Current status and the expected performance of GWACs

SVOM/GWAC team

Ground based Wide Angle Cameras

Before 2023:

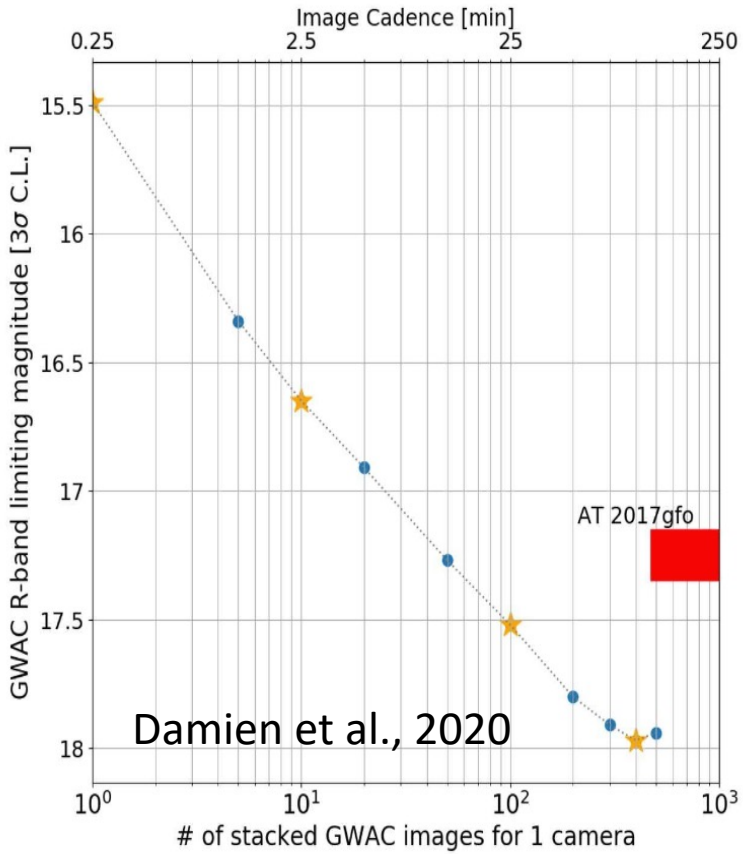
Location: Xinglong Observatory at China

Number： 20 cameras with D=18cm

4k*4k e2v CCD for each camera, giving a pixel scale of 11.7 arc seconds

Combined FoV: ~2300 sq.deg

Upper limit：~16V @10 seconds exposure；

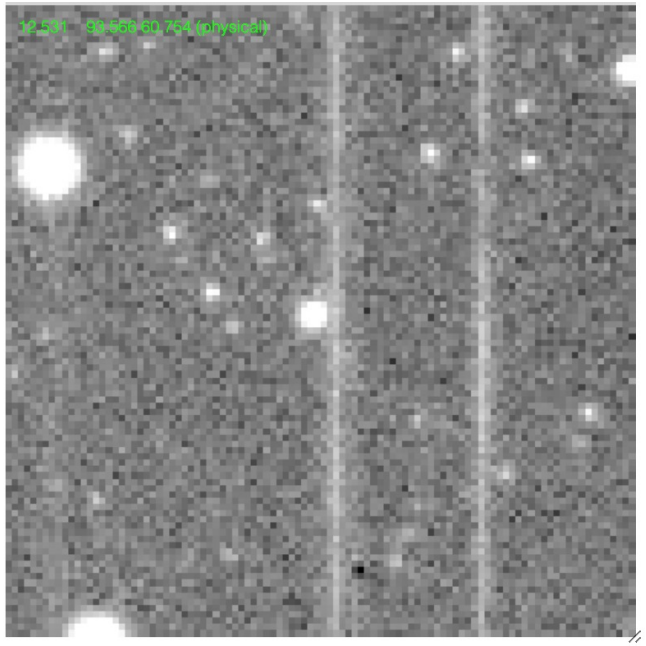


New GWACs will be installed at this winter

- In 2023,
- 6 new mounts will be installed.
- If we still use e2v 4k*4k CCD, the combined FoV will be more than 5000 Sq.deg

