BA tools developed by CSC

Liping Xin, Xuhui Han, Chao Wu, Yuelei, Qiu, Jin Wang, Jianyan Wei, Yuejie Xiao, Pinpin Zhang, Jianyan Bai, Maohai Huang

on behalf of NAOC and CSC team

SVOM BA workshop, 20220516-20, Les Houches and zoom meeting
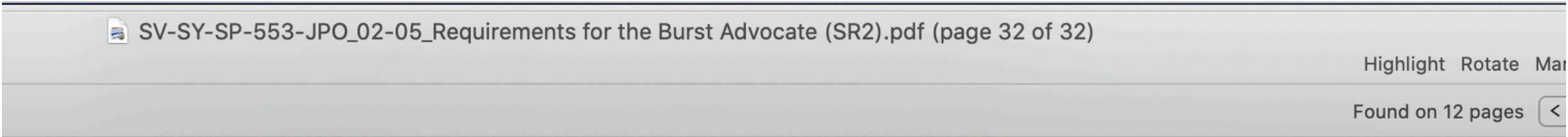
CSC BA tools

- Responsibilities and tasks

- Requirements and workflow

- Test for this training

- Next plans

Responsibilities of developments of BA tools

Requirements for the Burst Advocate (SR2)
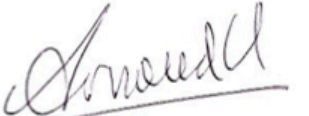
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		Visa
Prepared by:	A. Claret CEA/DRF/IRFU/SAP L. Xin NAOC	*(signatures)*
Other contributors:	J. Deng, O. Godet, D. Götz, P. O'Brien, J. Osborne, S. Vergani, Y. Qiu	Visa
Approved by:	B. Cordier CEA/DRF/IRFU/SAP J. Wei NAOC	Visa *(signatures)*
For application:	J.-P. Le Fèvre CEA/DRF/IRFU/SEDI M. Huang NAOC	Visa

be able to indicate that he/she responded to the alert message he/she received.
The IS shall be paged when X band data are expected to be available at both science centers (FSC & CSC) and also as soon as they are effectively available.

8.2. Functional requirements on BA tools

The BA tools mentionned in SR2-50 are being developed according to the AGILE method, i.e. prototypes already exist and are being continuously developed and improved. A Chinese prototype has been used in the framework of the monitoring by Chinese ground means (GWAC) of the gravitational wave error boxes detected by LIGO-VIRGO (run O2 and O3). Another French prototype has been developed in the framework of the 'burst advocate' school of Les Houches 2020 in order to visualize the scientific products resulting from the real-time analysis of VHF data. An updated prototype based on SR2-50 has being developed by Chinese side with joint validation and analysis display tools and follow-up tools. These prototypes, complementary, allowed to define the essential functions necessary for the BA, and more widely for the IS as well.

For the final tools, it was agreed that:
1) The Chinese side will be in charge of the BA Tools infrastructure.
2) The French side will be in charge of high-energy validation and display tools, including VHF and X-band data.
3) The Chinese side will be in charge of optical validation and display tools, including VHF, X-band, and ground data.

Optical telescopes/instruments include VT and SVOM ground telescopes (FGFT, CGFT...)
Chinese side fully follows the agreement during our developments after the SVOM 2020 CDR meeting

SVOM GRB observations and CSC tasks
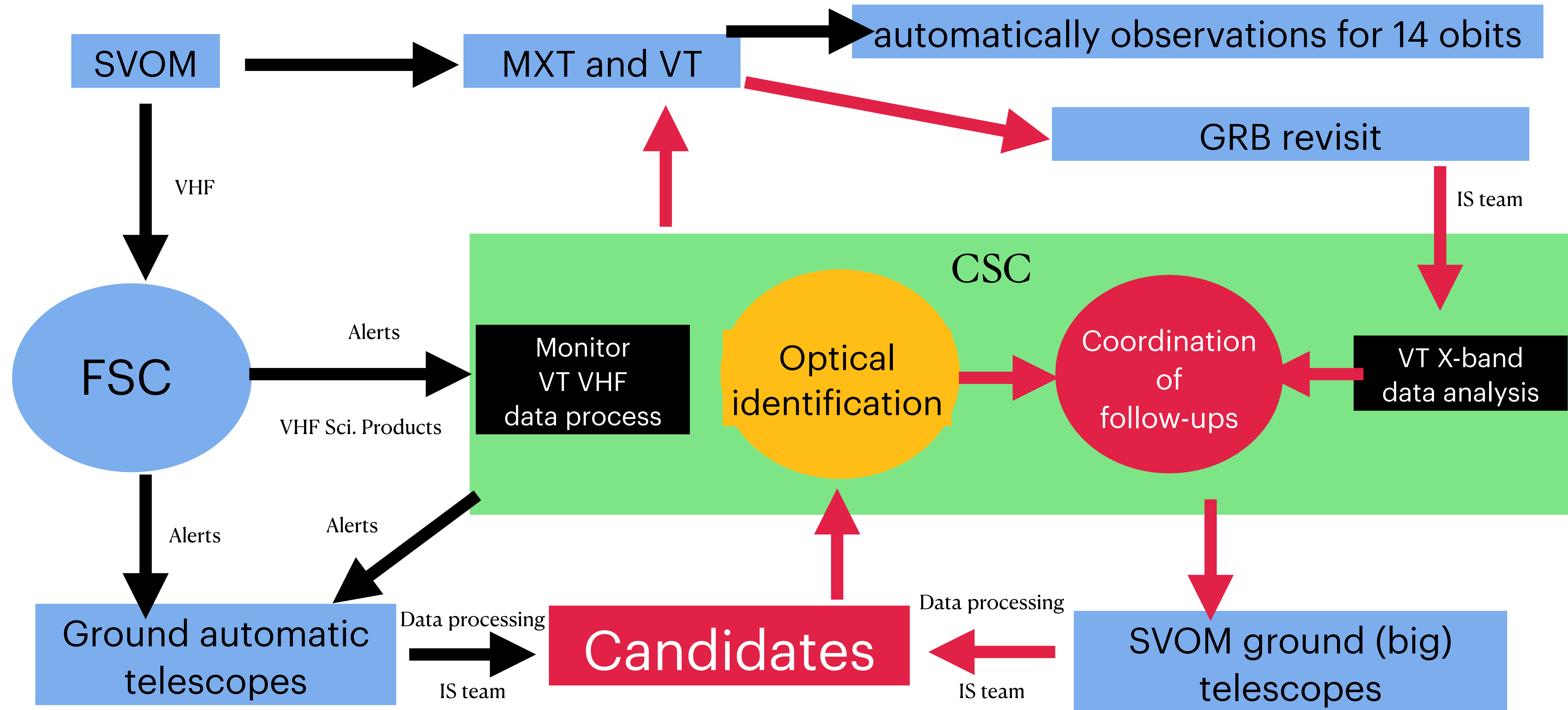
Brief summary of requirements in CSC BA tools

- Chinese BA management

- SVOM alerts and external alerts (Swift / Fermi ...)

