

The Chinese-French SVOM mission: Ground segment, follow-up and data policy

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On behalf of the joint SVOM team

2019 Nanjing GRB Conference

Outlines

- SVOM ground follow-up facilities
 - Dedicated ground follow-up telescopes
 - LCOGT 1M system as a supplement for GFTs
 - Access to middle and large telescope
- SVOM data policy
 - ✓ Scientific programs: Core, ToO, General
 - ✓ Data policy
- Current GW EM counterparts follow-up observations

Proposed scientific instruments

- **ECLAIRs**, the X-ray and soft gamma-ray trigger camera
4-250KeV **2sr (~8000 Sq.deg)**



- **GRM**, the gamma-ray spectro-photometer
15KeV-5MeV **±60 Deg**



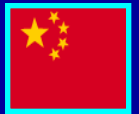
- **MXT**, the micro-channel soft X-ray telescope
0.3-6KeV **65'×65'**



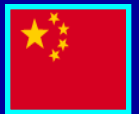
- **VT**, the visible telescope
400-650nm, 650-950nm **26'×26'**



- **GWAC**, an array of ground wide angle cameras
450-900nm **~ 5000 Sq.deg.**



- **C-GFT**, the Chinese ground follow-up telescope
400-1000nm **21'×21'**



- **F-GFT**, the French ground follow-up telescope
400-1700nm **26'×26'**



GRB observation strategy

Space

GRB trigger provided by **ECLAIRs** at time T_0

$T_0 + 5$ min

VT (V & R band photometry)
MXT (Soft X-ray photometry)

