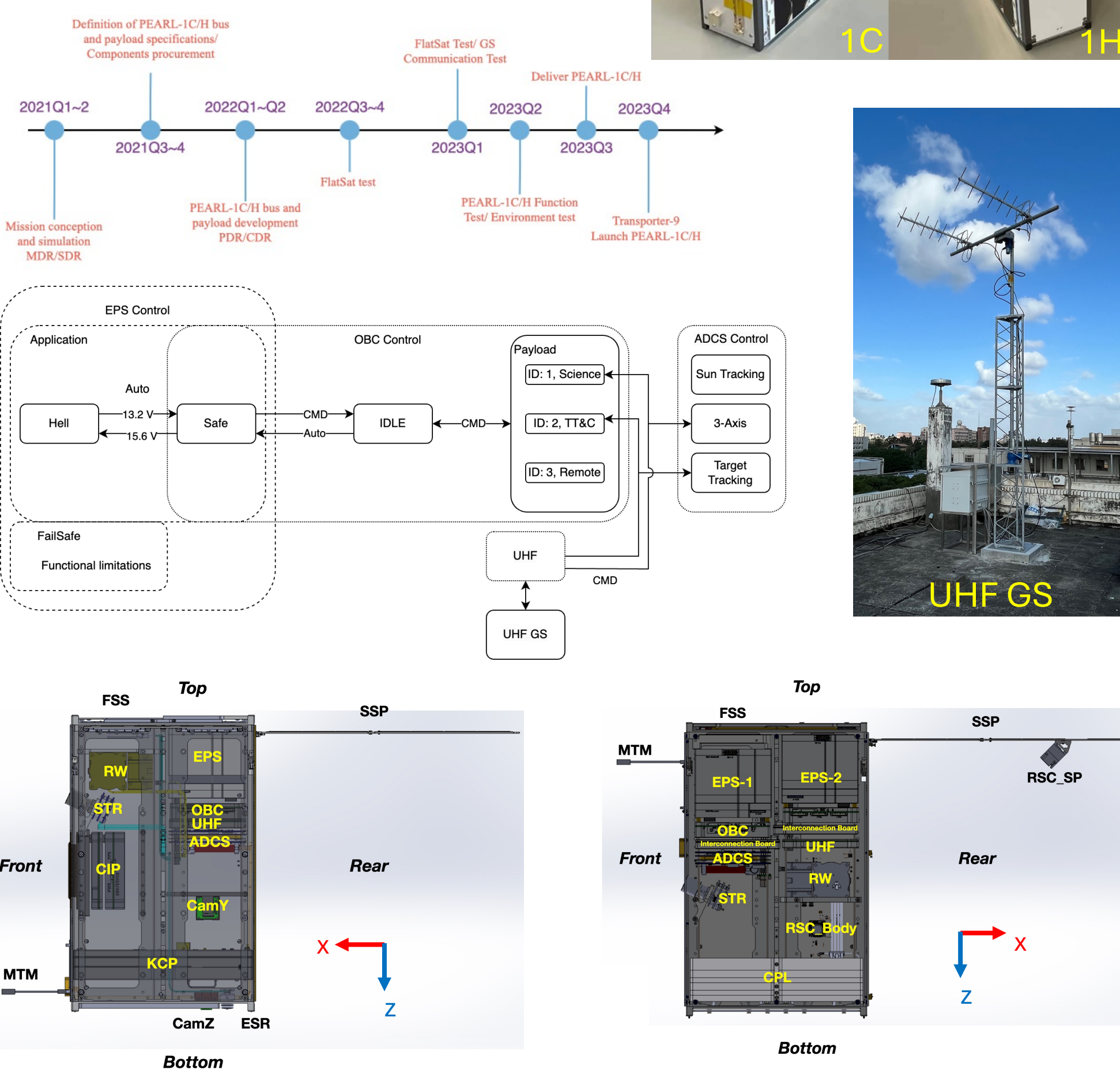
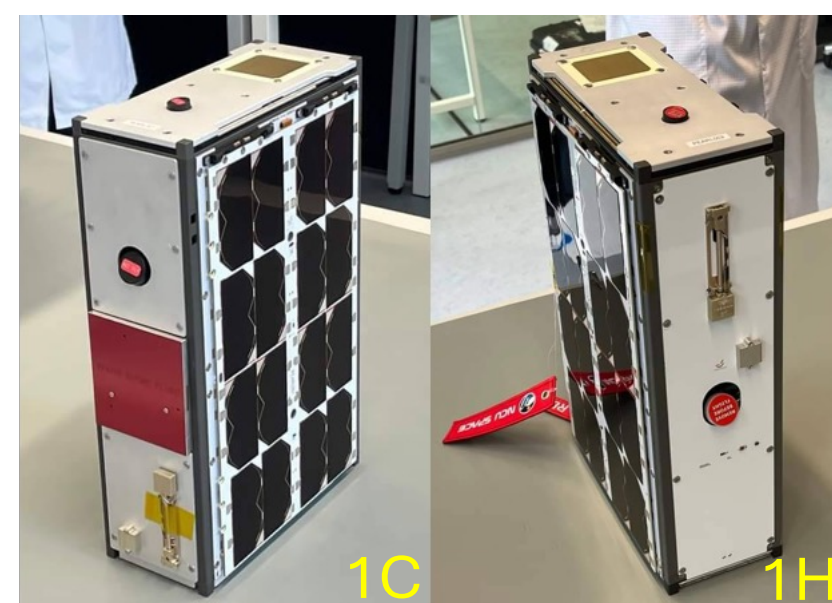


