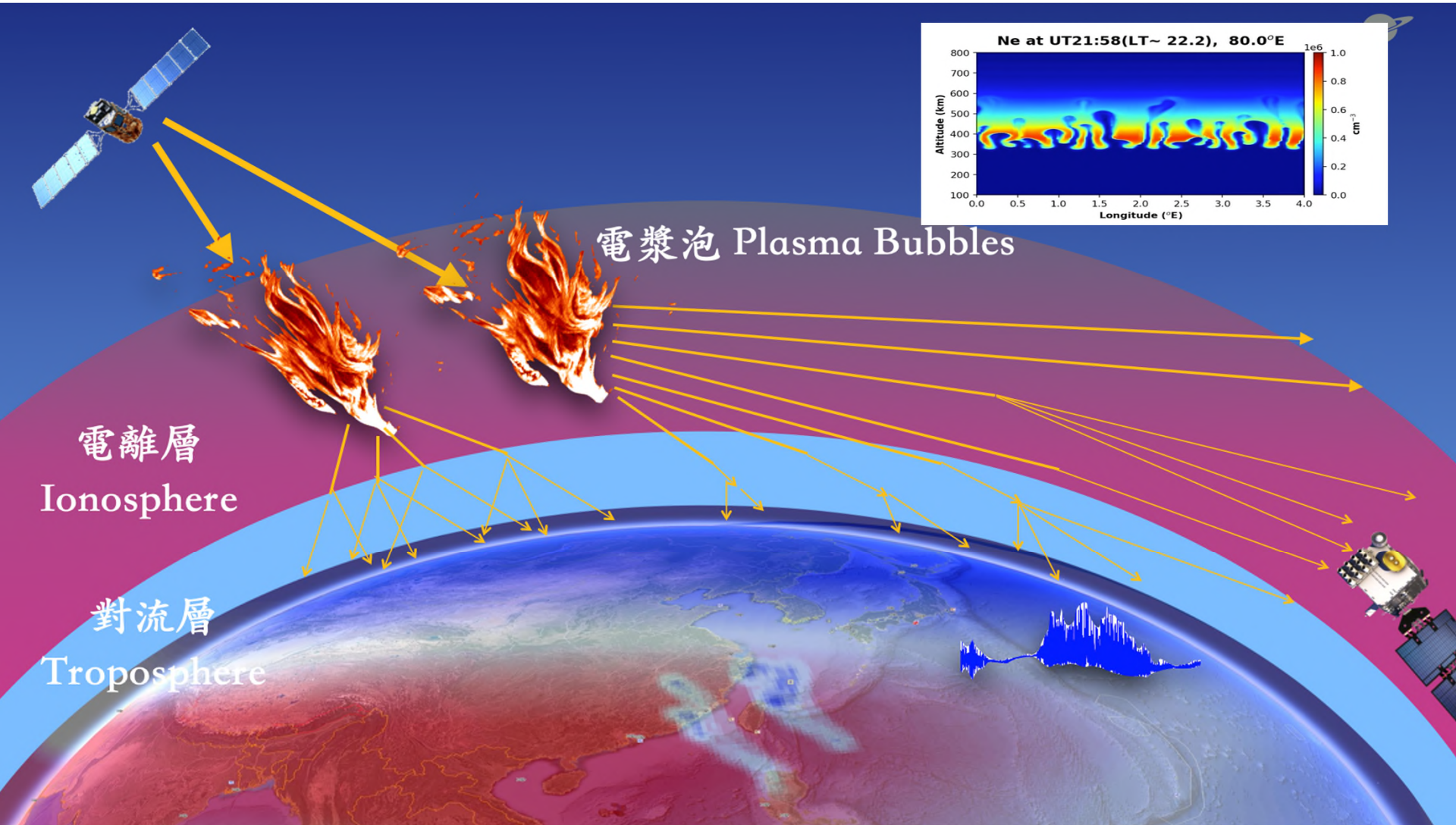

*A Real-Time Plasma Bubble Detection Method
Combining Neural Networks and All-Sky Imaging*