Ground

$T_0 + 1$ min

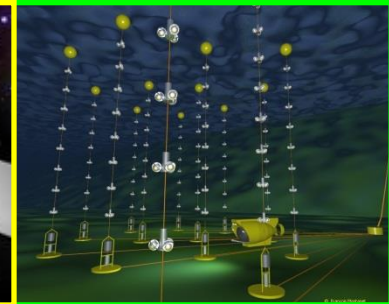
GWAC

GFTs (g, r, i, J, H), **LCOGT**

1-2 m robotic telescopes

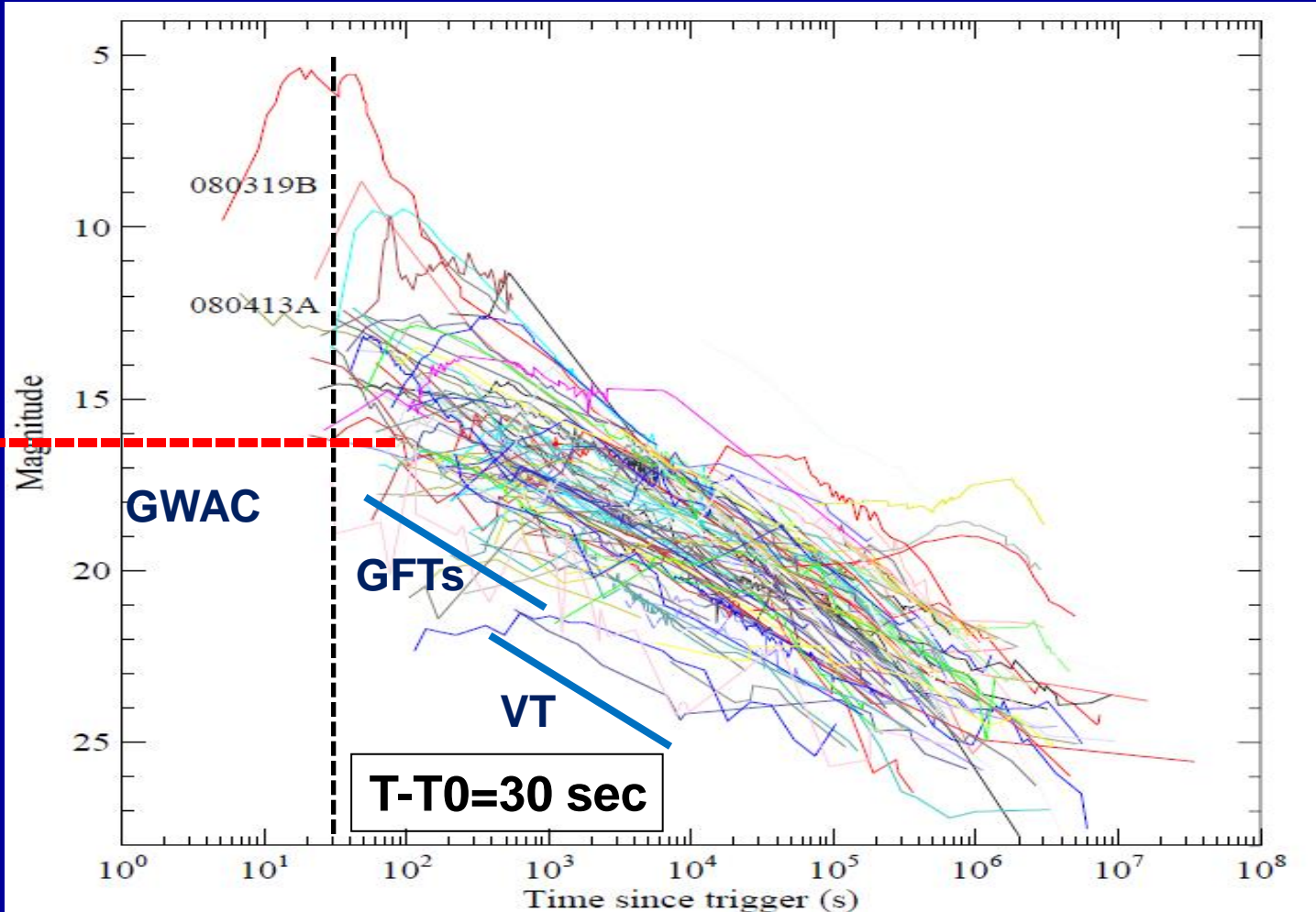


Multi messenger follow-up

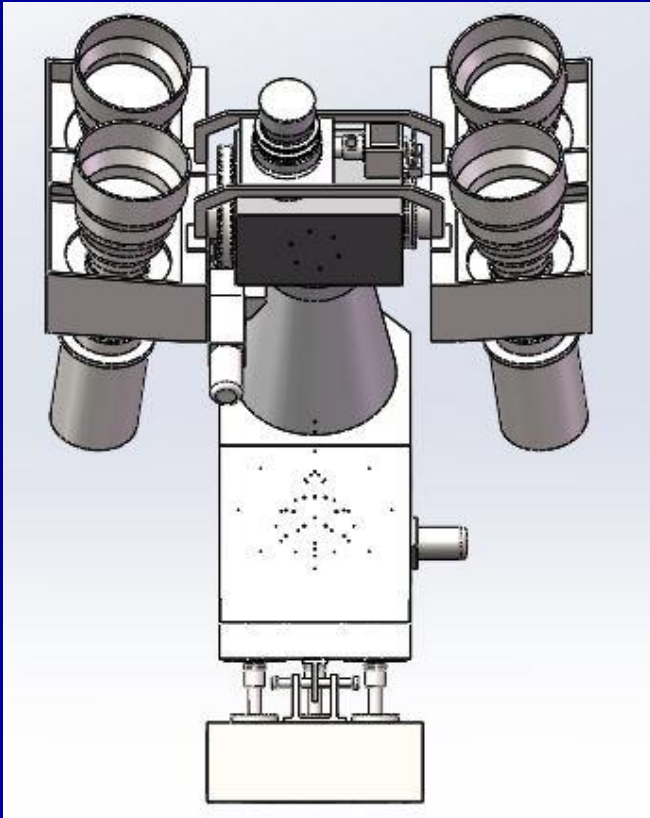


Lighcurves of long GRBs

(Wang et al. 2013)



Parameters of the GWAC



- Cameras: 40
- Diameter: 180mm
- Focal Length: 220mm
- Wavelength: 500—800nm
- Total FoV: ~6000Sq.deg
- Limiting Mag: 16.0V (5 σ , 10sec)
- Self Trigger: ~13*5sec

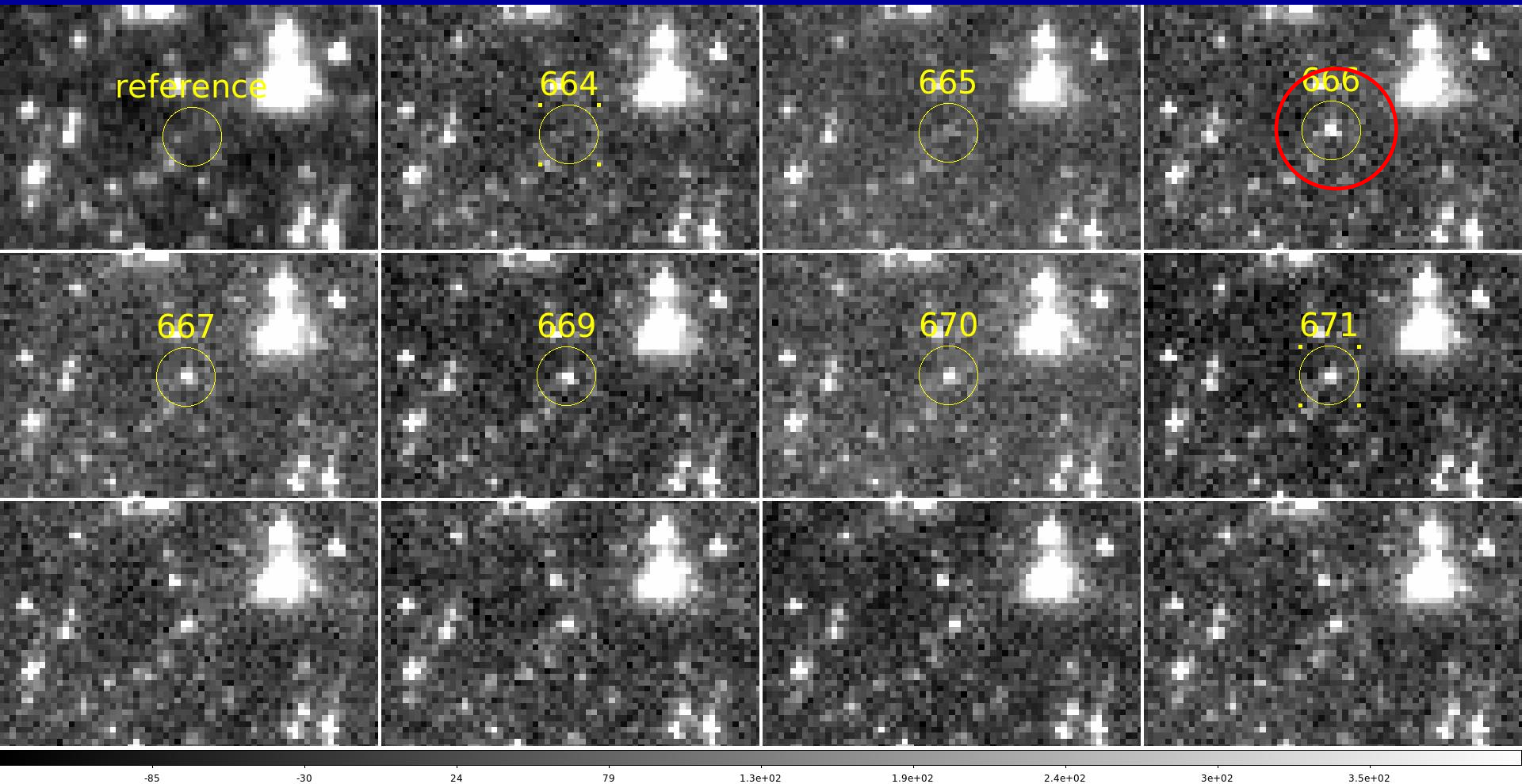
Prompt optical emission detection down to $M_V \sim 16.0$ (10 s exposure)