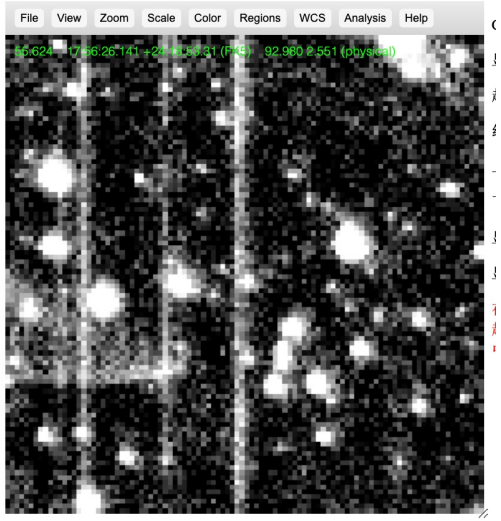
The failure of the mechanical shutter of CCD

A big challenge during the operation in the last years is the failure of the mechanical shutter of CCD, since the high-cadence survey, which decreases the operation efficiency seriously



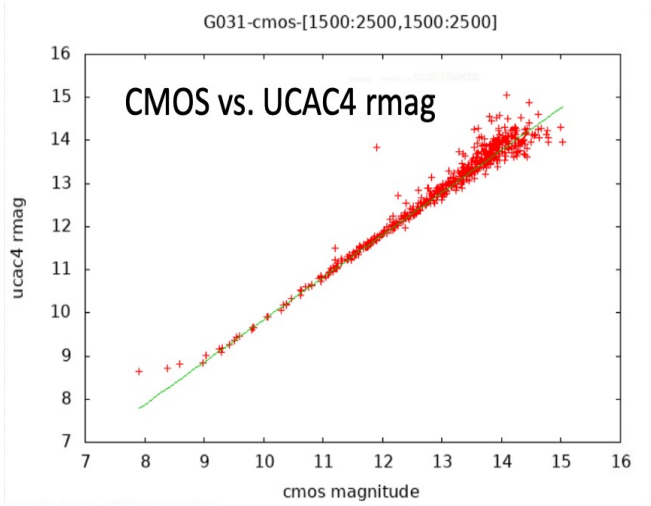
SYS-G-5.3-1340

The GWAC) availability shall be at least 90 %(TBC), including data link toward CSC (TBC)

