Colibri Reduction Pipeline

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Summary

* RATIR pipeline as basis for Colibri

  - active since 2012, unchanged for years now

* Active Development on Coatli/DDOTI

  (same underlying tools, but)

  - more interactive (Coatli)
  - faster (DDOTI)

Optical/NIR Pipeline Approach

All open source software, running in linux.

Cronjobs and shell scripts: embarrassingly parallel execution.

Core tasks/scripts:

Image reduction (bias-subtraction, flat-fielding, etc.) in cfitsio

Distortion/linearity corrections using custom python scripts

Images aligned with custom python scripts and astrometry.net

Image stacking using swarp

Photometry (aperture or PSF) using a combination of sextractor and custom python scripts.

Optical/NIR Pipeline Approach

Higher Level summary:

Images are mapped to a common pixel grid (swarp) → accurate lightcurves AND colors.

Catalog comparison allows for photometric calibration and new source identification.

Webpage to Summarize Results:

Plot lightcurves and SEDs. Determine photometric redshifts. Etc.

Example: The RATIR 6 channel Camera

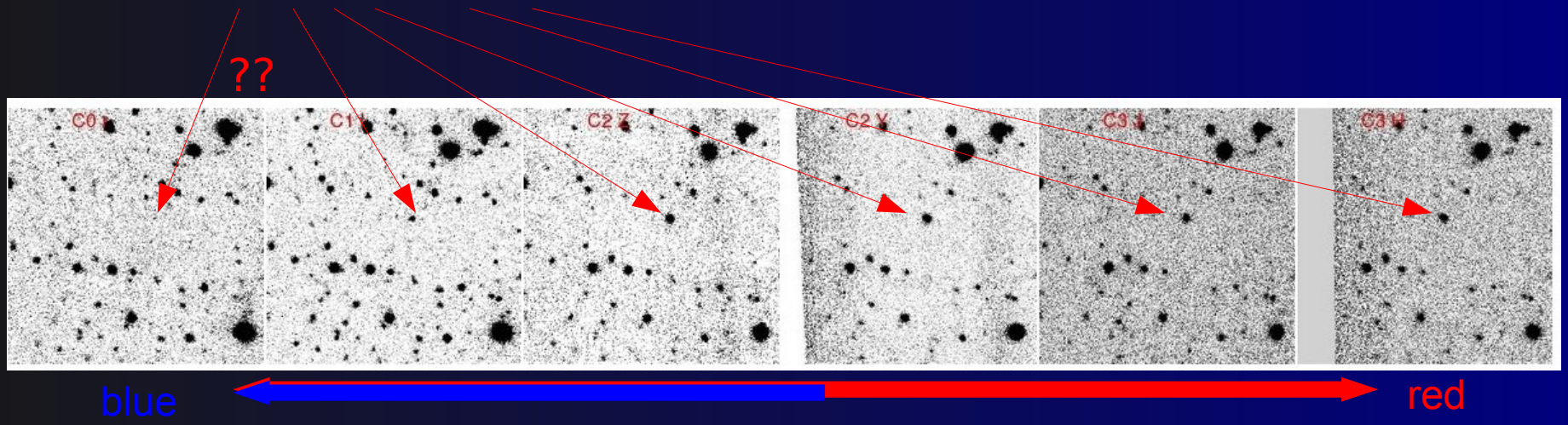
"Reionization And Transients InfraRed camera"

US/Mexican Collaboration.

Online Since Fall 2012.

Simultaneous images in 6 "colors."

First z~6 GRB detected in June 2013.