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PEARL (Propagation Experiment using kurz-Above-band radio in Low earth orbit) CubeSats consists of two 6U XL CubeSats, named as PEARL-1C and PEARL-1H, integrated by National Central University (NCU) and Hon Hai Precision Industry Co., Ltd. (Foxconn) for educational training/scientific research was launched into a sun-synchronous orbit at 520 km altitude around 1030 local time sector by SpaceX Transporter-9 rideshare mission from Vandenberg Space Force Base on 11 November 2023. On PEARL-1C, two payloads are installed: a Ka-band communication payload (KCP) is developed by Rapidtek Technologies for broadband communication experiment and a Compact Ionospheric Probe (CIP) is an all-in-one in-situ ion sensor developed by NCU to measure global ionospheric ion concentration, velocity, and temperature. On PEARL-1H, a Communication Payload (CPL), which is developed by Tron Future to conduct broadband communication experiment with beam-steering phase array antenna, is installed. Although both satellites are aimed at communication experiments, their system designs and configurations are still different. The CIP on PEARL-1C needs to face the forward direction to collect plasma. The attitude control is very important. There are two power distribution modules (PDM) and two battery packs (BP) on PEARL-1H. Except for the battery raw power, all power sources providing the same voltage are shared and each BP is managed individually through each PDM. It is heavier and requires attention to mode changing. Therefore, the performances of on-orbit operation for these two CubeSat are also different and we need to make different operating instructions in response to different conditions. In this research, we will discuss the performances of PEARL CubeSats on the ground and on orbit, and presented with some experimental results.

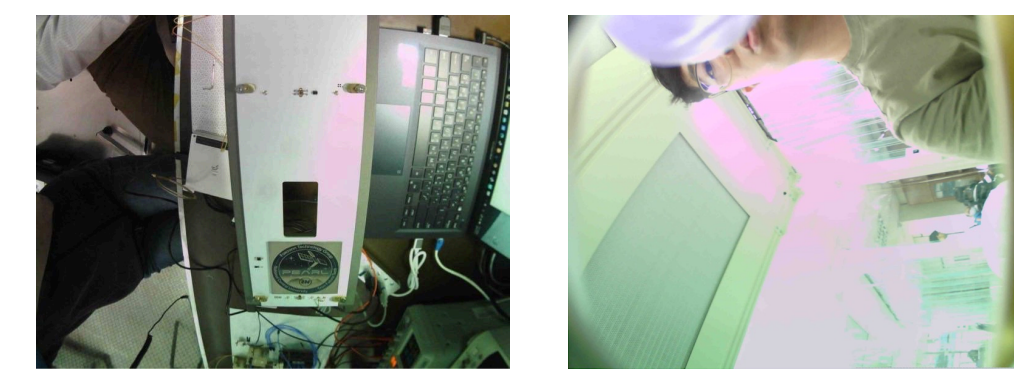
Mission and System Design

- Mission lifetime: 3-5 years
- Size: 100 x 226 x 366 mm (6U XL)
- Mass: 1C≈7.4 kg, 1H≈8.8 kg
- Orbit: ~520 km ~LTDN 1030 SSO
- Launch Date: 11 November 2023



The Photos from the Cameras

- Ground Test:
 - Right: PEARL-1C +Z Nadir Camera
 - Left: PEARL-1H +X Selfie Camera