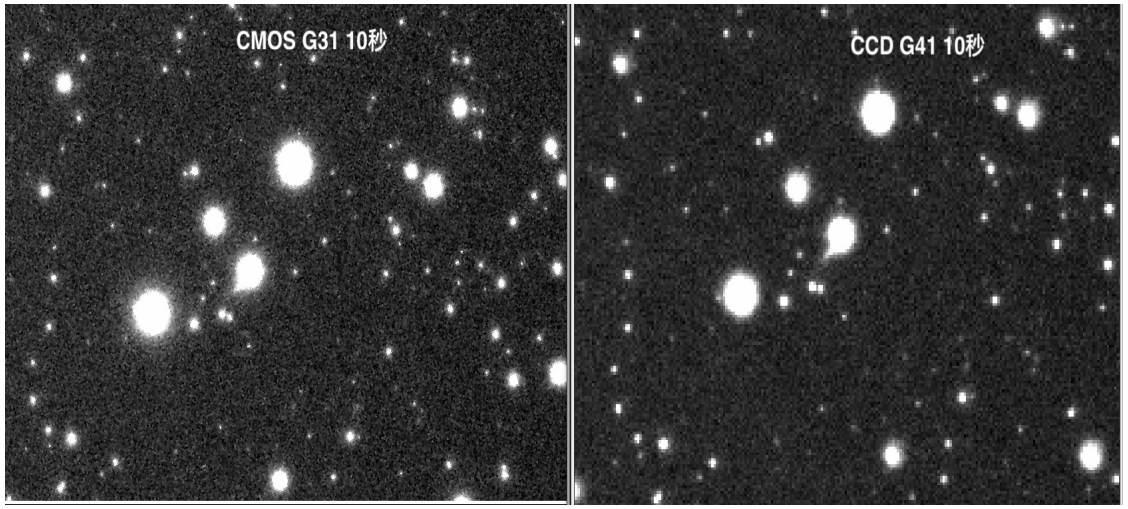


Updating GWAC detector from CCD to sCMOS

Dhyana 4040 sCMOS 4K*4K 9um



Test for GWAC + sCMOS



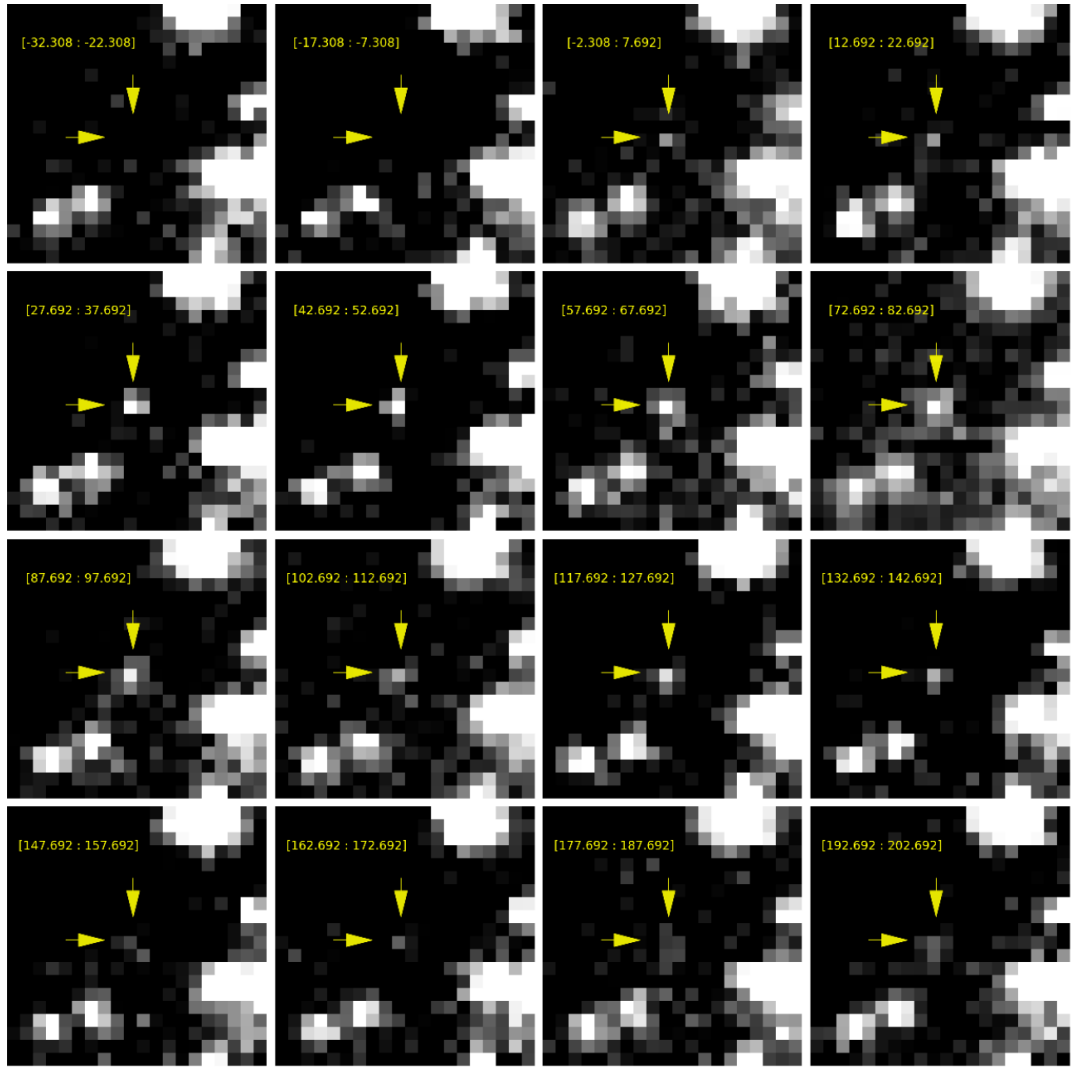
Comparison of performances for CMOS and CCD by obtaining the images simultaneously at Xinglong observatory

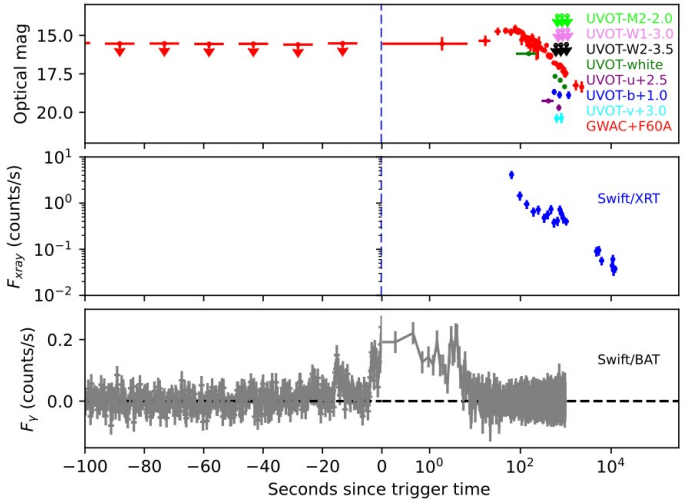
Updating GWAC detector from CCD to sCMOS

