Ocean Climate CubeSat Constellation (OCCC)

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Ocean climate

- 2 million casualties
  climate, weather, ar
- Climate is a comple
  → Atmosphere - Oce
  - More data
  - More accurate data

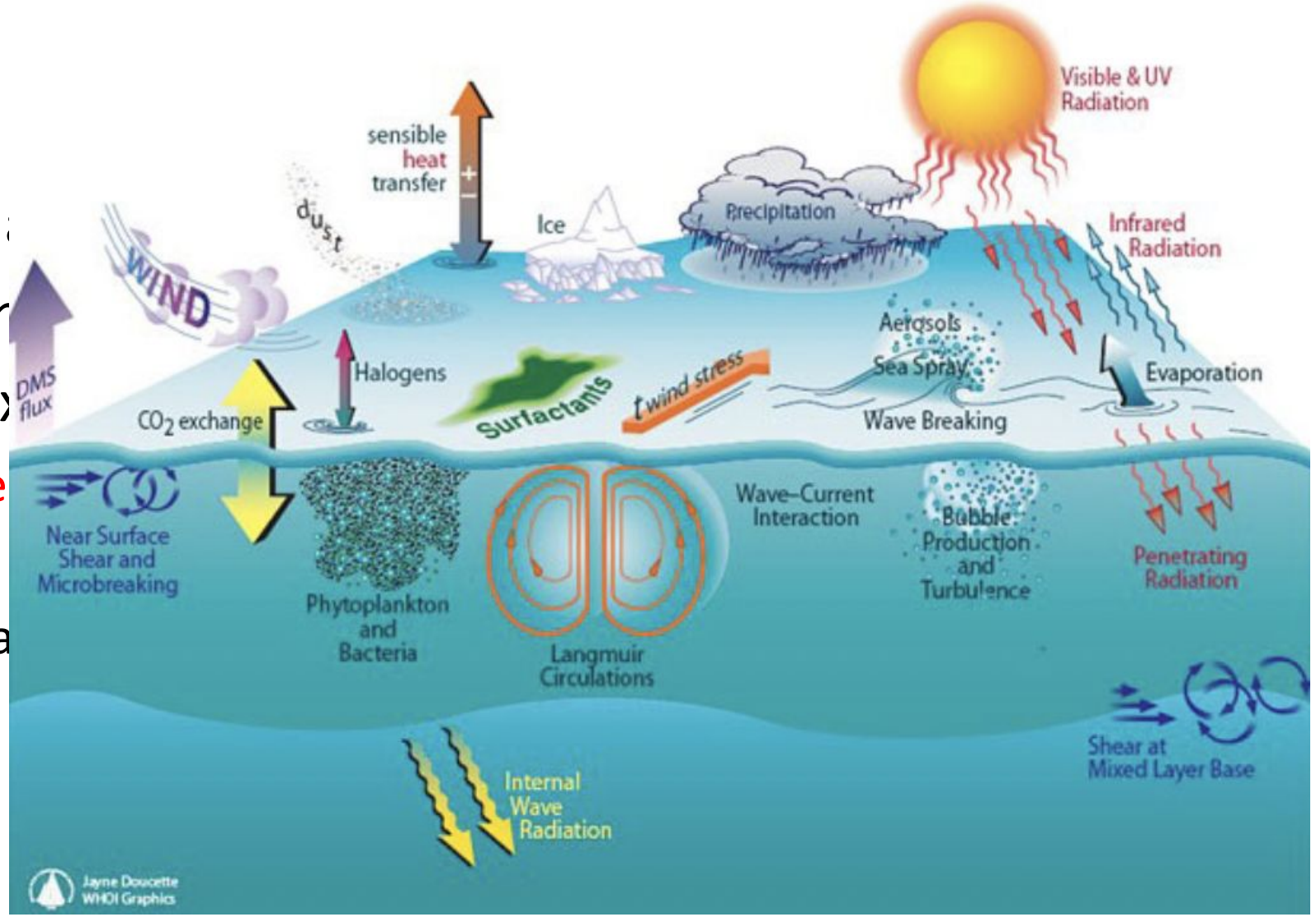


Fig. 1 Doucette, Jayne. "Processes operating at the air-sea interface" Copyright by Woods Hole Oceanographic Institution and WHOI, 2013.