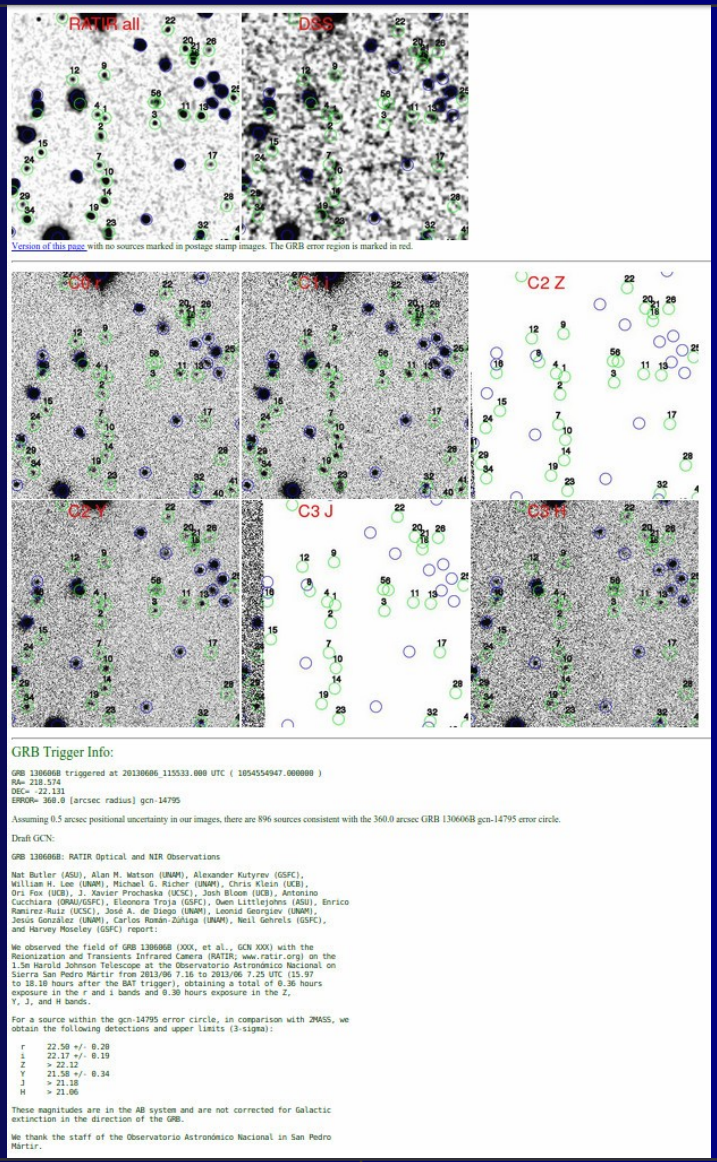
Fully Automated in Software

Telescope responds within minutes,
thanks to Alan Watson (and others).

(interrupts, schedules, and slews)

Images (6 channels):
reduced,
sources identified,
compared to existing catalogs.

New sources publicized automatically!

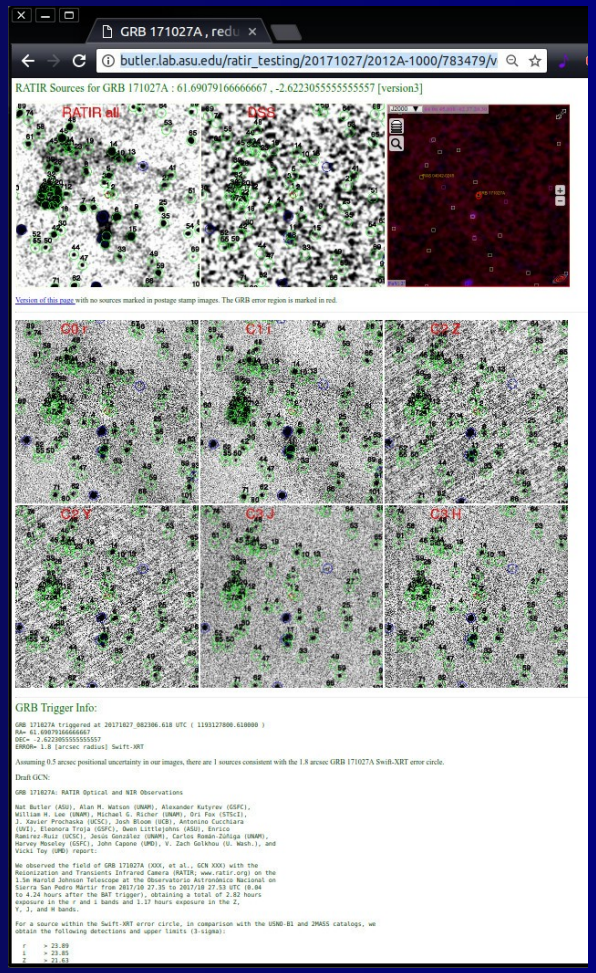


An Example RATIR Page

This is an auto-generated webpage
For a RATIR event in October 2017.