- Identification of optical candidates for all SVOM instruments/telescopes

  - VT VHF candidates

  - Ground telescopes

- VT operation

  - Monitor the VT VHF data processing

  - VT calibration

  - VT X-band data analysis

- GRM operation

  - Monitor the GRM operation

  - supervise the GRM X-band data processing

- Coordination of follow-ups with spaced and ground-telescopes

  - Follow-ups strategy based on the results from the latest observations

  - GRB revisit and ToO requirements (photometry / spec, follow-ups / confirmation....)

CONNECTION BETWEEN MXT AND VT

The originality of SVOM: the instruments communicate with each other directly in real time
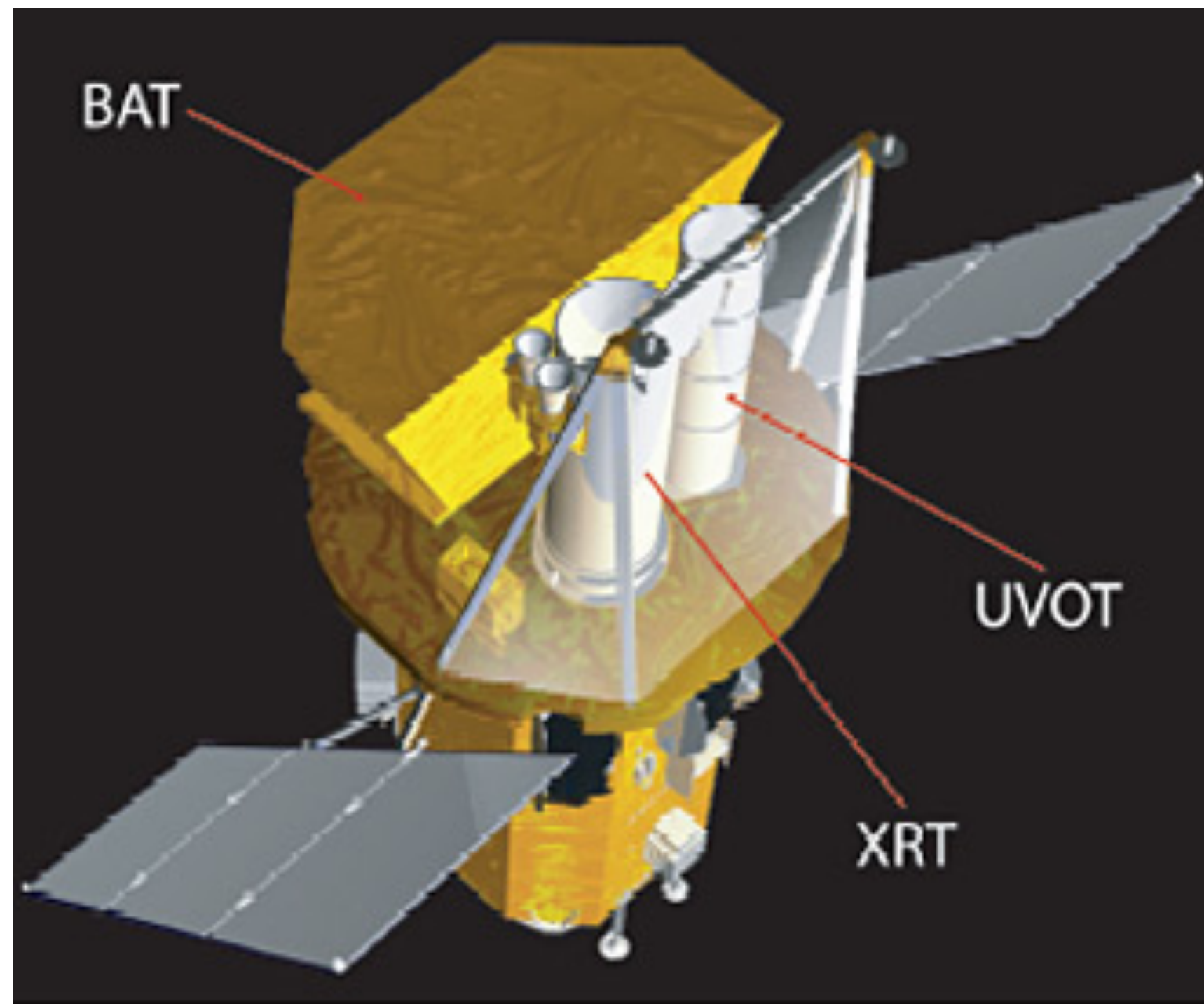
SNR	R90 loc min (arcsec)	R90 loc max (arcsec)	Quality Factor	loc error (arc min) including biais (*)	VT window size
SNR < 3	no loc	no loc	QF=0		10x10 at the center
SNR > 3	120	300	QF = 1	12	10x10 R90 is used for the position
SNR > 3	60	120	QF = 2	6	6x6
SNR > 3	30	60	QF = 3	4	4x4
SNR > 3	10	30	QF = 4	3	3x3

Early phase of a burst

From Bertrand 's presentation in the first day

Challenge in SVOM era for optical search
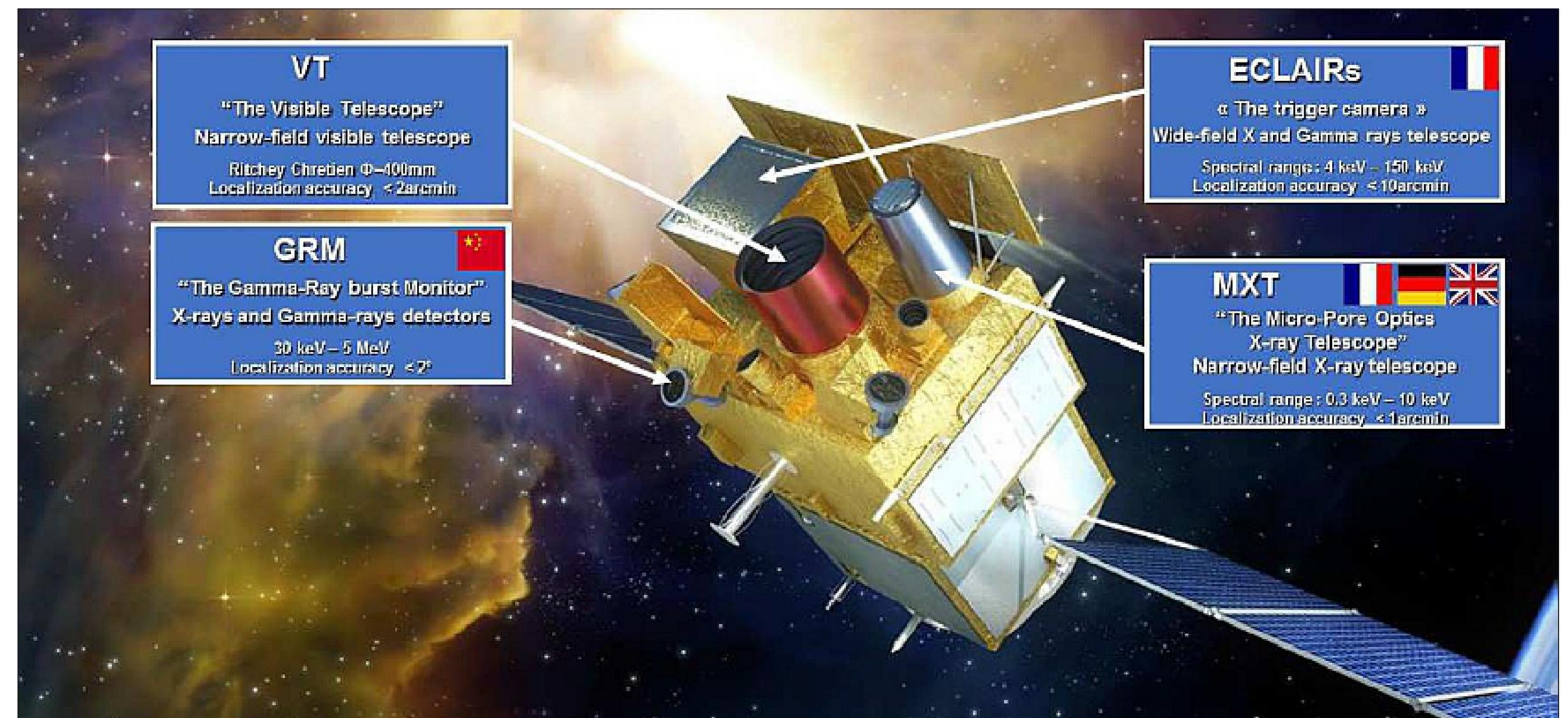