Status: GWAC

- 2013-2016: Mini-GWAC for developing Pipelines V1.0;
- 2014-2015: two 60cm, one 30cm telescopes from GXU and .
- 2016-2017: the first 18-GWAC system (10 telescopes from NJU);
- 2018: 22 GWAC manufactured, waiting for setup



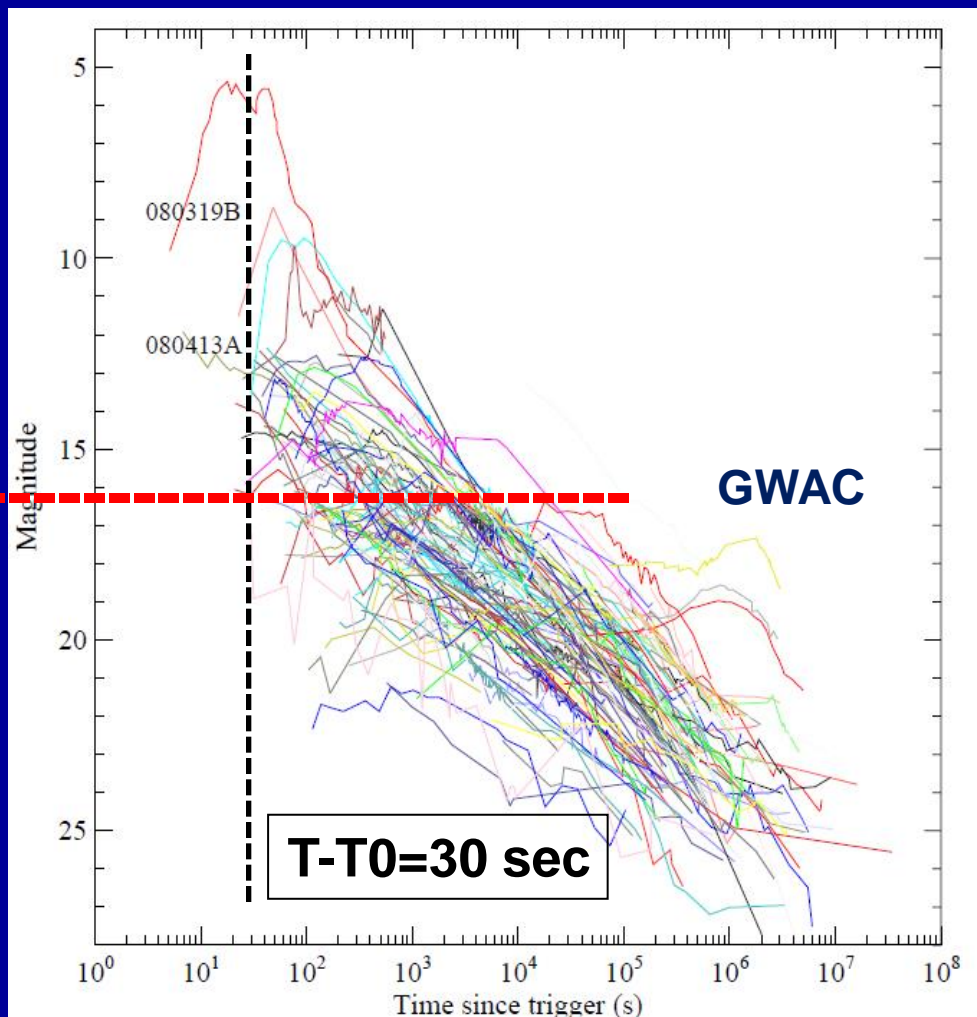
The first flare star triggered by Mini-GWAC in 18th Dec. 2015