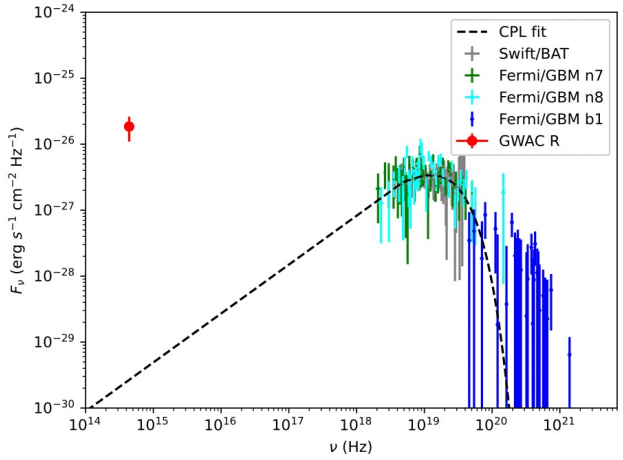
CCD	sCMOS	Comments	Advantage
The large mechanical shutter	Electronic roller shutter	Increase the operation efficiency	Allow the availability
11.7 arcsec/pix	8.3 arcsec/pix	Lower the noise from background	Better spatial resolution
15sec	< 10 seconds	Could stack the images thanks for the low read noise	Better temporal resolution
5 sec read out	0.18 seconds read out	Better for the second-scale transient survey	Lower the dead time

Benefit for many sciences: 1) GRBs, 2) GWs, 3) Stellar superflares, 4)Second-scale transient survey …

Prompt optical emission of GRB 201223A by GWAC + F60A







We would have more detailed information during the prompt phase if temporal resolution is increased

Xin et al., 2023

The field of view is smaller for CMOS

Advantage	CCD	CMOS	Comments
Allow the availability	The large shutter mechanical failure is serious	Electronic roller shutter	Increase the operation efficiency
Better spatial resolution	11.7 arcsec/pix	8.3 arcsec/pix	Lower the noise from background
Better ten resolut			ages read
Lower the dead time	5 sec read out	0.18 seconds read out	Better for the second-scale transient survey

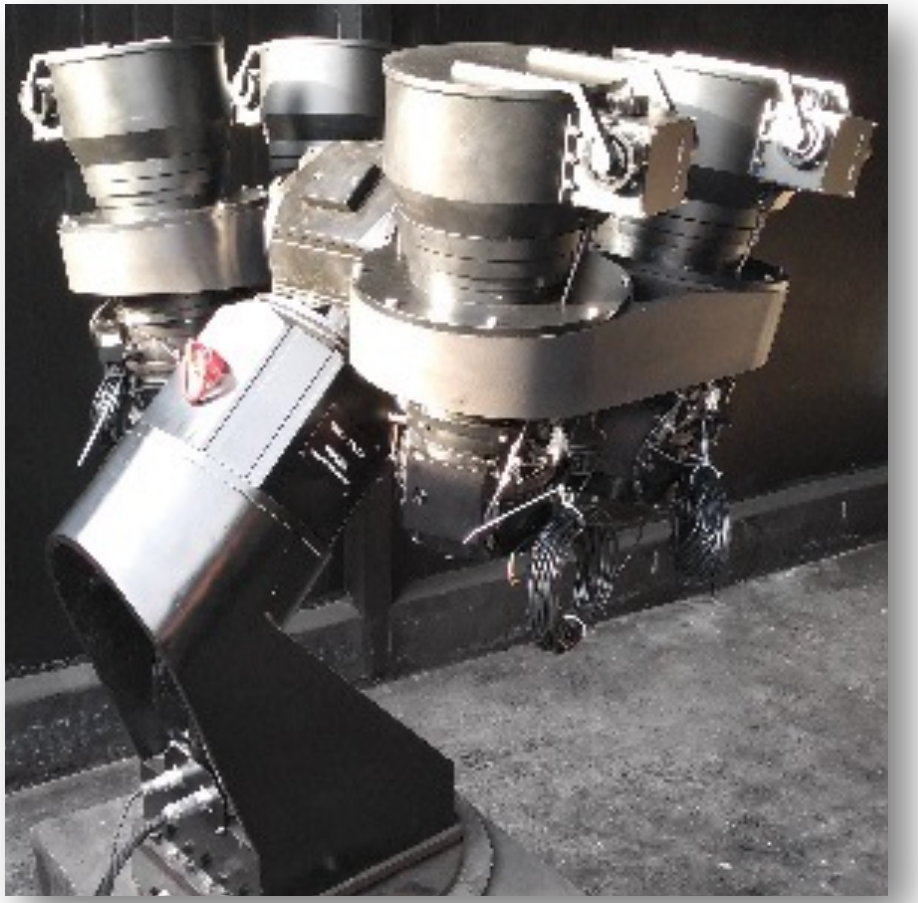
FoV for single detector: 12.4 →9.5 deg

Combined FoV: ~5000 Sq.deg →~3250 Sq.deg

Benefit for many sciences: 1) GRBs, 2) GWs, 3) Stellar superflares, 4)Second-scale transient survey …

