



1<sup>st</sup> workshop of the Mexican-French LIA ERIDANUS



# MANAGEMENT OF THE ALERTS BY SVOM

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on behalf on the SVOM collaboration

Université Fédérale de Toulouse Midi-Pyrénées – 2019, June 5<sup>th</sup>

## CONTEXT

- ▶ *Svom* is mini-satellite class mission (< 1000 kg) which will study GRBs in a wide spectral band (from  $\gamma$ -rays to IR) to be launched end of 2021 by CAS (China) & CNES (France)
- ▶ The '*Svom payload*' also includes ground telescopes, both on Chinese side (GWAC & C-GFT) and French side (*Colibri*)
- ▶ During next decade
  - ▶ *Svom* GRBs will benefit from follow-up with a new generation of astronomical instruments: JWST, SKA, CTA, LSST, etc
  - ▶ *Svom* will also operate in the era of advanced GW detectors, providing the opportunity to search correlations between GW and GRBs
- ▶ The purpose of this presentation is to show how the *Svom* collaboration will broadcast the alerts to the world community and how *Colibri* will be involved

## OUTLINE

1. Overview of the *Svom Alert System*, with focus on
  - ▶ the **Core** program (gamma-ray bursts)
  - ▶ the **General** program (transient sky)
  - ▶ the **ToO-MM** program (multi-messengers)
2. Data policy