BAT :   ~ 3 arcmin
XRT: ~ 3 arcsec
UVOT: ~1 arcsec

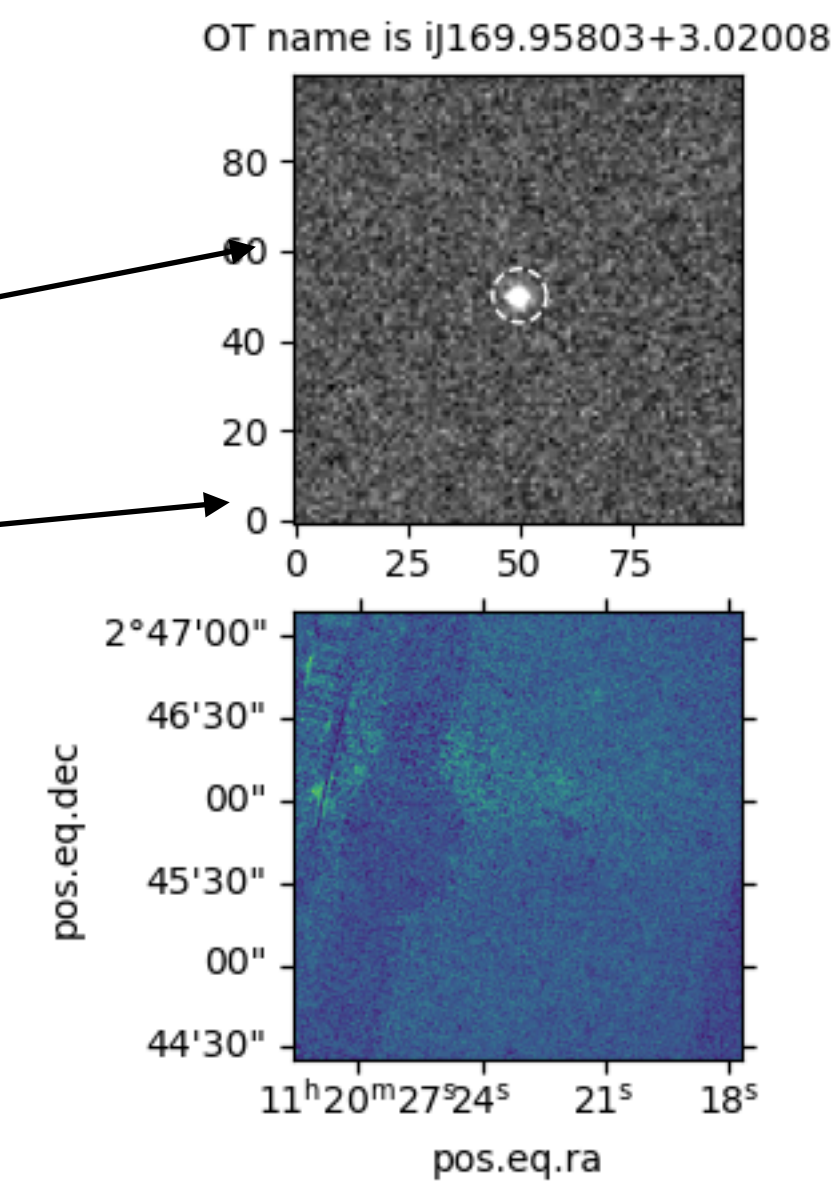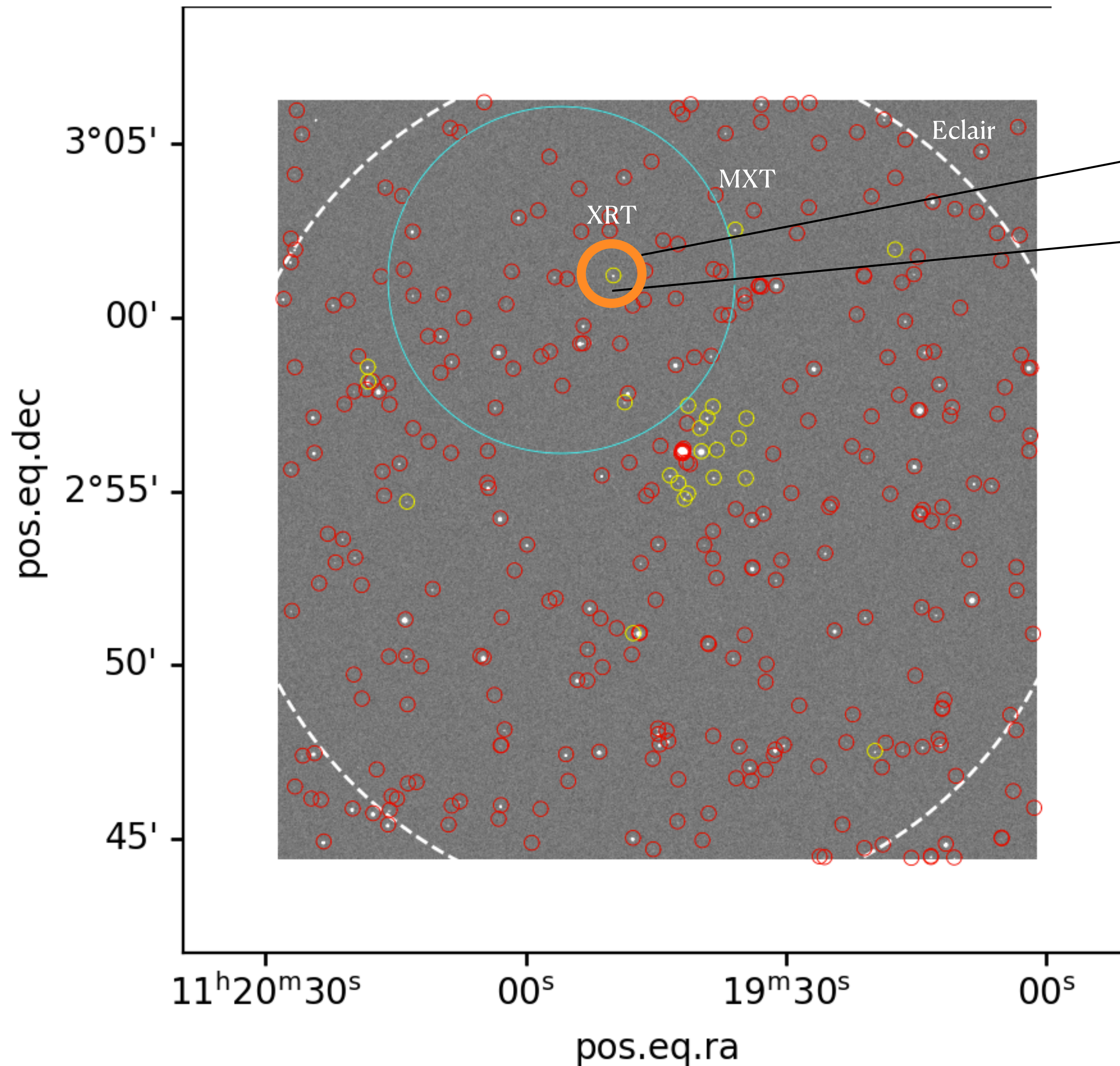Search the optical counterpart at pixels area

