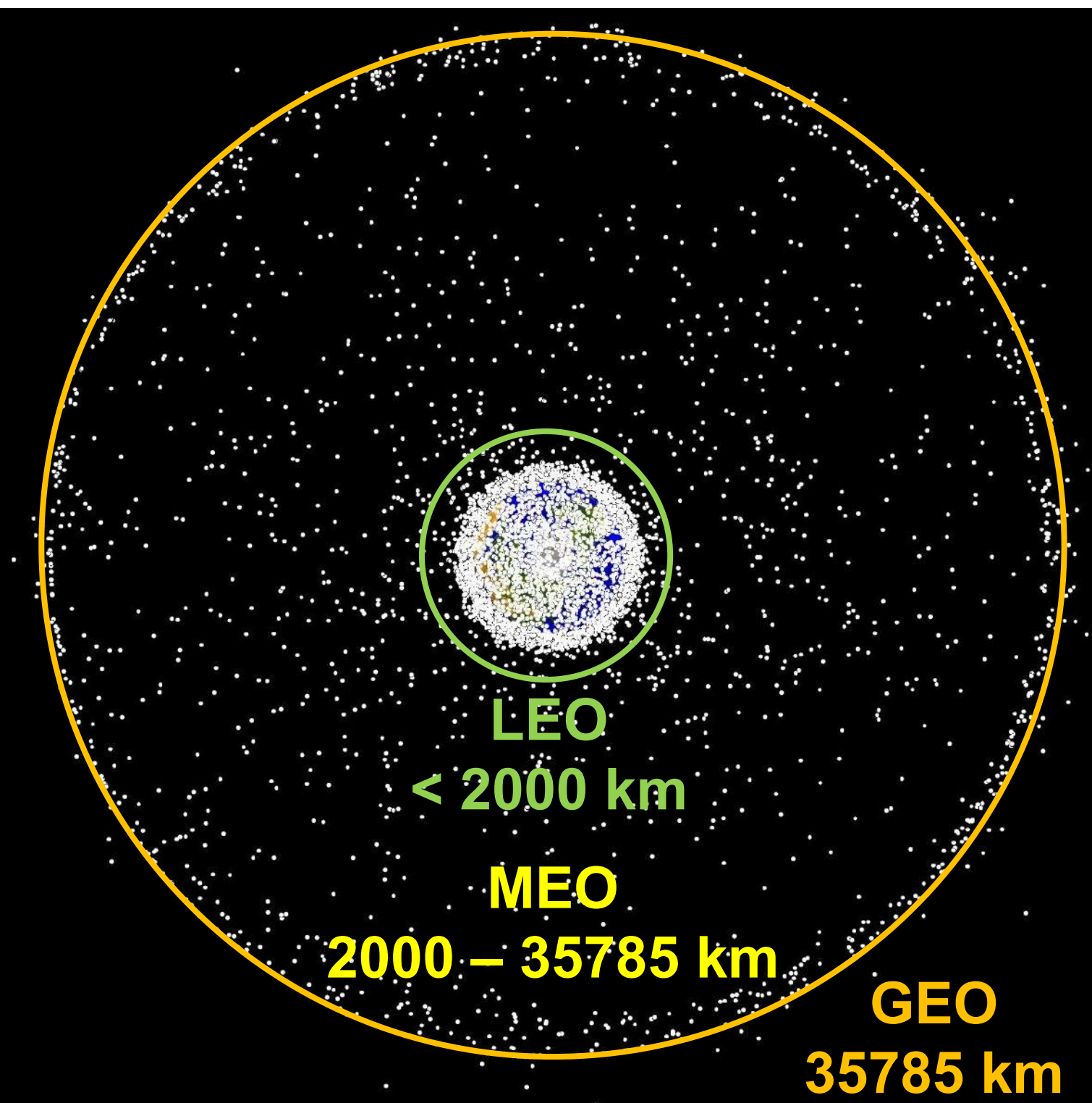


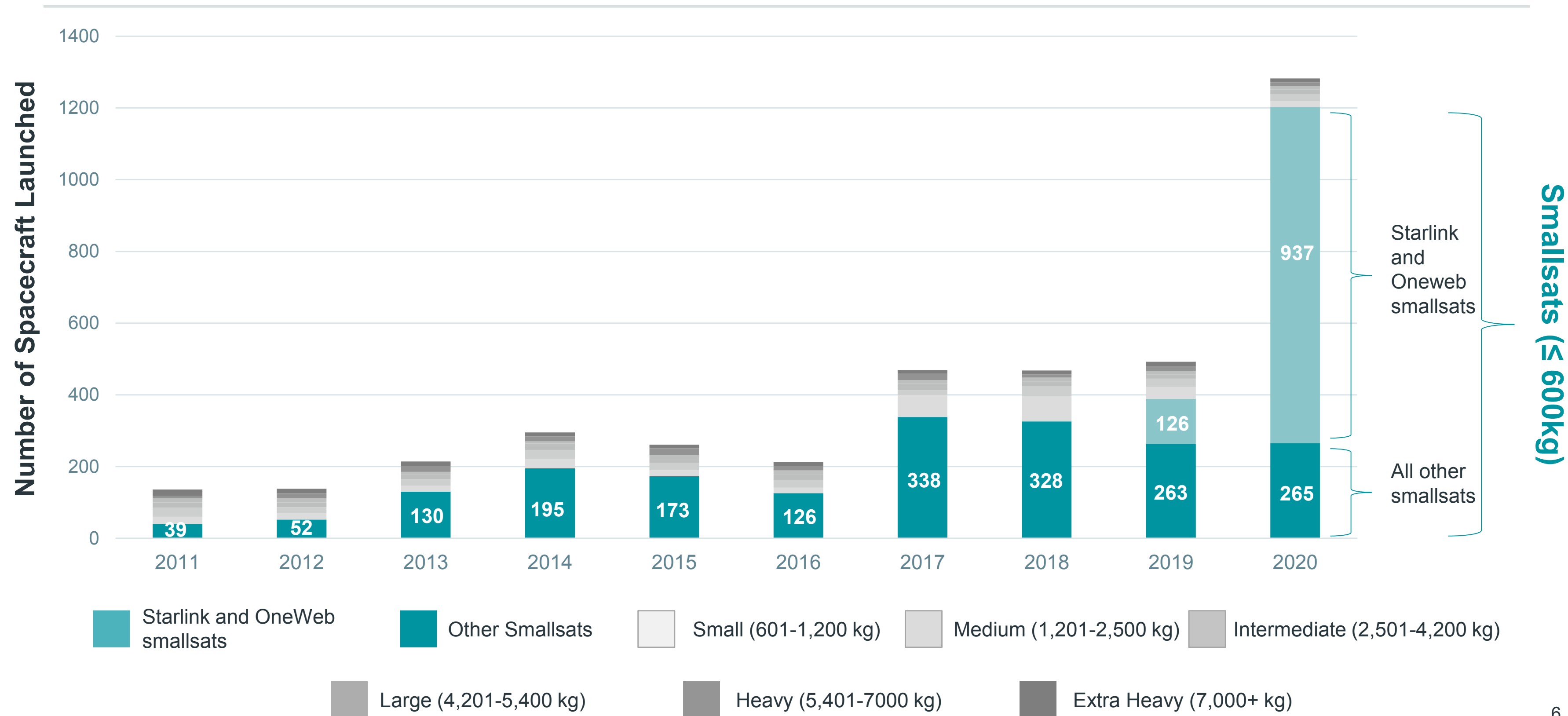
Development and Operational Experience from IDEASSat and Lessons Learned

國立中央大學 太空科學與工程學系
張起維 教授



Active Satellites: 4084 (2021/04/30)

Source: Bryce Tech



Increasing utilization of space using small satellites.

Satellite Sizes (US Federal Aviation Administration)