Mission Objective

- Atmosphere-Ocean Climate Study
  - Physical coupling
- Natural Disasters
  - Tropical cyclone
  - Heat waves
- UN SDGs: 11, 13, 14

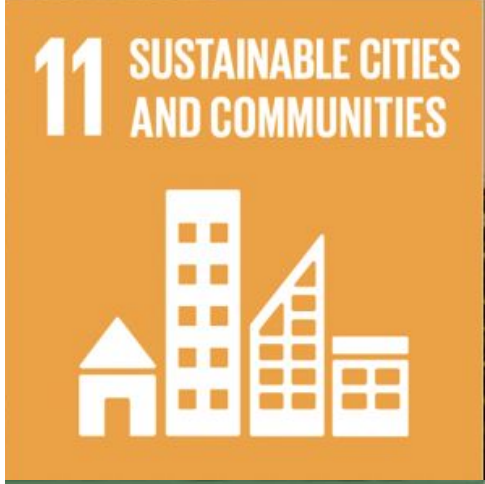


Fig 2. "Achieved UN SDGs"

Concept of Operations

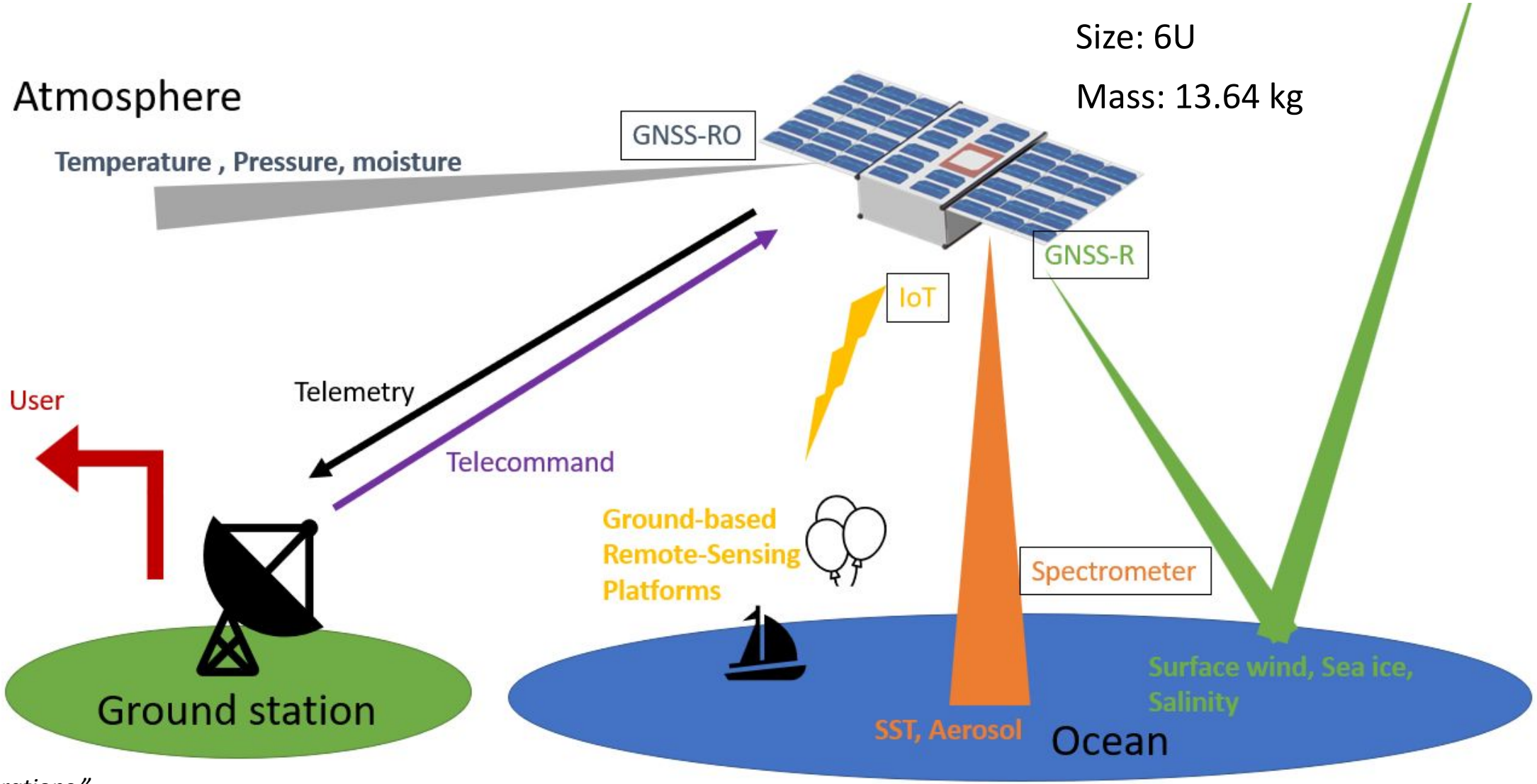


Fig 3. "Concept of operations."

GNSS-R Payload

- Global Navigation Satellite System - Reflectometry (GNSS-R)