Eclair :   ~ 12-8? arcmin
MXT :   ~1-2? arcmin
VT   :   ~ 1 arcsec

Search the optical counterpart in whole images (>2 arcmin)

OT name is iJ169.95803+3.02008

For Swift GRB :
    Detected or not?
    is it an astronomical source?

For SVOM GRB :
    Is the whole Eclair/MXT errorbox coveraged?
    Are some "New" or "variable" sources detected?
    What is the nature for them?
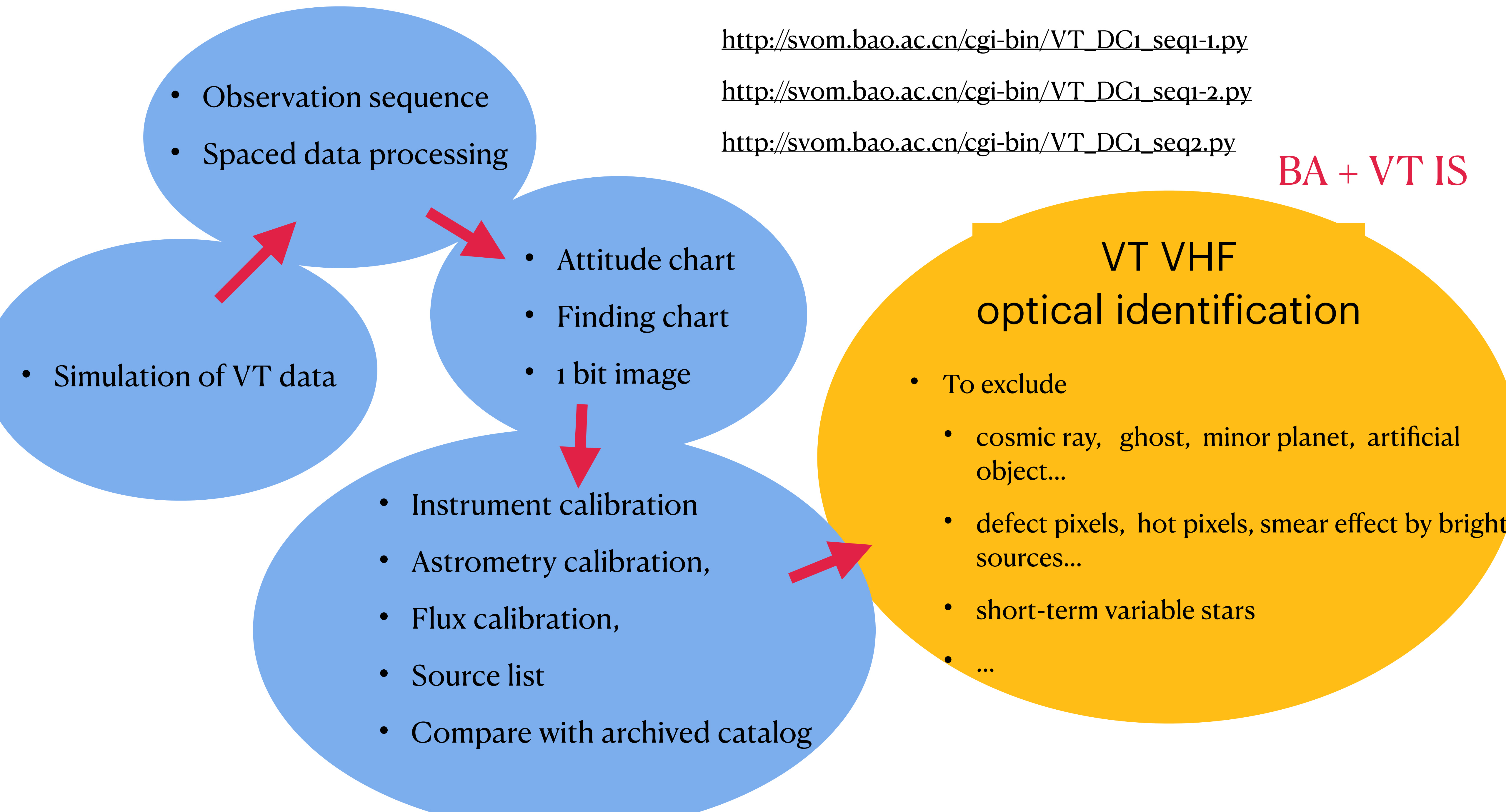   Which is the counterpart or the best candidate?

Optical validation strategy

- In principle, the optical validation is different for different telescopes.

  - Science(Prompt, early afterglow, color, jet, high-redshift, host, SN...)

  - Observation strategy (FoV, response time, filter, photometry/spec...)

  - Detection ability

  - Instrument calibration

  - Ease of data access

  - Method of OT search

  - Data processing pipelines

Validation strategy for VT

- Advantages for VT in GRB science

  - Do the observations for All SVOM slewed GRBs from 5 min after the bursts

  - ~23 mag in 300 sec exposure

  - Could be a good indication for high-z GRBs / optical dark GRBs / heavy extinction GRBs ——— request the big telescopes to confirm by photometry or spec.

- Disadvantages for VT in reality

  - Limit to the download speed via VHF

  - Only limited data could be obtained at early phase.

- What do we need for a quick optical search and how to deal with the situation?

- Observation sequence
- Spaced data processing

http://svom.bao.ac.cn/cgi-bin/VT_DC1_seq1-1.py

http://svom.bao.ac.cn/cgi-bin/VT_DC1_seq1-2.py

http://svom.bao.ac.cn/cgi-bin/VT_DC1_seq2.py

BA + VT IS

- Attitude chart
- Finding chart
- 1 bit image

- Simulation of VT data

VT VHF
optical identification

- To exclude

  - cosmic ray, ghost, minor planet, artificial object...