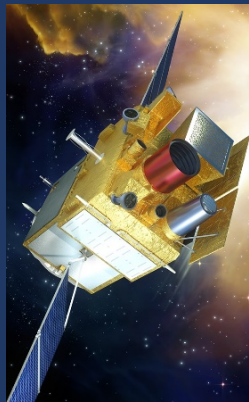
SVOM ALERT SYSTEM

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**CORE PROGRAM**

# OPERATIONAL SCENARIO FOR GRB

SVOM Satellite



ECLAIRs detects a new gamma-ray burst

Automatic slew and observation start



VHF Band



X & S Band



Tracking antennas



Robotics & Large Ground Telescopes



SVOM users



VHF alert data

Science and housekeeping data

Processing by French Science Center

Processing by French and Chinese Science Centers



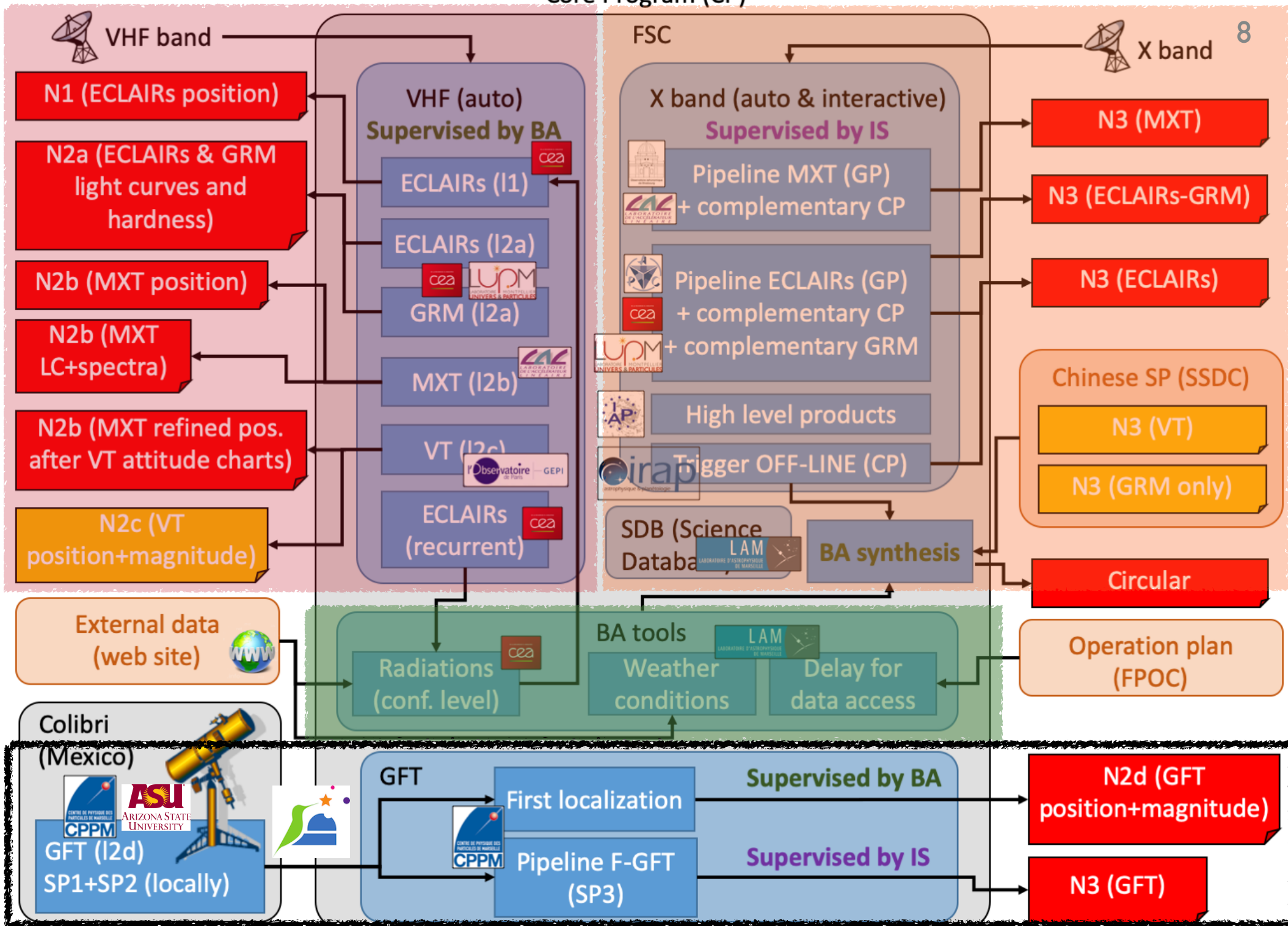
## BURST ADVOCATES AND SUPPORT TEAM

- ▶ Based on Swift/Fermi/Integral feedback
  - ▶ The Burst Advocate (BA) has an astronomical role (one for each burst candidate)
    - ▶ distribute quickly the information and trigger the follow-up
    - ▶ supervise the distribution of notices elaborated **automatically** on the basis of VHF data, send the first circular relative to **all instruments**, validate the trigger and decide about the revisit
  - ▶ The Instrument Scientist (IS) is an expert about data analysis (one for each instrument)
    - ▶ generate and validate the **final scientific products** of the highest confidence level elaborated from X band data, send the circular relative to **one instrument**
  - ▶ The Instrument Expert (IE) has an engineering role (one for each instrument)
    - ▶ reachable in case the BA faces something he does not understand about an instrument
- ▶ Special add-on for Svom
  - ▶ The BA-assistant provide local support to unexperienced BA (one at each science center CSC/FSC)

## WORKFLOW OF NOTICES

- ▶ **Notice N1** based on results processed on-board received by VHF, managed automatically at FSC
- ▶ **Notice N2** based on partial set of data still received by VHF, results are produced automatically on ground at FSC, the IS can be called if necessary ; *same for GFT except that data are received by Internet*
- ▶ **Notice N3** based on full set of X band data
  - ▶ first set of results is produced automatically for BA use only
  - ▶ more accurate set is produced interactively by IS for a single instrument
  - ▶ all results are compiled by BA for multi-instrumental follow-up

# Core Program (CP)





## RESPONSE TIME

| Instrument  | Data                        | Analysis  | Delay   |
|-------------|-----------------------------|---|---|
| ECLAIRs     | VHF<br>Prompt alert phase   | Automatic, supervised by the <b>BA</b>  | no  |
| MXT         |                             | Automatic, supervised by the <b>BA</b> (the correction from VT attitude charts may require automatic check or BA validation before sending) | no  |
| VT          |                             | Automatic, supervised by <b>BA</b> (the VT position may require BA validation in case of low SNR)   | no  |
| GRM         |                             | Automatic, supervised by the <b>BA</b> (if not 'GRM-only' trigger)  | no  |
| ECLAIRs     | X band<br>Final alert phase | Could wait for day working time of the <b>French-IS</b>   | < 6h (TBD) in any case  |
| MXT         |                             | Could wait for day working time of the <b>French-IS</b> (only if the VHF data analysis does not show special problems)                      | as short as possible in some cases (ECLAIRs trigger with low SNR) |
| VT          |                             | Shall be performed systematically by <b>Chinese-IS</b>  | as short as possible in all cases                                 |
| GRM         |                             | Shall be performed by the <b>Chinese-IS</b> , but only on-demand in case of ECLAIRs trigger with low SNR                                    | < 6h (TBD) only for some difficult cases                          |
| GFTs / GWAC | <b>Ground</b>               | Shall be performed by dedicated <b>ISs</b> (at C-GOS / FSC)   | as short as possible in all cases                                 |