Extra Heavy
> 7000 kg

Heavy
5400 - 7000 kg

Large
4200 - 5400 kg

小型衛星
Smallsats

Himawari 8, 3500 kg



Intermediate satellite
2500 - 4200 kg

NOAA-19, 1440 kg



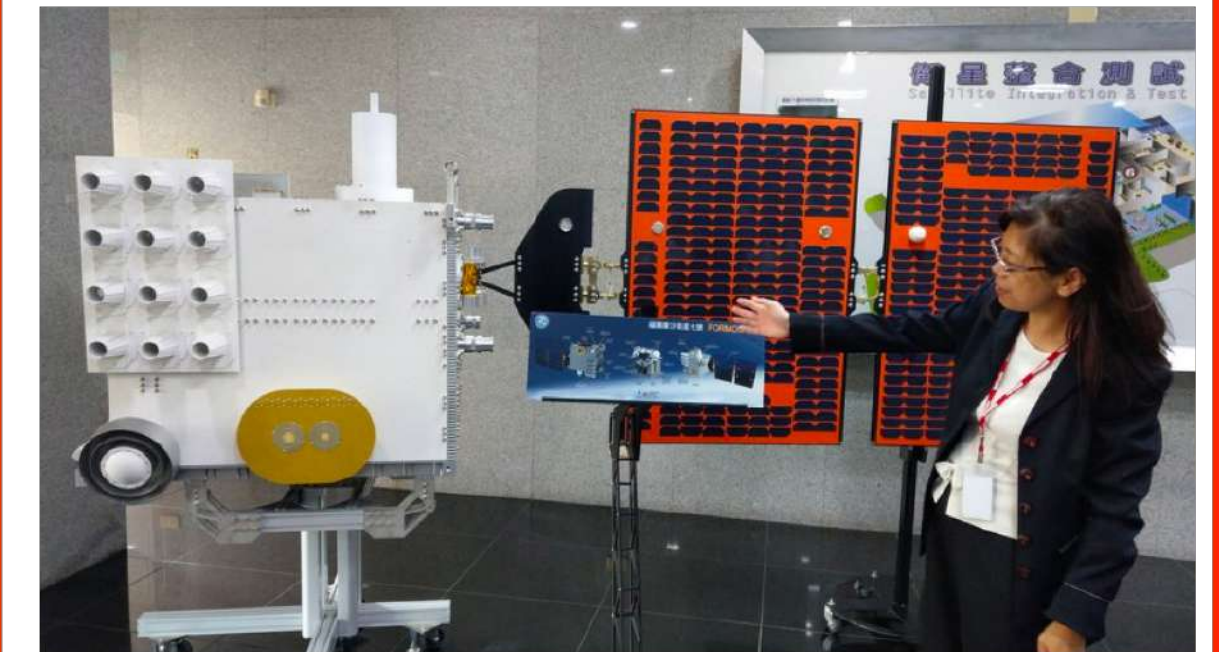
Medium satellite
1200 - 2500 kg

FORMOSAT-2, 768 kg



Small satellite
600 - 1200 kg

FORMOSAT-7, 300 kg



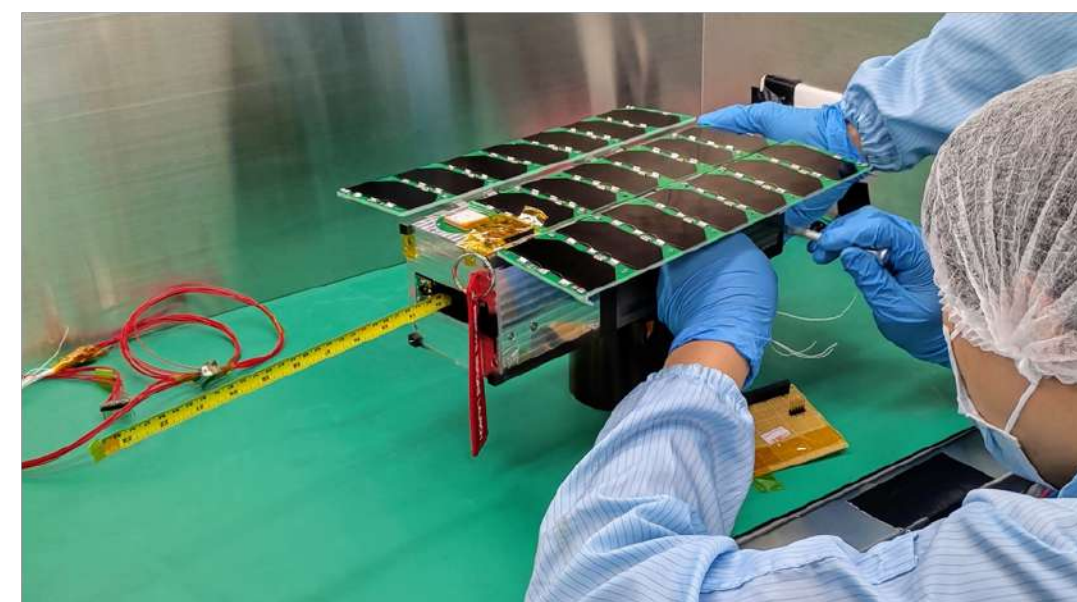
Minisatellite
200 - 600 kg

FORMOSAT-3, 62 kg



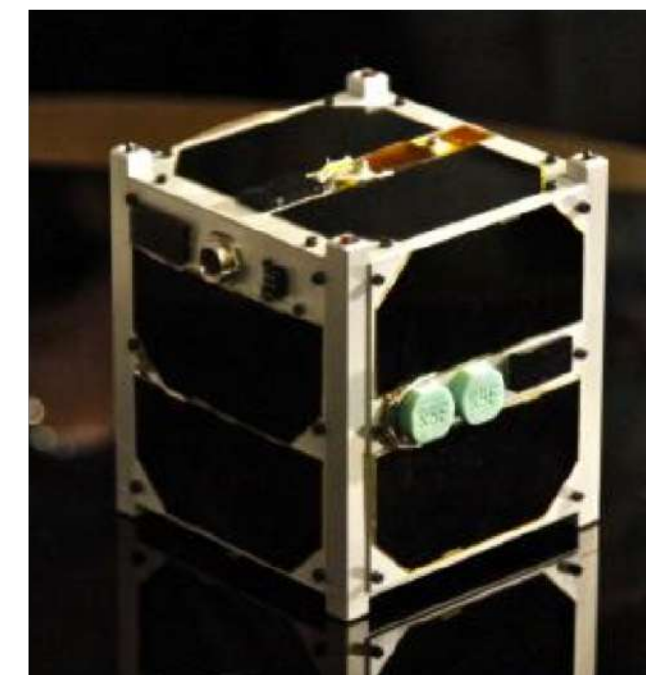
Microsatellite
10 - 200 kg

IDEASSat, 4.5 kg



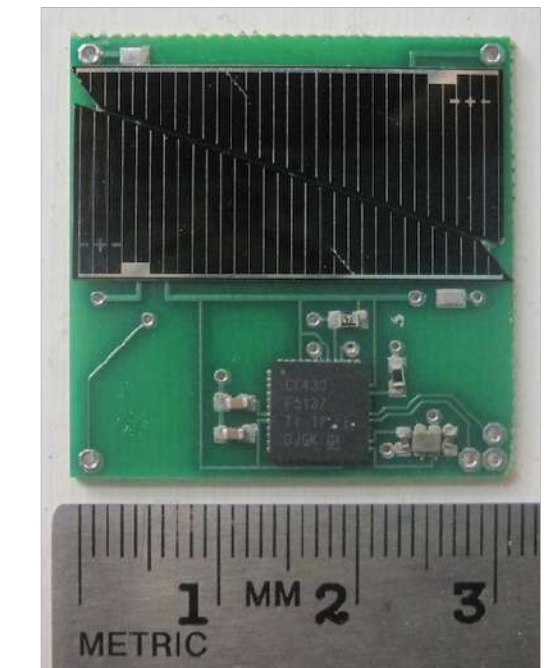
Nanosatellite
1 - 10 kg

ESTCube, 1.05 kg



Picosatellite
0.1 - 1 kg

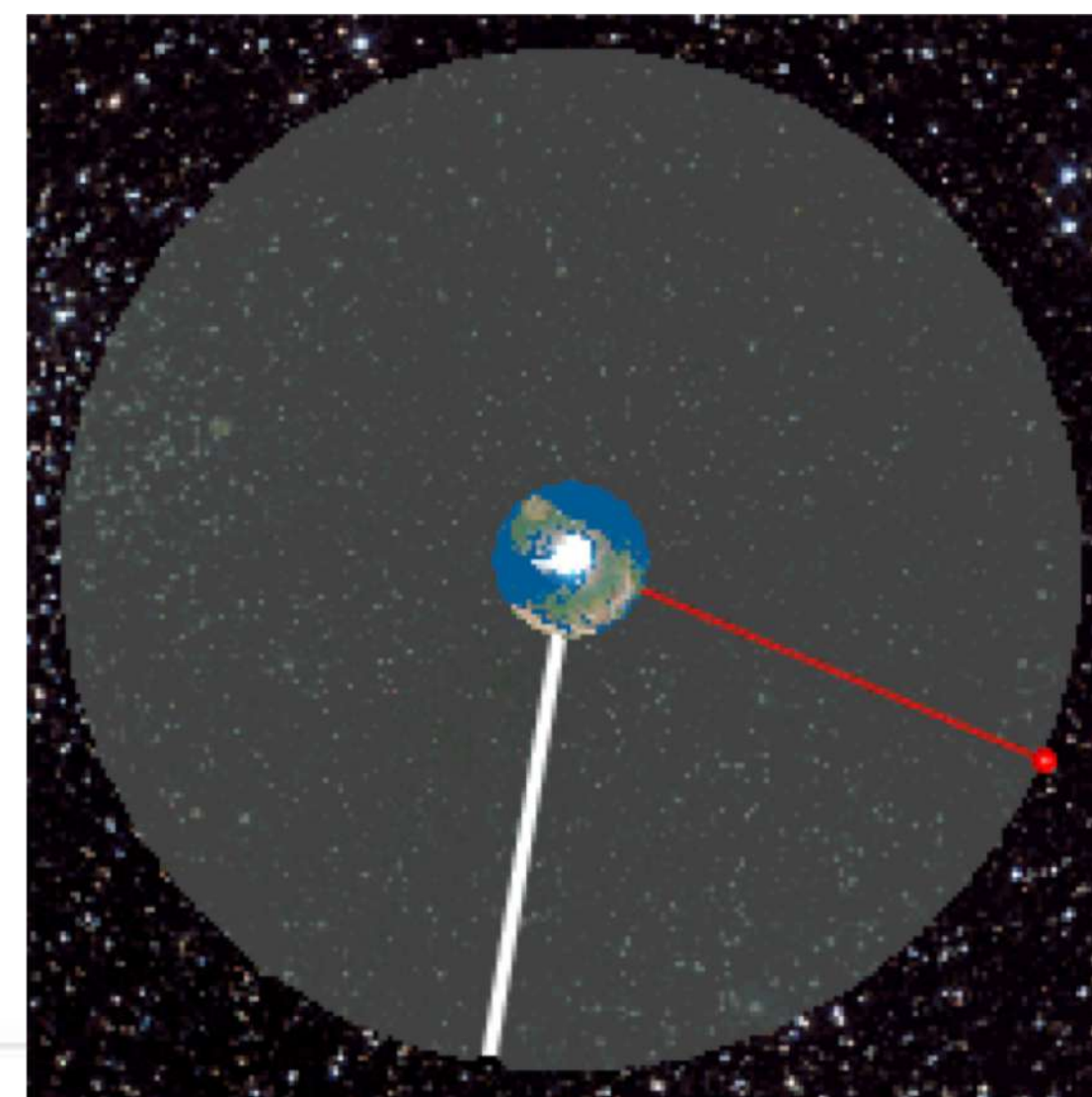
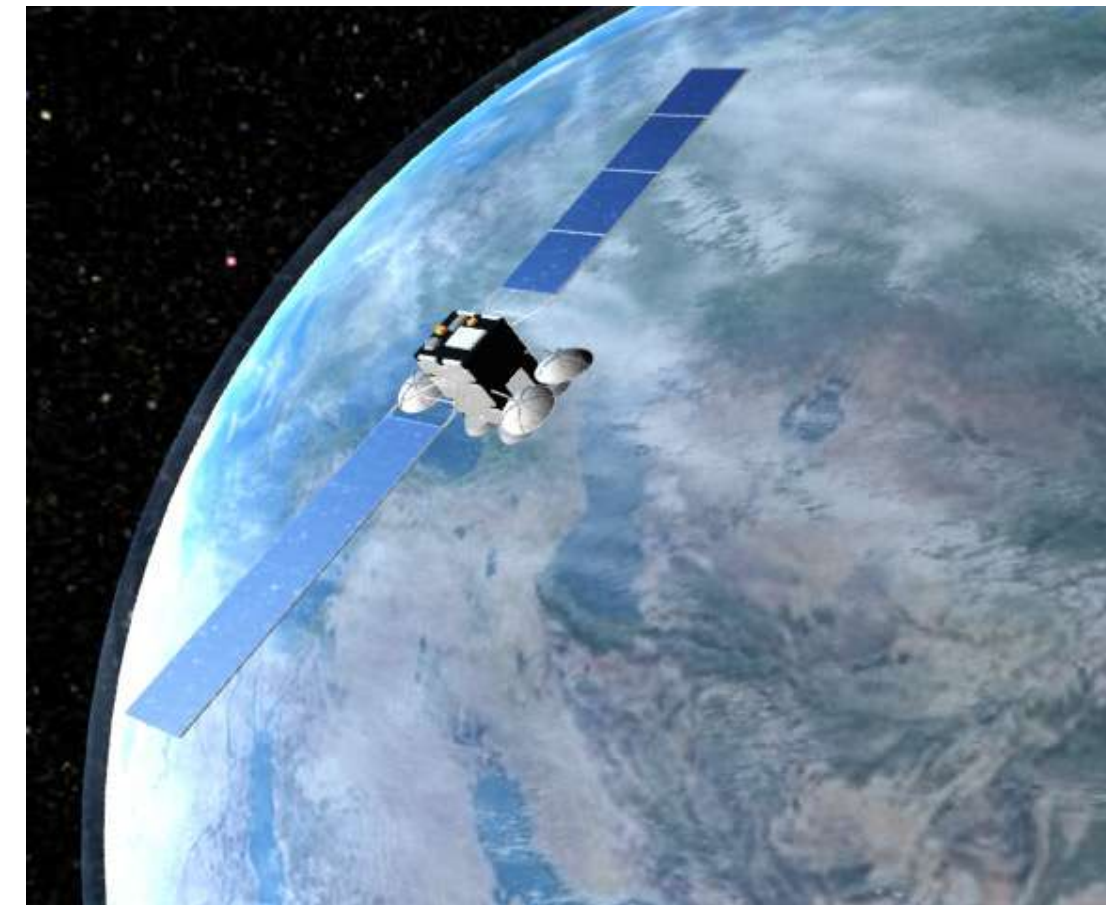
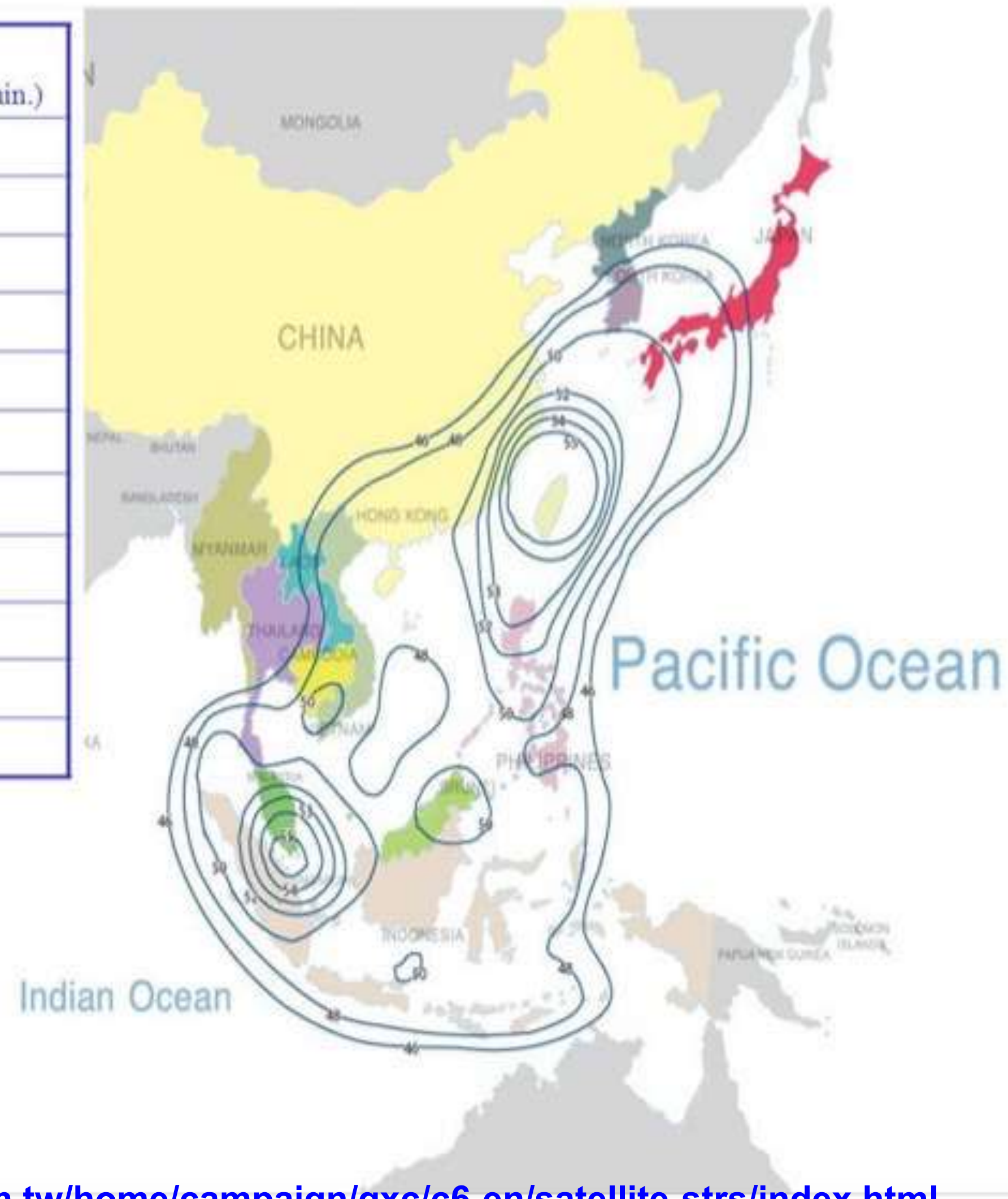
Sprite, 10 g



Femtosatellite
< 0.1 kg

Geostationary Satellite: ST-2 (中新2號)

ST-2 K1 Band	EIRP (dBW, min.)	G/T (dB/K, min.)
台北	56.3	8.7
高雄	55.6	9.0
上海	51.5	3.7
福州	55.1	7.6
香港	51.3	3.7
金邊	50.6	1.7
胡志明市	50.3	3.1
馬尼拉	51.0	3.3
雅加達	50.3	3.9
新加坡	55.6	7.7
Peak	56.4	9.4



Mass: 5090 kg
Lifetime: 15 years
Orbit: 35785 km
Geostationary

中華電信：<https://www.cht.com.tw/home/campaign/gxc/c6-en/satellite-strs/index.html>

Standardization



SEA CONTAINER SPECIFICATIONS

DRY CARGO CONTAINERS



• DIMENSIONS

Type	Container Weight			Interior Measurement				Door Open	
	Gross (kg)	Tare (kg)	Net (kg)	Length (m)	Width (m)	Height (m)	Capacity (m ³)	Width (m)	Height (m)
20 ft	24,000	2,370	21,630	5.898	2.352	2.394	33.20	2.343	2.280
40 ft	30,480	4,000	26,480	12.031	2.352	2.394	67.74	2.343	2.280

• CHARACTERISTICS

Manufactured from either Aluminium or steel, they are suitable for most types of cargo / general cargo. Aluminium containers have a slightly larger payload than steel, and steel containers have a slightly larger internal cube.

REFRIGERATED CONTAINERS



• DIMENSIONS

Type	Container Weight			Interior Measurement				Door Open	
	Gross (kg)	Tare (kg)	Net (kg)	Length (m)	Width (m)	Height (m)	Capacity (m ³)	Width (m)	Height (m)
20 ft	24,000	3,050	20,950	5.449	2.290	2.244	26.70	2.276	2.261
40 ft	30,480	4,520	25,960	11.690	2.250	2.247	57.10	2.280	2.205

• CHARACTERISTICS

Recommended for delicate cargo. Bottom-air delivery system ensures refrigerated cargo reaches its destination in optimum condition.