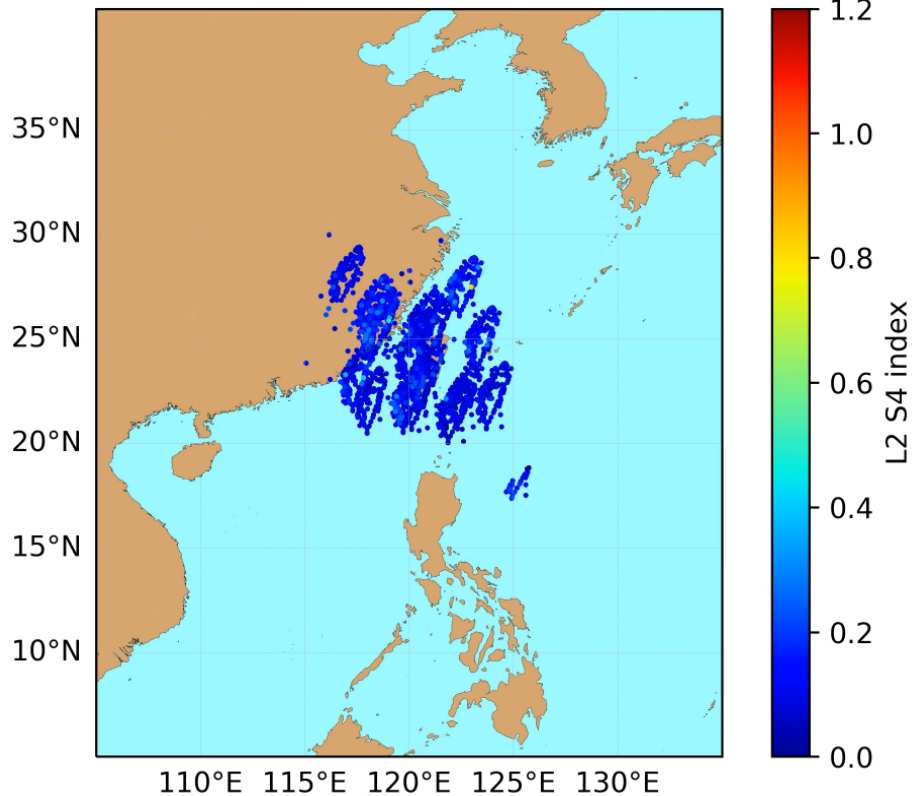
Tung-Yuan Hsiao, NTHU
Charles Lin, NCKU

Plasma Bubbles

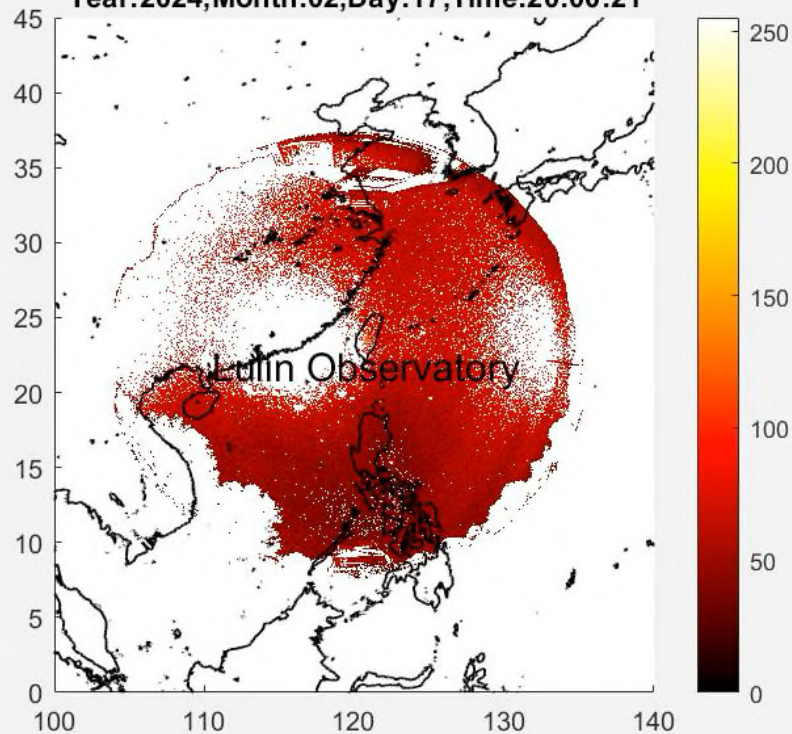


GNSS stations and All sky imager

2024-02-17 09:50:00



Year:2024,Month:02,Day:17,Time:20:00:21

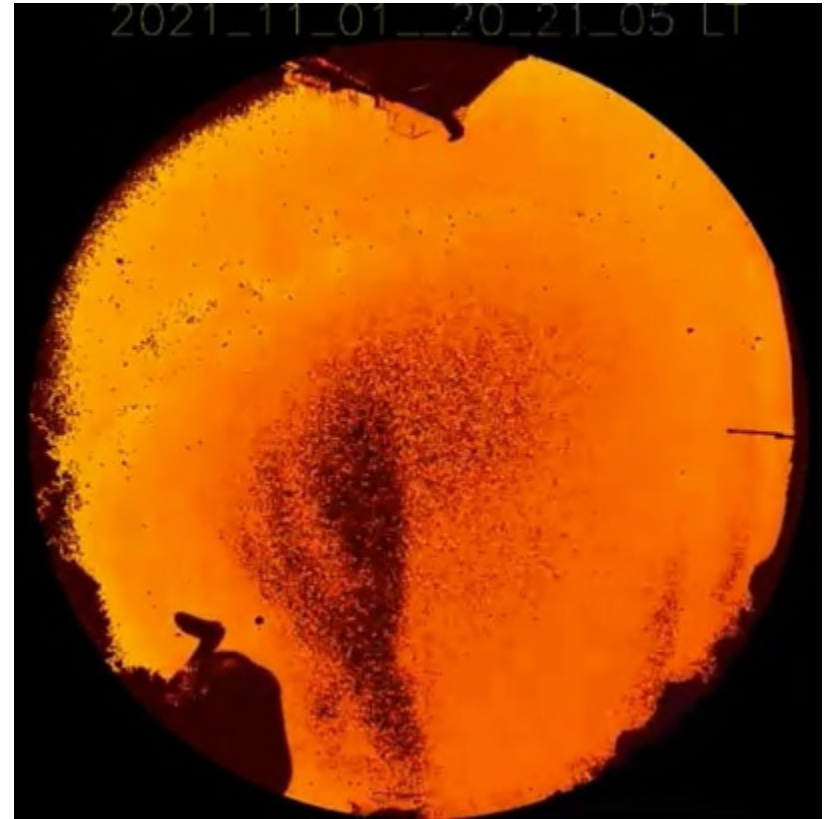


LuLin All Sky Camera

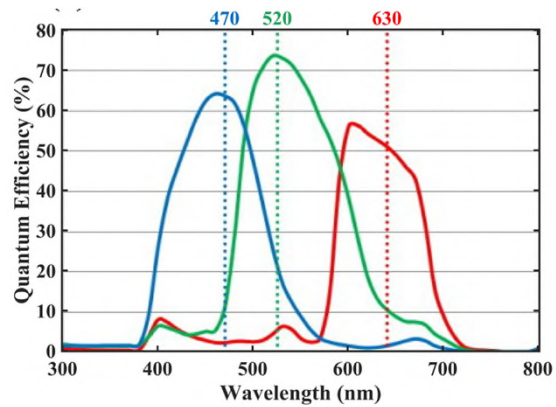
Original



After processing



Low-cost allsky(sony cmos sensor)