- Retrieves:
  - Sea wind speed
  - Sea surface height
  - Sea ice
  - Sea salinity
- Requirements:
  - 13 dBi nadir LHCP L-band antennas
  - L-band radiometers

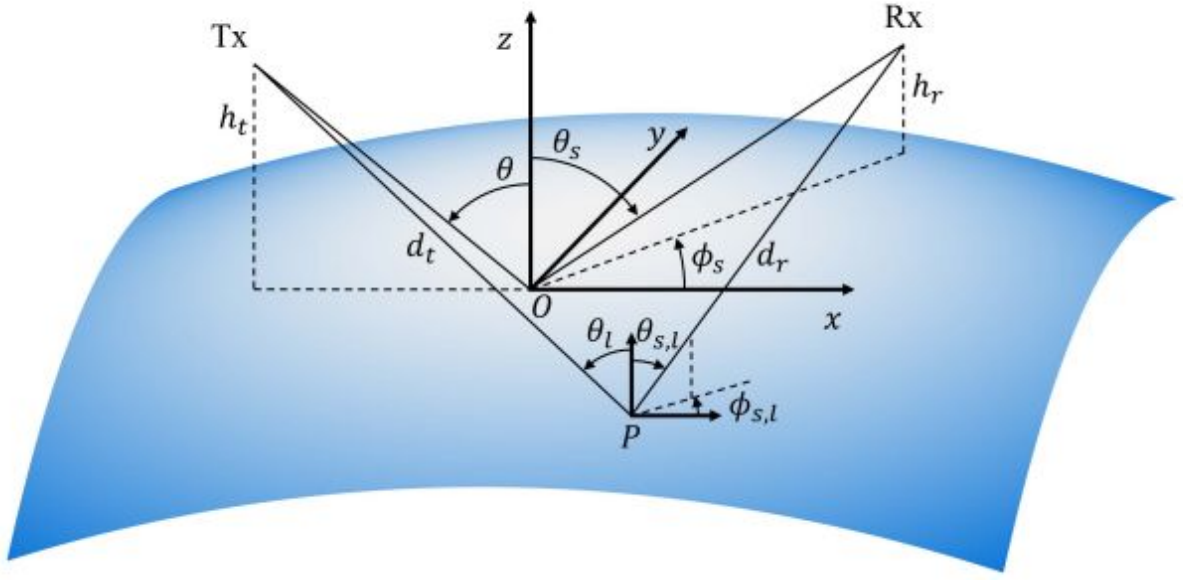


Fig 4. Di Martino, Gerardo, et al. "Scattering geometry and reference system. " Copyright by Remote Sensing, vol. 14, no. 3, Jan. 2022, p. 520. Crossref.