So far, more than 100 flare stars were triggered by GWAC

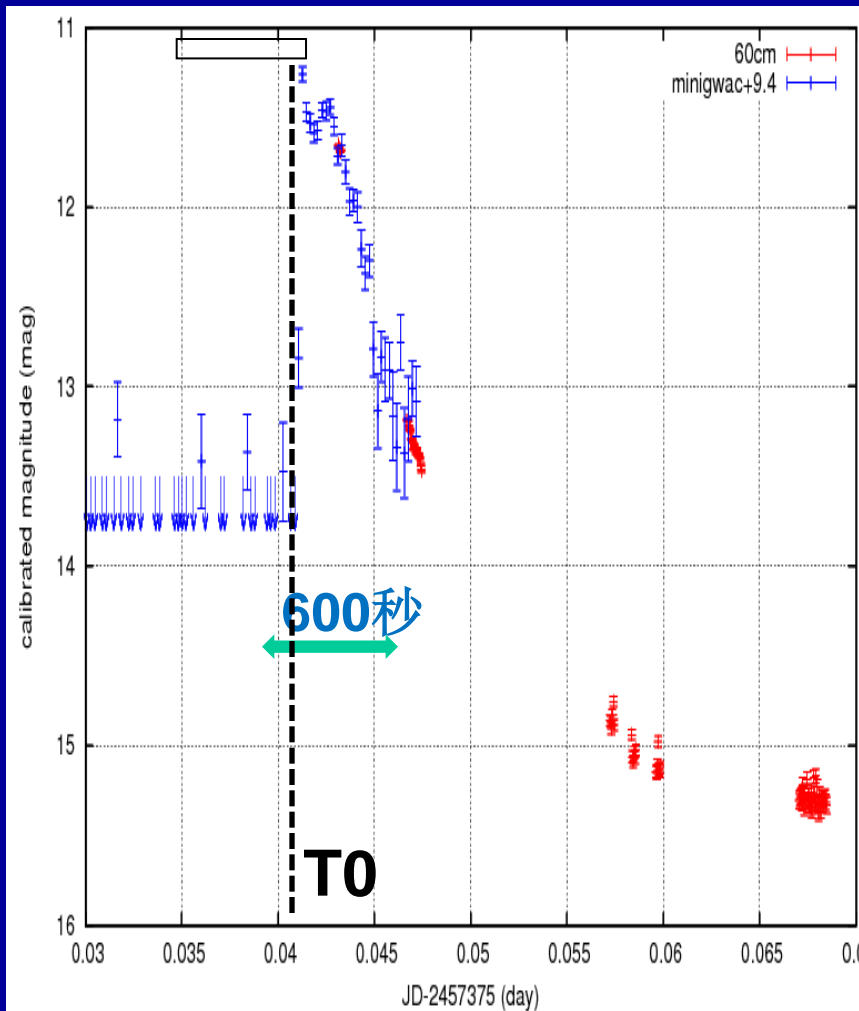
GRB

(Wang et al. 2013)



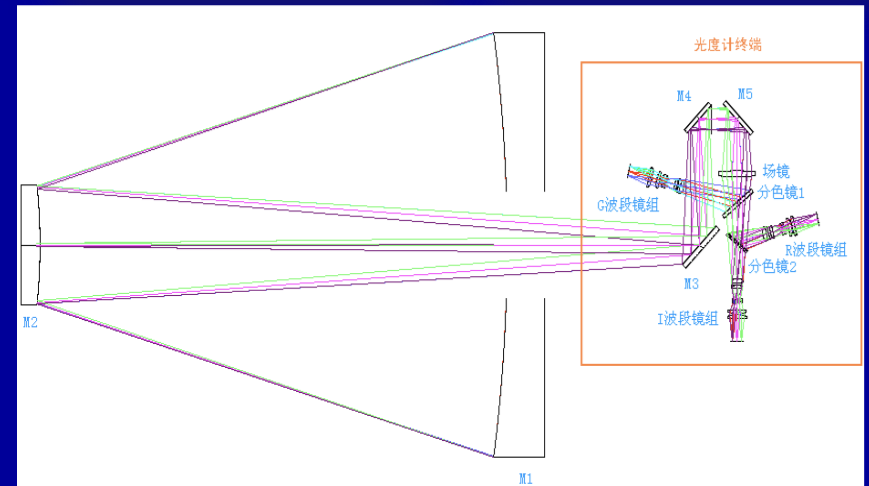
Flare star

(Mini-GWAC 2015)



C-GFT

- Aperture: 1.2m with two focus
- C-F with 3-channel:
g,r,i, FoV~21arcmin
- M-F with filt wheel:
FoV~1.5deg



F-GFT

- Jointly developed by France and Mexico.
- Primary mirror diameter: 1.3 m, FoV~26 arcmin
- Three simultaneous arms: visible domain up-to H band



LCOGT 1m system as a supplement of GFTs



- NAOC and GXU contribute one LCOGT 1m at Ali (Tibet)
- China will share LCOGT 1m system ~2000hr/yr

Access to middle and large telescopes

- SVOM team will:
 - apply for ToO time: 2.15m, 2.4m, CFHT, ..., VLT, GTC
 - buy ToO time: especially middle class NIR telescopes
 - cooperate with other groups
- Two key points
 - ✓ high-z GRBs candidates follow-up by NIR telescopes :
detected by MXT, but not by VT & GFTs
 - ✓ high signal to noise ratio spectra of bright GRB afterglows:
analyze the environment of progenitors

SVOM Observing Programs

- Core Program,
 - ✓ Observations of SVOM GRBs
- Targets of Opportunity (ToO)
 - ✓ Not only open to Co-Is, but also the general scientific community.
- General Program
 - ✓ Pointed Observations
 - ✓ Surveys: by ECLAIRs, GRM and GWAC
- Instrument Calibrations
 - ✓ To be regularly performed through the course of the mission.

SVOM ToO

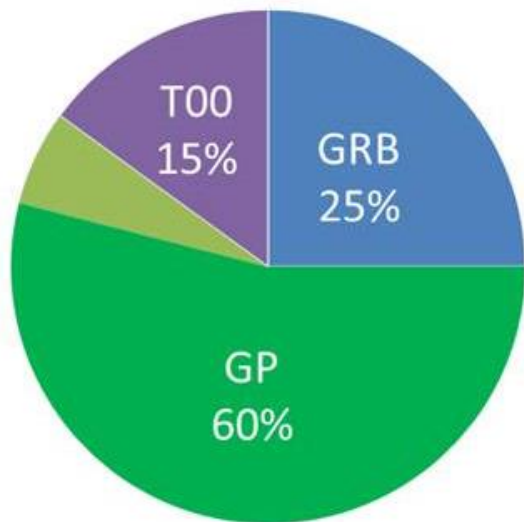
- Targets of Opportunity (ToO)
 - ✓ ToO-Nom: targets with schedules plan, including GRB re-visit
open to public applications, <48hrs, 1-5/day;
 - ✓ ToO-Ex: ToO targets with great public interests,
open to public applications, <12hrs, 1/month;
 - ✓ ToO-MM: Multi-Messege targets, <12hrs, 1/week;
- Burst Advocates
 - ✓ BAs take charge of the GRB, ToO-MM obs., data analyses and paper draft.

