

VT VHF data

Tutorial on the quick-look analysis

Jesse T. Palmerio

SVOM

Space Variable Object Monitor

SPACE

ECLAIRS

(4 - 150 keV)
FoV: ~ 2 sr
Loc.: < 12'

MXT

(0.2 - 10 keV)
FoV: 64' x 64'
Loc.: < 13''

VT

(400 - 1000 nm)
FoV: 26' x 26'
Loc.: < 1''
mlim ~ 23 (V - 300 s)

GRM

(30 keV - 5 MeV)
FoV: ~ 5.6 sr
Loc.: 5 - 10°

GROUND

GWAC

(500 - 800 nm)
FoV: 2x5000 deg²
40 cameras
mlim ~ 16 (V - 10 s)

C-GFT

(400 - 950 nm)
FoV: 21' x 21'
Diam.: 1.2 m
mlim ~ 19 (R - 100 s)

F-GFT (COLIBRI)

(400 - 1700 nm)
FoV: ~ 26' (diam.)
Diam.: 1.3 m
mlim ~ 20.5 (r - 60 s)

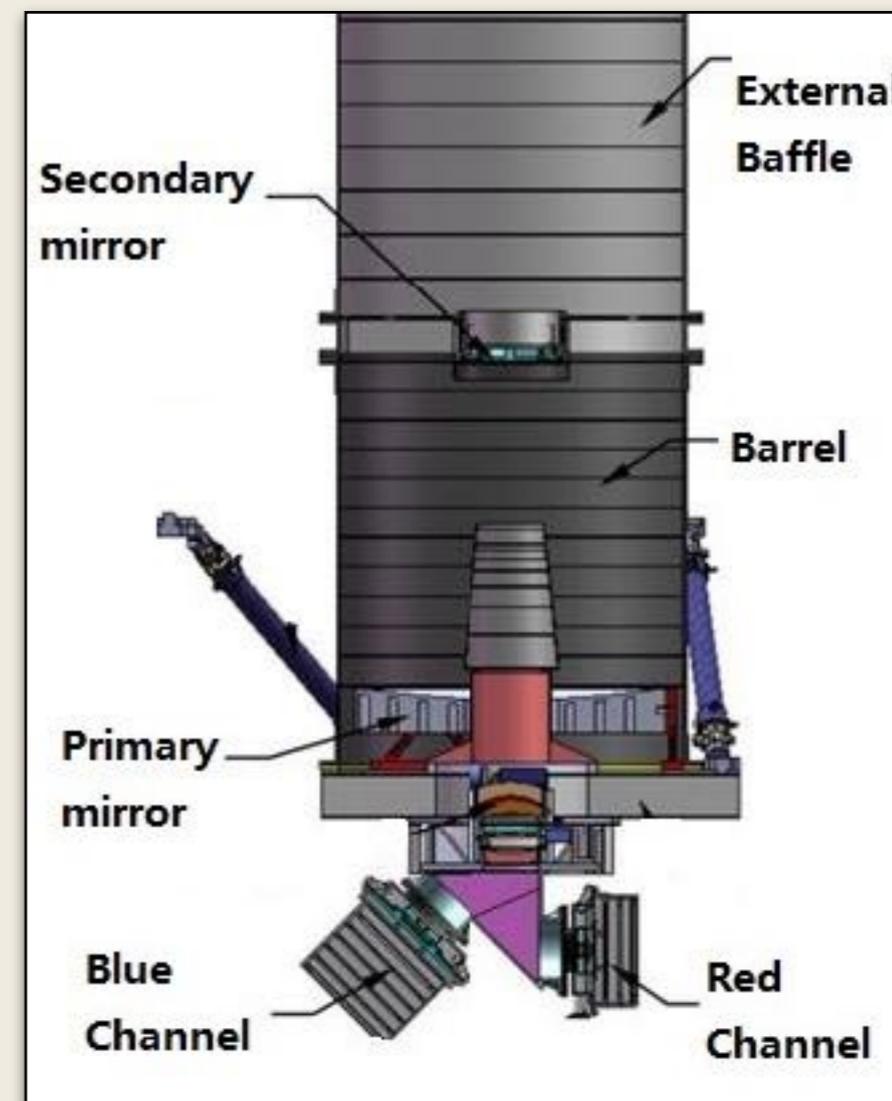


Visible Telescope (VT)