GNSS-RO Payload

- Global Navigation Satellite System - Radio Occultation (GNSS-RO)
- Descending RO
- Retrieves: vertical profile of temperature, pressure, and moisture of the atmosphere.
- Requirements:
  - L1 and L2 dual-bands
  - high gain antennas (12.5 dBi)
  - reliable clock source
  - compute modules

Spectrometer

- Visible and InfraRed Radiometer (VIRR)
- Contrastive calculation of cloud and ocean sensitivities using visible and near-infrared channels

1	Sea Surface Temperature	Multi-Channel SST (MCSST)
2	Ocean Aerosol	The Aerosol AOD wavelength coefficient algorithm
3	Cloud Detection	Temperature difference between each band

Table 1. "Spectrometer parameters, the observation wavelength, and the algorithms."

Internet of Things (IoT)

Long Range (LoRa) Technology

- Long range
- Low power
- An-ti Doppler (Chirp Spread Spectrum, CSS)

Sensor Network

- Sounding balloons (atmosphere)
- Buoys (ocean)

Atmosphere

Ocean

Fig 5, "IoT sensor platforms."

Key Performance Parameters

- Spatial resolution: 1 km
- Time resolution: a temporal resolution better than 12 hours
- Global ocean coverage: 1 day
- Mission Lifetime: 6 years (1 year of calibration + 5 years of operation)

Orbit

- 4 orbit planes

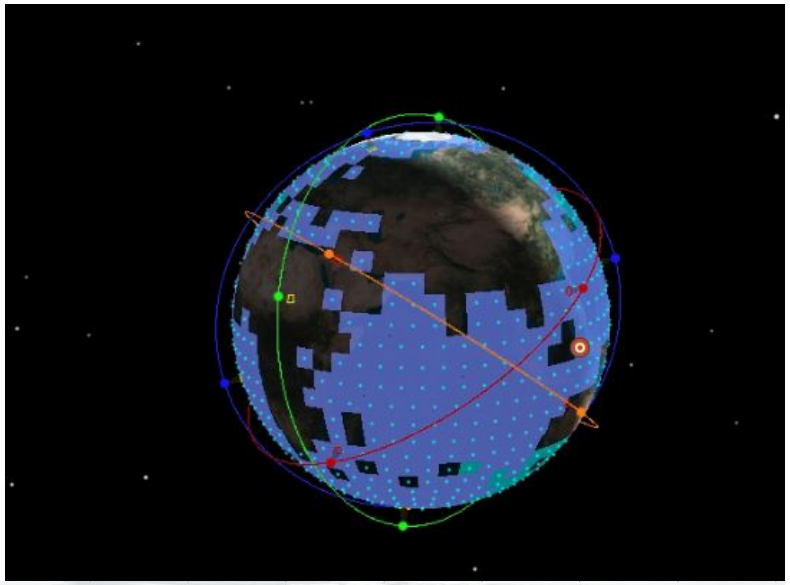
  ∵ hard to change RAAN, change orbit less