Data Policy

- Core Program
 - ✓ Most of the scientific products generated under the supervision of the Burst Advocate are public as soon as they are available;
 - ✓ All the scientific products are public six month after the data production.
- General Program
 - ✓ All the SVOM data products will be distributed to the Responsible Co-I
 - ✓ After one year of proprietary period, the data products will be public.
- ToO:
 - ✓ ToO-MM: the policy same as Core Program
 - ✓ ToO-Nom and ToO-Ex: the data are immediately public.

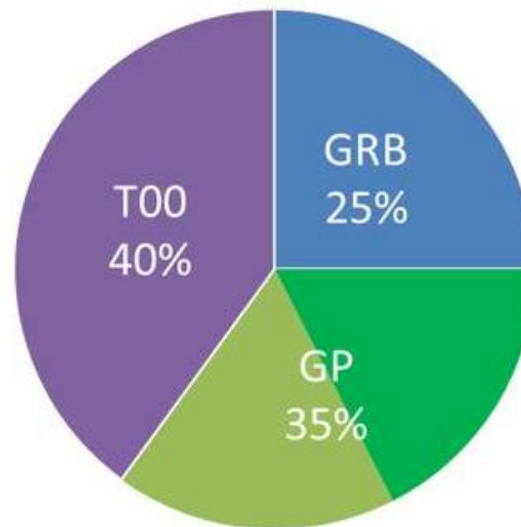
SVOM repartition: useful observing time

Nominal mission
USEFUL MISSION TIME



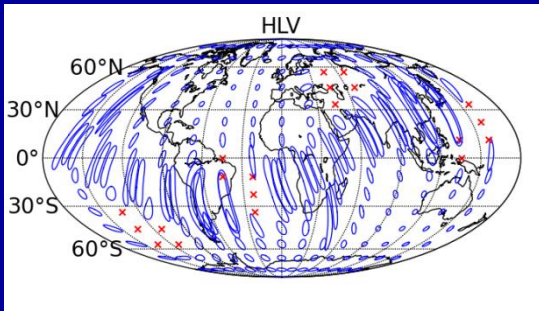
1 ToO per day
10% of the GP outside the B1 law

Extended mission
USEFUL MISSION TIME



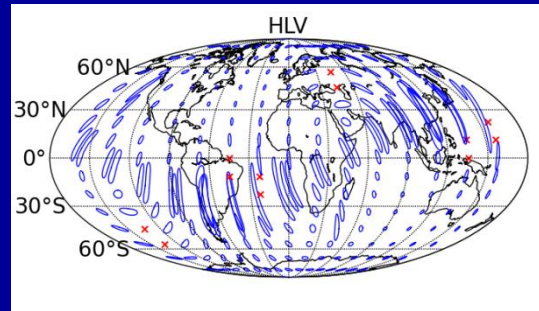
5 ToO per day
50% of the GP outside the B1 law

The strategy for SVOM to observe GW bursts

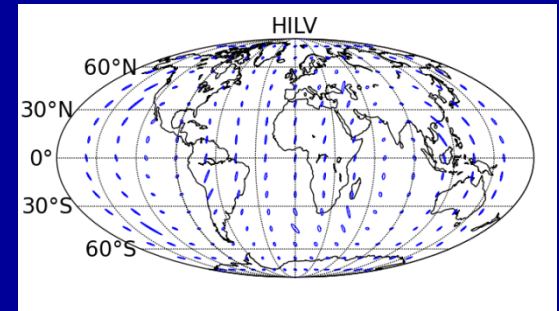


2015

Error box: ~600 Sq.Deg



2019



2022

~<10 Sq.Deg.