PEARL-1C +Z Nadir Camera

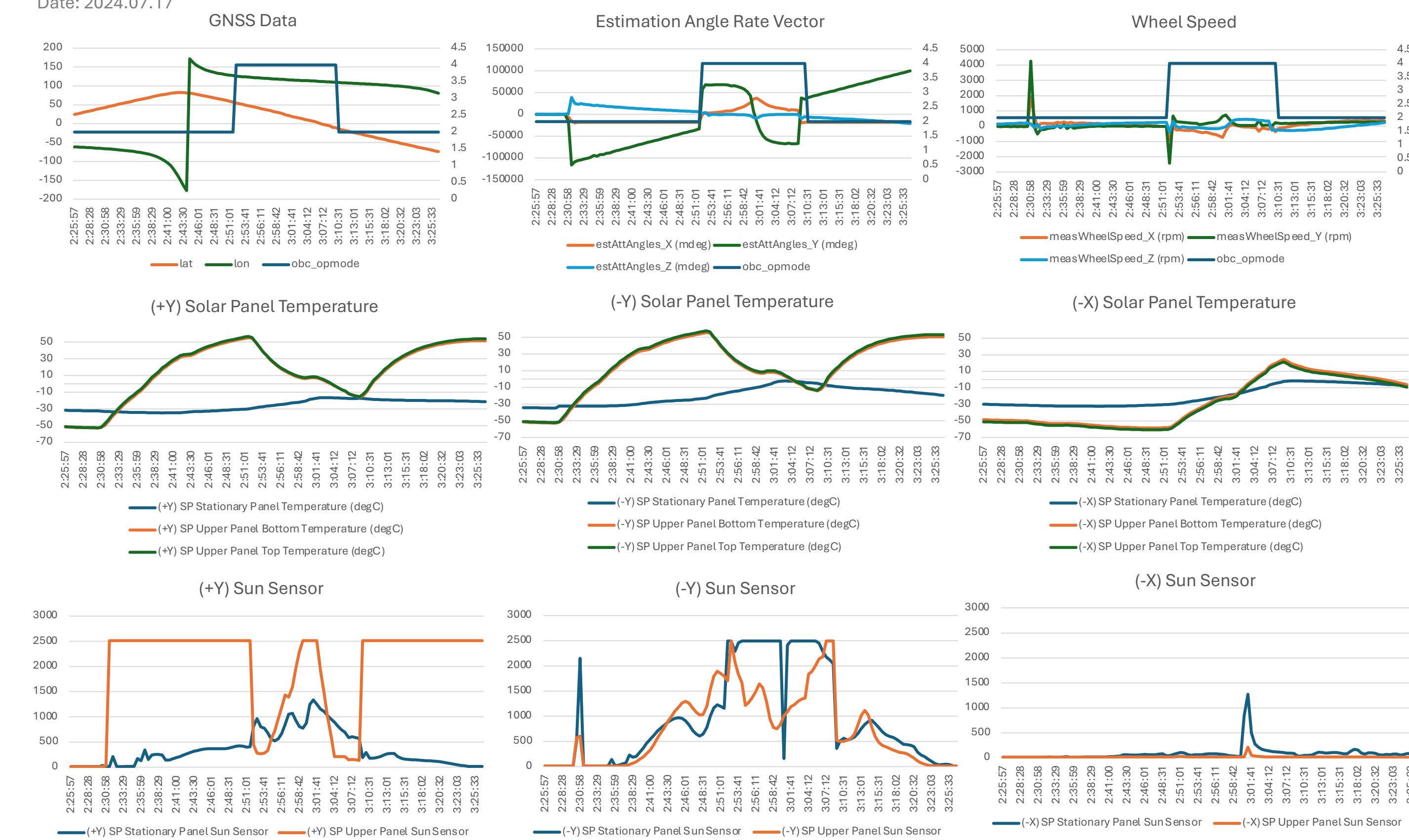


PEARL-1H +X Selfie Camera

Target Tracking and KCP Operation

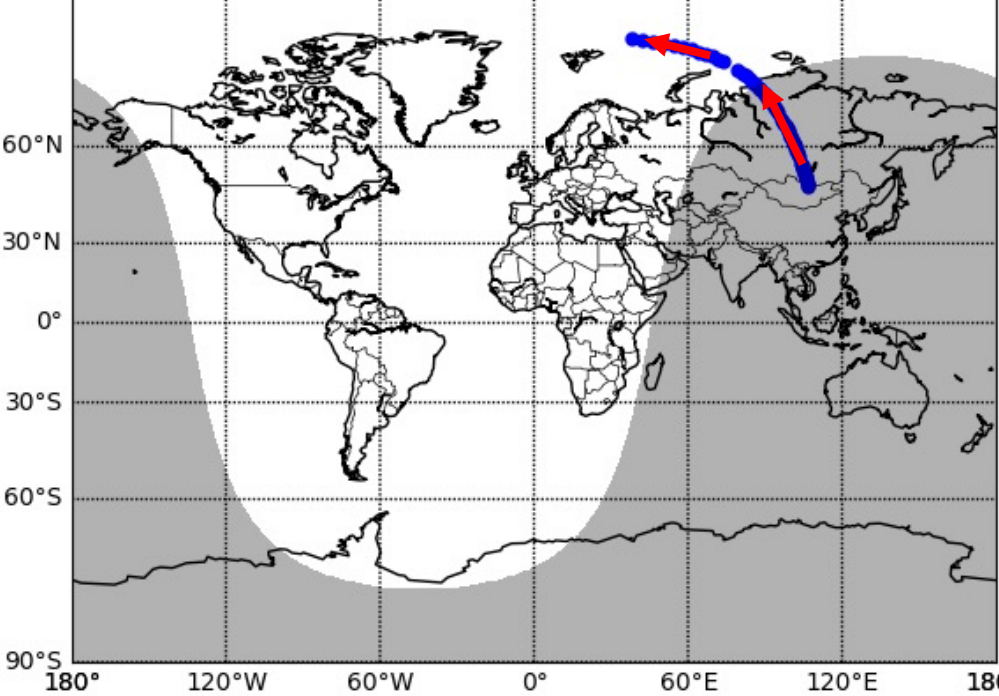
- Eclipse time: 2024.07.17 01:56:00 ~ 02:30:00 UTC
- KCP operation time: 2024.07.17 02:52:00~02:07:00 UTC