  - defect pixels, hot pixels, smear effect by bright sources...

  - short-term variable stars

  - ...

- Instrument calibration
- Astrometry calibration,
- Flux calibration,
- Source list
- Compare with archived catalog

GFT

- Advantage for GFT

  - Ease to access the images

  - BA could get the all images

  - Pipelines could be developed in more intelligent

- Disadvantages for GFT

  - Detection ability

  - weather condition

  - seeing——image quality

  - Could rapid response to only parts of GRBs

CGFT

- three channels, g, r, i
- 21*21 arcmin
- ~19mag @300sec

- Simulation the data for this training
  - The best scenario
    - The GRB afterglow is bright, single power law decaying
    - The errorbox of Eclair could be covered by the images
    - 60*30sec are simulated.
  - The worst scenario
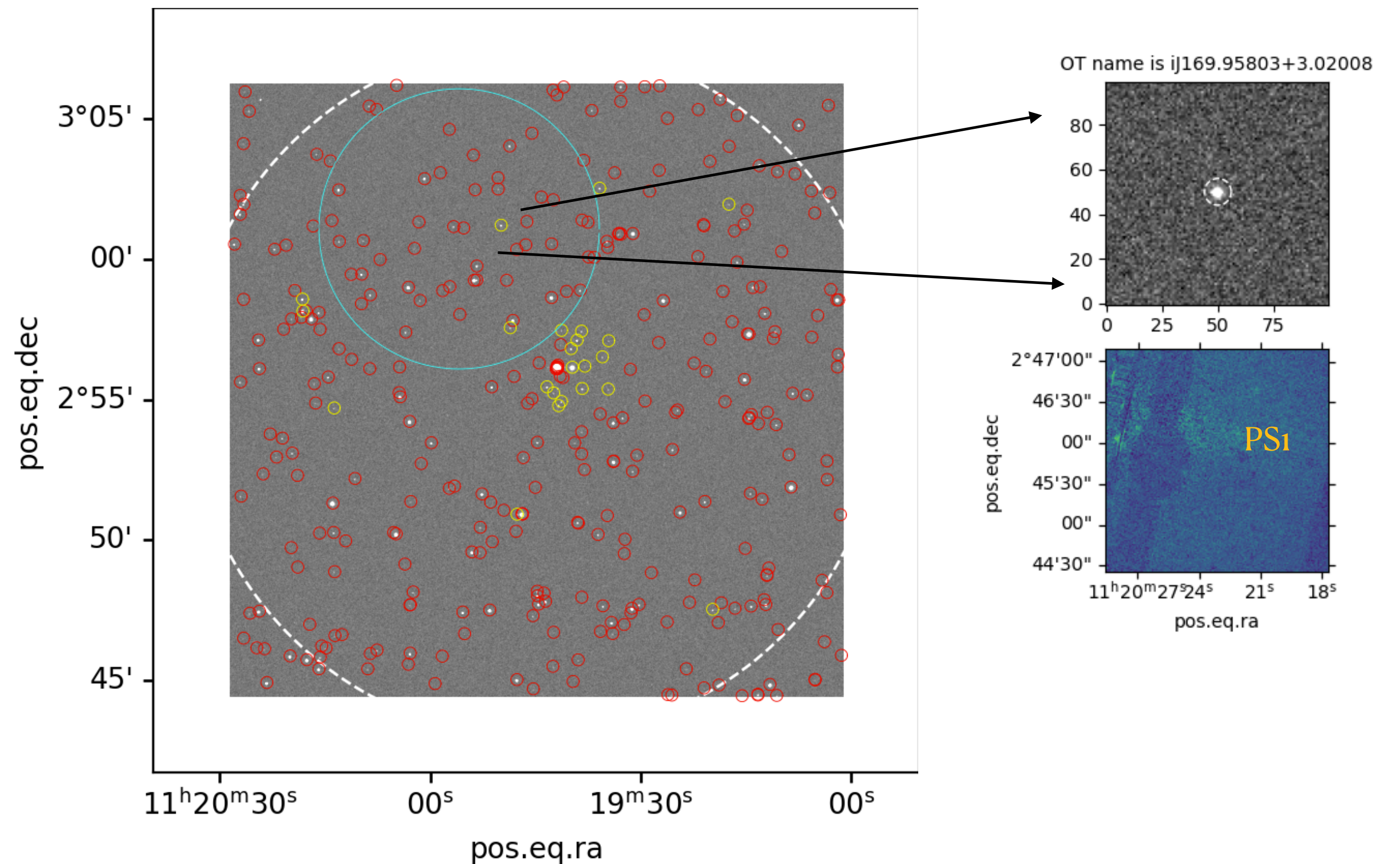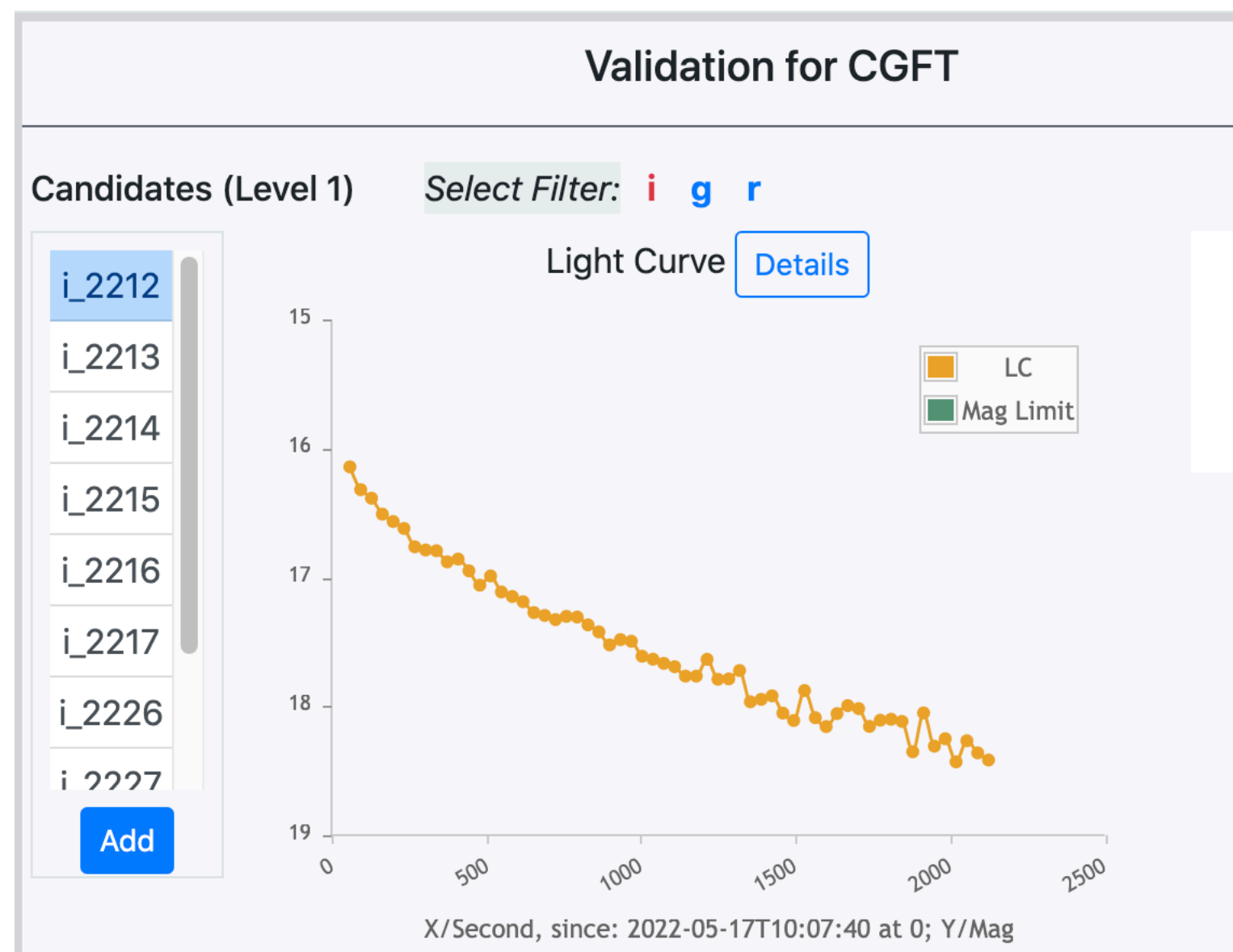   - Eclair error: 12 arcmin. MXT Q=2: 2 arcmin
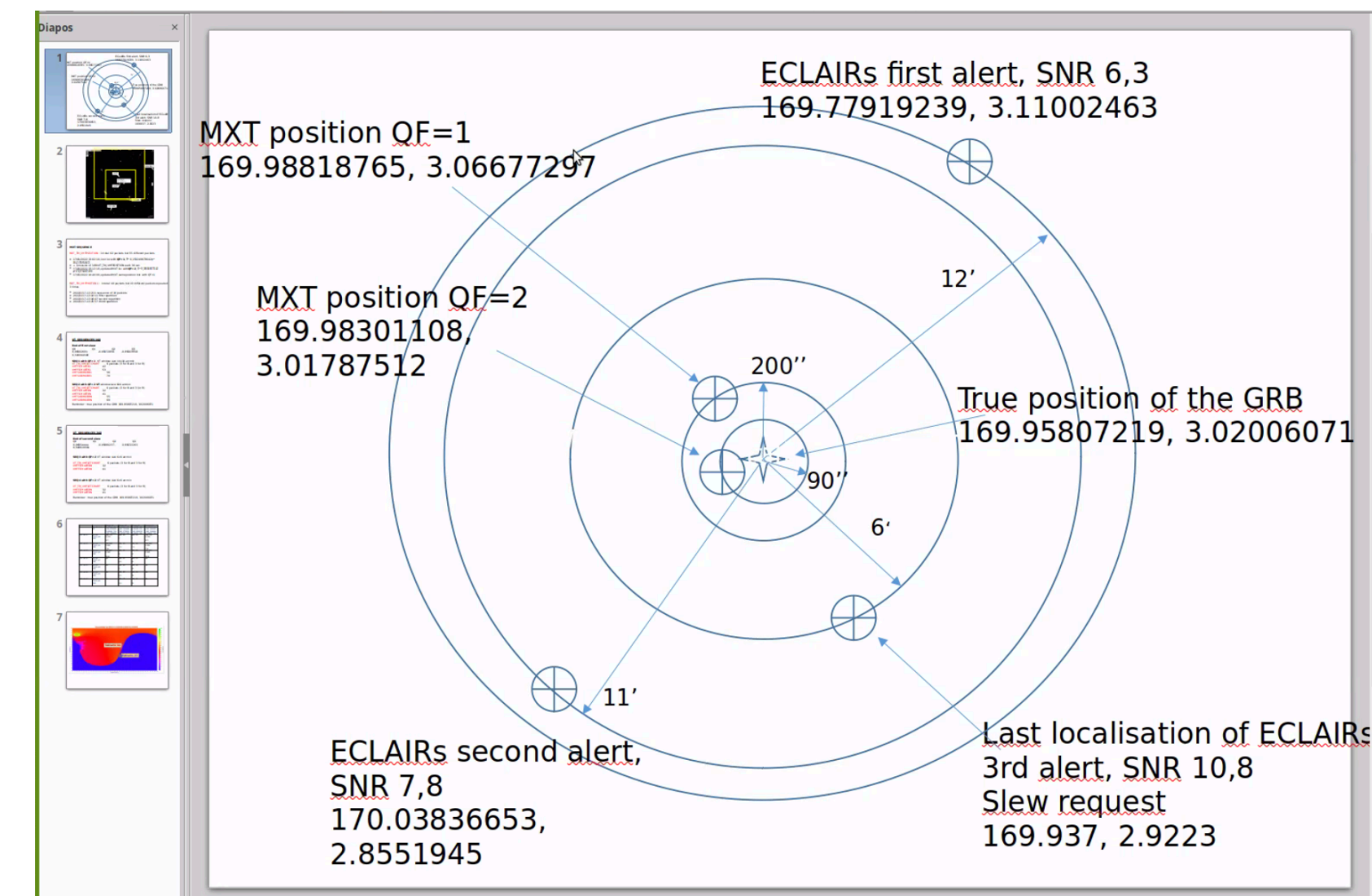
Optical identification for CGFT simulated images