The webpage shows our 6 images, with
DSS stars and the Swift
XRT error circle.

The new source is
identified and a GCN circular is drafted.



An Example RATIR Page

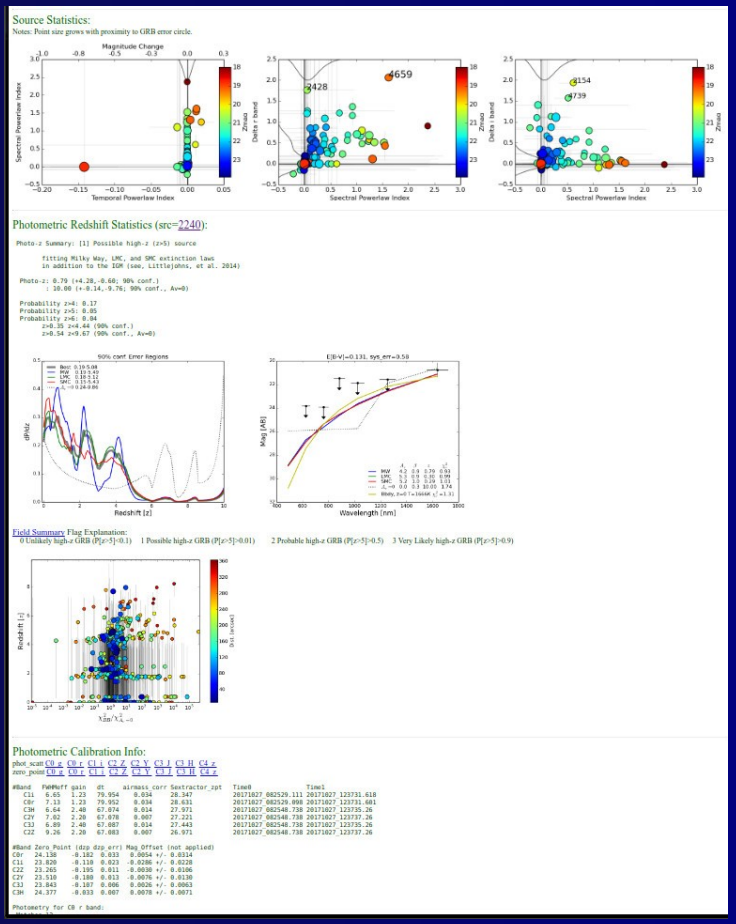
Now look further down the page:

This event is detected in H, and possibly in J, but not bluer.

Color and time histories are used to help identify interesting sources.

Photo-z are calculated (quickly) for all sources in the field.

The new source photo-z and models are plotted along with statements about the photo-z included in GCN.