Low-cost allsky(sony cmos sensor) by 3D printer



Low-cost allsky(sony imx462 cmos sensor)

Install at LuLin



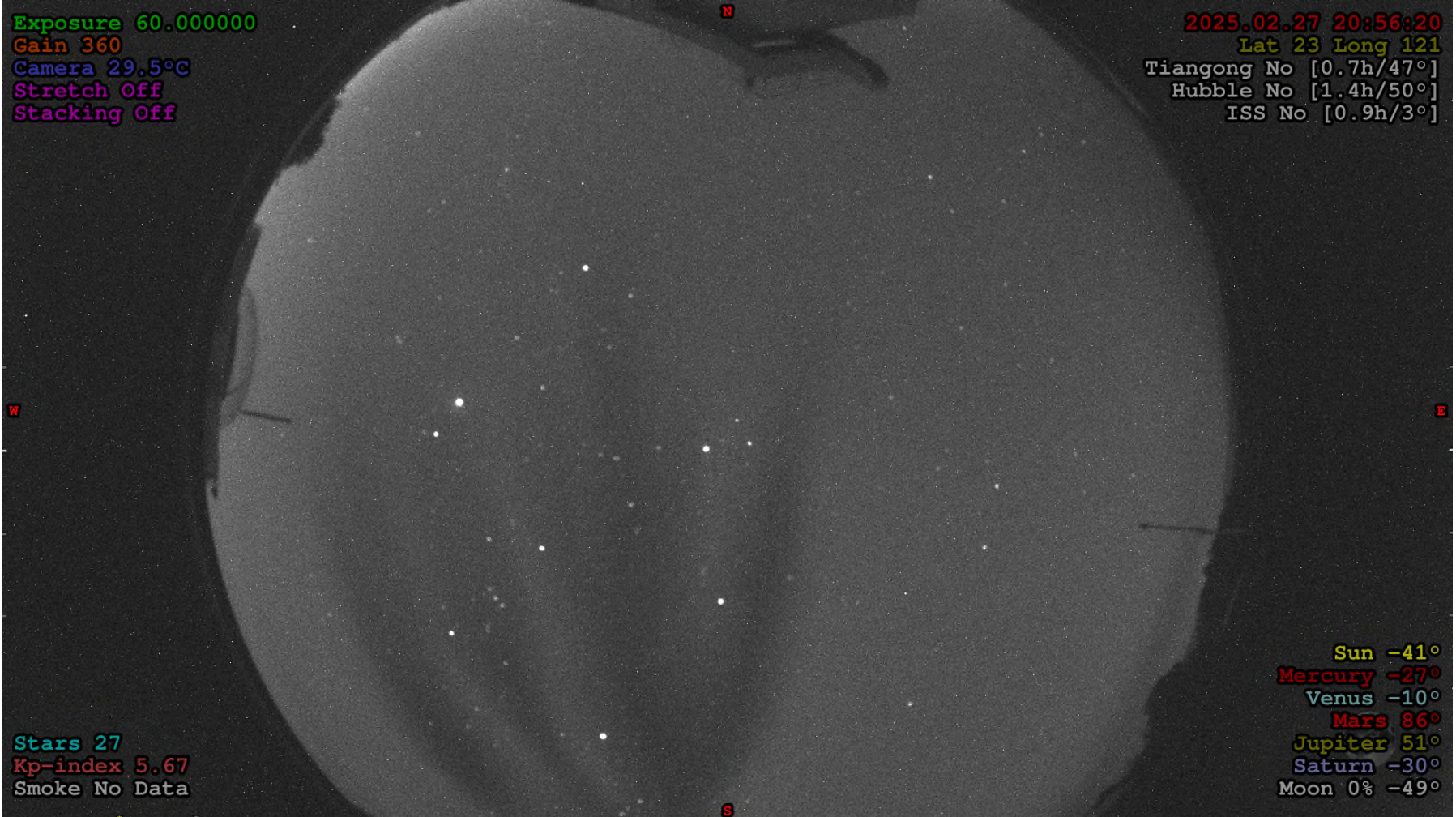
- (1) All made by the 3D printer
- (2) Camera: imx462
- (3) Field of view: 180°, the whole sky.
- (4) Lens: F/1.4 Fisheye-Fujinon
- (5) With Linux Base SBC(raspberry pi) in inside.

Exposure 60.000000
Gain 360
Camera 29.5°C
Stretch Off
Stacking Off

2025.02.27 20:56:20
Lat 23 Long 121
Tiangong No [0.7h/47°]
Hubble No [1.4h/50°]
ISS No [0.9h/3°]

Stars 27
Kp-index 5.67
Smoke No Data

Sun -41°
Mercury -27°
Venus -10°
Mars 86°
Jupiter 51°
Saturn -30°
Moon 0% -49°



Exposure 00.000000
Gain 200
Camera 22.0°C
Stretch 0.22
Stacking 0.22

Stars 0
Rp-index 0.22
Smoke No Data

2025.02.27 18:23
Zak 22 Zakg
Wavelength No [0.0h/
Hubble No [0.7h/
ISS No [2.4h/

Exposure 0.000000
Gain 200
Camera 22.0°C
Stretch 0.22
Stacking 0.22

Sun
Mars
Venus
Mer
Jupiter
Saturn
Moon 10 ←

Exposure 0.000000
Gain 200
Camera 22.0°C
Stretch 0.22
Stacking 0.22

2025.02.27 18:23
Zak 22 Zakg
Wavelength No [0.0h/
Hubble No [0.7h/
ISS No [2.4h/

Stars 0
Rp-index 0.22
Smoke No Data

Rocket event

The image displays two screenshots of the ALASKA INDI software interface, showing astronomical observations of a rocket event. The interface is split into two panels, each showing a different view of the same event.