New Wide-angle cameras at Jilin will join in the GWAC network
(The same place as CGFT)

Changchun WAC-15cm



D：150mm

f：160mm

Num of mount: 1

Num of cameras：4

Cameras：FLI CMOS 4040

4K*4K, 9μm for each pix

V：~14.5 mag @10 sec

FoV：696 Sq.deg

Pixel scale：11.6 arc sec.

First light：Sep. 2019

Credit: Kang zhe and Lu xiaomeng

Changchun WAC-28cm

D：280 mm

f：324mm

Num of mount: 3

Num of cameras：6

Cameras：FLI CMOS 4040

4K*4K, 9μm for each pix

V：~17.0 mag @10 sec

FoV：253 Sq.deg

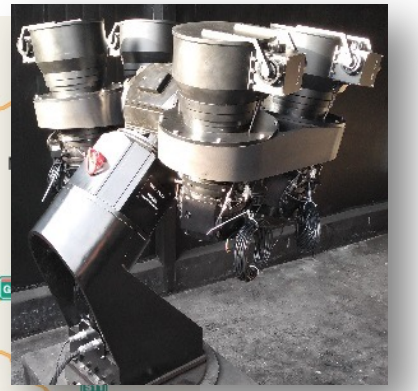
Pixel scale：5.7 arc sec.

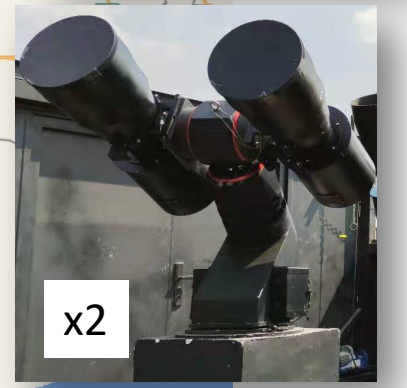
First light：Mar. 2021

Credit: Kang zhe and Lu xiaomeng

GWAC network for SVOM mission located in two sites

(3250+950 ~ 4200 Sq.deg)





CGFT

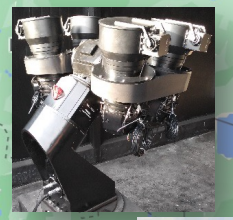
Xinglong

~3250 Sq.deg

~ 950 Sq.deg

More WACs at Xingjiang are being discussed to join in the GWAC network

(3250+950 + 640 ~ 4840 Sq.deg)



CGFT

x2

Xinglong

Hosted by Shandong University, Weihai

Улаанбаатар
Mongolia
Almaty
Алматы
Bishkek
Бишкек
Kyrgyzstan
XINJIANG
JILIN
LIAONING
Beijing
北京
HEBEI
GANSU
NINGXIA
SHANXI
SHAANXI
QINGHAI
China
SHANDONG
South Korea
Yellow Sea
HENAN
JIANGSU
HUBEI
ANHUI
Shanghai
上海
East China Sea
SICHUAN
Chongqing
重庆
ZHEJIANG
GUIZHOU
HUNAN
JIANGXI
TIBET
Nepal
Bhutan
New Delhi
दिल्ली
Taipei

Analysis for the requirements for GWAC

《SYS_SV-SY-STB-49-JPO.system requirement》

5.3.4.4 GWAC

SYS-G-5.3-1340

The GWAC) availability shall be at least 90 %(TBC), including data link toward CSC (TBC)

Level *To be completed*
Verification method *TBD*
Verification justif *TBD*

← Meet

SYS-R-5.3-1350

GWAC shall observe simultaneously with 5 min. before and 15 min. after T_0 more than 12% (TBC) of these events in the visible band down to a limit magnitude $M_v = 15$

Level **To be completed**
Verification method *TBD*
Verification justif *TBD*

← Meet

SYS-R-5.3-1360

GWAC shall have a FOV of at least 5,000 square deg

Level **To be completed**

← ~4200 Sq.deg or expected ~4860 Sq.deg