Example: The DDOTI

6 telescopes: 70 deg^2 field

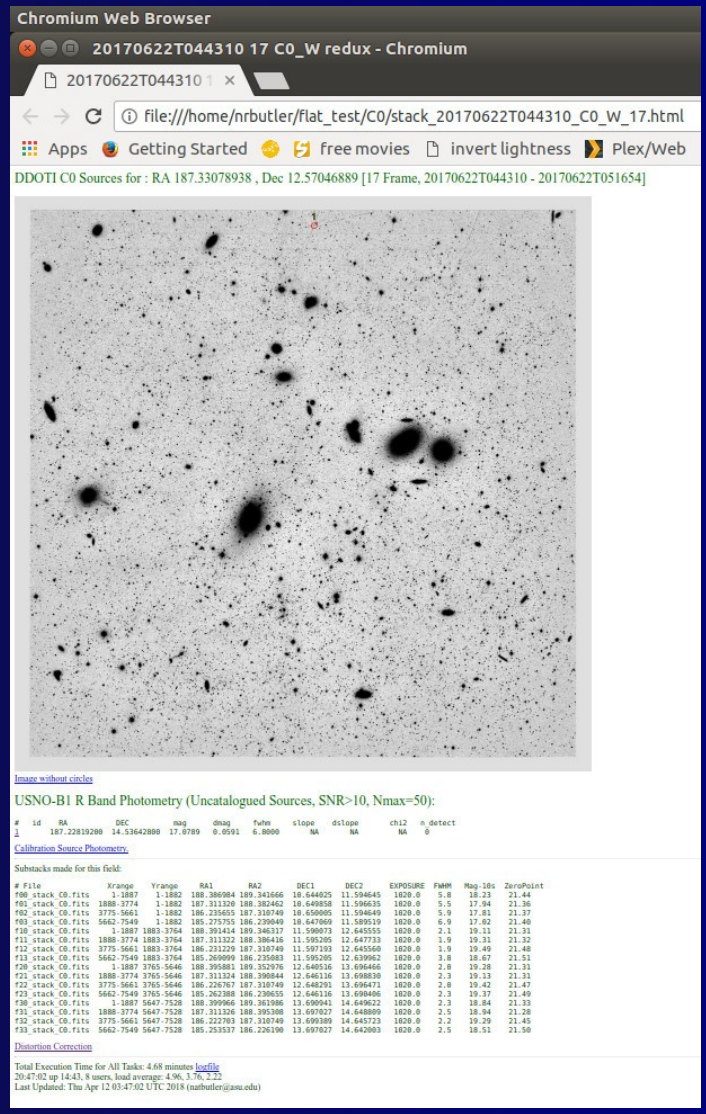
The DDOTI

Also, fully automated in software.

This single image contains 40,000 stars and galaxies.

Find the needle in the haystack!

(All sources shown are catalogued.)



The DDOTI

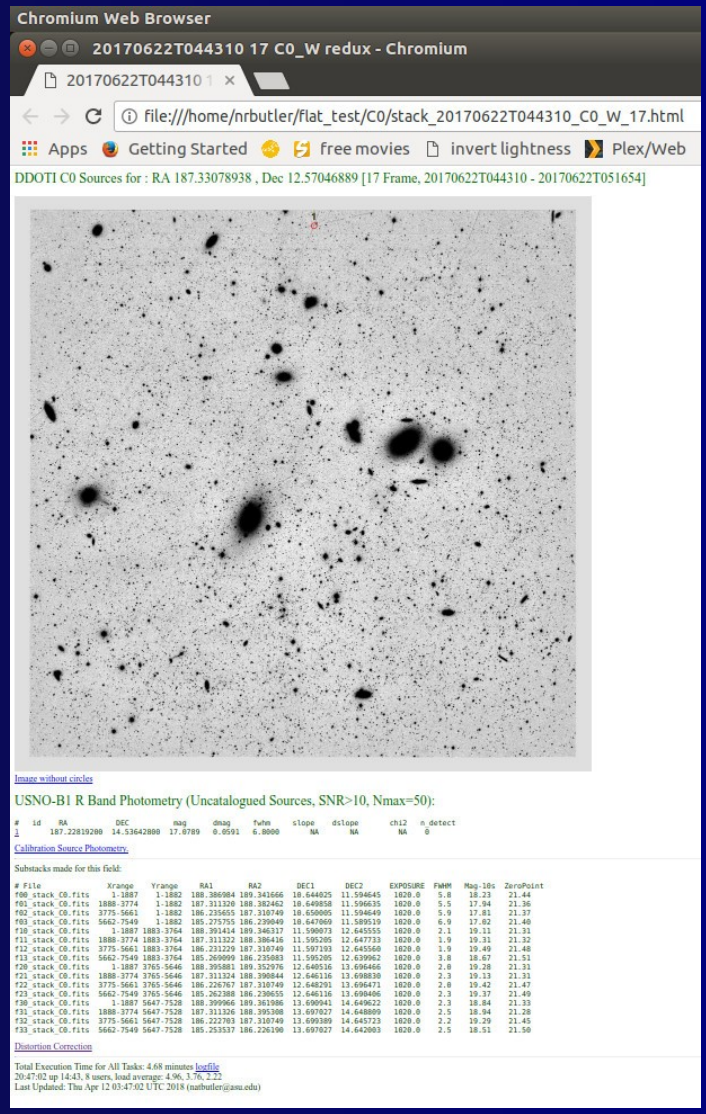
For DDOTI, I try to avoid operations directly on the large (6k x 6k) images.