- Ritchey-Chrétien telescope
- Aperture: 440 mm
- Magnitude limit: ~ 22.5 after 300s
- Field of View : $\sim 26' \times 26'$
- RON: $< 6e^-/\text{pix}$ (rms) in 100s
- Two wide filters (VT_B, VT_R) similar to Gaia BP/RP



VT at SCEM for testing.
Credit: Yulei QIU



Visible Telescope (VT)

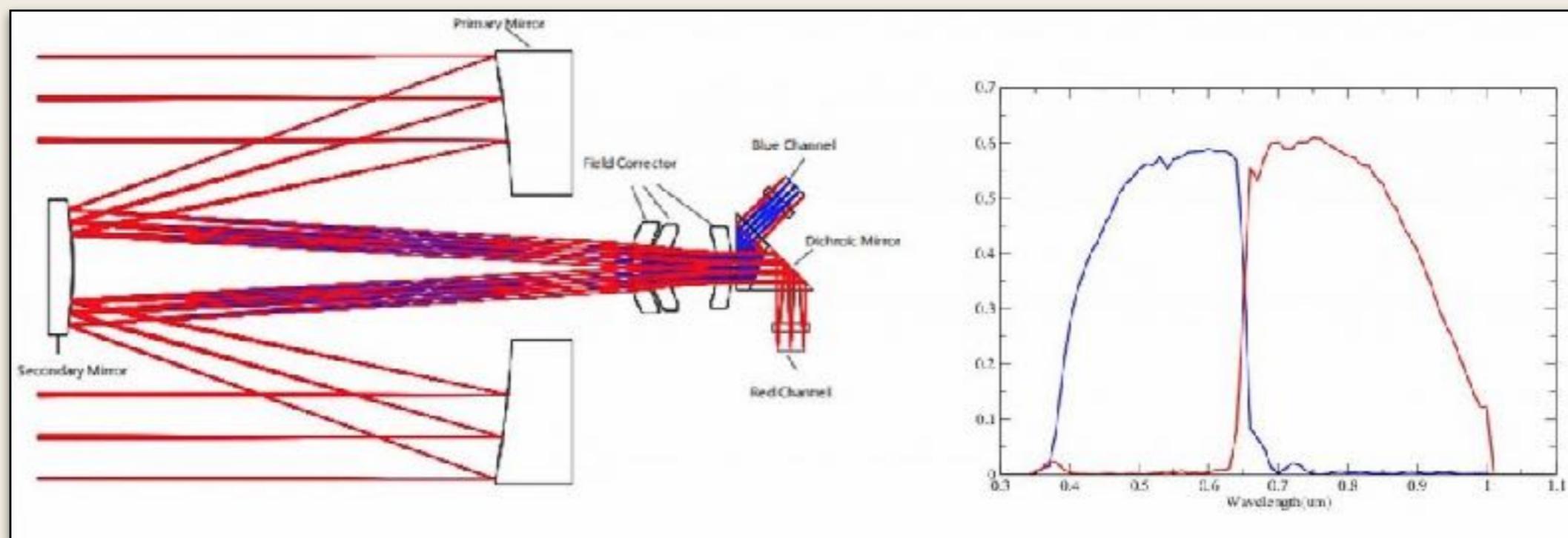
Two simultaneous channels split by a dichroic:

Blue channel:

- 4000 - 6500 Å
- 2k×2k normal back-illuminated CCD detector
- PSF: 2.9'' (diameter of 80% energy)

Red channel:

- 6500 - 10000 Å
- 2k×2k deep-depleted CCD detector for sensitivity at longer wavelengths
- PSF: 1.9'' (diameter of 70% energy)



