SVOM Science Ground Segment

Maohai Huang
National Astronomical Observatories, CAS

on behalf of the SVOM Ground Segment team
GRB Mission “SVOM”

- The Space-based multi-band astronomical Variable Object Monitor (SVOM) is a collaborative project between China and France to detect, localize and study of ~60 Gamma Ray Bursts (GRBs) per year.
- SVOM is being transformed into a time-domain orbital observatory.
- Passed PDR and goes into Phase C starting 2017. Planned to be launched to a low inclination, low earth orbit in 2021, with a life of 3-5 years.
Payload instruments

- **ÉCLAIRs**, dedicated to GRB trigger and localization, having a large field of view (FOV) which can detect GRBs in the hard X-ray energy band (CNES, IRAP, CEA, APC)
- **GRM** (Gamma Ray Monitor) dedicated to measurement of gamma-ray in high energy band (IHEP)
- **VT** (Visible Telescope) an optical instrument dedicated to GRB follow-up observation on board (XIOPM)
- **MXT** (Micro-Channel X-ray Telescope) dedicated to GRB follow-up observation in soft X-ray band (CNES, CEA, LAL, UL, MPE).

Ground based instruments

- **C-GFT**, the Chinese ground follow-up telescope
  400-1000nm  26’×26’
- **GWAC**, an array of ground wide angle cameras
  400-900nm  5000 SqDeg
- **F-GFT**, the French ground follow-up telescope
  400-1700nm  25’×25’
Overview of SVOM ground segment

French Ground Segment

Chinese Ground Segment

VHF network

C-GOS

Mission Center

Chinese X band station

S band HK

Pointing request

Chinese Control Center

SVOM users

GRB notices and circulars related to GRM and C-GOS

SVOM users

GRB worldwide network (GCN, VO)

Mission Center

Space Science Data Center

Chinese Science Center

C-GOS

SVOM PIs

Pointing request: GRB Revisit, ToO OBS program TBC

French X band station

French Payload Operation Center

ECLAIRs instrument center

French Network Operation Center

French X band station (ToO prog)

Orbit, pass-reg, PLTM...
SVOM Observing Programs

• Core Programs (GRB)

• General Programs

• ToO Programs
  – Nominal ToO (including revisit of GRBs)
  – Exceptional ToO
Core Program actions and time requirements from satellite to VOEvent network / GCN

Data acquisition on board
T0+22 sec

Onboard instruments -> VHF Network Ground Stations

VHF Data (All onboard instruments)
5 sec

FSC (CEA, Saclay)

Alert notice
5 sec

CSC (NAOC, Beijing)

Alert notice
2 sec

GRB Notices
5 sec

VOEnet, GCN

Mission Center

X-band and S-band telemetry

Data acquisition on board
T0+22 sec

Many telescopes can be added to follow-up networks with flexibility.

Space Sci. Data Center

L0 data
T0+4 to +14 hour

Mission Center

X-band and S-band telemetry

Data acquisition on board
T0+22 sec

Many telescopes can be added to follow-up networks with flexibility.

Mission Center

X-band and S-band telemetry

Data acquisition on board
T0+22 sec

Many telescopes can be added to follow-up networks with flexibility.

Mission Center

X-band and S-band telemetry

Data acquisition on board
T0+22 sec

Many telescopes can be added to follow-up networks with flexibility.
GRB (Core) Program
General Programs

1. PIs issue call for proposal once a year for ÉCLAIRs, VT, MXT, and ground instruments
2. Observers write and submit proposal with tools supported by the Science Centers
3. TAC evaluates, selects and allocates time, and form a one-year Pre-Planned Target
4. PPT executed by the Mission Center, subject to interruption and re-scheduling due to Core and ToO activities
5. Once observed, data are processed in standard pipeline and released to observer.

- the details are being refined.
GP and ToO workflow as of PDR

Joint Science Committee | TAC | PI | Proposer | CSC | FSC | SSDC | Operational Coordination Group
---|---|---|---|---|---|---|---
Start

Issue Call for Proposal

Submit proposal

Proposal Evaluation Selection

ToO-GP?