Instrument Scientists of Colibri  
will be frequently solicited



SVOM ALERT SYSTEM

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**GENERAL PROGRAM**

**The general program (GP)**

Observation proposals being awarded by a TAC (a SVOM co-I needs to be part of your proposal) for astrophysical targets of interest mostly compliant with the satellite attitude law

Only 10% of the time can be spent on low Galactic latitude sources during the nominal mission, up to 50% during the extended mission

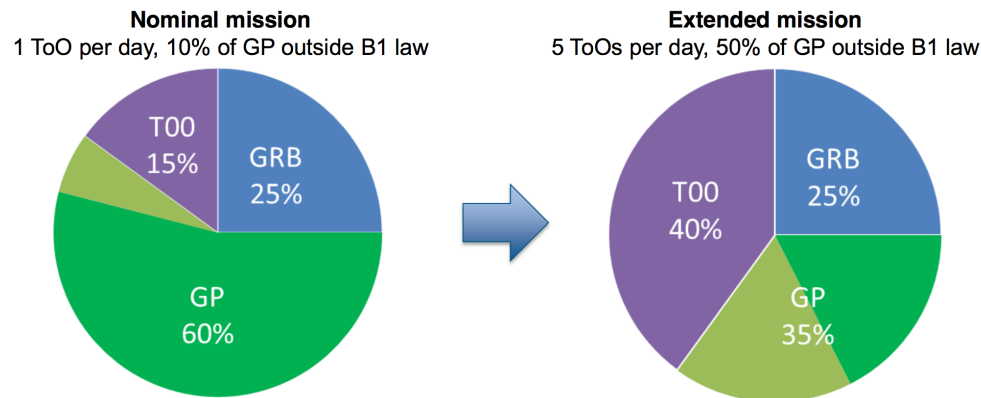
**Target of Opportunity (ToO) programs**

**ToO-NOM** is the nominal ToO which covers the basic needs for efficient transient follow-up alerts sent from the ground to the satellite (GRB revisit, known source flaring new transient)

**ToO-EX** is the exceptional ToO which covers the needs for a fast ToO-NOM in case of an exceptional astrophysical event we want to observe rapidly.

**ToO-MM** is the ToO-EX dedicated to EM counterpart search in response to a multi-messenger alert. What differs from the ToO-NOM and ToO-EX is the unknown position of the source within a large error box.