Image operations (e.g. flat fielding) row-wise with cfitsio.

Sextractor/swarp to apply common apertures across frames for photometry.

The rest of the work is in catalog space.

Pipeline runs for 6 cameras on a single 4-core machine!



DDOTI → Colibri

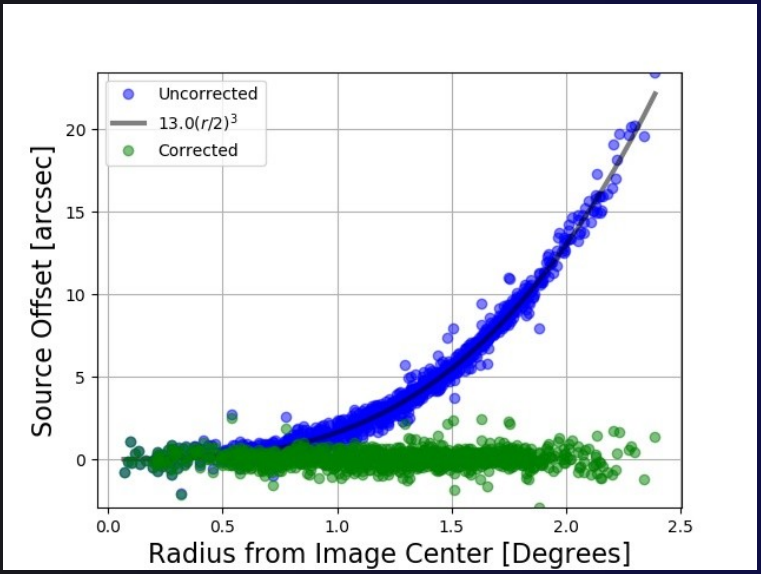
DDOTI utility for Colibri:

Reductions elements have been greatly sped-up versus RATIR.

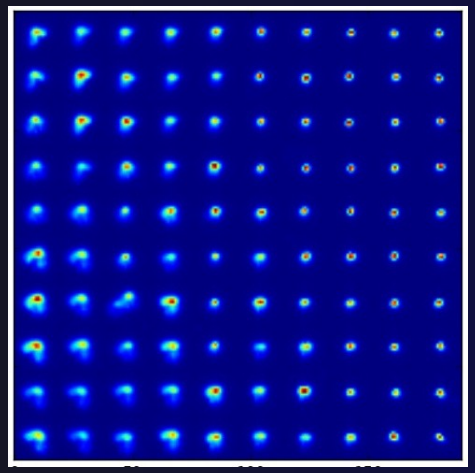
Can now:

- Be faster:
  - Handle all files and catalogs in fits binary
  - Avoid most python scripts in favor of c
- Do more:
  - Correct for Distortions and PSF variations
  - Remove satellite trails
  - Apply sextractor apertures in custom c code
  - Utilize local (USNO/APASS) catalogs