Left Panel (Screenshot 1):

- Header:** Year: 2025, Month: March, Day: 27, Hour: 0, Image: 00:11. Includes a toggle for "Exclude Image From Timelapse" and "Detections".
- Camera:** ZWO CCD ASI423MM.
- Exposure Data:** Exposure: 60,000000, Gain: 300, Camera: 30.5°C, Stretch: Off, Stacking: Off.
- Object Data:** 2025-03-27, Zns: 23, Tiangong No: [1], Hubble No: [1], ISS No: [1].
- Object Properties:** Stars: 13, Kp-index: 5.67, Smoke: No Data.
- System Status:** Status: RUNNING, Lat: 23.5/Long: 120.9, Sidereal: 15:28:28.01, Mode: Night, Sun: -38.0°, Moon: -16.0°, Phase: Waning, Smoke: No Data, Kp-index: 5.67 MEDIUM, Aurora: 0%.
- Navigation:** Loop, Mini Timelapse, Chart, Image, RAW.

Right Panel (Screenshot 2):

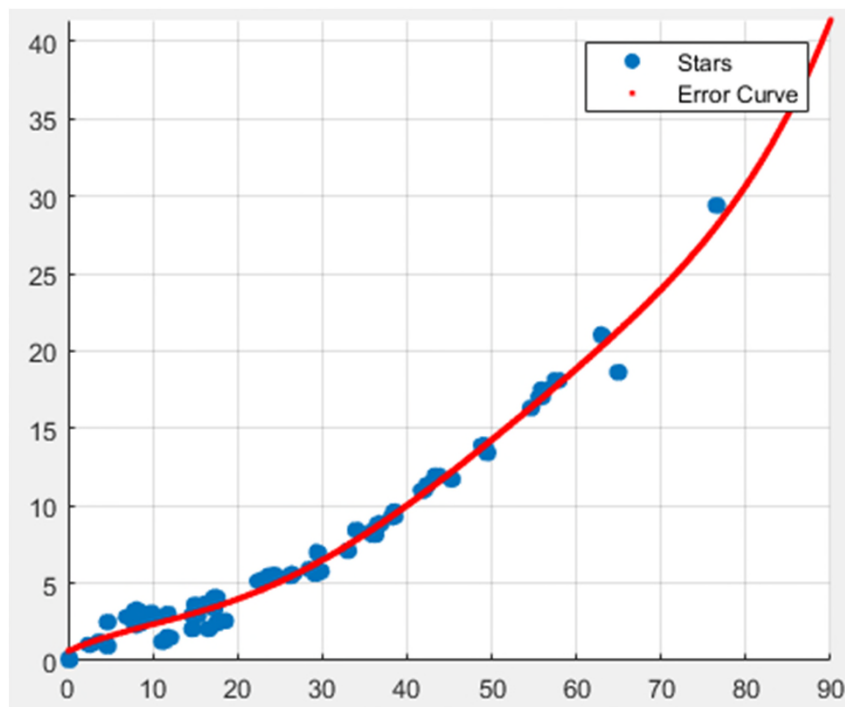
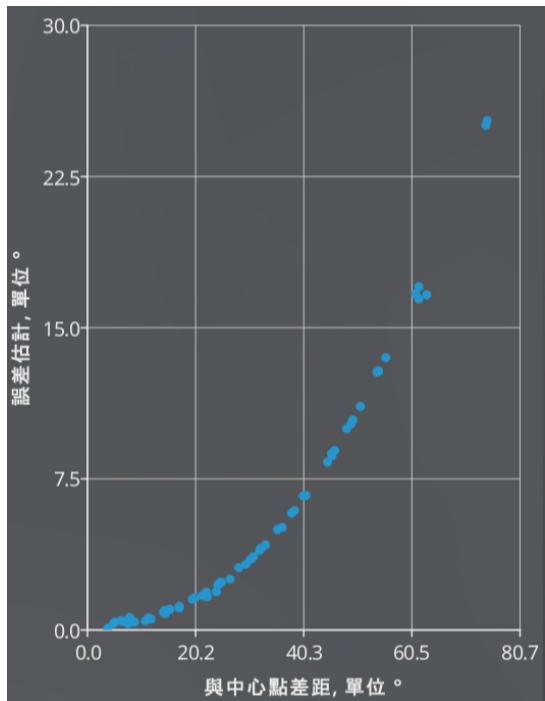
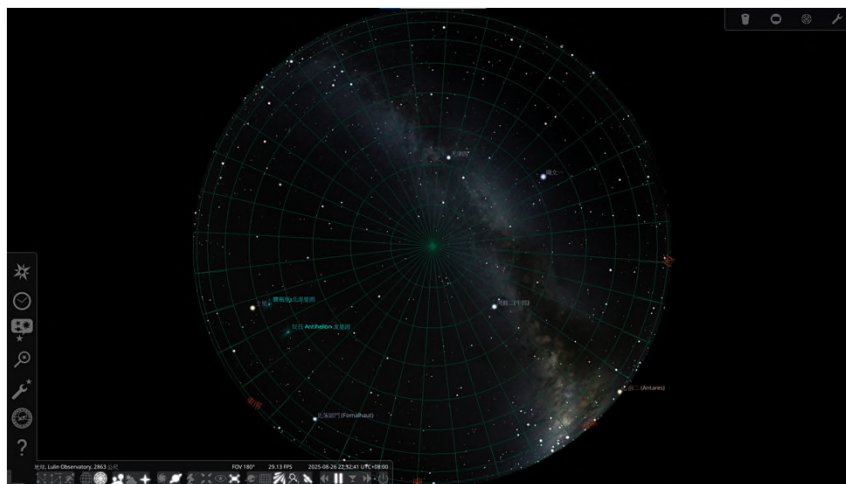
- Header:** Year: 2025, Month: March, Day: 27, Hour: 0, Image: 00:16:14. Includes a toggle for "Exclude Image From Timelapse" and "Detections".
- Camera:** ZWO CCD ASI423MM.
- Exposure Data:** Exposure: 60,000000, Gain: 300, Camera: 30.5°C, Stretch: Off, Stacking: Off.
- Object Data:** 2025-03-27, Zns: 23, Tiangong No: [1], Hubble No: [1], ISS No: [1].
- Object Properties:** Stars: 13, Kp-index: 5.67, Smoke: No Data.
- System Status:** Status: RUNNING, Lat: 23.5/Long: 120.9, Sidereal: 15:32:47.59, Mode: Night, Sun: -37.1°, Moon: -15.1°, Phase: Waning, Smoke: No Data, Kp-index: 5.67 MEDIUM, Aurora: 0%.
- Navigation:** Loop, Mini Timelapse, Chart, Image.