OBC OpMode: Safe = 1, IDLE = 2, Payload = 4
 Sun Sensor: 0~2500
 Date: 2024.07.17

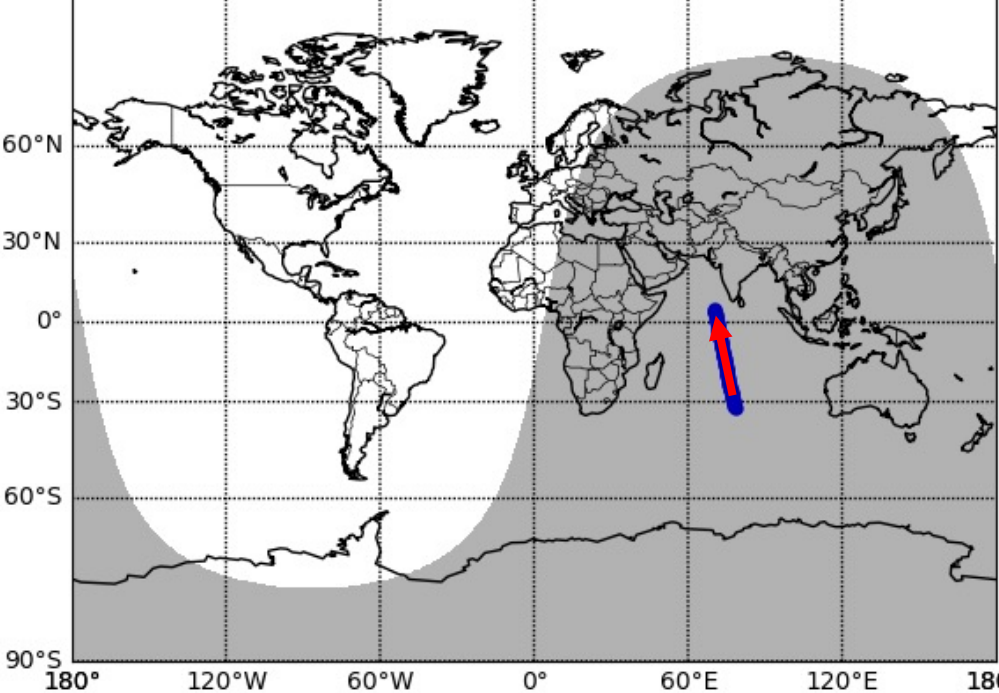


CIP Short-time Operation and Result

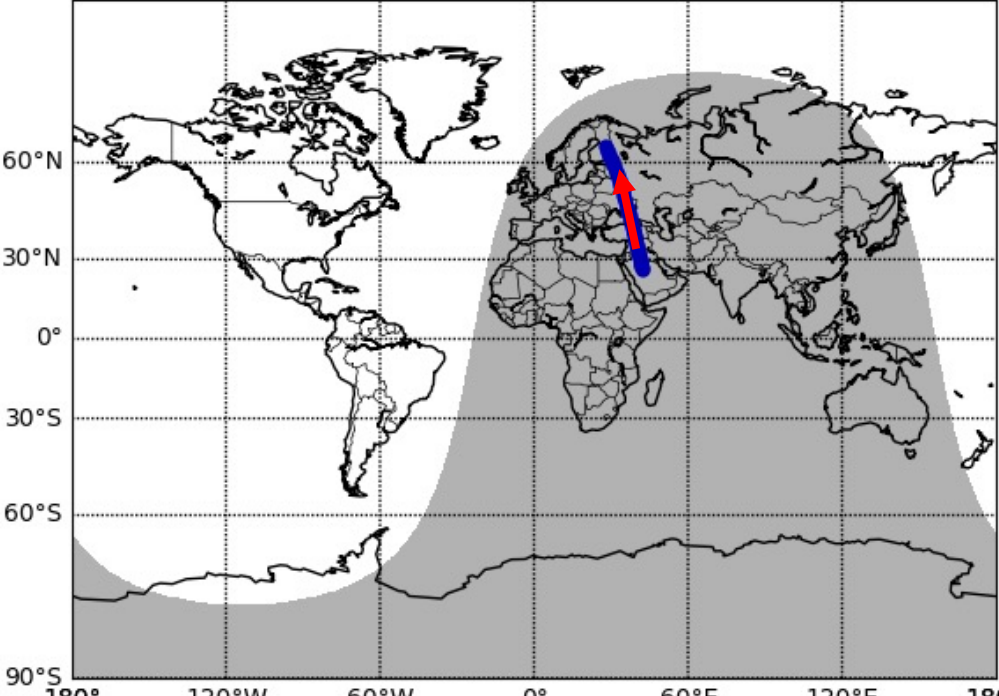
Satellite Track from 2024-04-16 14:50:45 to 2024-04-16 15:01:00