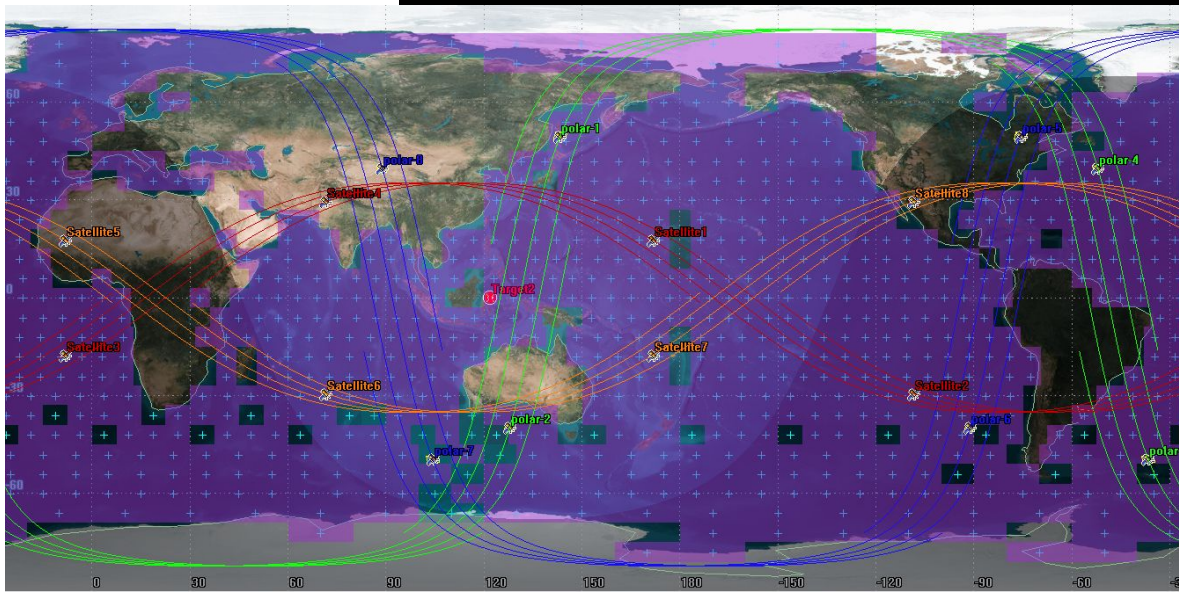
- 2 polar + 2 low inclination (35^0)

  ∵ where tropical cyclones occur

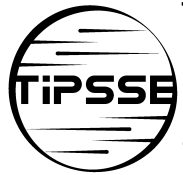
- Height: 575 km
- Global ocean coverage: 1 day

Fig 6. "Orbit of OCCC"





Implementation Plan



Taiwan Institute of Planetary Science and System Engineering (TIPSSE)