OPEN TOP CONTAINERS



• DIMENSIONS

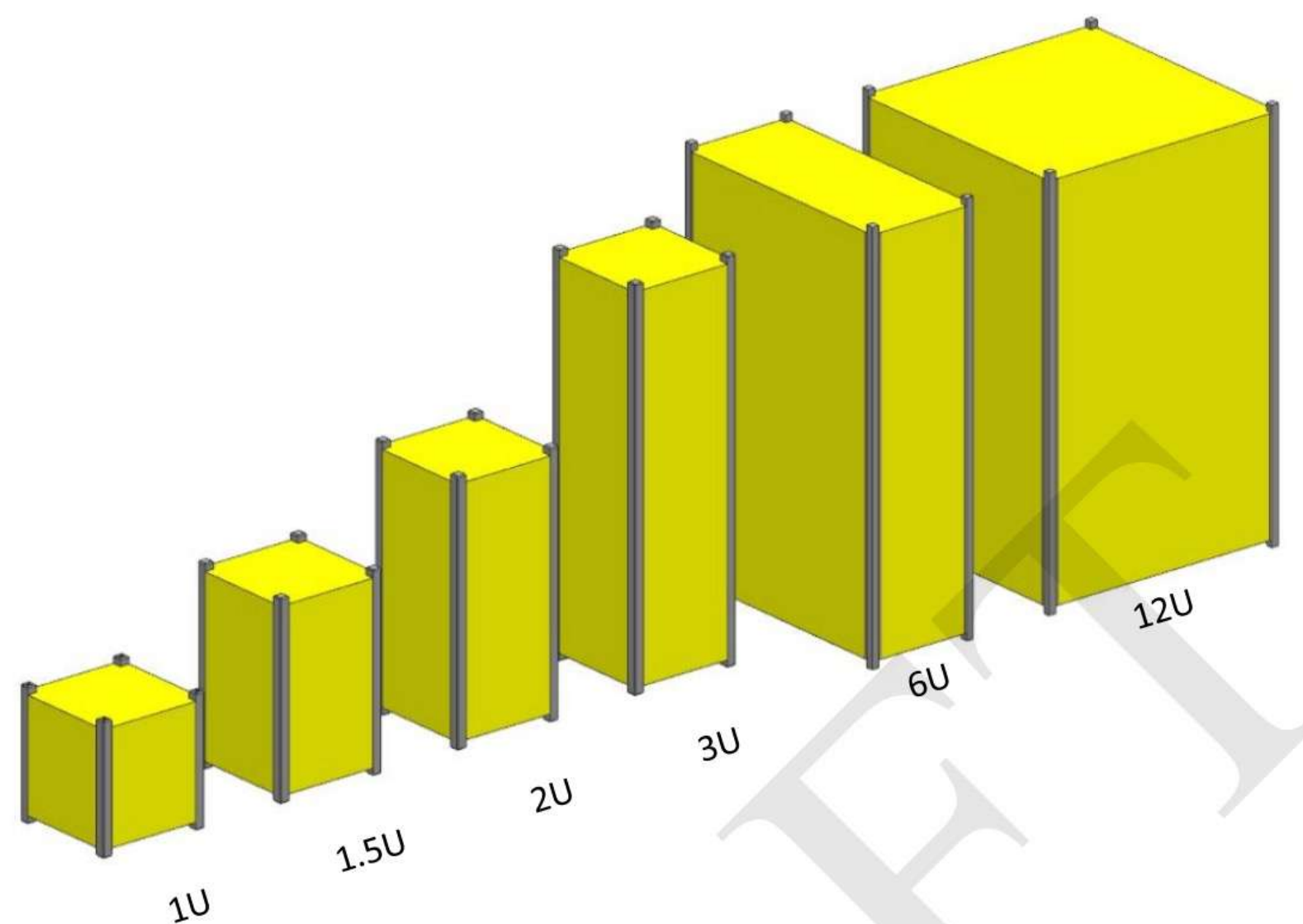
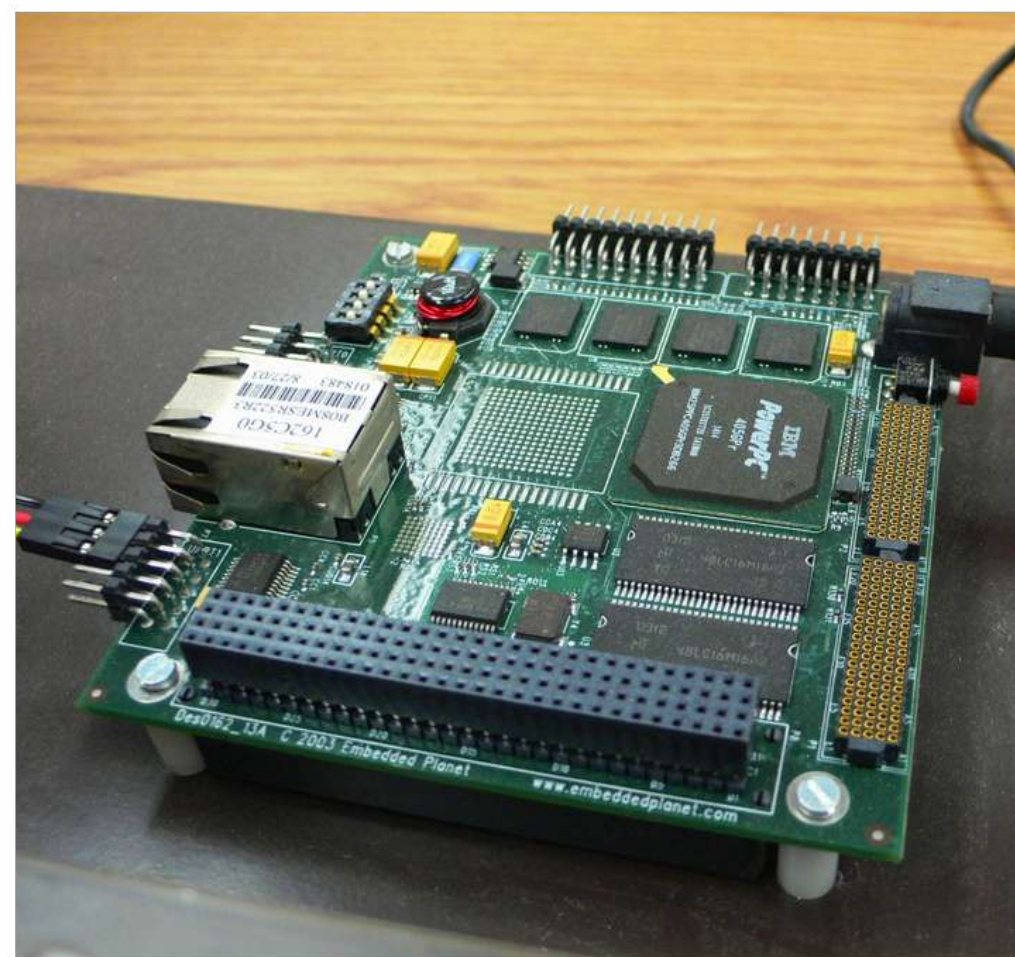
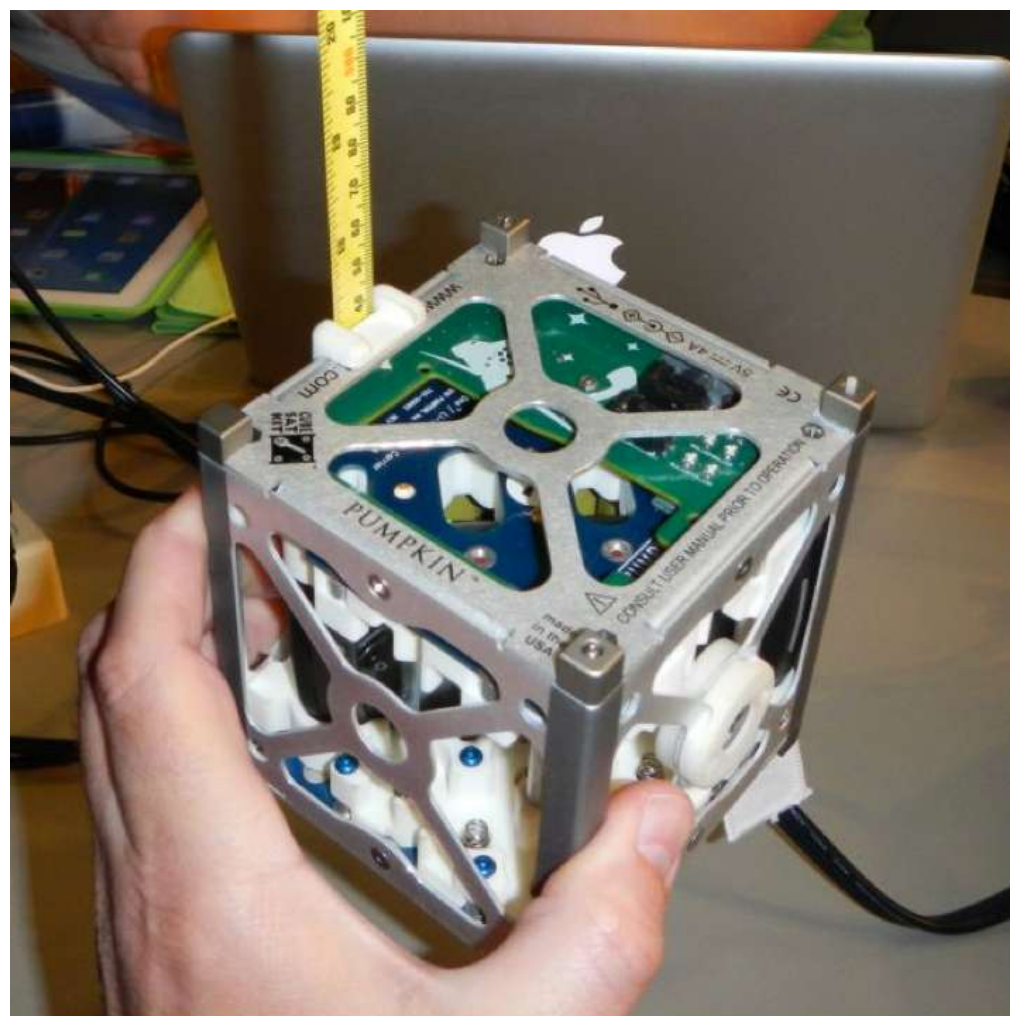
Type	Container Weight			Interior Measurement				Door Open	
	Gross (kg)	Tare (kg)	Net (kg)	Length (m)	Width (m)	Height (m)	Capacity (m ³)	Width (m)	Height (m)
20 ft	24,000	2,580	21,420	5.629	2.212	2.311	32.00	2.330	2.263
40 ft	30,480	4,290	26,190	11.763	2.212	2.311	65.40	2.330	2.263

• CHARACTERISTICS

Allowing cargo to be loaded from the top, open top containers are particularly suitable for bulky cargo such as machinery. They are fitted with a PVC tarpaulin cover and attachable bows with cable sealing devices. The container doors can be removed to make the stuffing of cargo more convenient. Manufactured from steel.

Significant reductions in time and cost of shipping through use of standardized containers.

CubeSats (立方衛星)



- Proposed in 1999 by Bob Twiggs (Stanford) and Jordi Puig-Suari (CalPoly) for use in science and engineering education.
- Commercial grade hardware in PC-104 form factor.
- 1U = 10 x 10 x 10 cm
- Users: Universities, Commercial, Government.
- Fast development time. CubeSat Design Specification 由CalPoly (加州理工州立大學)定義、維護：
<https://www.cubesat.org/cubesatinfo>