GRM



Eclairs



MXT



VT

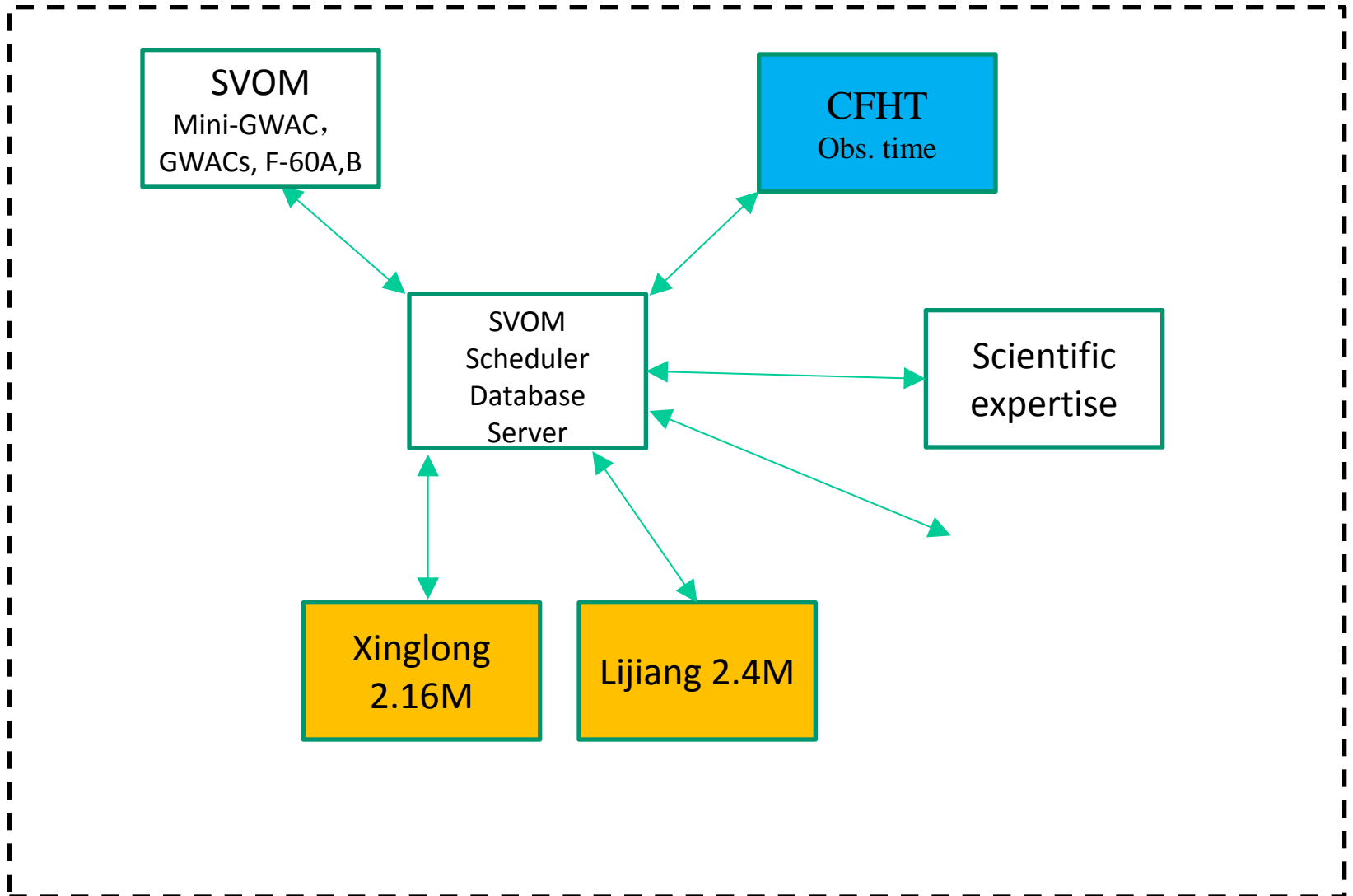


GWAC



SVOM Follow-up testing system

2017 -2018



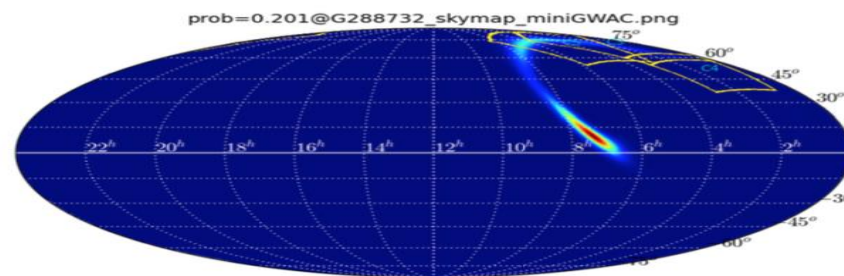
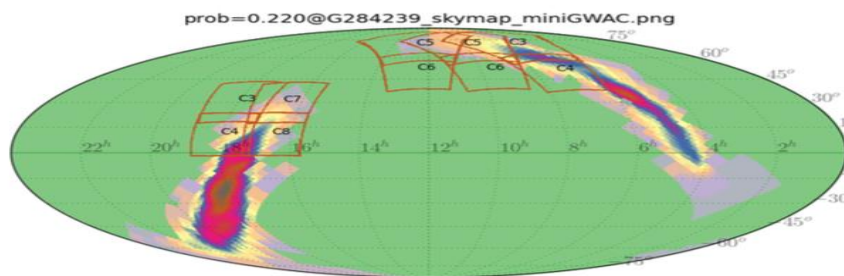
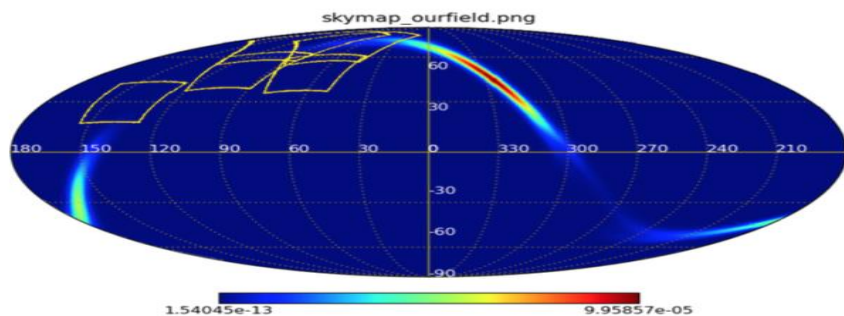
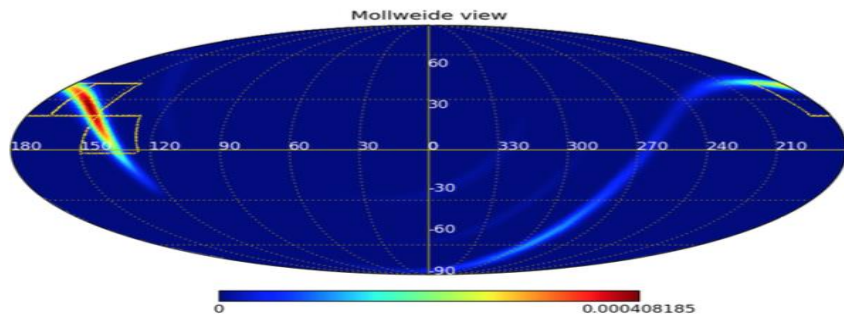
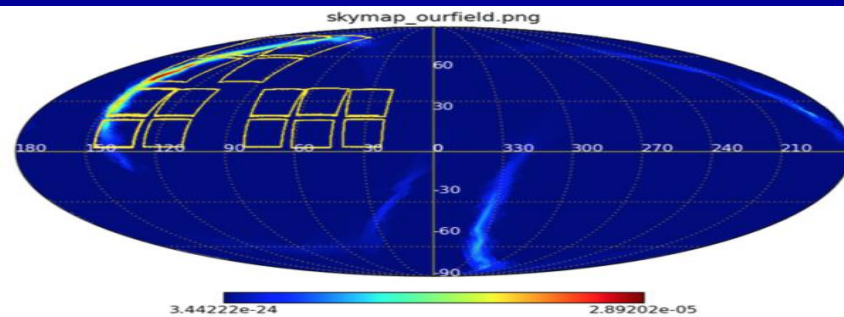
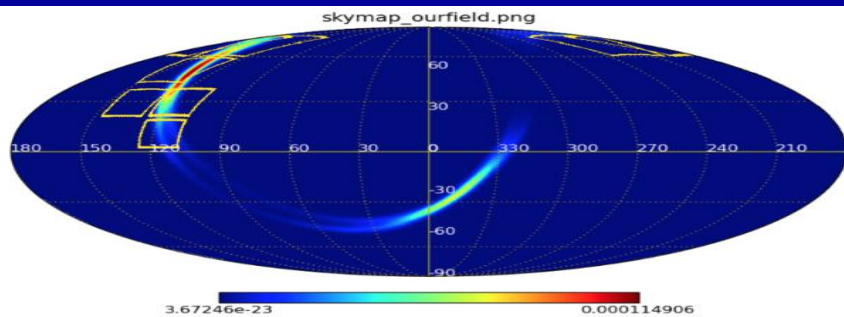
7 GWs followed during O2