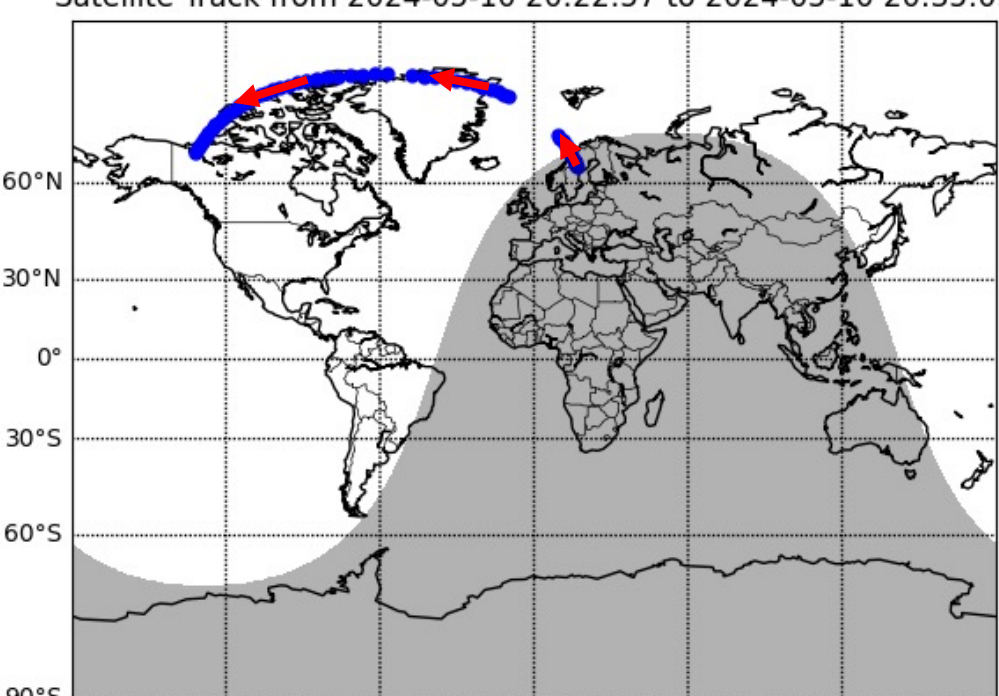
Satellite Track from 2024-04-16 17:38:50 to 2024-04-16 17:49:00