Trends: COTS Spacecraft, Complete Solution



Customer

Spacecraft Service Provider

Customer

Payload
Mission Concept

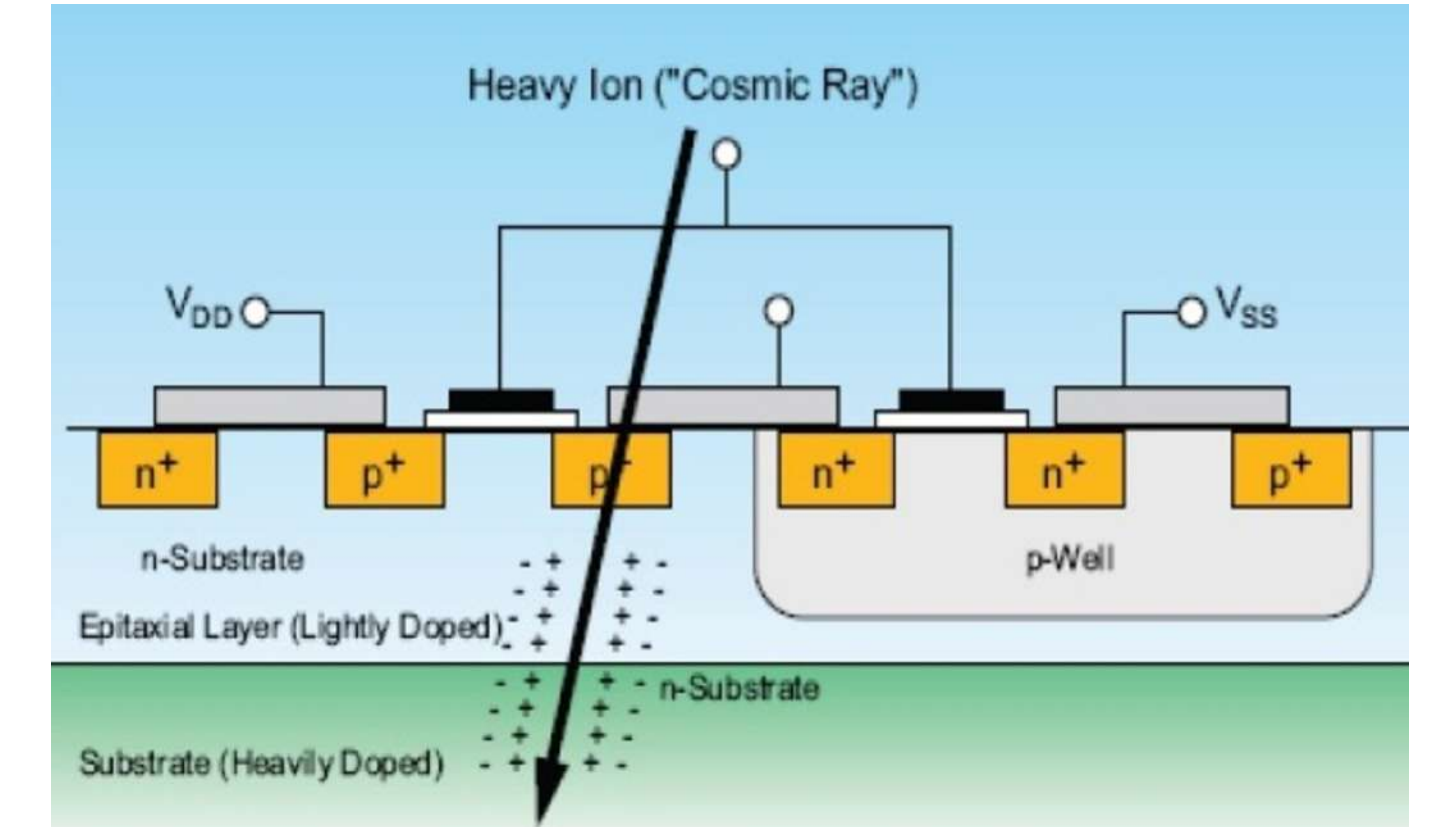
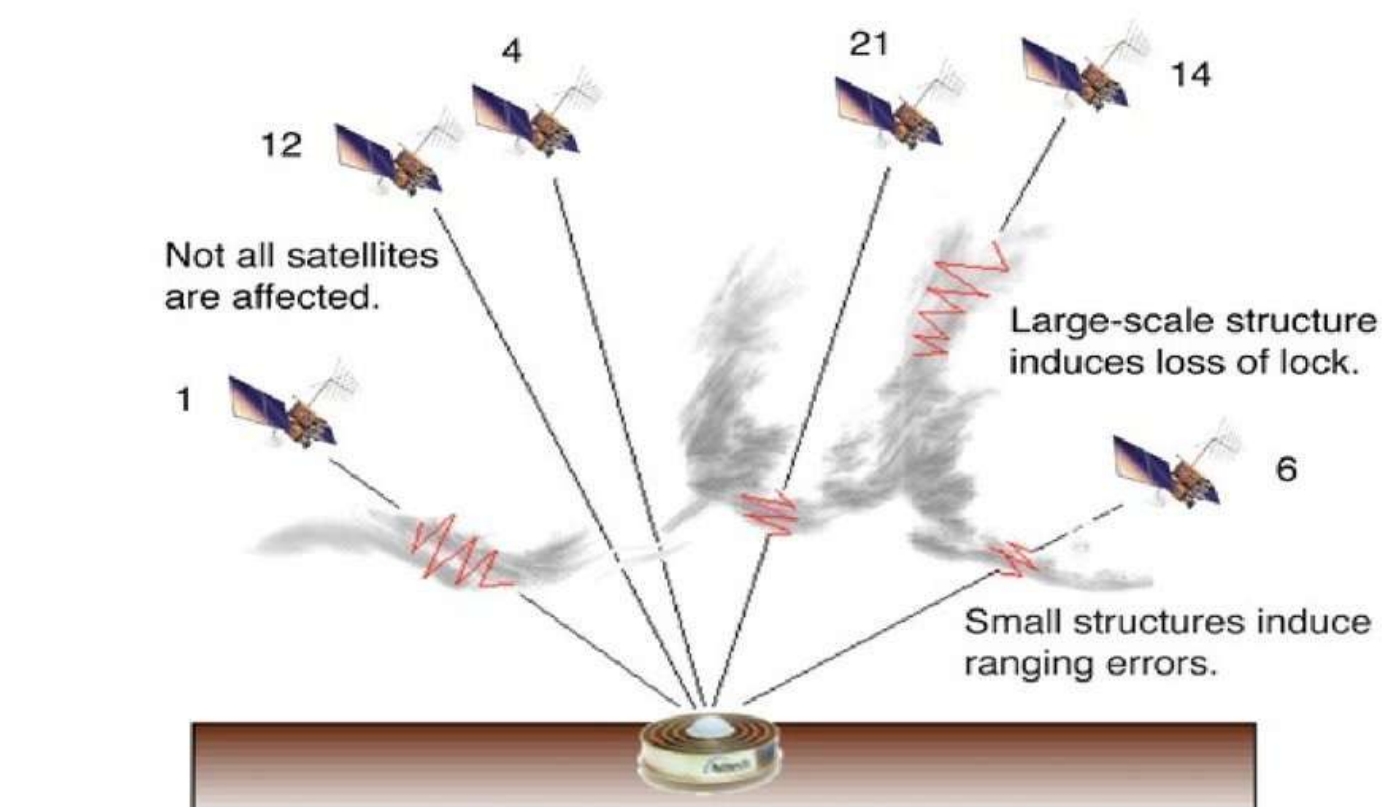
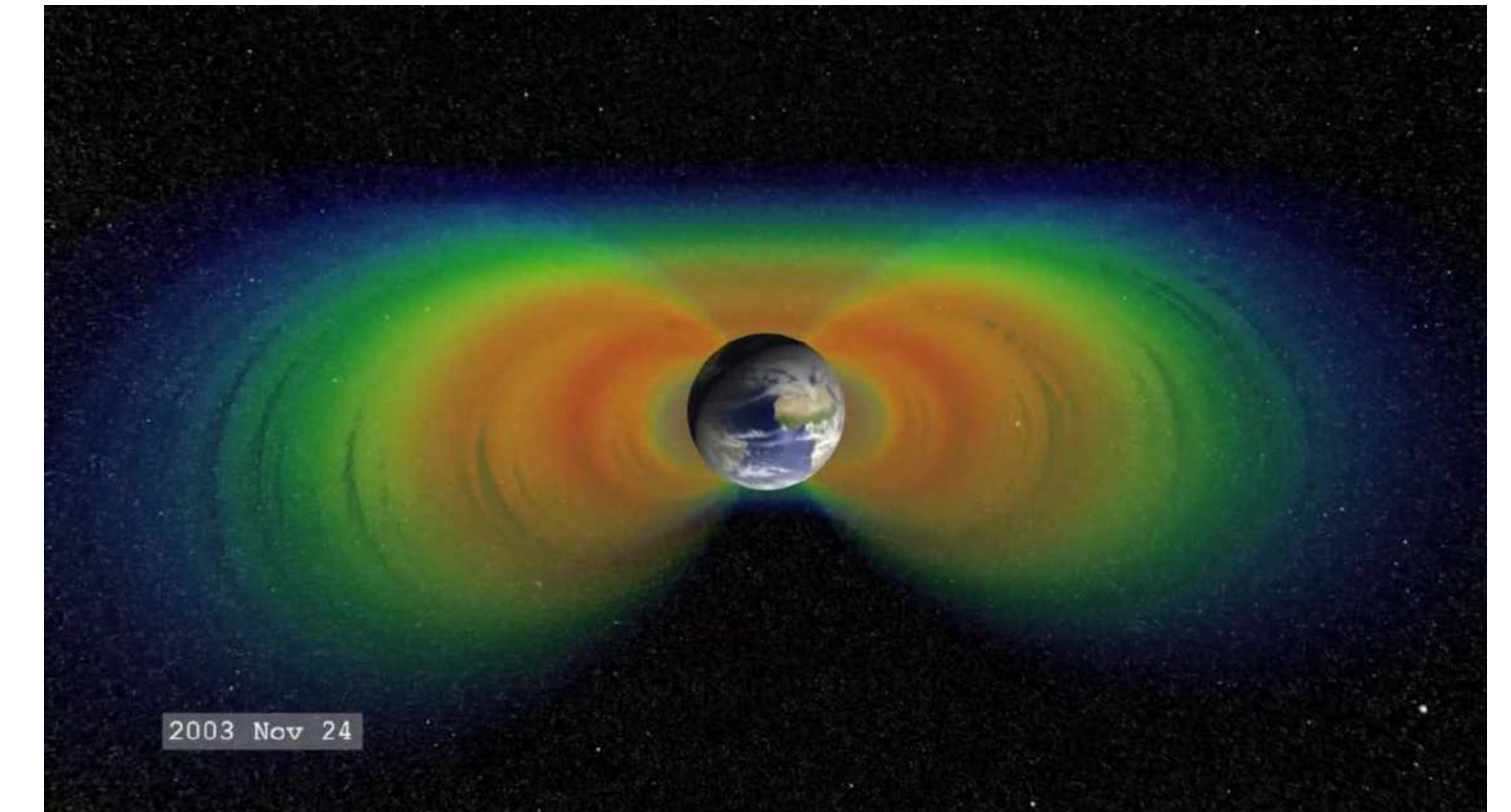
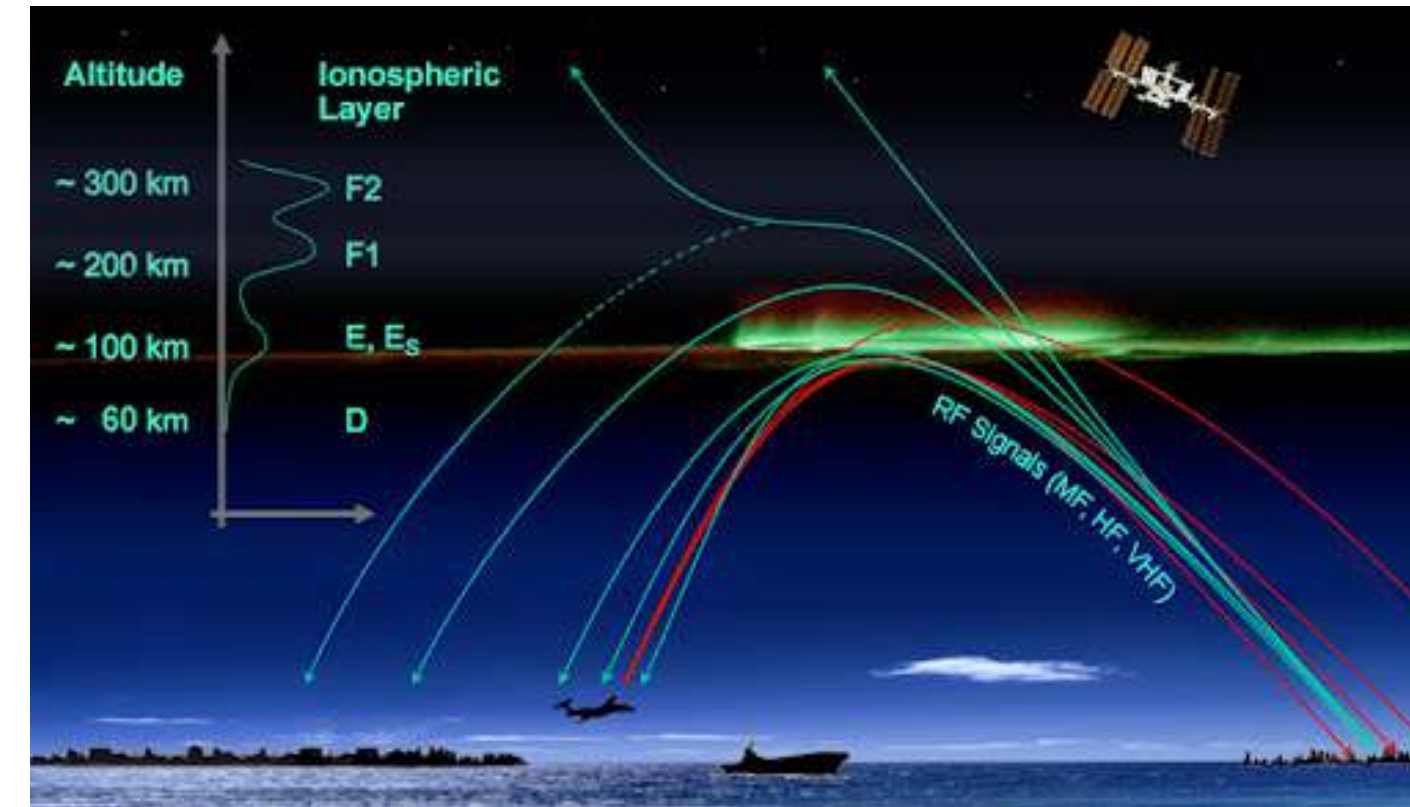
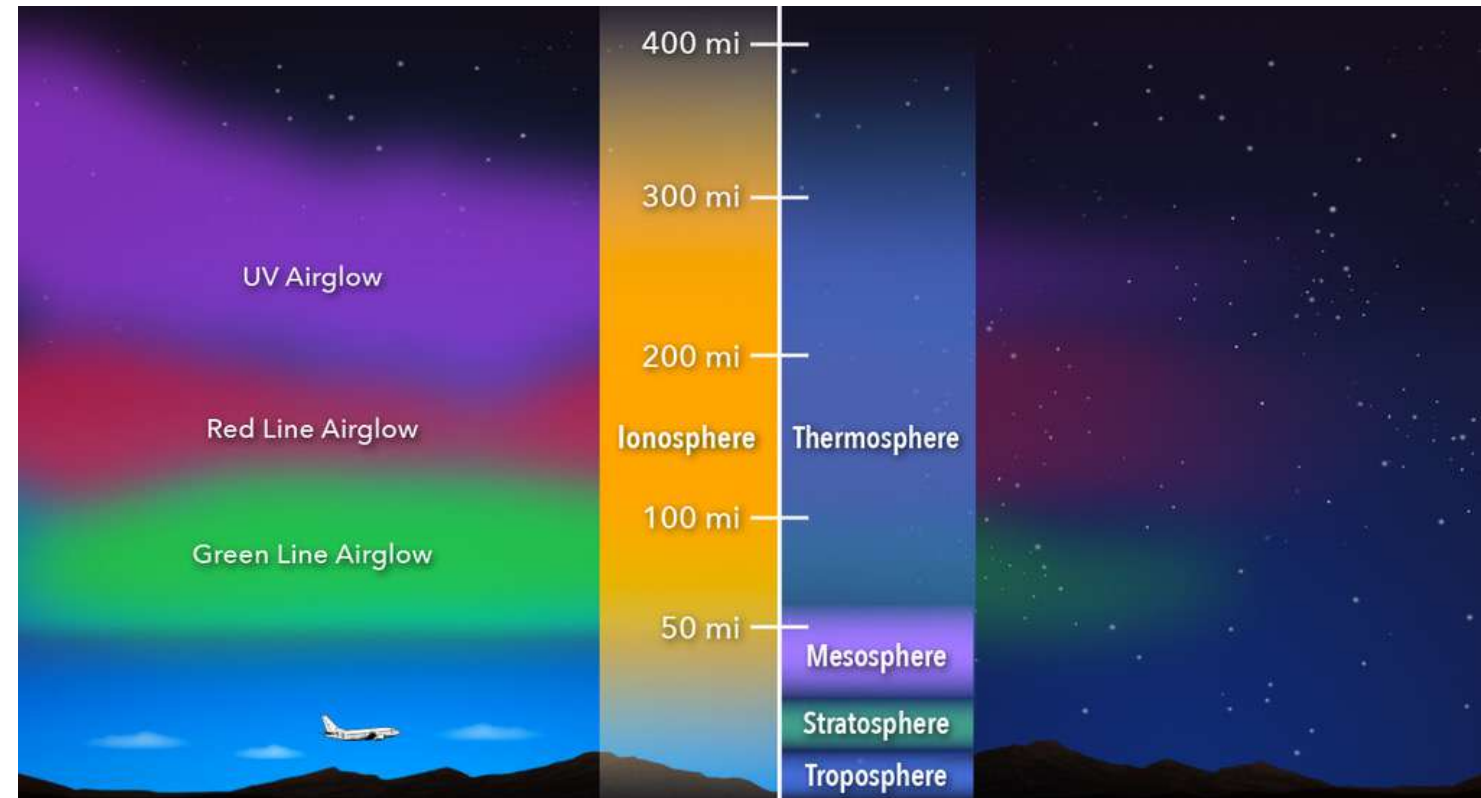
Spacecraft Design
Fabrication

Integration & Test

Launch
Operations

Data

LEO Natural Space Environment Hazards



THERMOSPHERE 熱氣層

Orbit perturbations and de-orbit from upper atmospheric drag.
 Corrosion of spacecraft structure from atomic oxygen.

IONOSPHERE 電離層

Disruption of satellite communications and navigation signals.
 Introduction of GPS range error.
 Spacecraft surface charging.