No

PrePlanned Target (PFT) List Generation

(to 1 year in advance)

Yes

ToO-GP-PP list Generation

Tools and Support

Tools and Support

ToO-GP-PP Trigger Generation

approval

Yes

ToO-GP-NP Proposal Writing

Tools and Support

Weekly OCG Meeting

No

approval

Yes

ToO-Ex?

Daily OCG Meeting

No

ToO-MM Agreement or MoU

ToO-MM Triggering

Tools and Support

ToO-Ex/MM OCG Meeting

Yes

approval

Yes

2016-10-11

Hotwiring the Transient Universe V, Villanova, M. Huang
Exceptional ToO observation: from obs. proposal to satellite execution
# ToO Summary

<table>
<thead>
<tr>
<th>ToO</th>
<th>Approval</th>
<th>From acceptance/trigger</th>
<th>GRB interruption</th>
<th>Frequency</th>
<th>Duration</th>
<th>Tiling process</th>
<th>Science product availability</th>
<th>VHF Canal</th>
<th>VHF data</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToO-NOM</td>
<td>PI</td>
<td>&lt;48h</td>
<td>Yes</td>
<td>MAX 1/day =&gt; 5/day</td>
<td>1 orbit</td>
<td>No</td>
<td>24h</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>ToO-EX</td>
<td>PI</td>
<td>&lt;12h</td>
<td>No</td>
<td>MAX 1/month</td>
<td>1-14 orbits</td>
<td>No</td>
<td>24h</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>ToO-MM</td>
<td>Automatic +PI</td>
<td>&lt;12h</td>
<td>No</td>
<td>MAX 1/month</td>
<td>1-14 orbits</td>
<td>Yes, 3 tiles/orbit</td>
<td>VHF&lt;1h BX 24h</td>
<td>Yes</td>
<td>MXT photon-list</td>
</tr>
</tbody>
</table>

**ToO-NOM:**
- **ToO-CP (GRB revisit)**
- **ToO-GP-PP (Pre-planned General Program targets)**
- **ToO-GP-NP (General Program targets not planned)**

**ToO-EX:** for exceptional astrophysical events

**ToO-MM:** search for EM counterpart to multi-messenger alert
Ground telescopes SVOM to use

- Two base-line ground follow-up telescopes with guaranteed fast (T0+5 min) turn around photometric results. More telescopes can and will join the network with flexibility (implementing a standard interface).
- A wide angle camera array as a time-machine (T0-5 min)
- Burst Advocates (BAs) will coordinate extensive use external large telescopes and missions for multiband and spectroscopic follow-ups.

Dynamic expandable GFT network.
Baseline location at Xinglong
Overall development approach

• There is significant risk in SGS readiness if a “Water Fall” development approach is adopted, where a full functional system only come into existence at the end of Satellite/System development.

• To mitigate the risk, the Science Centers are to follow an iterative approach to develop a Basic simulation system, a Core function system, and a Full system in Phase B, C, D, respectively.

• The goal is that by the time of launch, the SGS will be highly mature. It will have been used by its users for years to process simulation data, ground instrument data, and payload testing data during development phases. There will be a smooth, seamless transition between mission phases.
summary

SVOM ground segment is being designed to offer guaranteed follow-up capabilities, quick reaction time, a flexible architecture, and essential infrastructure to meet the requirements of SVOM observation programs as time-domain astronomy enters a rapidly expanding period.

Wishes

• A pool of follow-up telescopes implementing a standard interface (data, control, condition), ready to observe with little human negotiation.

• Automated broker/aggregator to provide not only all available data of a given position with error box, but also all scheduled observation of that position in a given time window in near future. APIs need to be in place by telescope facilities for this.

• A mobile multimedia platform to connect BAs, IS/IEs (instr. Scientists and experts), proposal observers, and anyone who has observed the target, and make result sharing easy.
Thank you