GNSS Septentrio X5 module

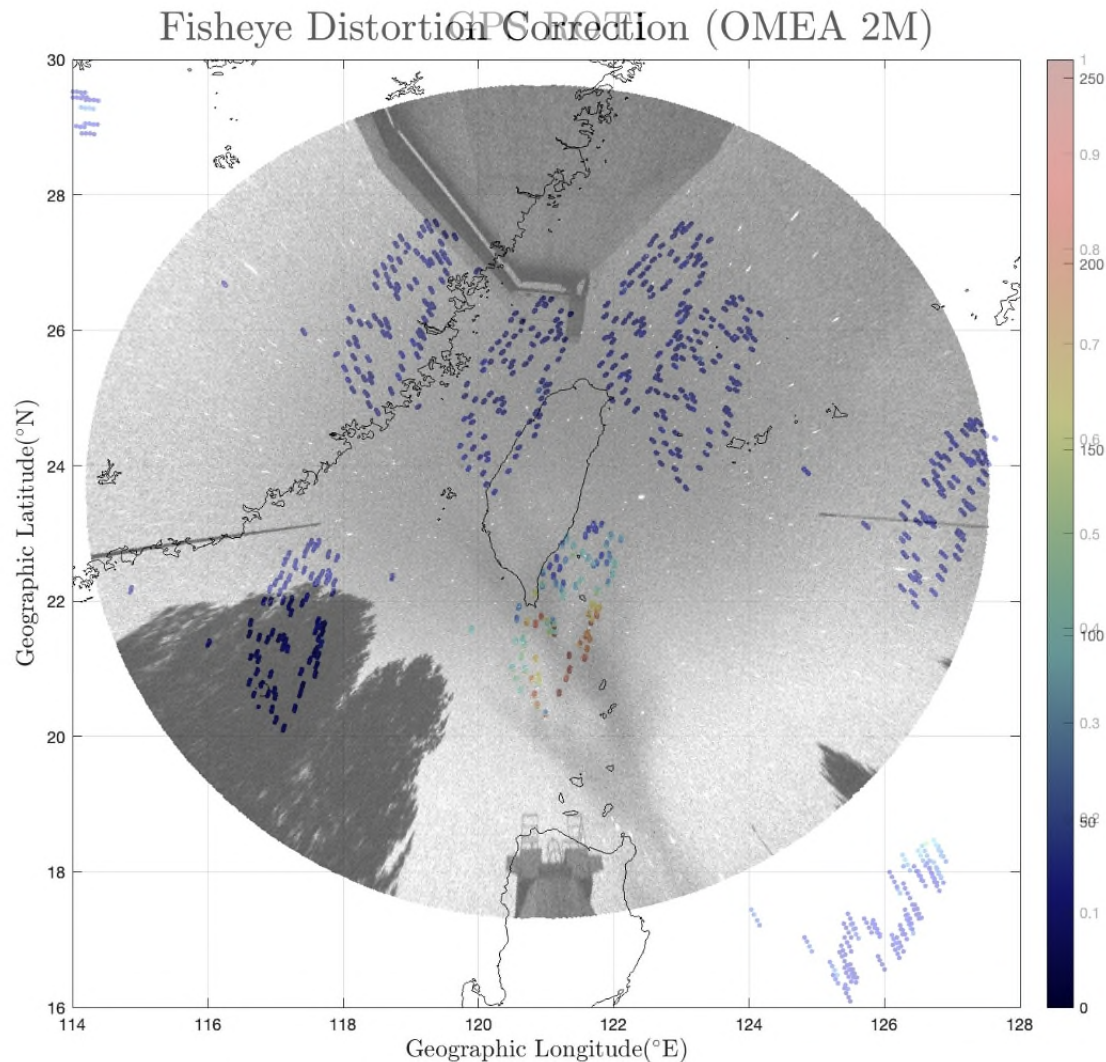


- (1)GNSS 100 Hz sampling rate receiver.
- (2)100Hz 10 and 35 TARI stations(50hz) at Taiwan.
- (3)With Linux Base SBC(raspberry pi 4) caculate S4, TEC, ROTI, ZTD, PPP-AR(by Bernese 5.4) etc. on board.