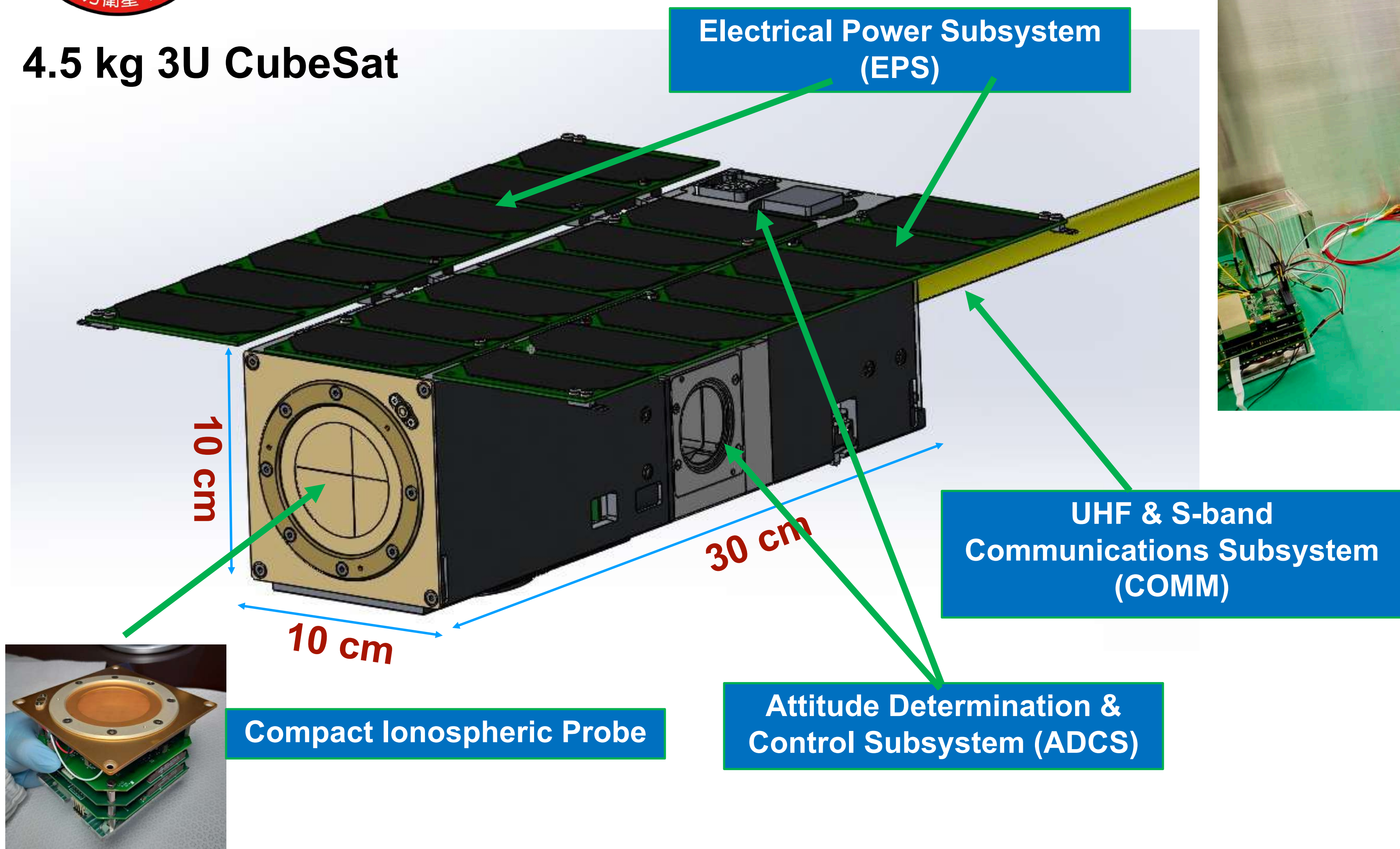
IONIZING RADIATION 游離輻射

Total Ionizing Dose
 Single Event Effects



IDEASSat / INSPIRESat-2

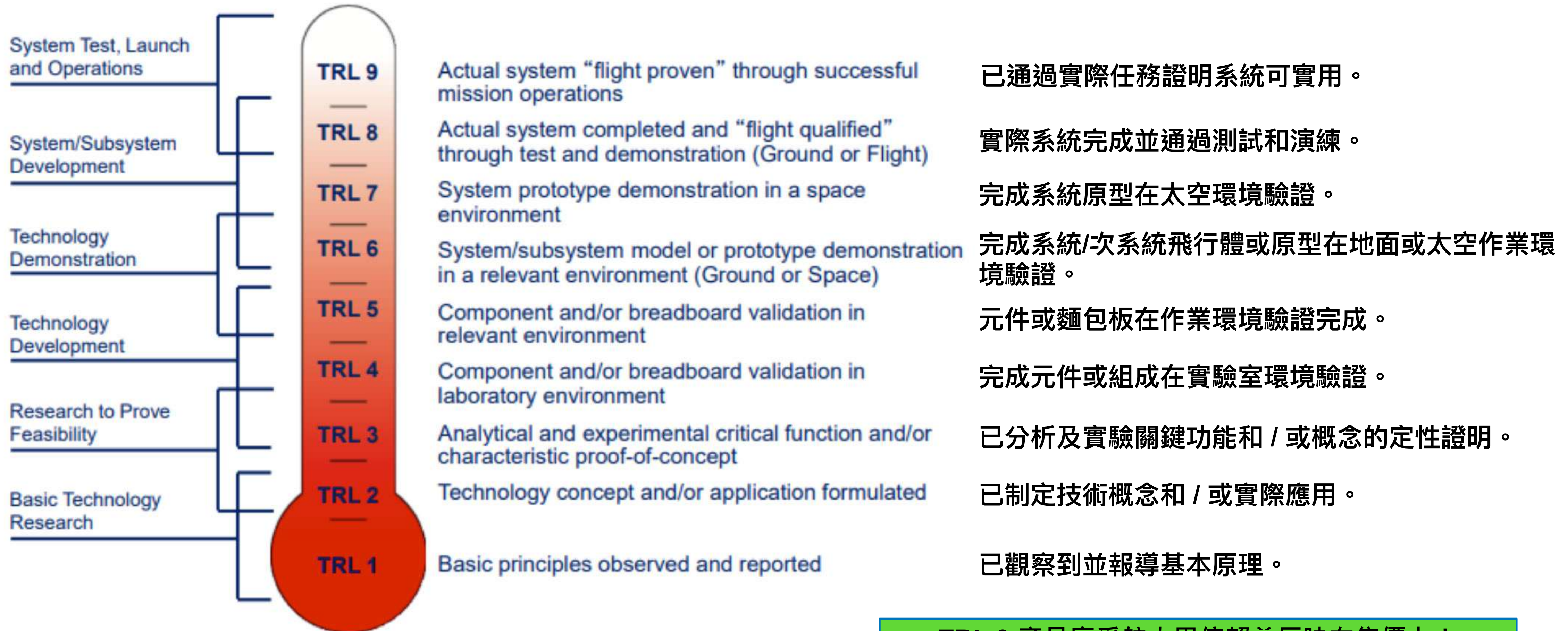
4.5 kg 3U CubeSat



Orbit	500 km Sun Sync.
Mass / Volume	4.5 kg / 3U
Development	2017 – 2020 2 yrs + 1 yr extension
Launch	2021/01/24 SpaceX Falcon 9

Flight Heritage 飛行履歷

Technological Readiness Level 技術完備等級 (TRL)



TRL 9 產品廣受航太界信賴並反映在售價上！

Figure 1. NASA Technology Readiness Level chart (©NASA)

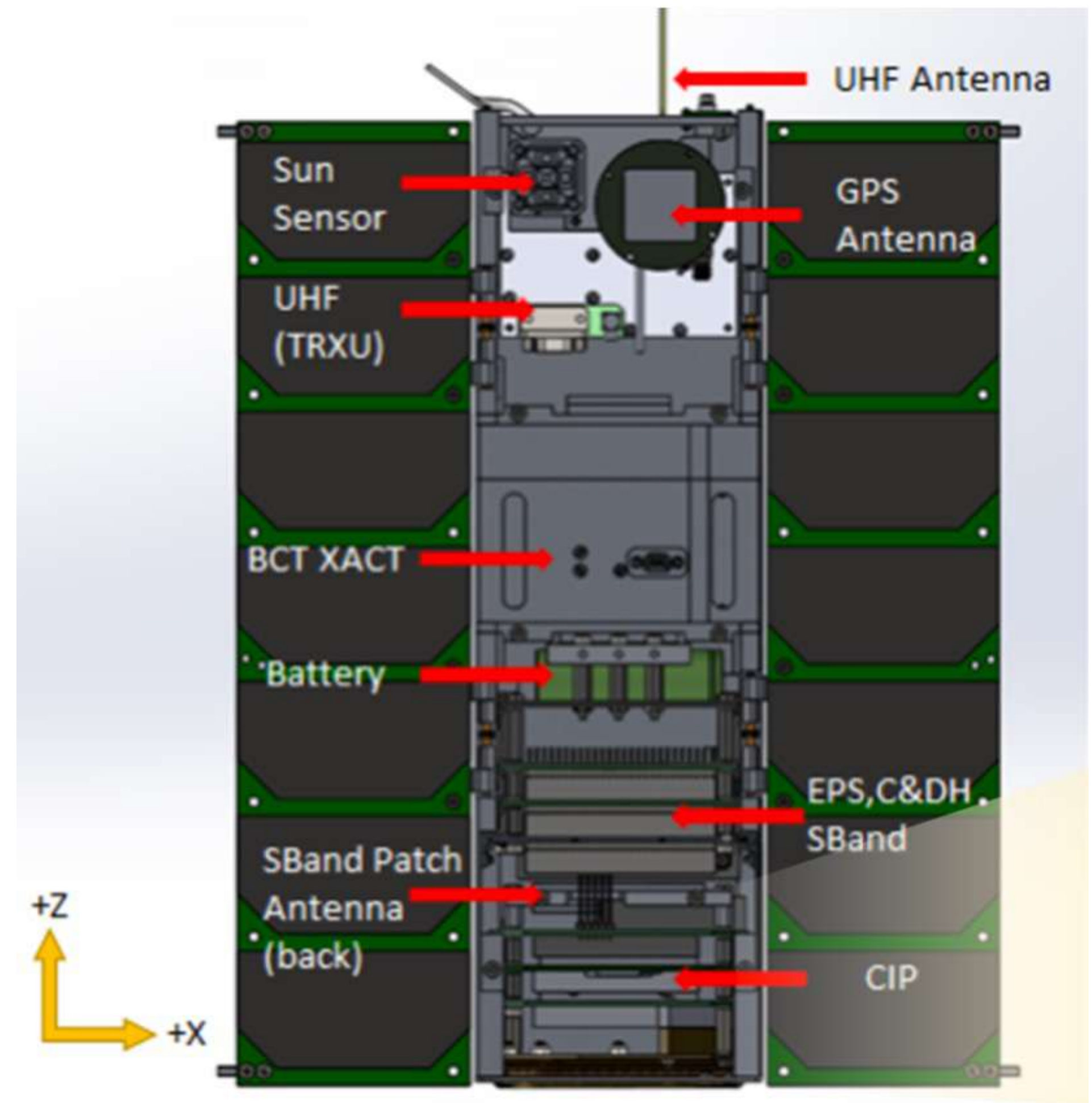
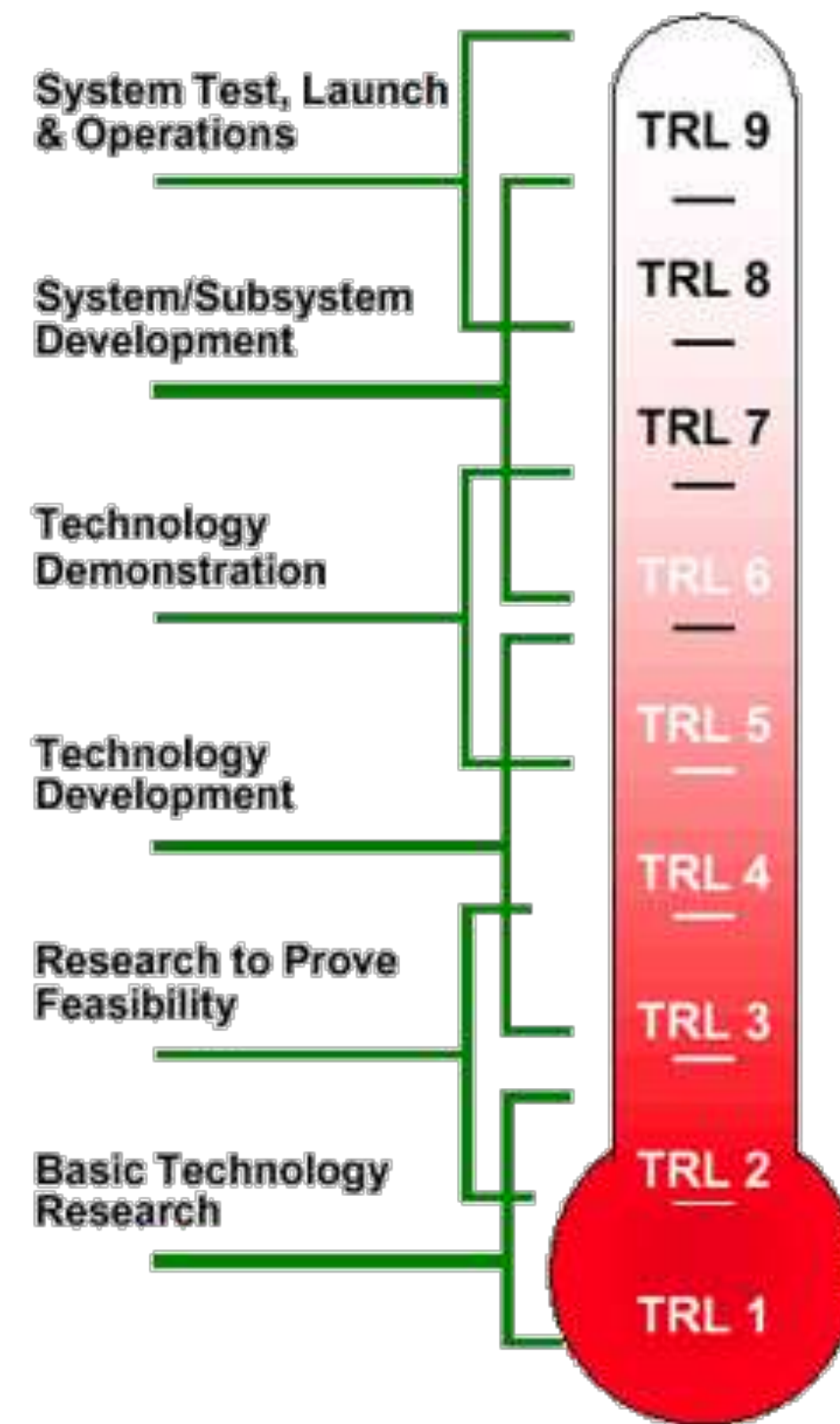
IDEASSat System Overview

Subsystem	Solution	TRL
ADCS	Blue Canyon Technologies XACT with GPS	9
COMM (UHF transceiver)	SpaceQuest TRX-U	9
COMM (UHF Antenna)	Deployable monopole antenna	9
COMM (S-band transmitter)	CPUT STX-01-0017	9
EPS (Battery & Control PCBs)	NCU EPS	8
	18650 Li-ion batteries	9
EPS (Solar Cells)	AzurSpace TJ Solar Cell Assembly 3G30A	9
CDH (On Board Computer and Flight Software)	NCU CDH Interface Board	9
	Microsemi SmartFusion2 System-on-Module	9
STR	NCU 3U bus	9