Satellite Track from 2024-04-16 19:29:15 to 2024-04-16 19:39:30

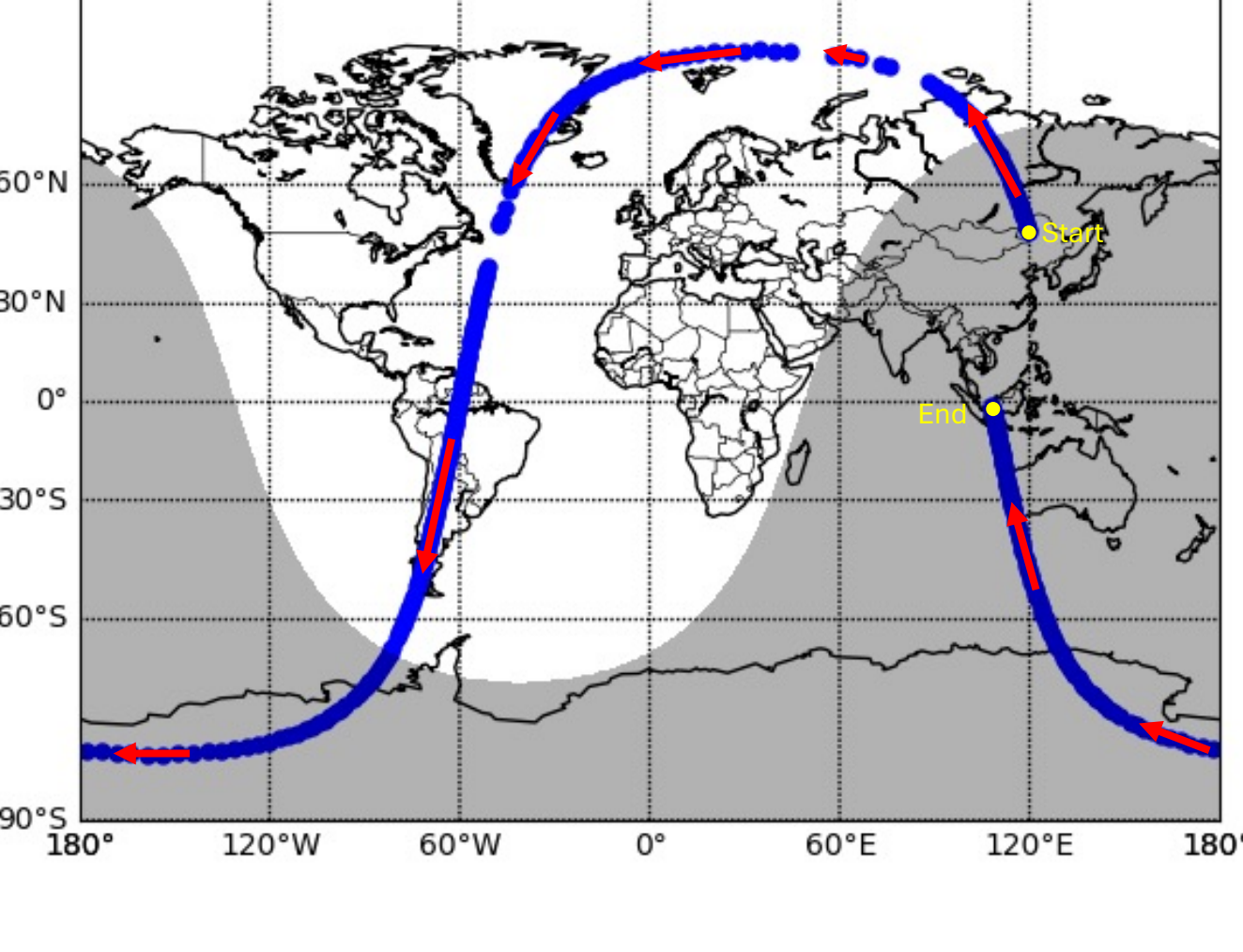


Satellite Track from 2024-05-10 20:22:57 to 2024-05-10 20:35:09

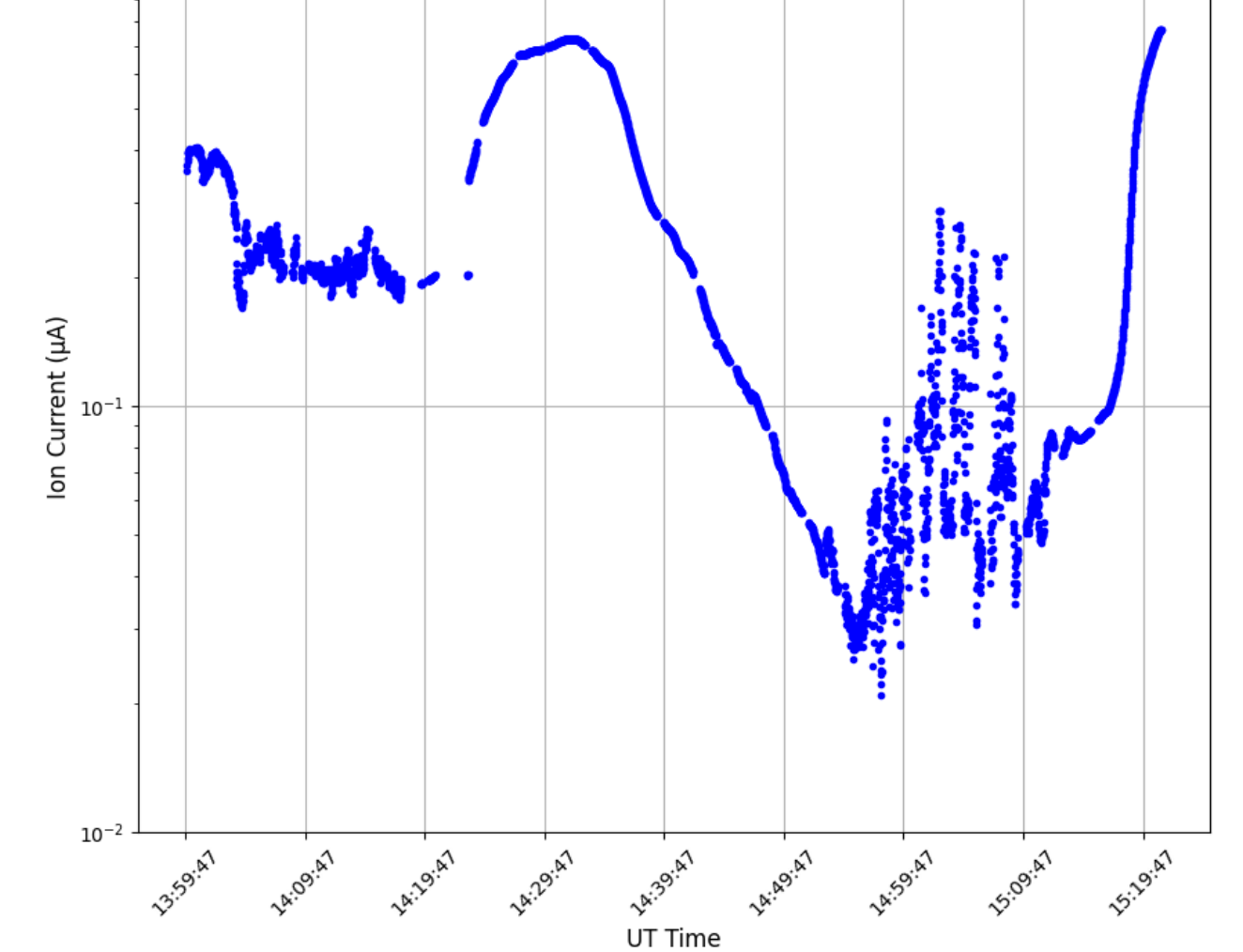


CIP Long-time Operation, Result and 3-Axis Control