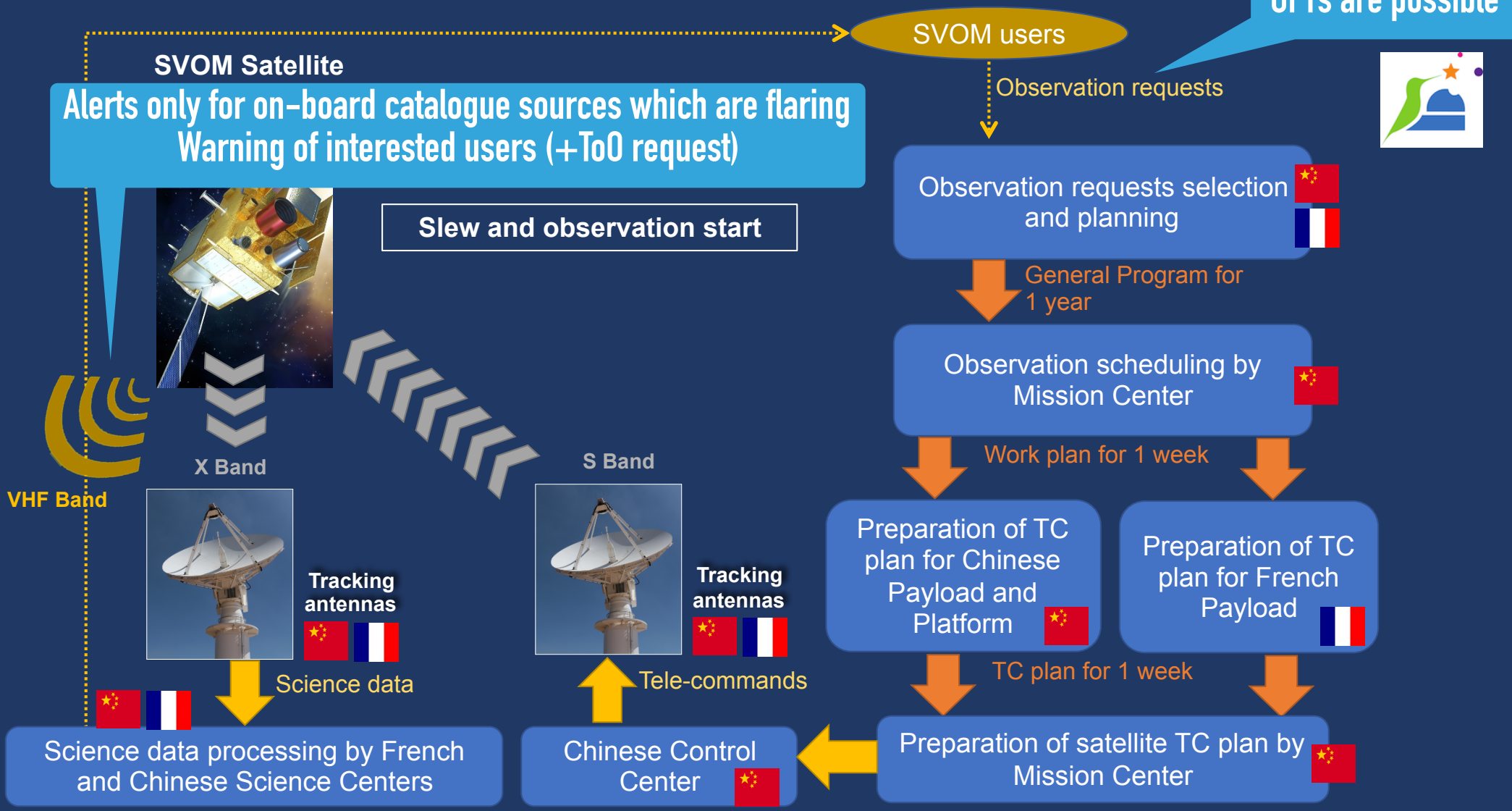
Initially 1 ToO/day focussed on time domain astrophysics including multi-messengers, will increase during the extended mission



| ToO     | Approval | From acceptance/trigger | GRB interruption | Frequency          | Duration    |
|---------|----------|-------------------------|------------------|--------------------|-------------|
| ToO-NOM | PI       | <48h                    | Yes              | MAX 1/day => 5/day | 1 orbit     |
| ToO-EX  | PI       | <12h                    | No               | MAX 1/month        | 1-14 orbits |