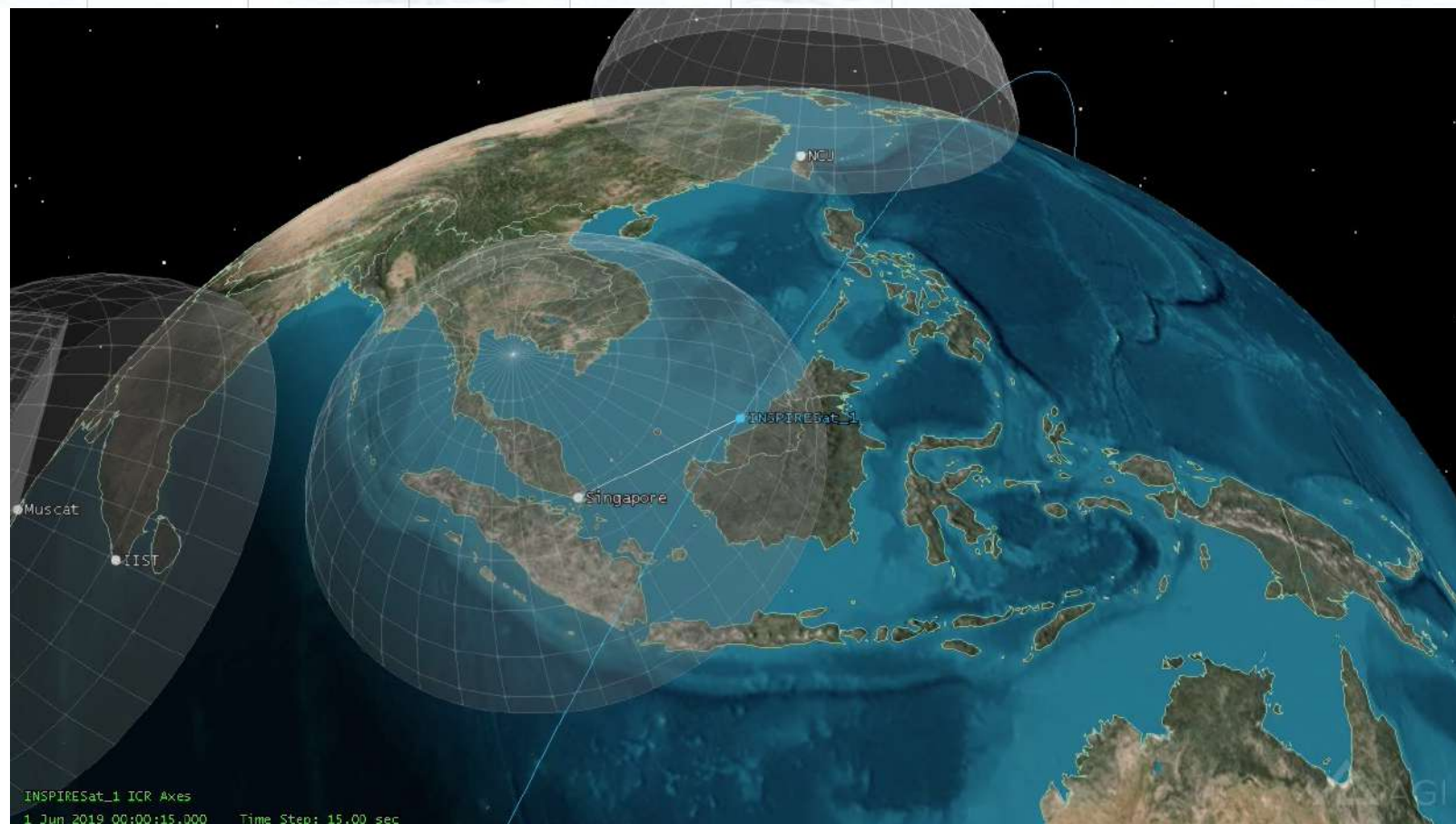
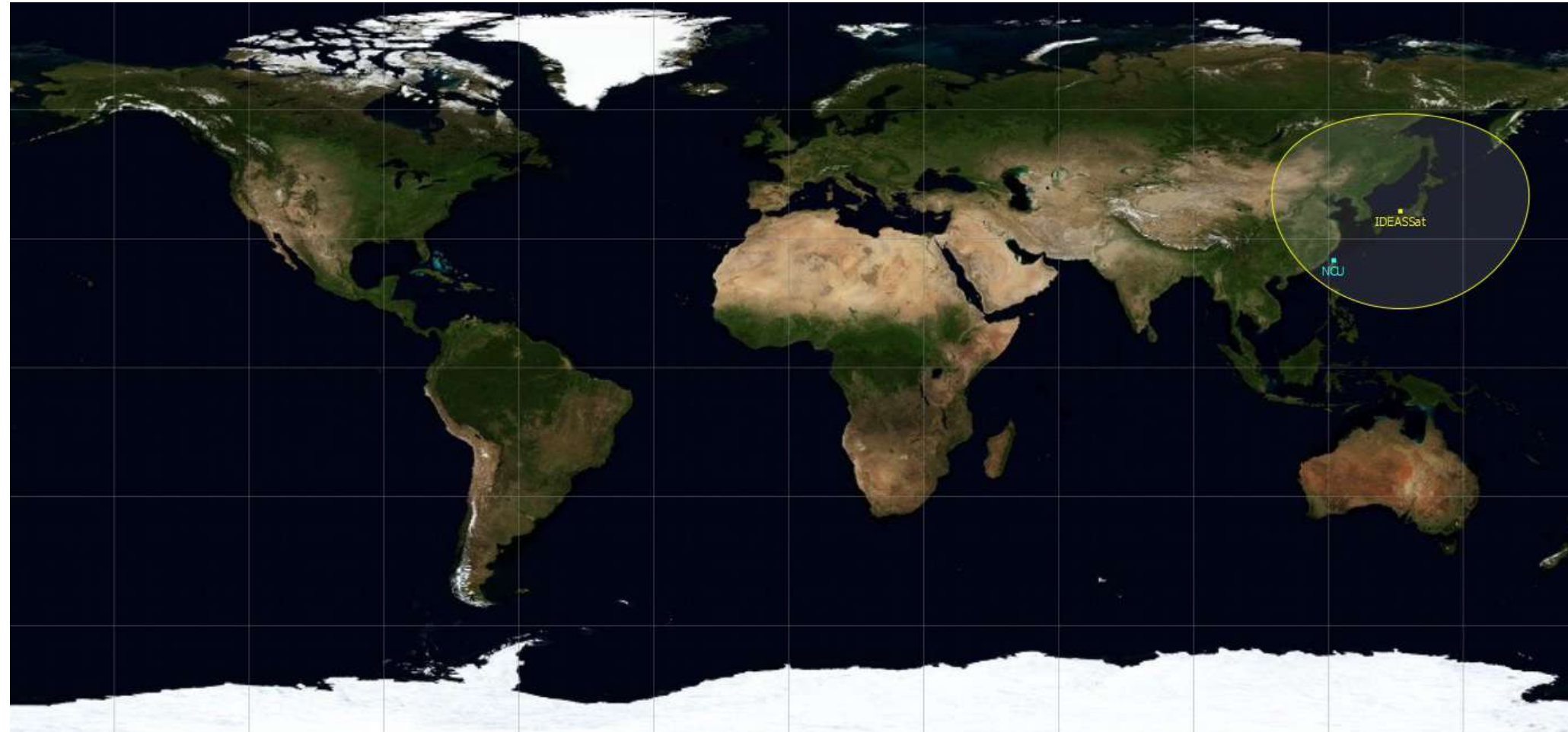
Designed at NCU / Manufactured in Taiwan

Flight Heritage Commercial Off the Shelf (COTS)

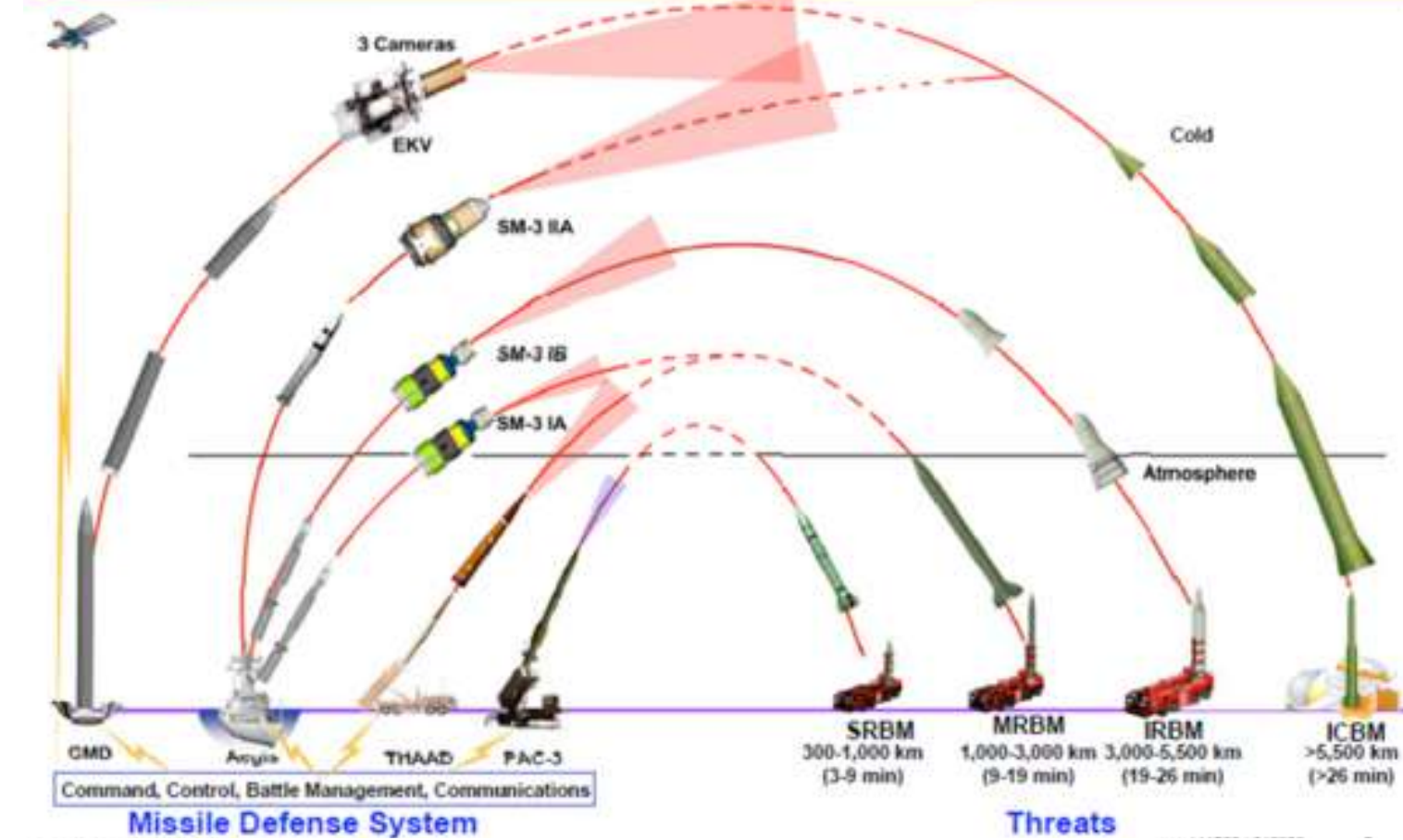
Technological Readiness Level (TRL)



Space Operational Challenges



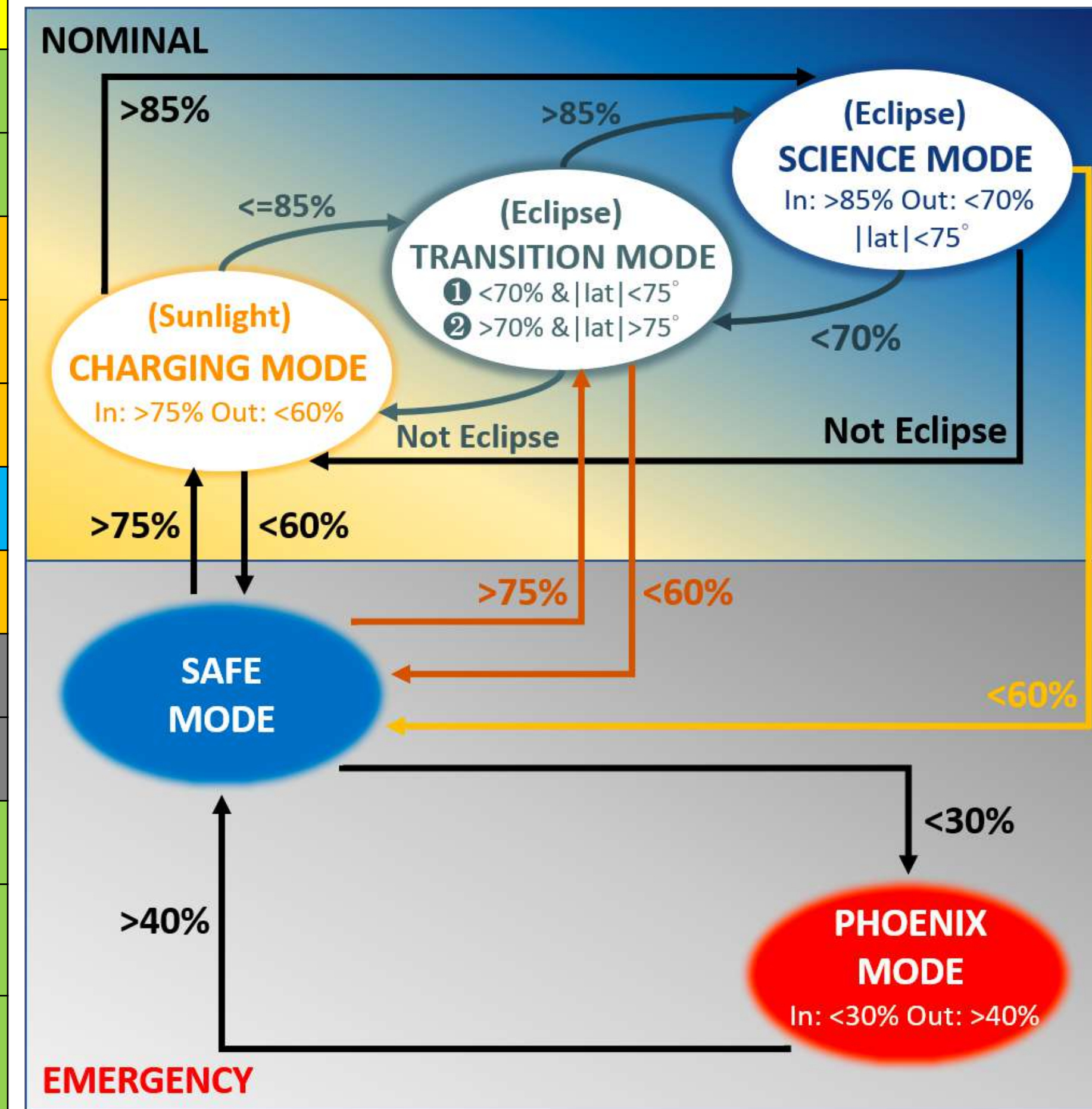
SHORT ACCESS TIMES 短暫視線通訊時間
LEO line of sight limited.
Orbital velocity 7 – 8 km s⁻¹



LONG OPERATIONAL DURATION 連續有效工作時間
Missile: Minutes
Aircraft & Launch Vehicles: Hours
Satellites: Months to Years