Satellite Track from 2024-05-10 13:59:47 to 2024-05-10 15:21:19



PEARL-1C CIP Current, 2024/05/10 13:59:47 - 2024/05/10 15:21:19

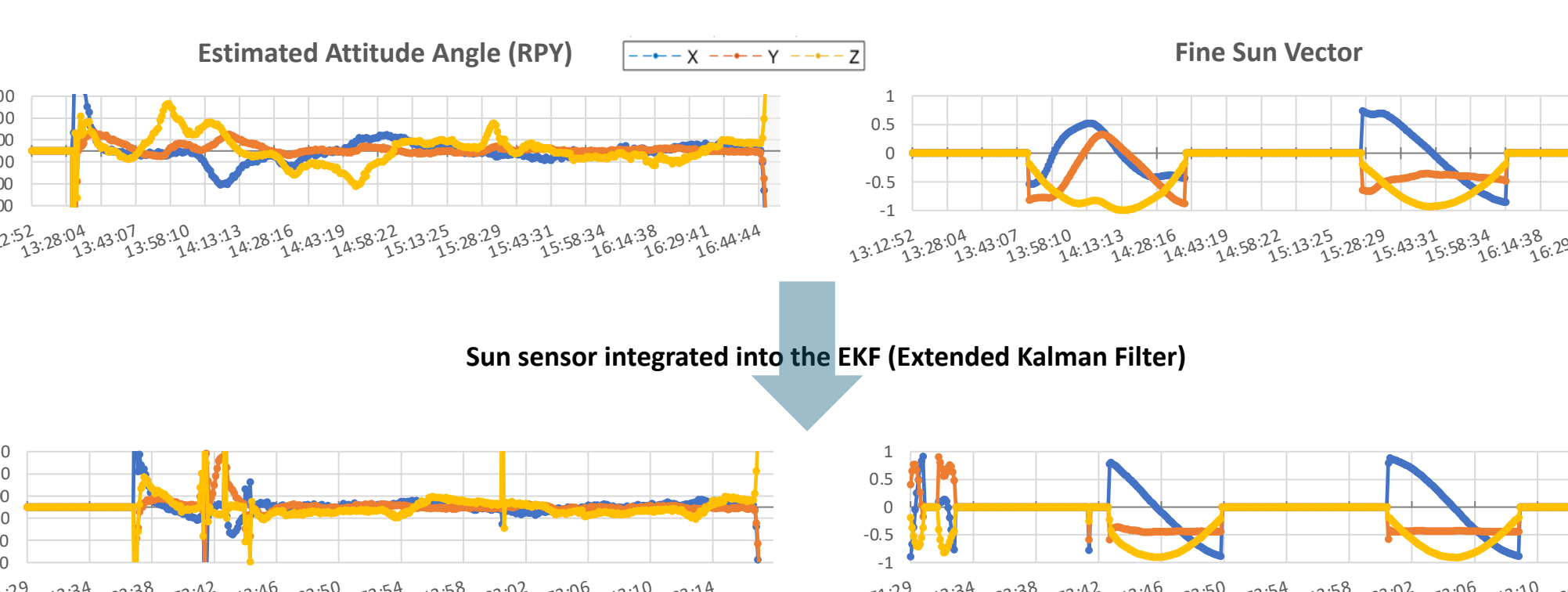


- Eclipse time: 2024.05.10 14:59:00~15:33:00 UTC
- CIP operation time: 2024.05.10 14:00:00~15:40:00 UTC