The best candidate at the early phase for a GRB:
➡New source compared with archived catalogs

➡located inner or around the error circle of high-energy instruments
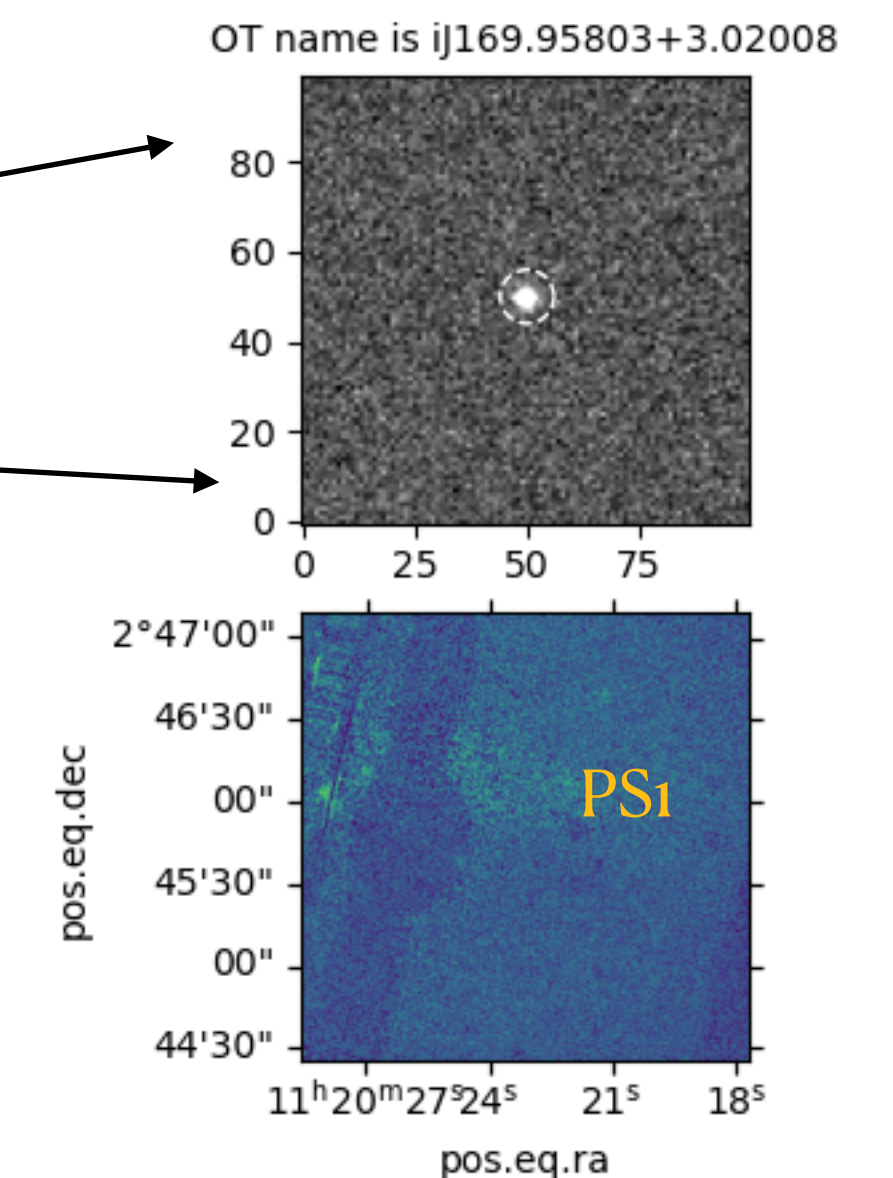
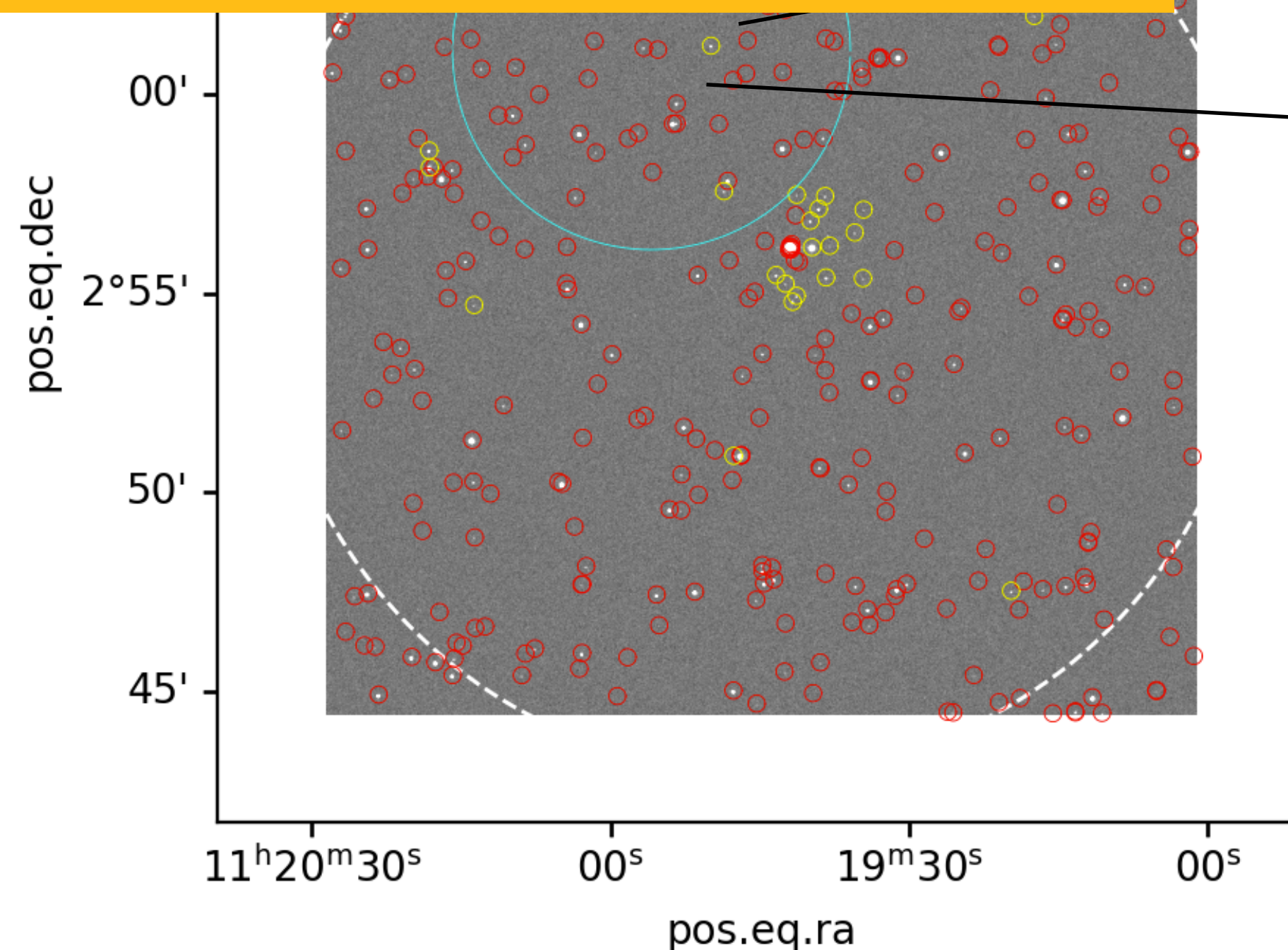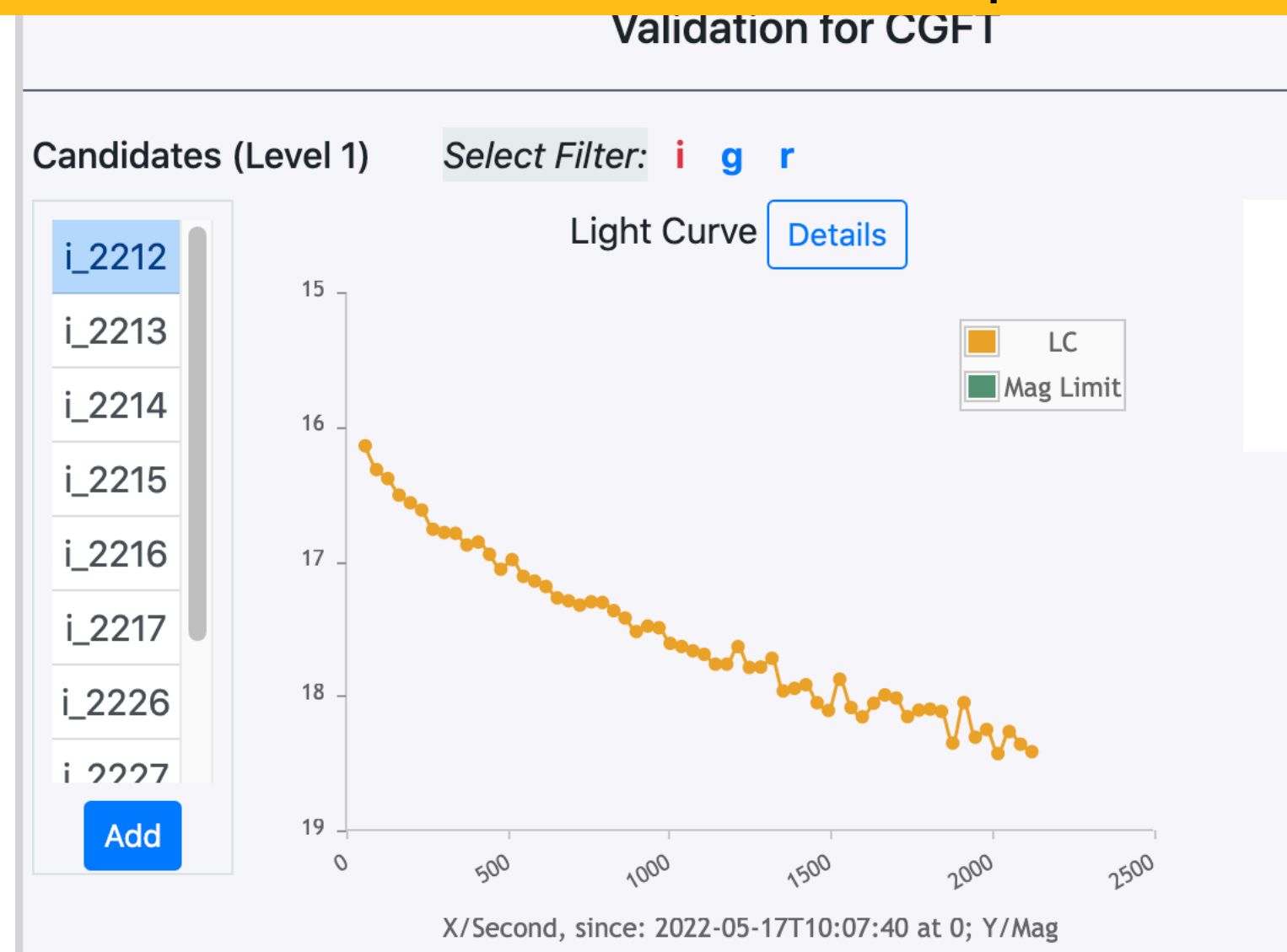➡Brightness changing (rising / decaying)