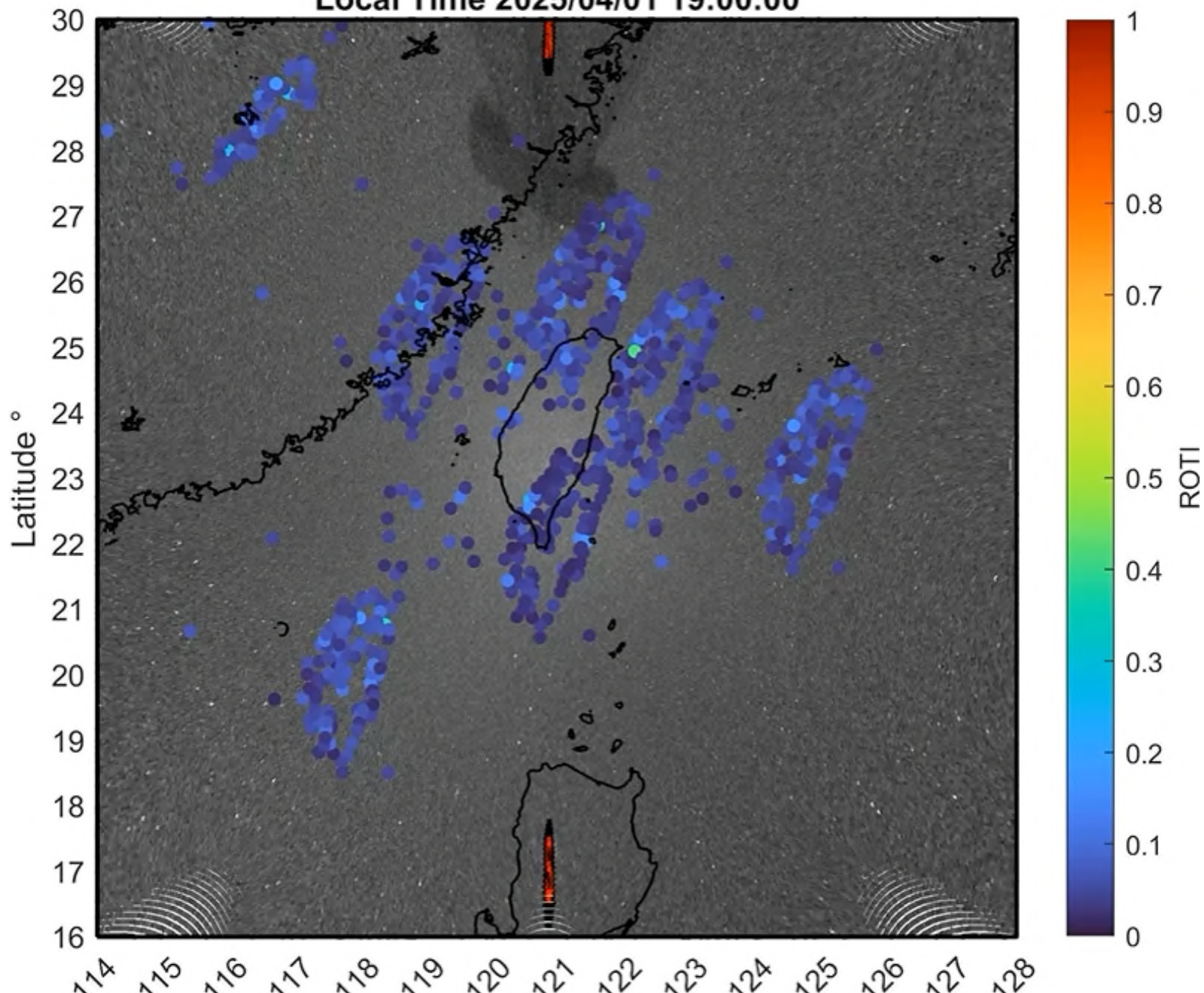
使用stellarium軟體，以天體得到校正曲線



使用stellarium軟體，以天體得到校正曲線，然後調整投影高度與GNSS比對

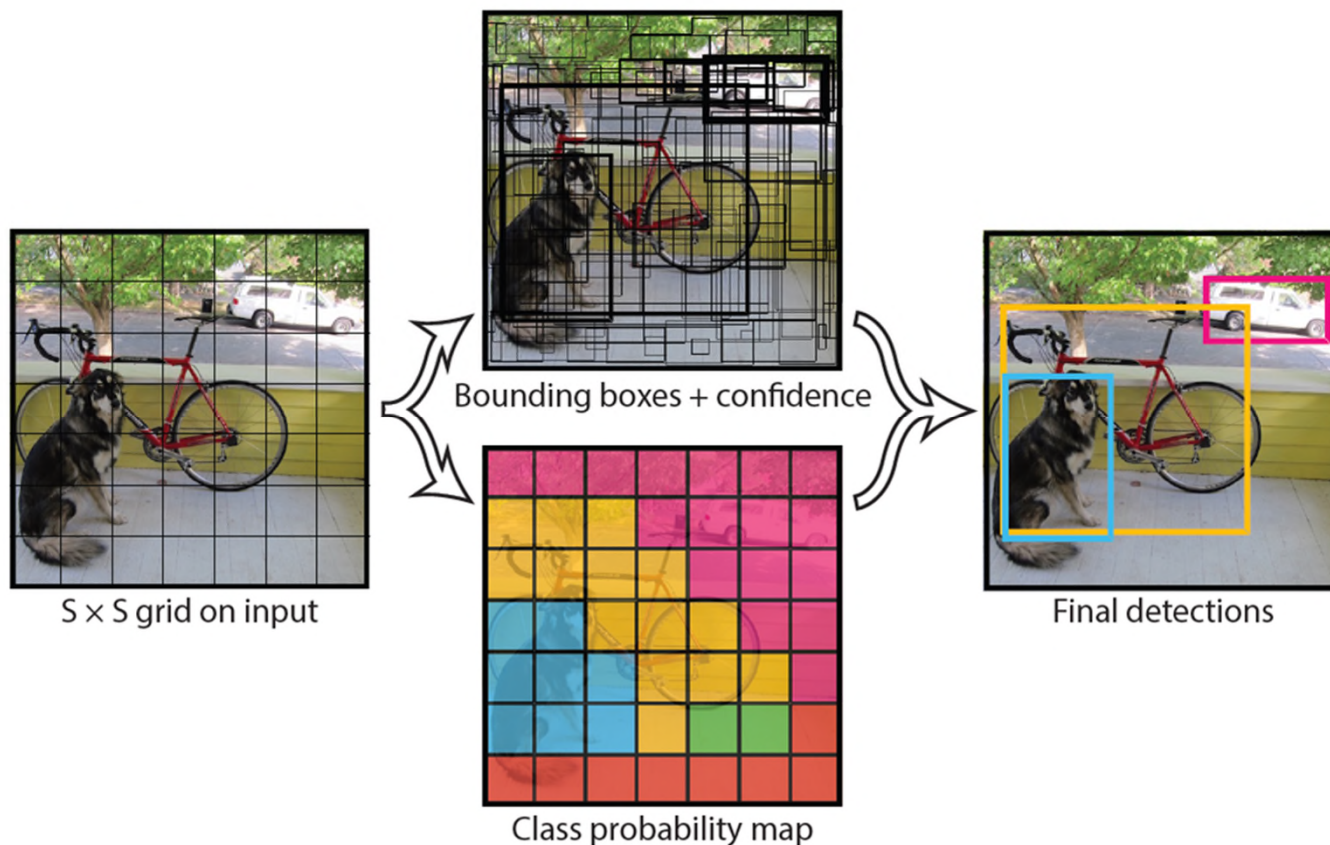


Local Time 2025/04/01 19:00:00



What is YOLO v12?

- YOLO (You Only Look Once) 系列：最廣泛使用的即時物件偵測模型



What is YOLO v12?

Let's look at a simple implementation of YOLO12 using Ultralytics pipeline:

```
1 | !pip install -q ultralytics  
2 | from ultralytics import YOLO
```

```
1 | model = YOLO("yolo12m.pt")  
2 | result = model(img_path, save = True, conf=0.5)
```

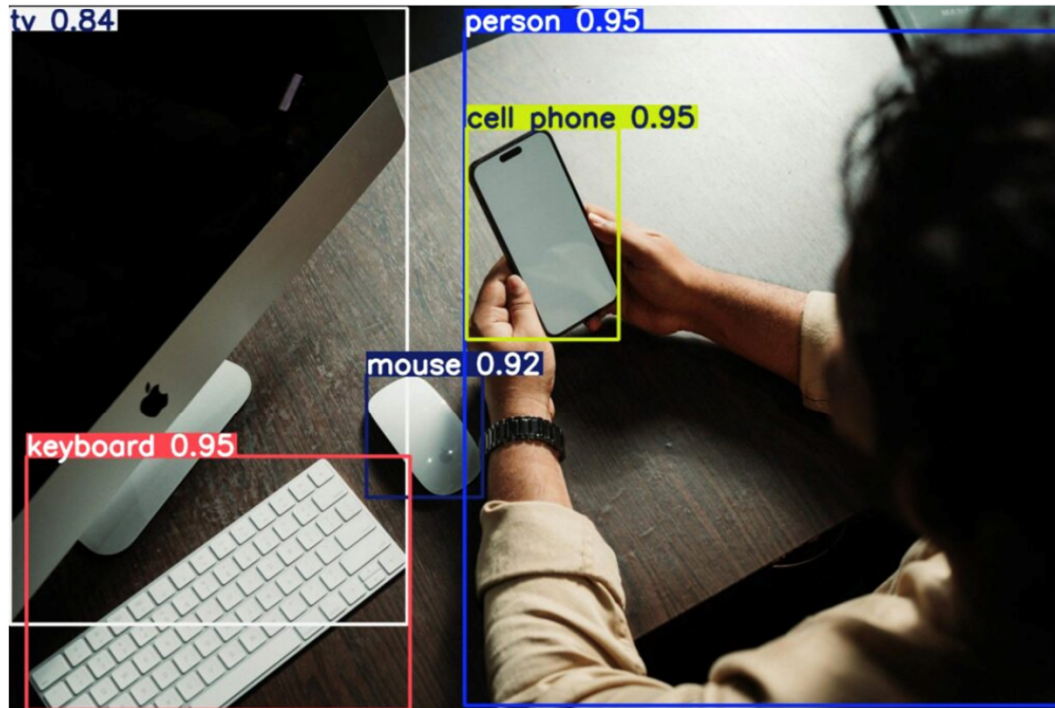


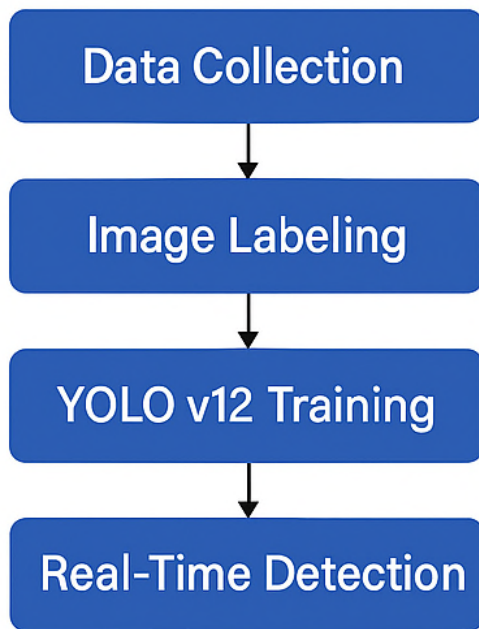
Fig 6: YOLO12 object detection result

Why we use YOLO v12?