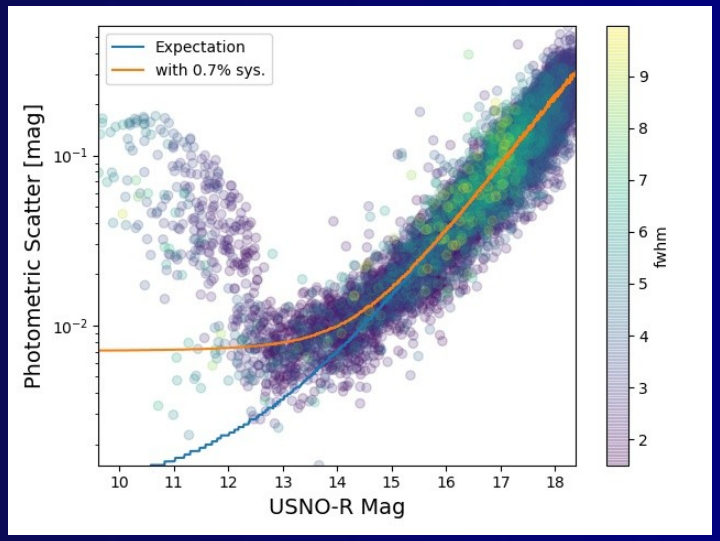
DDOTI → Colibri



+



→

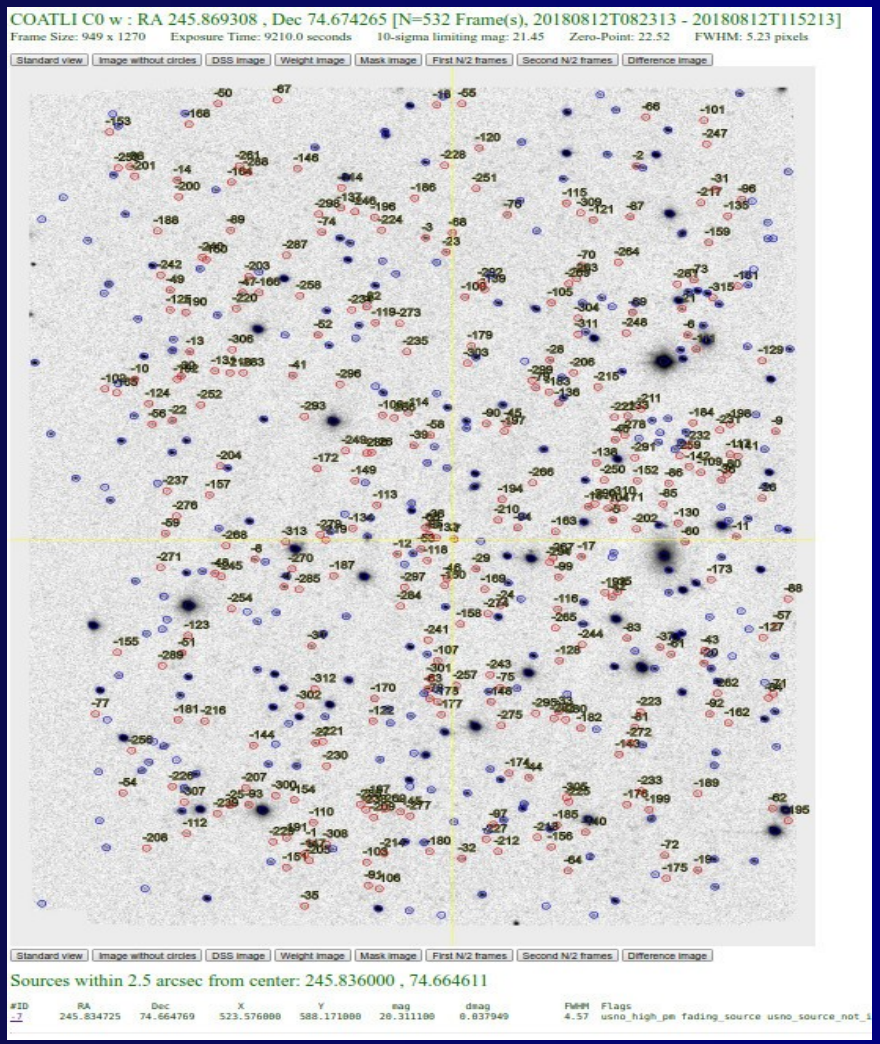


Final Example: Coatli

Another telescope / pipeline running on San Pedro.

Field of view more like Colibri.

Good example of other visuals and tools that could be provided to an SVOM duty operator.



Conclusions

I have been working with Damien to understand the Colibri/SVOM requirements.

I have the working RATIR pipeline, very close to what we need.

Rolling out the final Colibri pipeline will depend on seeing data (distortions, noise characteristics, etc.).

Will benefit from development on DDOTI and Coatli.