IDEASSat Flight Software

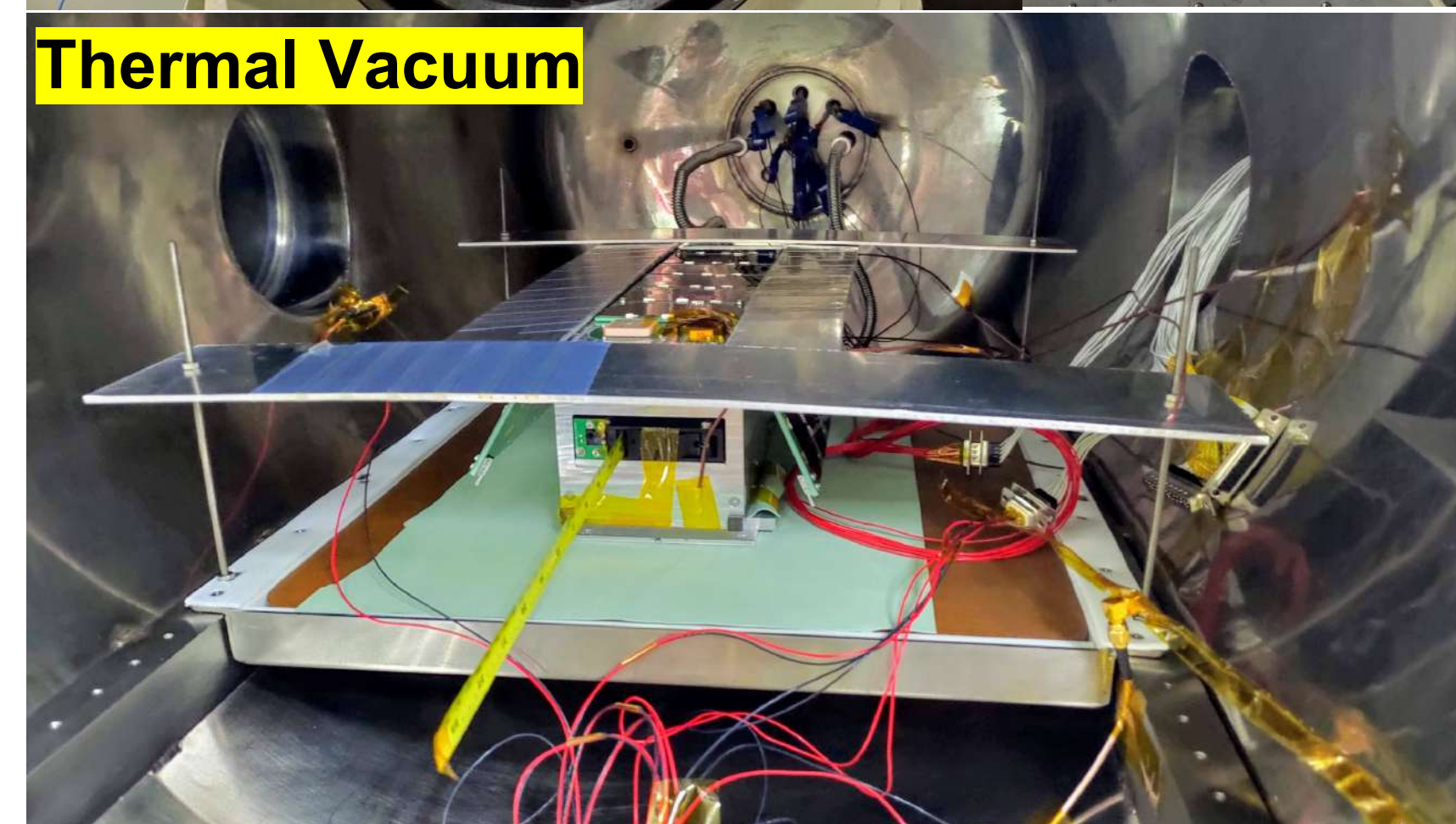
IDEASSat Operational Modes					
Mode	EMERGENCY		NOMINAL		
State	Phoenix	Safe	Charging	Science	Transition
EPS	ON	ON	ON	ON	ON
ADCS	OFF	Sun Point	Sun Point	LVLH	LVLH
CDH	ON	ON	ON	ON	ON
UHF(Tx)	BEACON	BEACON	BEACON	BEACON	BEACON
UHF(Rx)	ON	ON	ON	ON	ON
S-Band(Tx)	OFF	OFF	AS REQ	AS REQ	OFF
CIP	OFF	OFF	OFF	ON	OFF
Battery Heater	AS REQ	AS REQ	AS REQ	AS REQ	AS REQ
Avg. Power Required	2.18 W	5.0 W	13.79 W		
Avg. Power Generated	2.18 / 2.42 W Undeployed / Deployed	14.52 W	14.52 W		



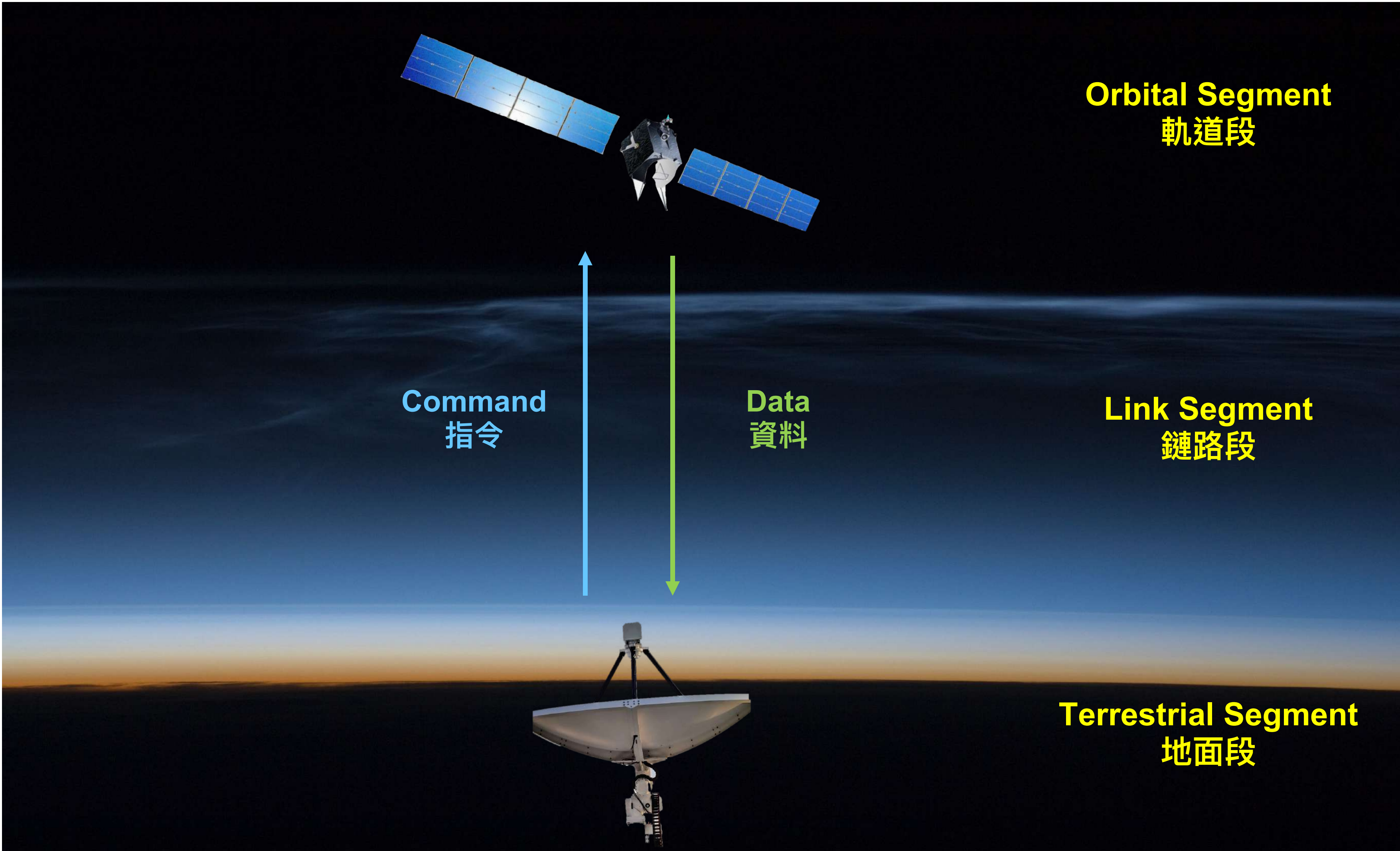
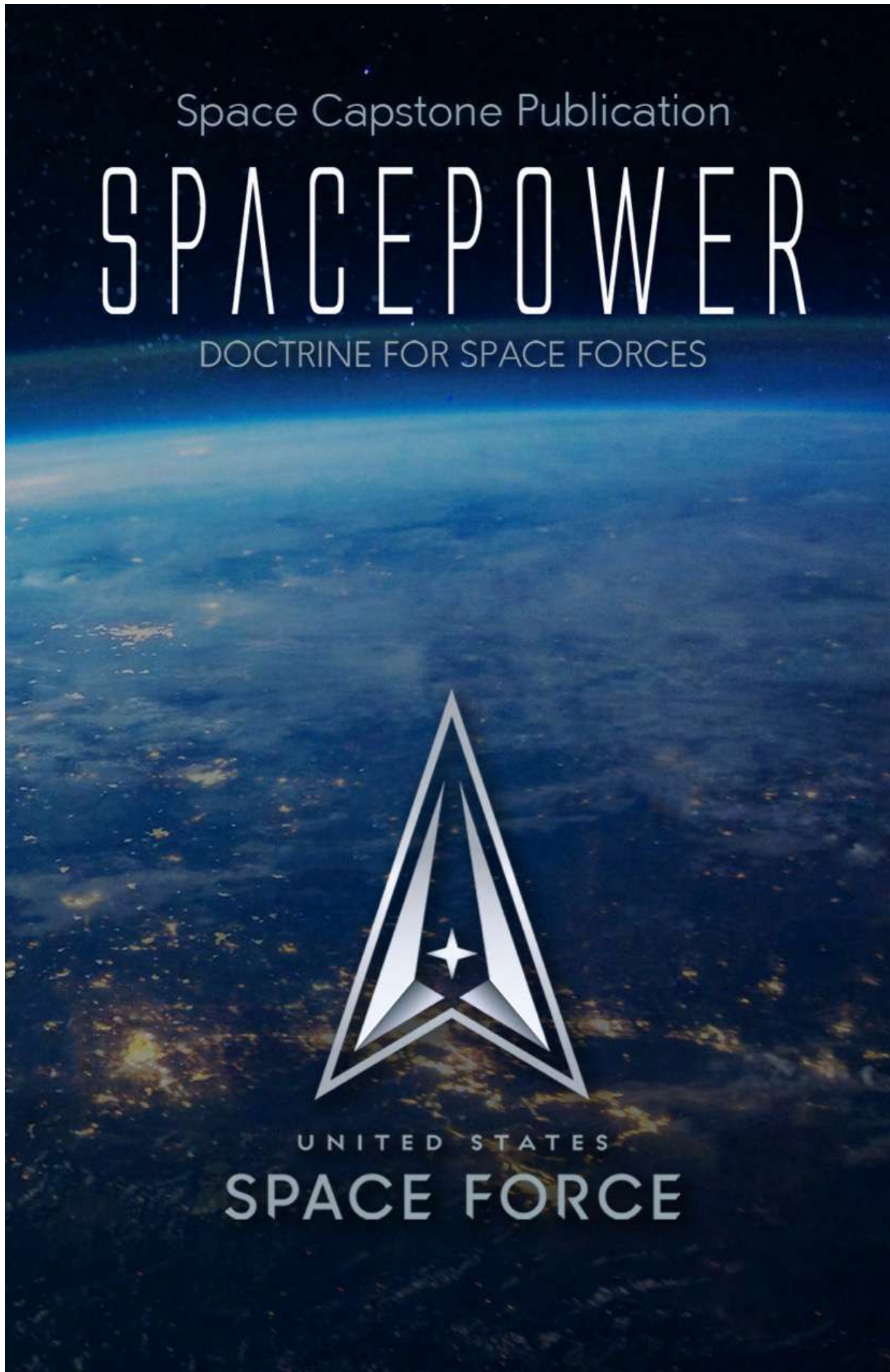
Environmental Testing (Minimal)

Table 3-13: Payload Unit Test Levels and Durations

Test	Fleet Qualification Approach		Single unit Approach	Required or Advised
	Qualification	Acceptance	Protoqualification	
Shock	6 dB above MPE, 3 times in each of 3 orthogonal axes	Not Required	3 dB above MPE, 2 times in each of 3 orthogonal axes	Required ²
Acoustic	6 dB above acceptance for 2 minutes	Envelope of MPE and minimum spectrum for 1 minute	3 dB above acceptance for 1 minutes ¹	Advised
Random Vibration	6 dB above acceptance for 2 minutes in each of 3 axes	Envelope of MPE and minimum spectrum for 1 minute in each of 3 axes	3 dB above acceptance for 1 minutes in each of 3 axes ¹	Required
Combined Thermal Vacuum and Thermal Cycle ³	±10°C beyond acceptance for 27 cycles total	Envelope of MPT and minimum range (-24 to 61°C) for 14 cycles total	±5°C beyond acceptance for 20 cycles total	Advised
Static Load ⁴	1.25 times the limit load	1.1 times the limit load	1.25 times the limit load	Required
Pressure	Pressures as specified in Table 6.3.12-2 of SMC-S-016 following acceptance proof pressure test, duration sufficient to collect data	1.25 times MEOP for pressure vessels; 1.5 times MEOP for pressure components. Other metallic pressurized hardware items per References 4 and 5 from SMC-S-016	Not Applicable at the Payload Level ⁵	Required
Electromagnetic Compatibility ⁶	No Margin	Not Applicable	No Margin	Required