# OPERATIONAL SCENARIO FOR THE GENERAL PROGRAM

Simultaneous observations with GFTs are possible

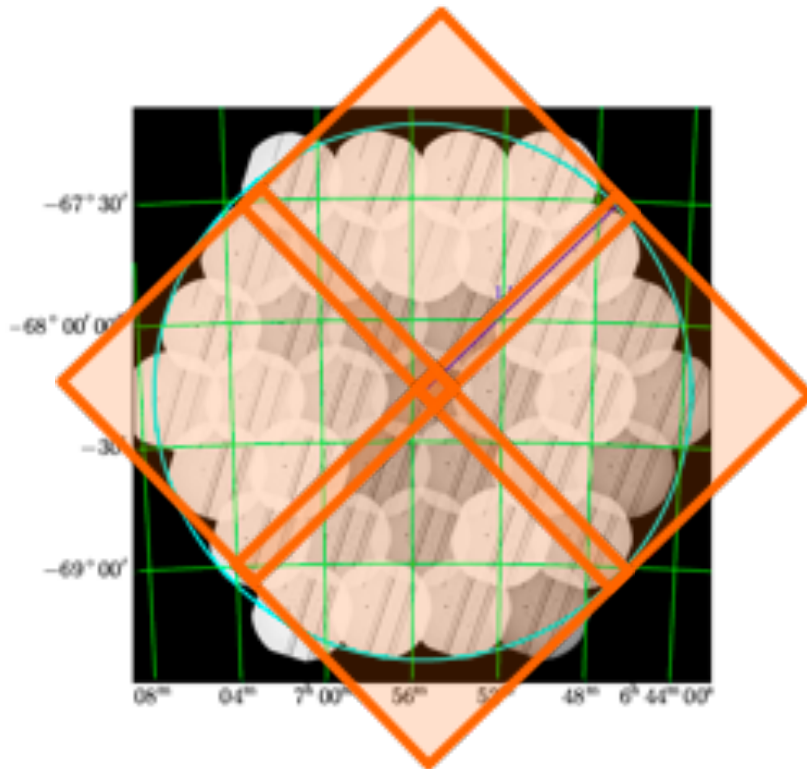


SVOM ALERT SYSTEM

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**ToO (MM) PROGRAM**

## SPECIFIC ToO-MM PROGRAM



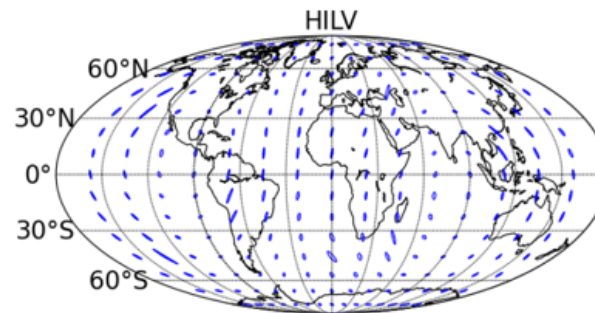
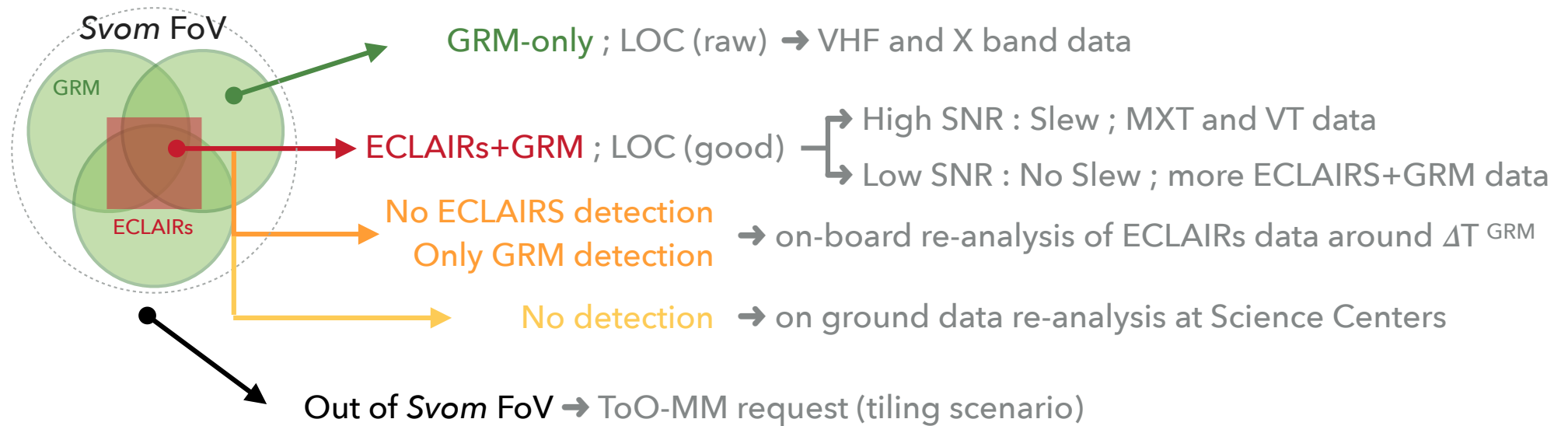
To follow multi-messenger (MM) alerts using tiles

Swift/XRT slightly better than SVOM/MXT...

But MXT is very competitive to rapidly cover large error boxes (e.g. neutrino, GW) with a slightly reduced sensitivity thanks to its large FOV (1 deg<sup>2</sup>)

| ToO    | Approval      | From acceptance/trigger | GRB interruption | Frequency   | Duration    | Tiling process     | Science product availability | VHF Canal | VHF data        |
|--------|---------------|-------------------------|------------------|-------------|-------------|--------------------|------------------------------|-----------|-----------------|
| ToO-MM | Automatic +PI | <12h                    | No               | MAX 1/month | 1-14 orbits | Yes, 3 tiles/orbit | VHF<1h<br>BX 24h             | Yes       | MXT photon-list |