VT goals

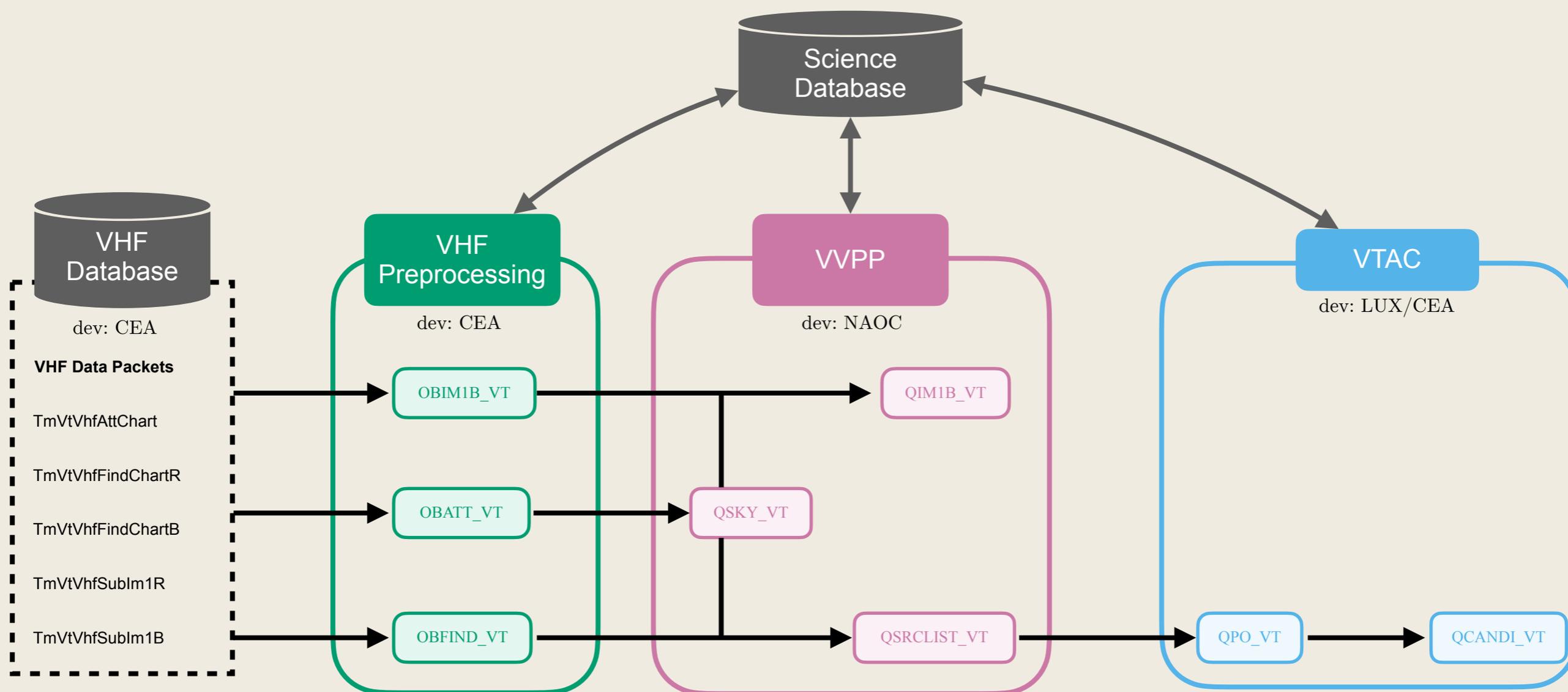
- Rapidly identify optical afterglow of GRBs detected by SVOM
- Provide arc-second localization of candidate afterglow
- Early optical/NIR information
(temporal evolution, extinguished GRBs, high redshift...)
- Crucial step to allow for further ground-based follow-up such as spectroscopy
(for redshift)

VT GRB observing sequence

After an ECL trigger with slew, VT will observe 4 sequences in its two bands:

- R0, R1, R2, R3 & B0, B1, B2, B3
- Each sequence is a combination of $6 \times 50\text{s}$ (= 5 min) images
- Full-frame images are too heavy for VHF, so a sub-image is extracted:
 - At the MXT on-board position if available. Size of the sub-image scales with the quality factor: QF1 $\rightarrow 11' \times 11'$, QF4 $\rightarrow 6' \times 6'$
 - At the ECL trigger location otherwise (using max size: $11' \times 11'$)
- If VT is Earth-occulted before it can finish the first sequences (0 and 1), they will be skipped and only sequence 2 and 3 will be produced

Pipelines running at FSC



VT VHF products

OBIM1B_VT : On-board 1bit sub-image in pixel coordinates reconstructed from VHF packets

OBATT_VT : On-board attitude chart (list of bright stars in pixel coordinates in the sub-image)

OBFIND_VT : On-board finding chart (list of all sources (max 200) in pixel coordinates in the sub-image)

QSKY_VT : Quick Sky position (processed attitude chart in celestial coordinates)

QIM1B_VT : Quick 1bit sub-image (processed 1bit sub-image in celestial coordinates)

QSRCLIST_VT : Quick source list (processed finding chart in celestial coordinates, with photometric calibration)

QPO_VT : Quick positions (combined list of sources from all sequences and bands, crossmatched with catalogs)

QCANDI_VT : Quick candidate (single source identified manually by the VT IS as a good candidate)

QPO_VT

Quick positions of the VT

Table with:

- Unique* VT identifier (VT_ID)
- Positions (RA/DEC)
- Calibrated magnitudes (MAGCAL_{SEQ**})
- Flags:
 - Sequences where the source was not found in catalog (NEW_SRC)
 - Sequences where the source was found brighter than in catalogs (DMAG_CAT)
 - Pair of sequences between which the source varied in magnitude (MAG_VAR)
 - Morphological flag (EFLAG_{SEQ**})
- Tier of the candidate (see next slide) (SRC_CATEGORY)