Project Management
TIPSSE

System Engineering
TIPSSE

Data Processing
NCU
NSPO
NCKU
NTU
NCHU
CWB
SWCB

Ground Stations
NCKU
NCU
NSPO

CubeSat

Bus
Babui - Aerospace team

Payload

GNSS R
Babui-Aerospace team

IoT
NCKU
Babui - Aerospace team

Sounding Balloons
NCKU
NCU
NTU

Buoys
NCU
Academia Sinica IES

GNSS RO
NCKU

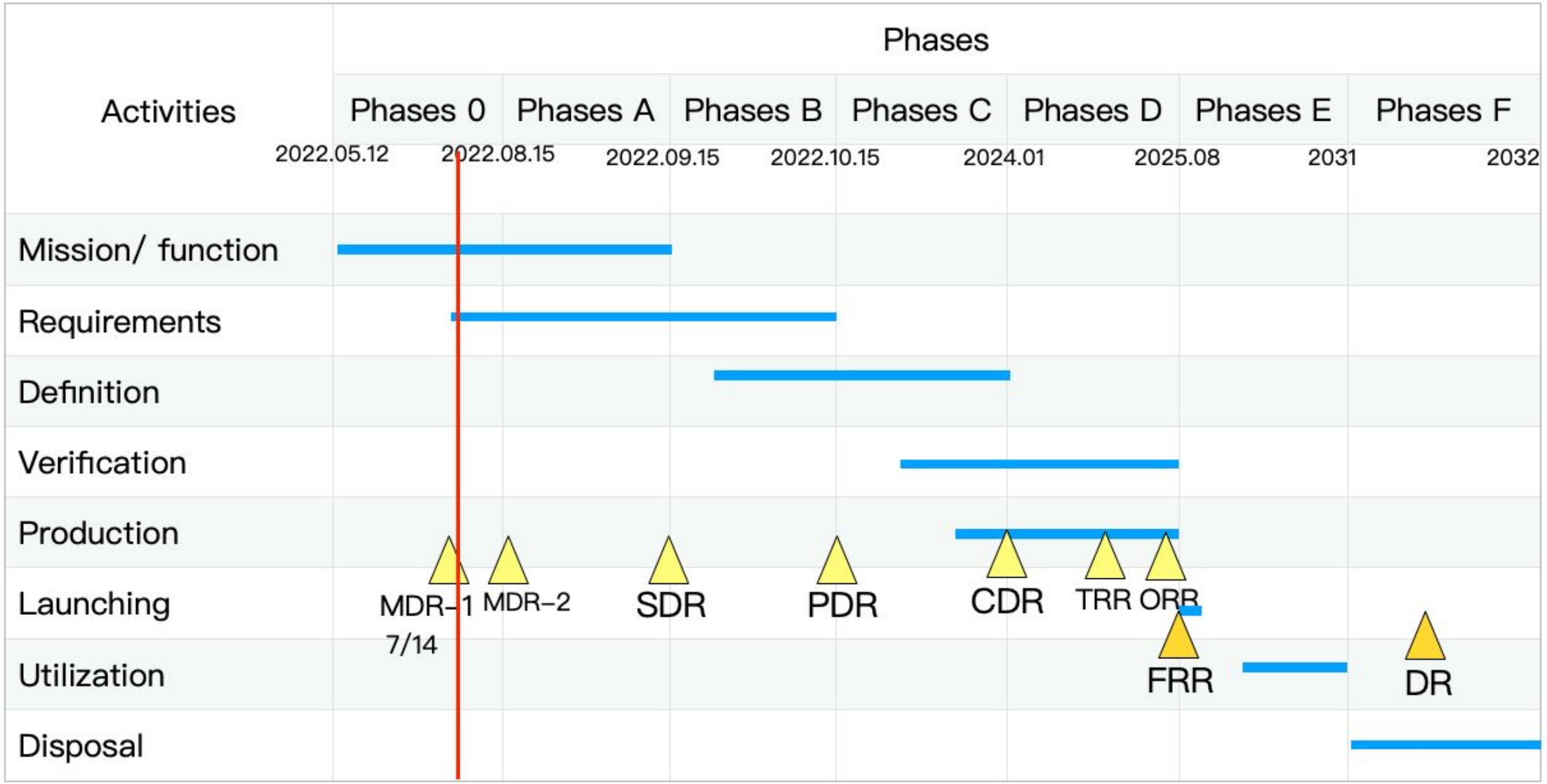
Spectrometer
NCKU

Budget

Procedure	Approximate cost (USD)
Unit Budget	1,289,400
Integration & Assembly	230,000
Testing	189,000
Launching	1,400,000
Total	3,241,400

Subsystem	Mass	Power	Price
Payload	19%	18%	24%
SMS	23%	0%	22%
TCS	2%	0%	1%
EPS	21%	5%	24%
OBDH	5%	4%	2%
AOCS	25%	36%	19%
TT&C	3%	36%	8%
Total	13.64kg	55W	$ 1,289,400.00

Schedule


Activities
Phases
Phases 0
Phases A
Phases B
Phases C
Phases D
Phases E
Phases F
2022.05.12
2022.08.15
2022.09.15
2022.10.15
2024.01
2025.08
2031
2032
Mission/ function
Requirements
Definition
Verification
Production
Launching
Utilization
Disposal
MDR-1
7/14
MDR-2
SDR
PDR
CDR
TRR
ORR
FRR
DR

Thank you!