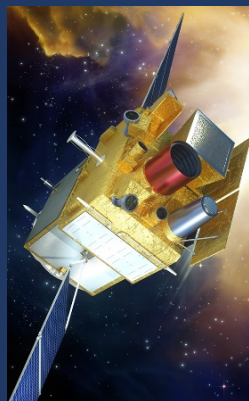
# OBSERVATION STRATEGY WITH SVOM IN SPACE



Detection → ToO-Ex request

# OPERATIONAL SCENARIO FOR MULTI-MESSENGERS

SVOM Satellite



Object detected by other observatories (space or ground)

Slew and observation start (several tiles)

SVOM users

VHF Band



X Band



Tracking antennas



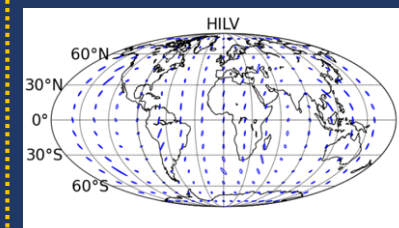
S Band



Tracking antennas



Observation requests (tiling strategy)



VHF alert data



Science data processing by French and Chinese Science Centers

Science data

Tele-commands

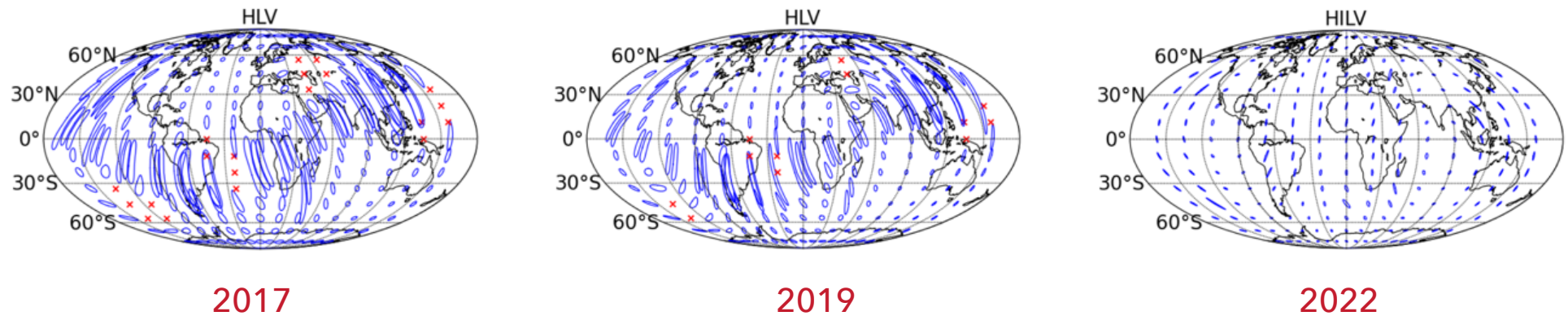
Chinese Control Center

Preparation of satellite TC plan by Mission Center





# OBSERVATION OF GW ERROR BOXES HAS ALREADY STARTED



Error box  $\geq 100 \text{ deg}^2$   $\longrightarrow$   $\leq 10 \text{ deg}^2$

GWAC

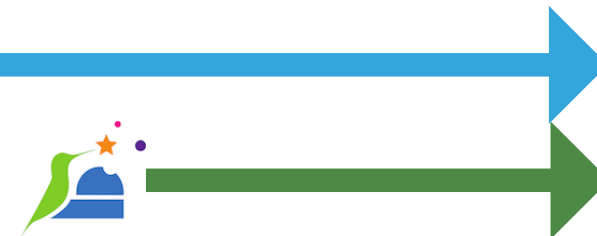
GFTs

GRM

ECLAIRs

MXT

VT



## DEVELOPMENT OF BA TOOLS

- ▶ *BA interface tool developed at NAOC (by D.Turpin) for GWAC*
- ▶ *Development is being taken over by LAM (towards a more professional and evolutive interface for Svom)*