*: Unique for a given burst-id

** : SEQ ∈ [R0, R1, R2, R3, B0, B1, B2, B3]

Candidate tiers

δm : Magnitude variation between two consecutive sequences in the same band

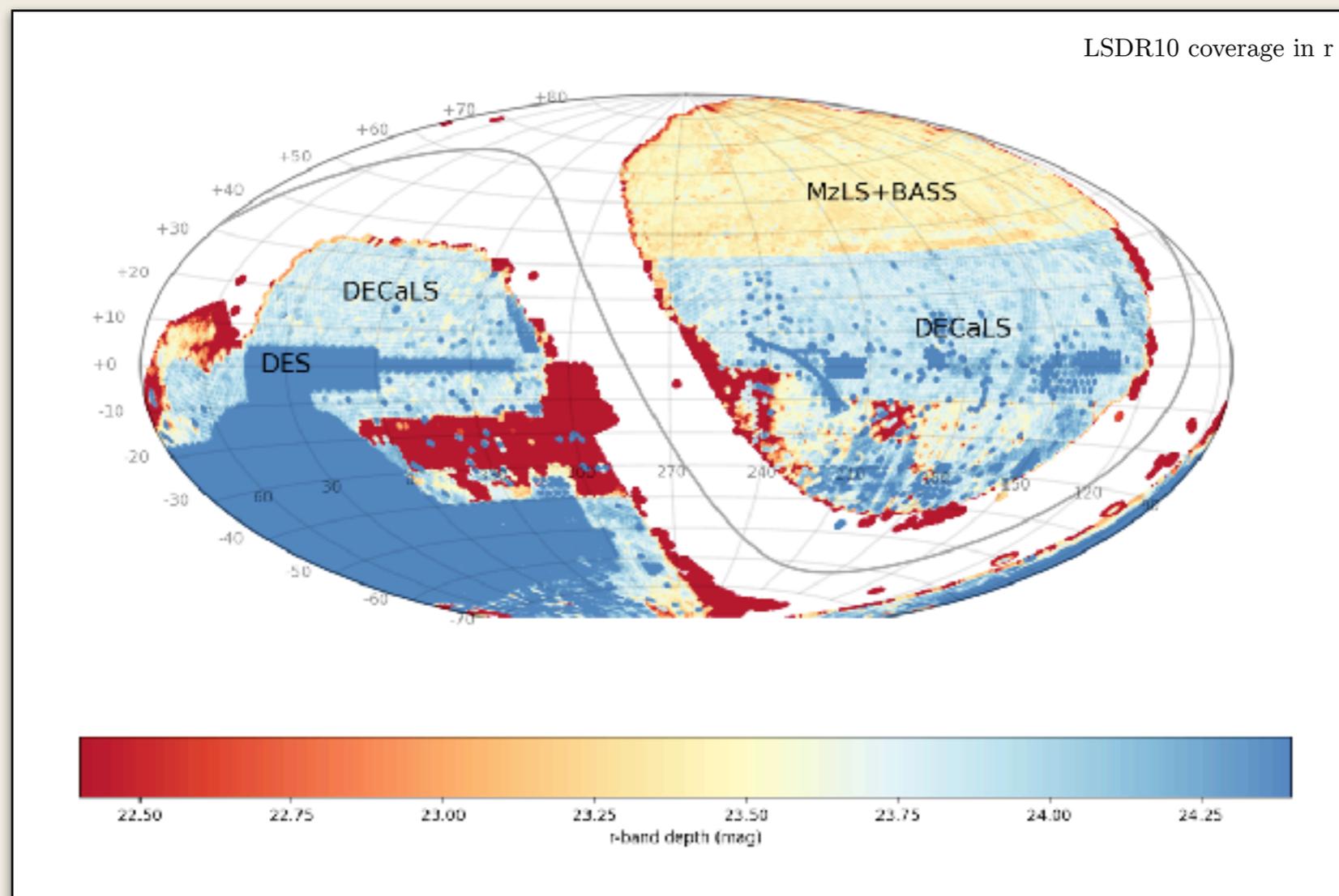
Δm : Magnitude difference with the cataloged magnitude (\neq photometric systems ! \rightarrow conversion is on-going)

! Exact thresholds are susceptible to change

Criteria	S-tier	A-tier	B-tier
Observation (OBSFLAG)	<ul style="list-style-type: none"> Detected in both R and B bands 	<ul style="list-style-type: none"> Can be detected in single band 	<ul style="list-style-type: none"> Can be detected in single band
Magnitude (MAGFLAG)	<ul style="list-style-type: none"> $m < 21$ for all measurements if multiple sequences, else $m < 20$ 	<ul style="list-style-type: none"> $m < 22$ for all measurements if multiple sequences, else $m < 21$ 	<ul style="list-style-type: none"> Any
Catalog (DMAGFLAG)	<ul style="list-style-type: none"> Uncataloged or $\Delta m > 5$ 	<ul style="list-style-type: none"> Uncataloged or $\Delta m > 3$ 	<ul style="list-style-type: none"> Catalogued and $\Delta m > 3\sigma$
Variability (VMAGFLAG)	<ul style="list-style-type: none"> $\delta m > 5\sigma$ and $\delta m > 0.1$ for at least one pair of measurements in both bands 	<ul style="list-style-type: none"> $\delta m > 3\sigma$ for at least one pair of measurements for a band (can either be R or B) 	<ul style="list-style-type: none"> $\delta m > 3\sigma$ for at least one pair of measurements for a band (can either be R or B)