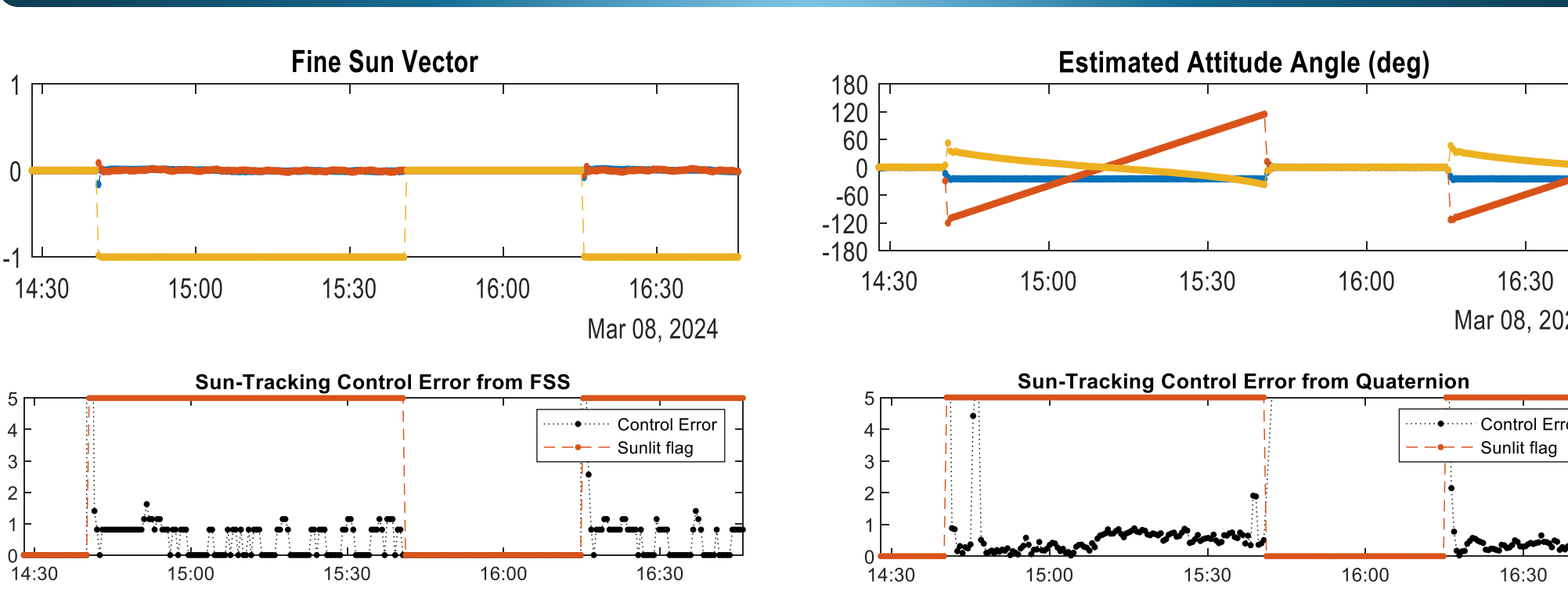
OBC OpMode: Safe = 1, IDLE = 2, Payload = 4
 Sun Sensor: 0~2500
 Date: 2024.05.10



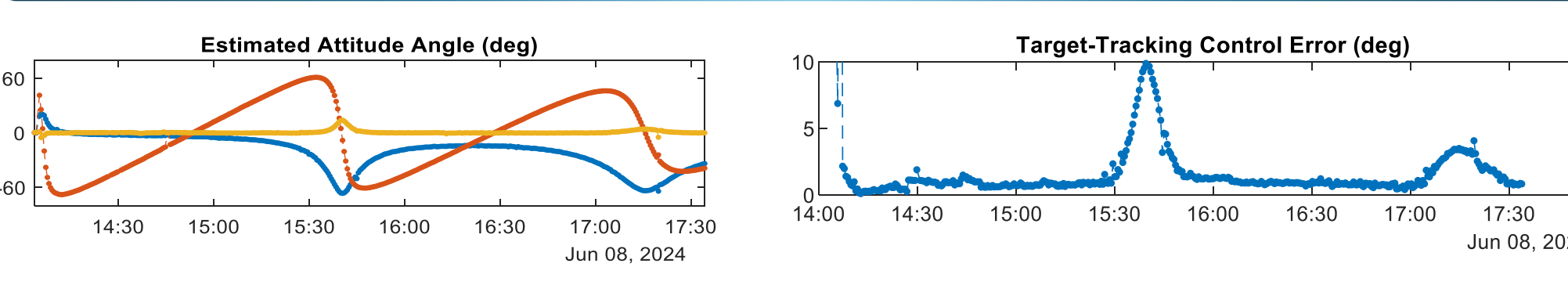
3-Axis Reaction Wheel and Sun/Nadir Sensor Commissioning



Sun Tracking and 3-Axis Control Analysis



Target Tracking Analysis



Solar Generating in Sun Tracking and 3-Axis Control

