.





Time-ordered via UTCS-OBS FITS keyword

Latent Report requested for image at time T_{DCE}, with σ_{rms}

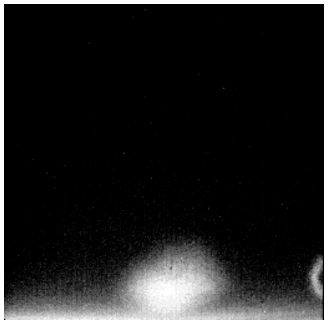
If persistence-time $T_p(i, j) > T_{DCE} - T_{hist}$

Flag pixel as containing latent in “flag image”

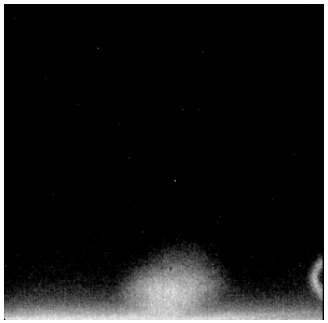
Testing LATIMREPORT

- Simplest test: Used a set of transmission calibrator images taken sequentially to study latent decay (at 3.6μm).
- Can produce a latent-report for the last image in this sequence

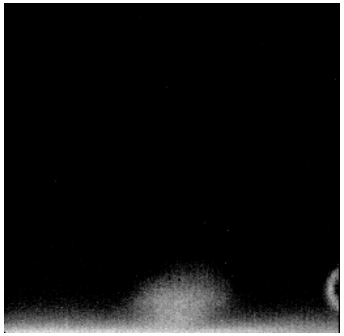
T=7 s



T=14 s

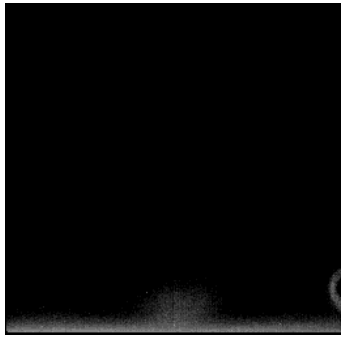


T=20 s



T=27 s

T=34 s



T=40 s

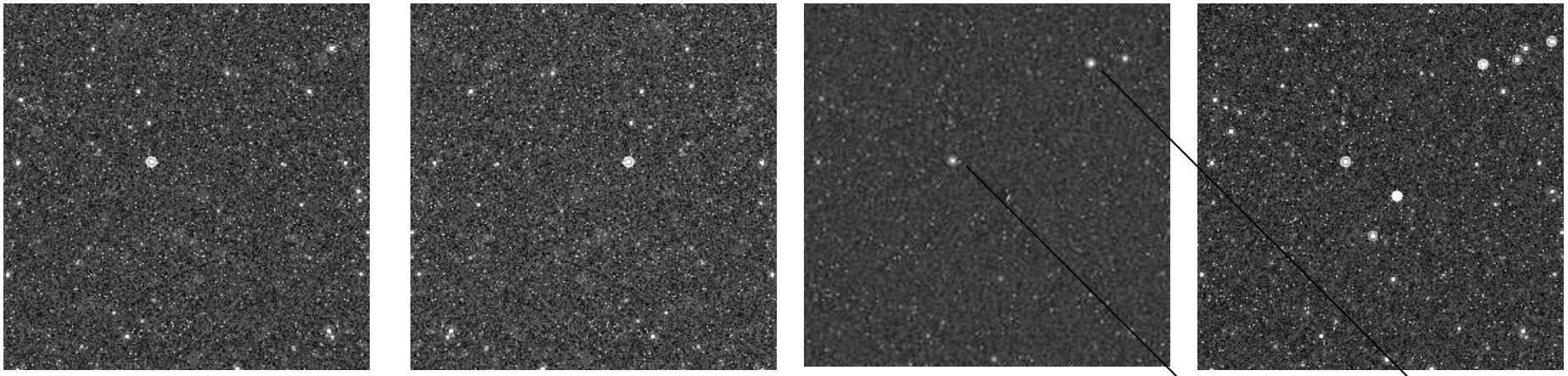
Latent-flag image

Testing Contd...

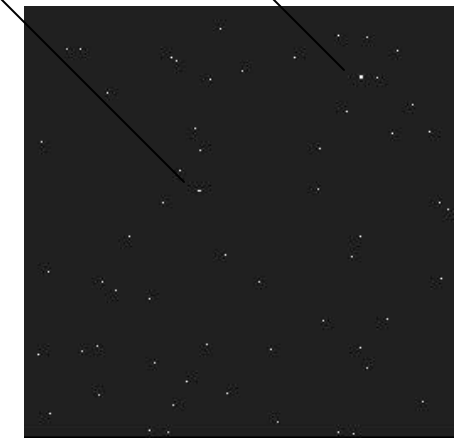
- More realistic situation:

  Four “mock” IRAC images at 3.6μm with random sources and updated their start-observation FITS header keywords to make a time-ordered sequence:

T = 0 T= 15 s T=30 s T= 45 s



LATIMREPORT: Latent-report “flag” image after T = 45 s:



Ancillary Information...

- Optional IPAC-Table output:

```
\character comment = Output from latimreport, version  2.00
\character Date-Time = Thu Jan 18 20:18:20 2001
\character inputFITSfile = ./testing/test2.fits
\character inputFITSimageLIST = latimreport_images.list
\real SecondsPerTick = 0.030000
\real IntegrationTime = 100.000000
\real startTIME = 90.000000
\integer Number of Planes = 1
\integer Number_of_Latents_in_Plane 1 = 4096
|Latent_No. |Plane_No. |Column |Row |
|i          |i         |i      |i   |

   1           1          2       1
   2           1          4       5
   3           1          8       10
   4           1          13      8
   5           1          9       11
   6           1          25      7
   7           1          23      8
   8           1          26      14
   9           1          23      6
   10          1          54      16
   11          1          76      10
   12          1          140     29
   13          1          135     19
   contd...
```

- Warning messages and processing statistics sent to standard output or optionally, a log file.

Software Specifics

- User can also specify a “latent-pixel fraction” parameter, or the fraction of latent pixels tolerated in an image before a warning message is sent to standard output (and/or a log file). This is instrument specific and relative to the total number of pixels in the array.

  $\Rightarrow$ Large number of latents expected in observations of the galactic plane.

- Processing time: A list of ~500 history (persistence-time) images preceeding a given DCE for which a latent report is requested takes ~ 6 mins on a 333 MHz (128 MB RAM) Ultra-10.

Remaining Issues/Further work

- More accurate latency decay curves for each band, parameterized analytically for input into LATIMDETECT. Channel dependent? Thorough analysis of test data required.

- Currently, latent pixels are simply flagged in an image. There are plans to compute a latent intensity pixel map (planned for S6). This will crucially depend on accuracy of derived latency models.

- What to do about saturated pixels. Unpredictable latent persistence-times.

- Need strategy to compute the noise σ in a DCE above which a latent-image pixel will persist. Use a single global value over entire image or compute locally (varying with position) in an image? (planned for S6).