Purpose for this training with CSC BA tools

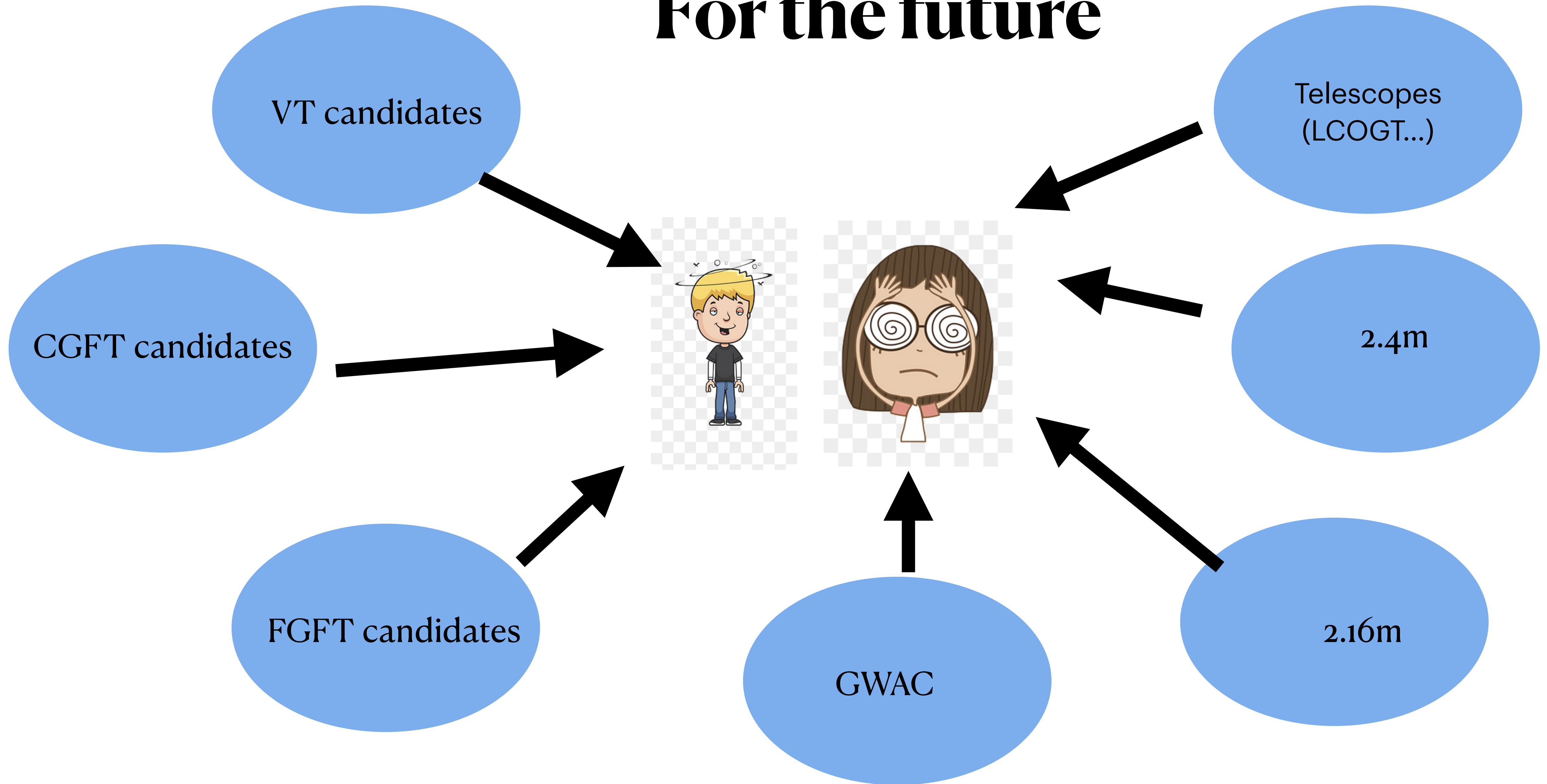Global understanding of the BA tasks

Get the basic idea of SVOM optical validation

To understand the functions in BA tools with the purpose of optical validation easily

Get feedback for the future optimization

For the future

VT candidates

CGFT candidates

FGFT candidates

Telescopes (LCOGT...)

2.4m

2.16m

GWAC

Proposal for the solution

Telescope observations → Data analysis by IS-team → Credible candidates ┊ Do the final inditification

IS team for every telescope

BA in BA tools