SVOM Burst Advocate

O3 CALENDAR ONLINE MODE REPORTING MODE ARCHIVE MODE NETWORK STATUS CHAT TELECON LOGOUT

Bienvenue / 欢迎  
ba\_user

Choose the mode you want to use for the SVOM BA tools

Beijing: 2019-06-04 13:39:32 Paris: 2019-06-04 07:39:32

Online mode Reporting mode Archive mode

Network Status SVOM-BA Chat SVOM-BA Telecon

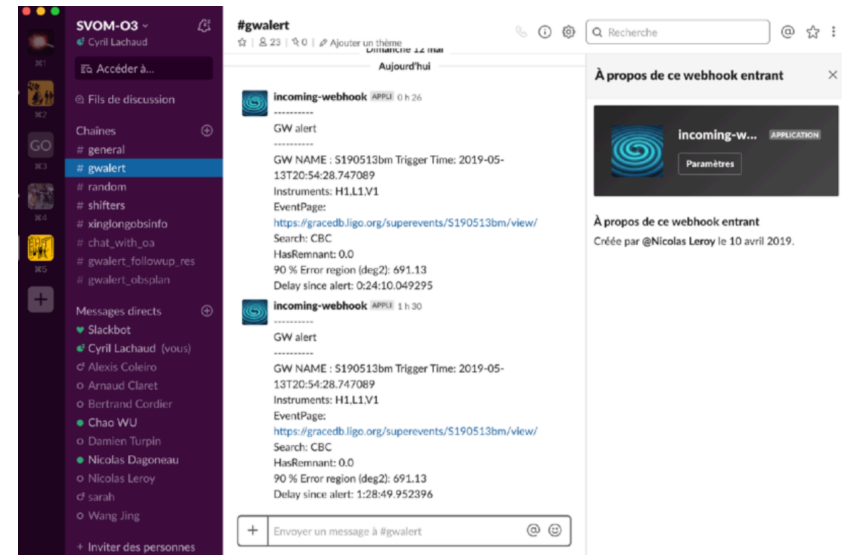
SVOM O3



Colibri results should be integrated in this tool

## DEVELOPMENT OF BA TOOLS, Cont'd

- ▶ *Intensive use of Slack*
- ▶ *Archive on wiki pages*
- ▶ *Coming soon*
  
- ▶ *next BA workshop  
(October 2019 in China)*
- ▶ *BA school (March 2020 in  
Les Houches)*



### Multimessenger activities Run O3

#### Practical Informations for BA Shifts

[Start of the shift](#)

[During the shift](#)

[GW Alert](#)

[End of the shift](#)

[Slack configuration to receive alerts](#)

[Shift Exchange](#)

#### Gravitational wave triggers

Here, we can find some information relative to the different gravitational waves alerts : circulars, sky-maps and observation fields of the GWACs.

| Trigger                   | Nature | Facility | Distance Mpc | 90% area deg2 | SVOM 1st obs. after T0 | GWAC cov. | F30 Tiles Obs/Prog | F60 Gal Obs/Prog | Spectro | GCN |
|---------------------------|--------|----------|--------------|---------------|------------------------|-----------|--------------------|------------------|---------|-----|
| <a href="#">S190602aq</a> | BBH    | H1,L1,V1 | 797          | 1172          | No obs.                | 0%        | No                 | No               | No      | No  |
| <a href="#">S190521r</a>  | BBH    | H1,L1    | 1136         | 488           | ~T0+7h                 | 30.2%     | 12                 | --               | No      | Yes |
| <a href="#">S190521g</a>  | BBH    | H1,L1,V1 | 3911         | 765           | ~T0+9.4h               | 32.6%     | 4                  | --               | No      | Yes |

SUMMARY OF

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# DATA POLICY



## DATA AVAILABILITY

- ▶ Core Program
  - ▶ Most of the scientific products generated under the supervision of the Burst Advocate are immediately public as soon as they are available
  - ▶ All the scientific products are public after six month
- ▶ General Program
  - ▶ All the data products are distributed to the Responsible Co-I
  - ▶ All data products are public after one year of proprietary period
- ▶ ToO-MM: the policy same policy as for the Core Program
- ▶ ToO-Nom and ToO-Ex: the data are immediately public

# CONCLUSION

- SVOM is designed to study the physics of the GRB phenomenon in all its diversity with good spectral (infrared to MeV) and temporal coverage for both the prompt and afterglow emission  
'less GRB but better observed from the ground'
- SVOM is prepared to play an important role in the time domain astrophysics and in the multi-messenger era
  - Colibri will play an important complementary role to Chinese observation resources (temporal and spectral coverage)
  - Colibri participates to all Svom follow-up observing programs (GRB and multi-messenger), as well as general program



## MORE INFORMATIONS

White paper: [arXiv:1610.06892](https://arxiv.org/abs/1610.06892)

Website: <http://www.svom.fr/en/>