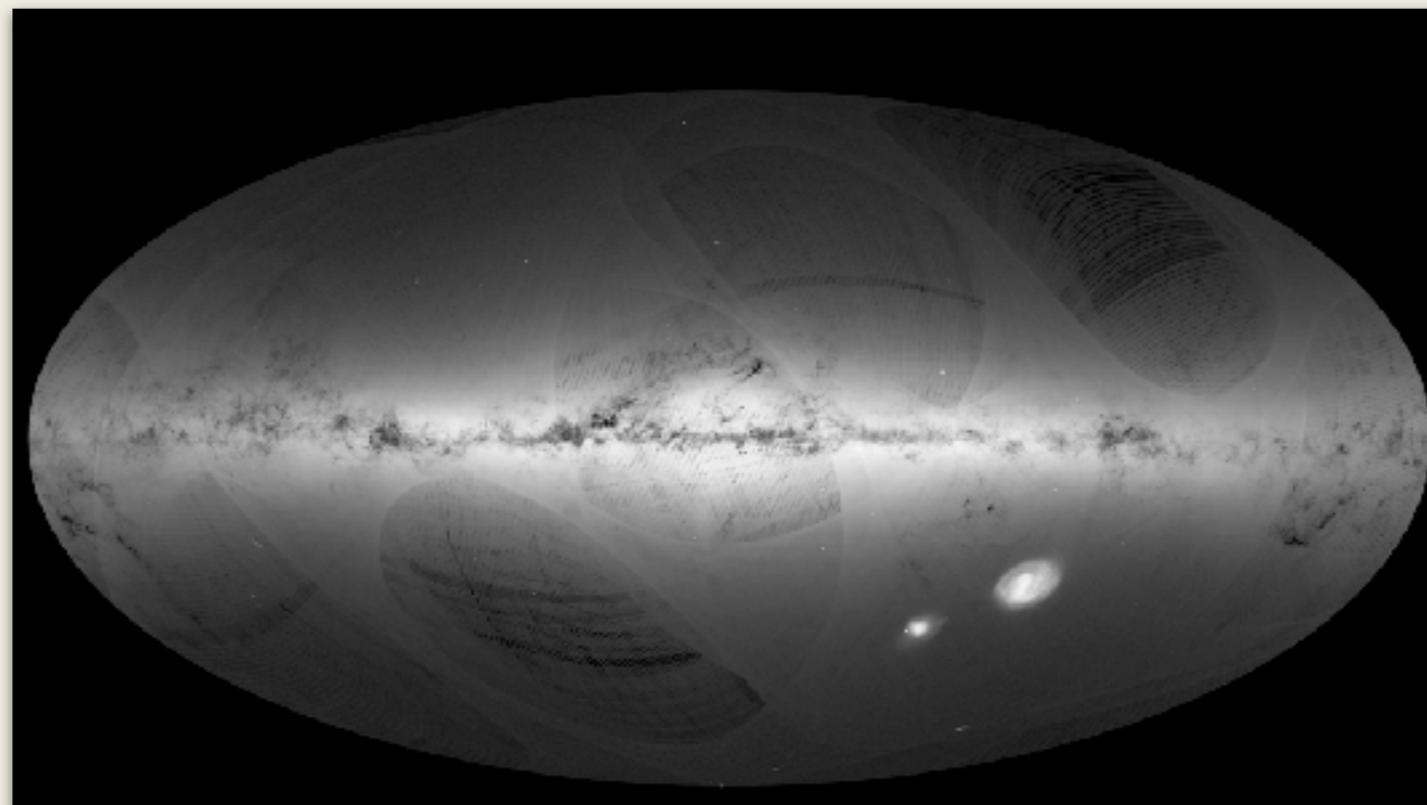
Catalogs

- Legacy Survey Data Release 10 (LSDR10):
 - Best combination of depth (down to mag ~ 23 -24 in g, r, i, z) and sky coverage



Catalogs

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 - Best combination of depth (down to mag $\sim 23-24$ in g, r, i, z) and sky coverage
- Gaia DR3:
 - All-sky coverage, great astrometry but not very deep (down to mag ~ 21 in G)
 - No images !!