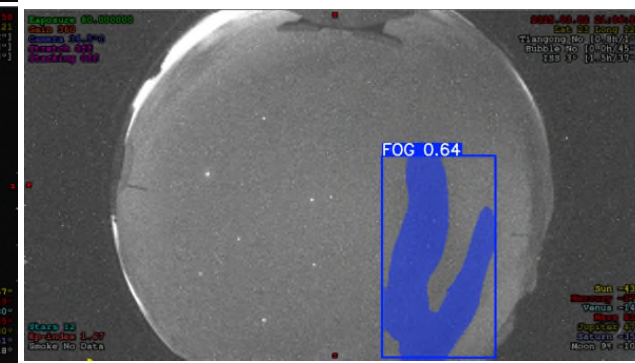
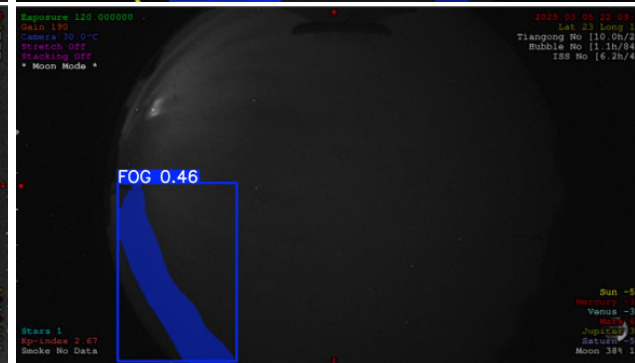
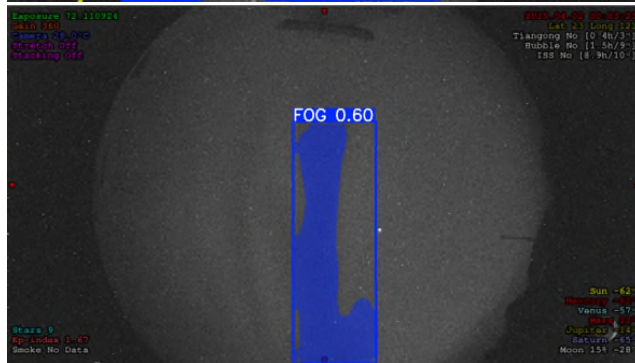
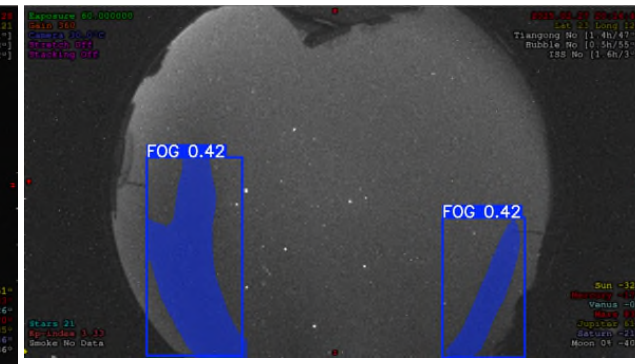
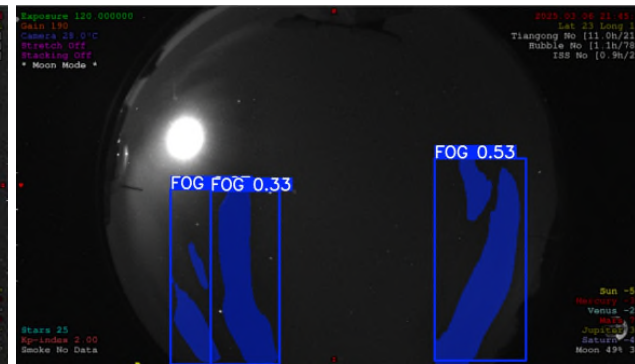
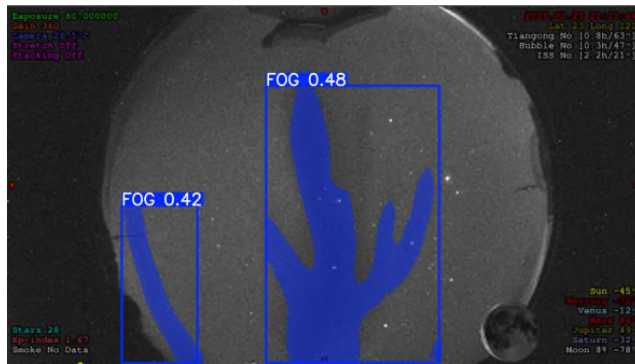
- Plasma bubble 特徵：暗條狀、延伸、低對比
- YOLO v12 改進的 **multi-scale feature**
- **extraction** → 能捕捉大範圍與細微結構
- 強化 **low-light image detection** → 適合夜間 All-Sky 影像
- 高速運算 → 可實現 **即時預警系統**

What is YOLO v12?

Plasma Bubble Detection (YOLO v12)



The initial results of Machine Learning



Thanks For Your Attention !!