(Turpin et al. 2019, RAA, Submitted)

name	circular	First exposure
G268556_20170104	mini:1 + F60B:1	+2h20min
G2*****	Mini:1 + GMG:1	+20mins
G2*****	Mini:1	+6h20min
G2*****	Mini:1	-5h29min
G2*****	Mini:1	+2d16hrs
G2*****	Mini:1	+12h30min
G2*****	Mini:1	+12h2min





O1:

- GW151226

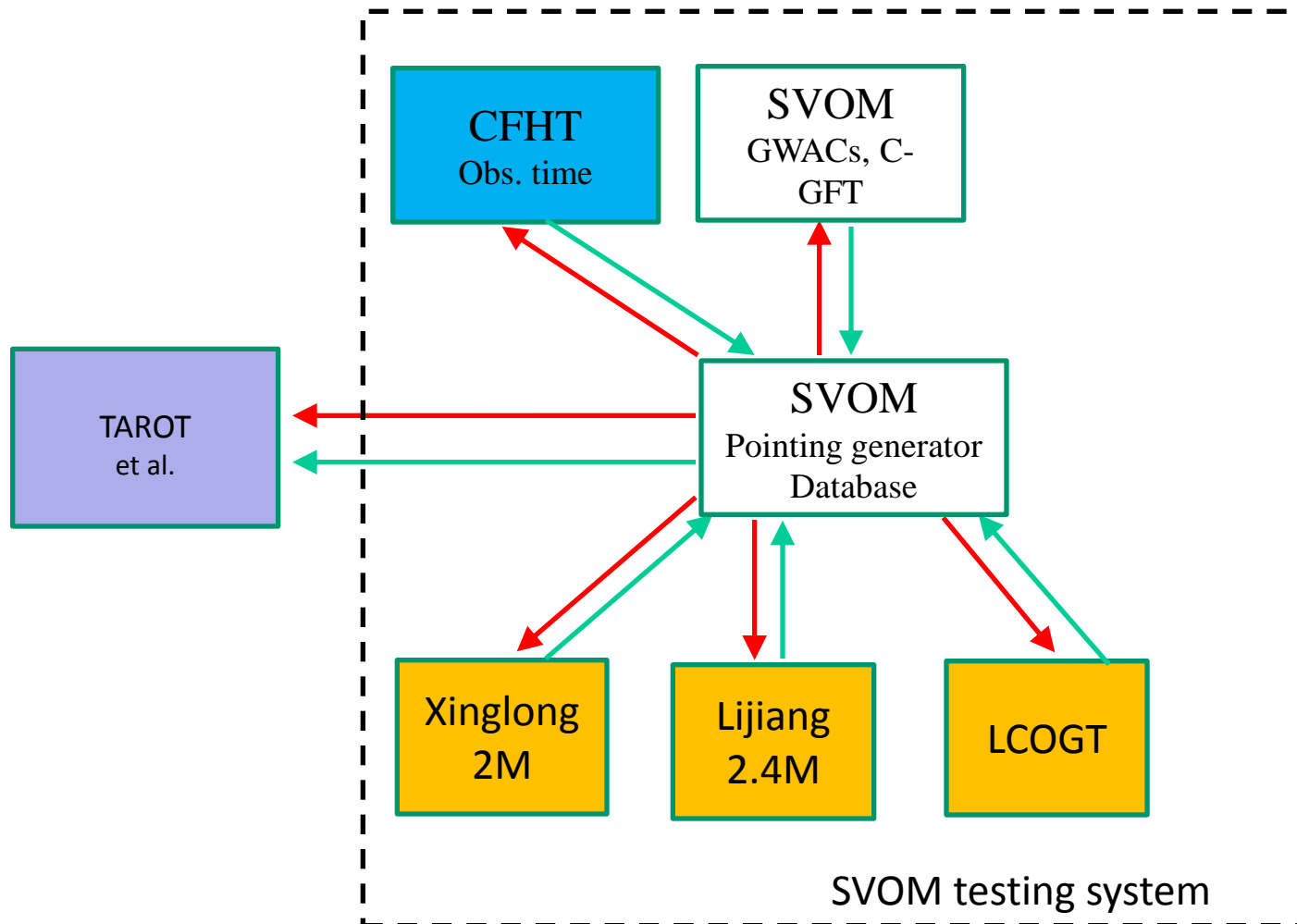
O2:

- GW170104
- 6 other events
- 10 GCN circulars

(其中2个使用2.16m 和2.4m)

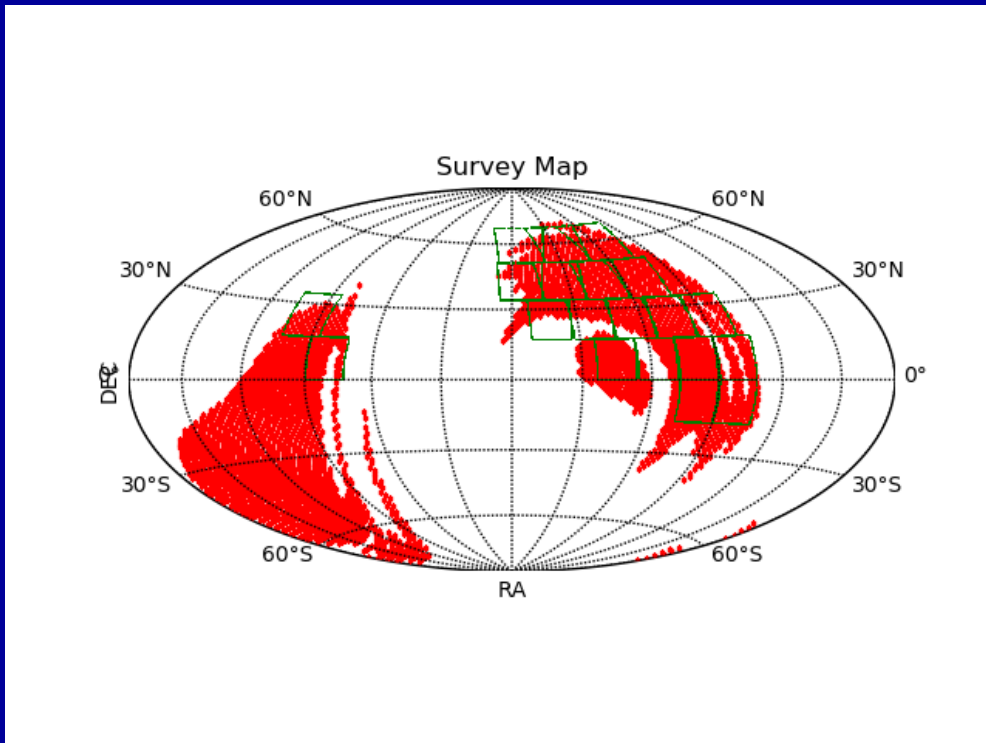
2019 -2020: O3

SVOM Follow-up testing system

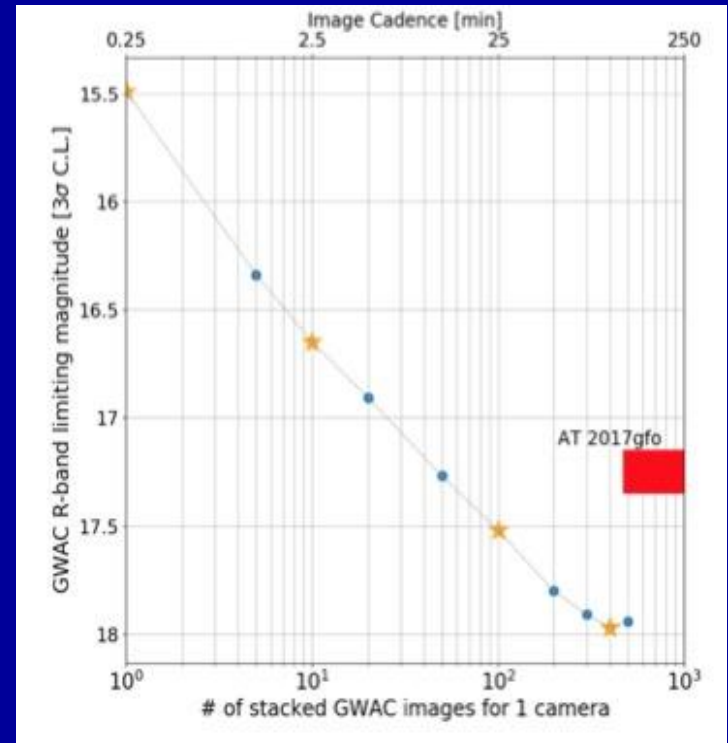


Follow the strategy of SVOM 2017-2018
Smoothly evolve to SVOM 2021

So far GWAC observed five O3 GW triggers:
S190412m, S190425z, S190426c, S190510g, S190512at



S190425z



Limiting mag. of GWAC

Short Summary

- SVOM will have very strong ground follow-up system:
 - Dedicated ones: GWAC, C-GFT, F-GFT
 - Supplement for GFTs: LCOGT 1M system
 - Deep follow-up obs.: middle and large telescopes
- Since of its powerful multi-band capability, SVOM will be a great chance for observing GRBs and ToOs.

(More information: SVOM white paper, [arXiv: 1610.06892](https://arxiv.org/abs/1610.06892))