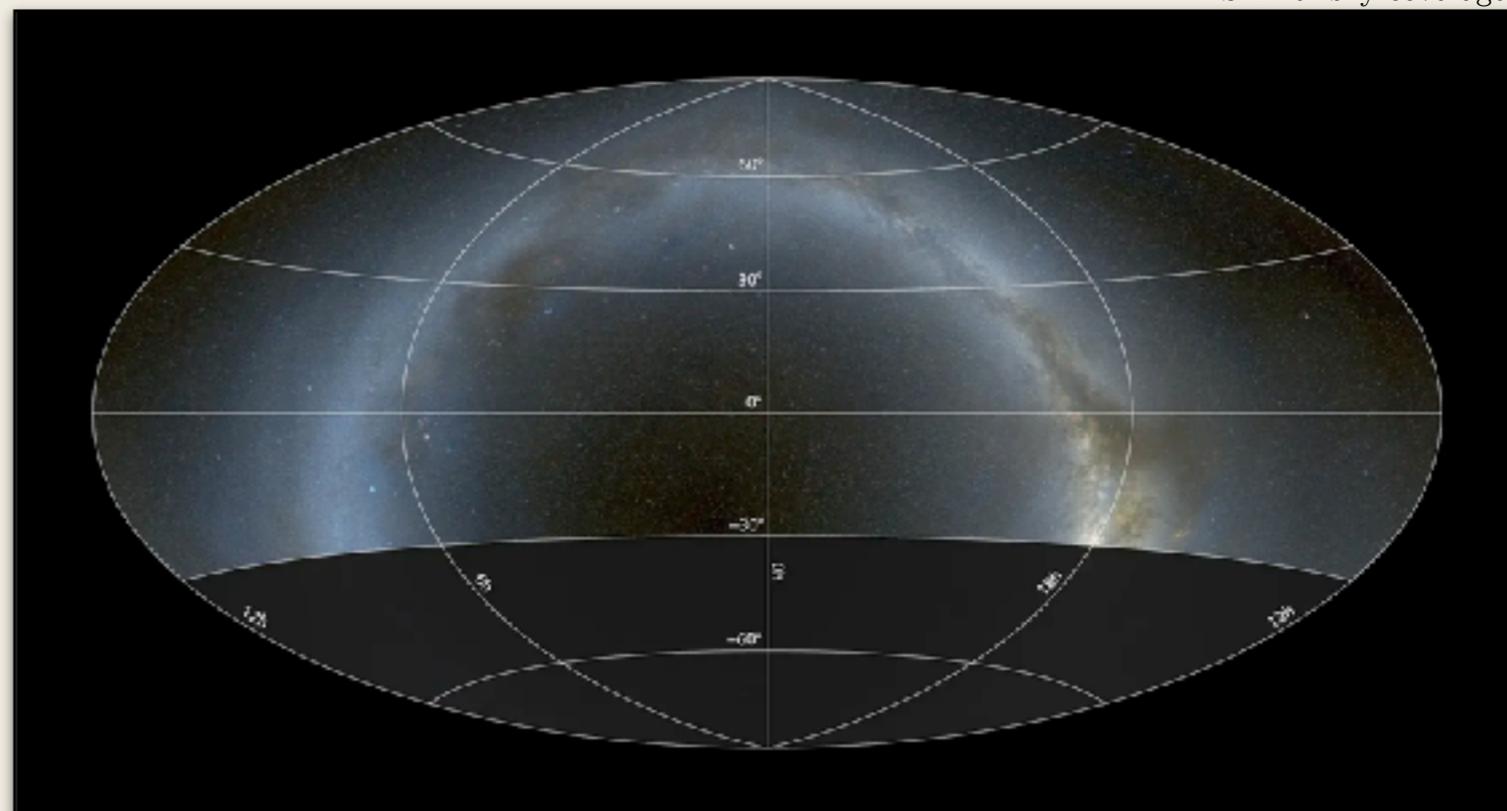


Gaia sky coverage (credit: ESA)

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- Gaia DR3:
 - All-sky coverage, great astrometry but not very deep (down to mag ~ 21 in G)
 - No images !!
- Pan-STARRS1 DR1 (PS1DR1):
 - Good sky coverage in the north
 - Not as deep as LSDR10

PS1DR1 sky coverage



Catalogs

- Legacy Survey Data Release 10 (LSDR10):
 - Best combination of depth (down to mag $\sim 23-24$ in g, r, i, z) and sky coverage
- Gaia (GAIADR3):
 - All-sky coverage, great astrometry but not very deep (down to mag ~ 21 in G)
 - No images !!
- Pan-STARRS1 (PS1DR1):
 - Good sky coverage in the north
 - Not as deep as LSDR10
- Sloan Digital Sky Survey (SDSSDR16):
 - Deeper than PS1DR1, not as deep as LSDR10 but small sky coverage
- Future: Euclid, LSST, etc...

VTAC-UI

Hands-on

<https://fsc.svom.org/vtac-ui/>

Click on the globe to open the visual tool

The screenshot shows the 'VTAC Related Scientific Products' interface. At the top, there are search filters for Burst ID, Product ID, and Date (07/14/2024 to 03/16/2026). Below the filters is a table with columns: BURST ID, QPO_VT, QCANDI_VT, QIM1B_VT, QSRCLIST_VT, QPO_MXT, and OBALERT_ECL. The first row of data is highlighted, showing a Burst ID of sb26831301 and several product entries with their respective dates and product IDs. A red box highlights a globe icon in the bottom left corner of the table, with a red arrow pointing to it from the text above.

BURST ID	QPO_VT	QCANDI_VT	QIM1B_VT	QSRCLIST_VT	QPO_MXT	OBALERT_ECL
sb26831301	Date: 2026-03-13 15:56:12 Product ID: 602156	Date: 2026-03-13 15:56:33 Product ID: 602157	Date: 2026-03-13 06:02:18 Product ID: 602639	Date: 2026-03-13 05:33:13 Product ID: 602155	Date: 2026-03-13 15:55:45 Product ID: 603734	Date: 2026-03-13 03:46:50 Product ID: 602307

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Click on table to open product viewer

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BURST ID	QPO_VT	QCANDI_VT	QIM1B_VT	QSRCLIST_VT	QPO_MXT	OBALERT_ECL
sb26831301	Date: 2026-08-13 15:56:12 Product ID: 602156	Date: 2026-08-13 15:56:35 Product ID: 602157	Date: 2026-08-13 06:02:18 Product ID: 602639	Date: 2026-08-13 05:33:13 Product ID: 602155	Date: 2026-08-13 15:55:45 Product ID: 603734	Date: 2026-08-13 05:46:50 Product ID: 602307

Some tips

- Be wary of candidates detected in a single band (especially VT_B): could be hot-pixels, cosmic rays, high-redshift (!) or dust-extinguished (if in VT_R) but don't get baited
- Be wary of candidates near the edge of the sub-image: can be caused by clipping of sources just outside the sub-image
- Be wary of candidates with $\text{mag} > \sim 21$
- VT_B has more hot-pixels: appear as A-tier candidates, varying between sequences
- VT_R has more light-bloom: can hide sources behind cross from bright stars
- Generally don't blindly trust MXT:
 - True candidate can be slightly outside (it is R90 after all, not R100)
 - Sometimes the on-board MXT position is wrong (especially for QF1)

Try to find the counterpart

- Easy:
 - sb25122206
 - sb25070609
 - sb25032706
- Medium:
 - sb25020504
- Hard:
 - sb25032901
 - sb25040203
- Very Hard/impossible:
 - sb25102605
 - sb24121704

QCANDI_VT

Quick candidate of the VT

- Table with light-curve for a single VT_ID
- Header contains position (RA/DEC) and detection time
- Created by the VT-IS via the VTAC-UI
- Automatically generates the VT notice which is on-hold by default

Work In Progress

- Automatic creation of VT notice when QCANDI_VT is created
- Conversion between SVOM and catalog photometric system
- Inclusion of hot-pixel map for better hot-pixel flagging
- New catalogs as they come out

THE END

Documentation page: <https://fsc-integration.svom.org/documentation/vtac/index.html>

If any questions or feedback:

Mattermost: @jesse.palmerio (preferred)

Mail: jesse.palmerio@cea.fr