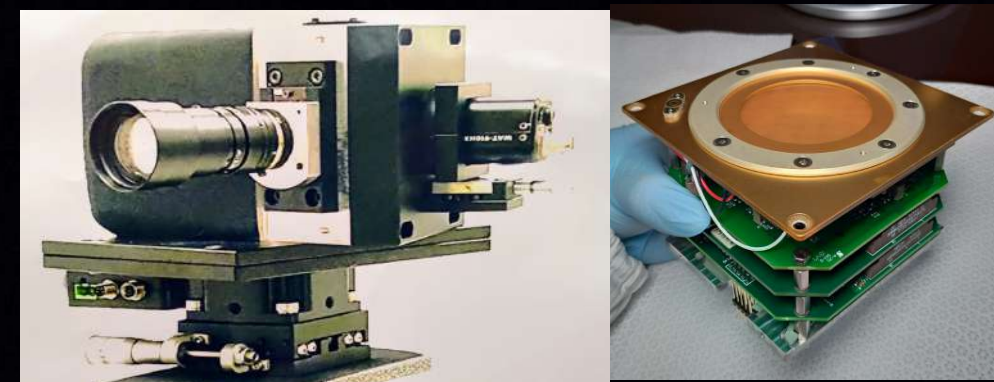
太空系統架構



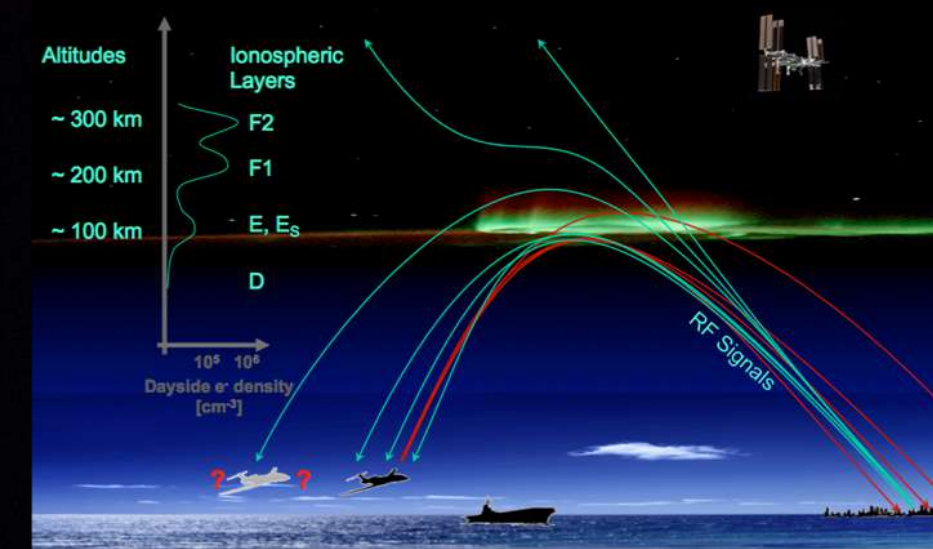
太空系統架構



自製衛星



衛星酬載與元件



應用太空環境研究

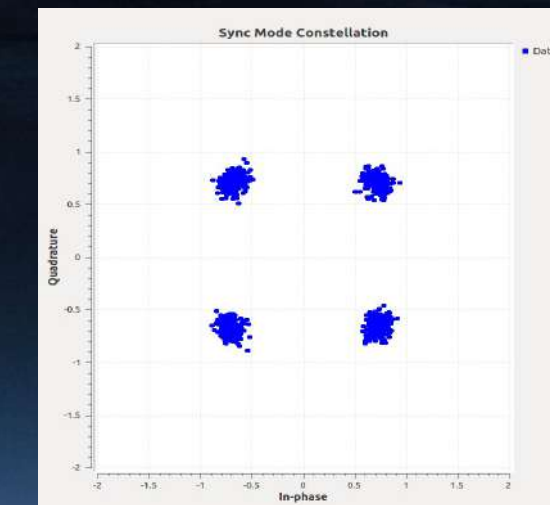
Orbital Segment
軌道段



地面接收站



通訊次系統整測



訊號處理

Link Segment
鏈路段



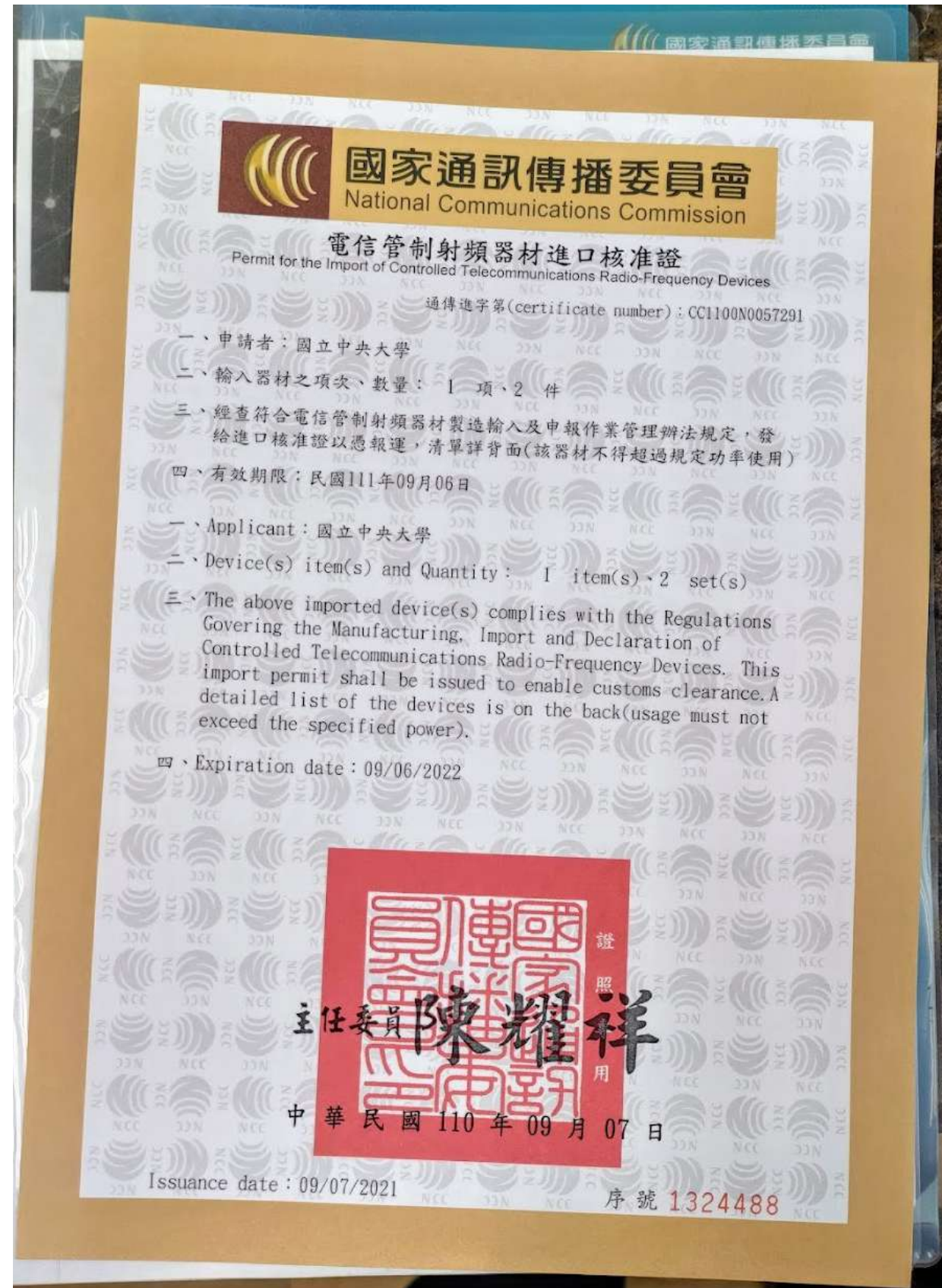
衛星作業中心



衛星環測設施

Terrestrial Segment
地面段

Communications Regulation



NCC Import Permit Required for RF Components:
專案暫時進口加工後出口



The International Amateur Radio Union

Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST

(Make a separate request for each space station to be operated in the amateur-satellite service.)

Have you read the instructions? Here is the link

http://www.iaru.org/uploads/1/3/0/7/13073366/instructions_iaru_amateur_satellite_coordination_request.doc

Please do NOT submit the request before it is 100% filled and signed.

Administrative information:

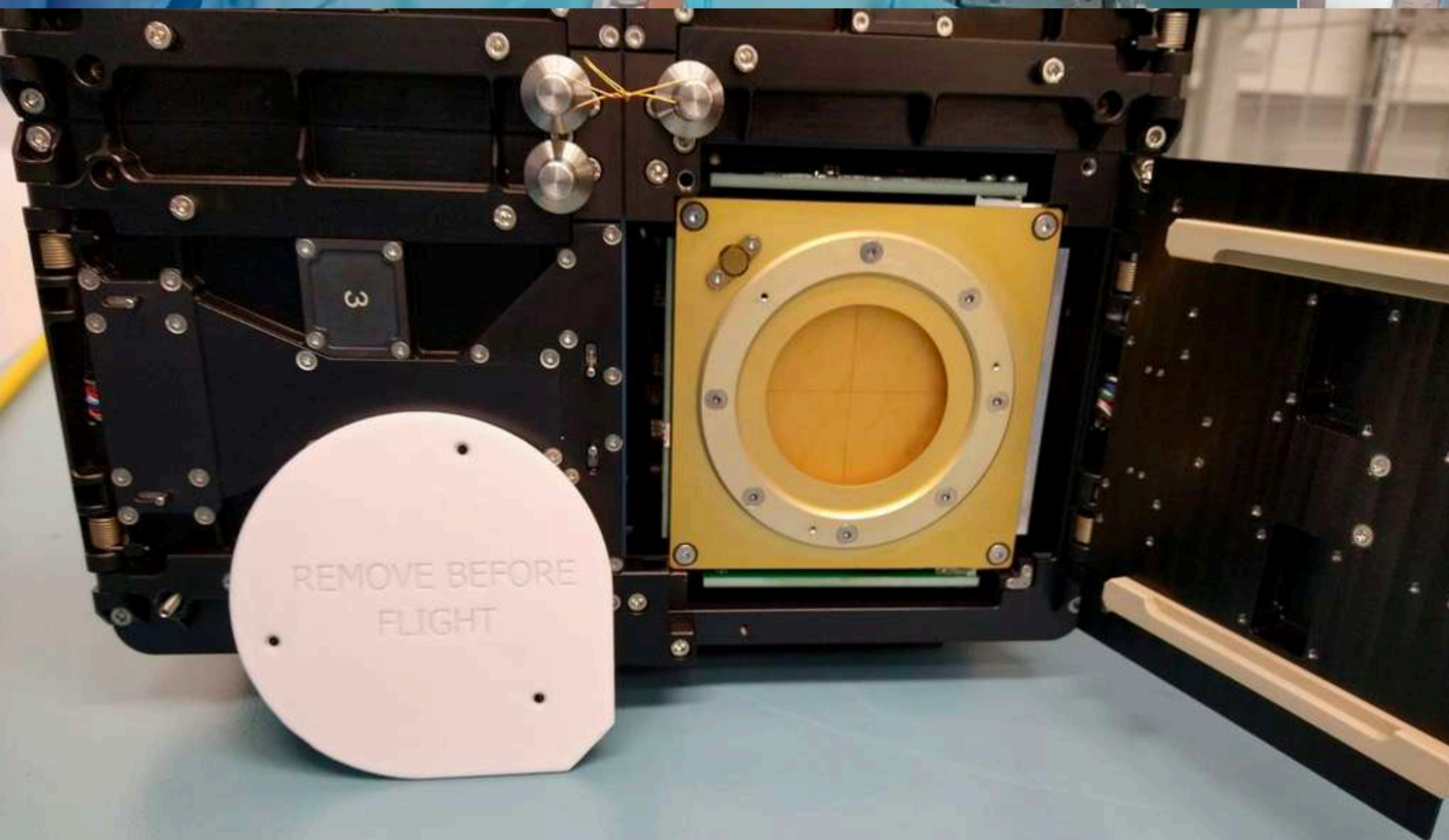
0	DOCUMENT CONTROL	
0a	Date submitted	2019/10/18
0b	Document revision number	NCU-001
1	SPACECRAFT (published)	
1a	Name	IDEASSat
1b	Notifying administration	National Central University
1c	API/A number	

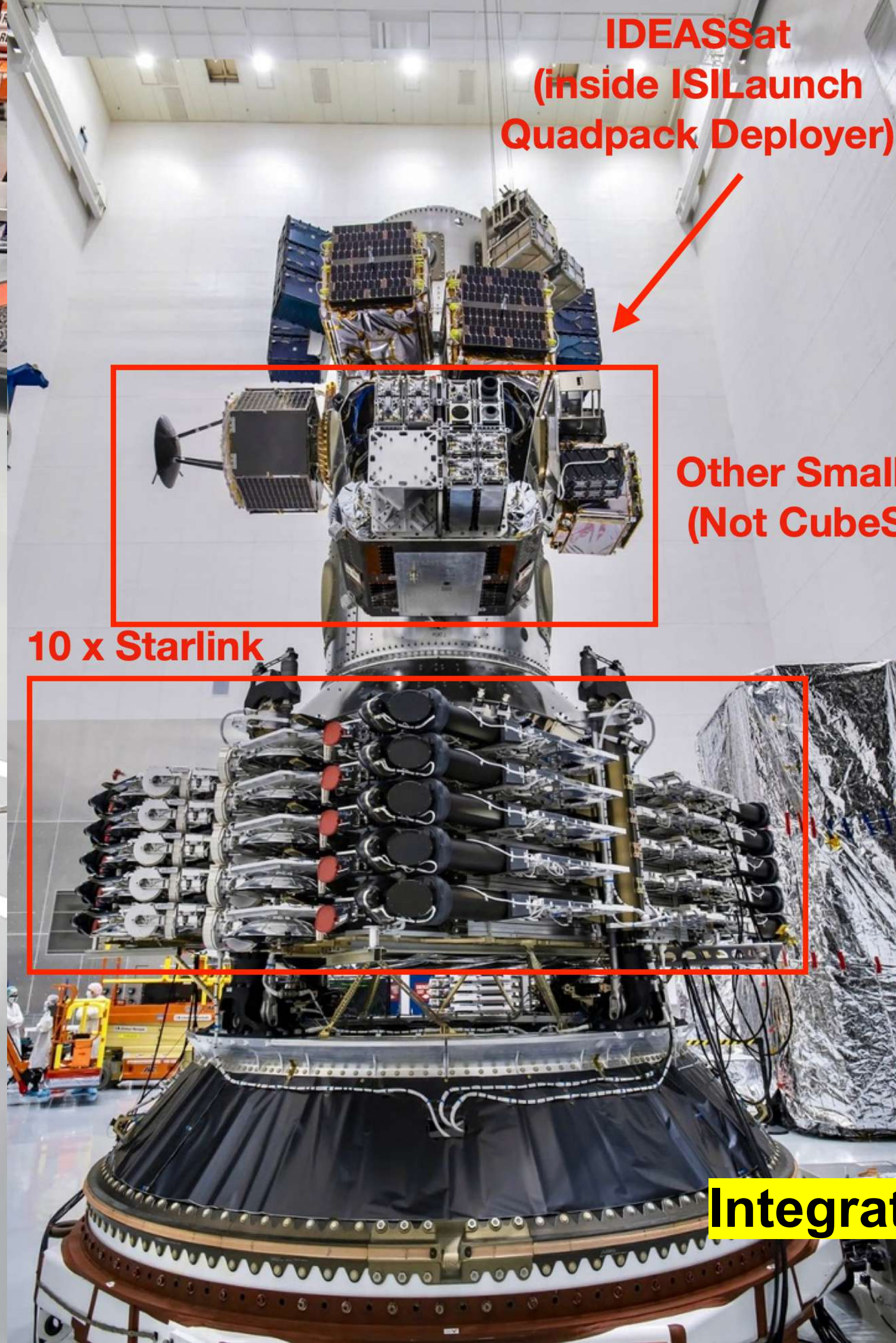
Frequency Coordination required from International Amateur Radio Union (IARU):

Problem – Taiwan not International Telecommunication Union (ITU) member.
Cannot submit Advance Publication Information.

Deployment Pod Insertion

2020/12/01





Integration with launch vehicle
2020/12/22



NCU GroundStation v3.3
Beacon \ Transmission \ Configuration

Address: 127.0.0.1 Browse
Port: 4015 Normal
Start Rx Clear

IDEASSat Beacon Packet

Last packet at: 2021-01-24 19:19:39 UTC
BNOCU 0 BNOI DAO

Spacecraft			Attitude Data		
Spacecraft mode	Safe Mode		ADCS Mode	SUN POINT	
Onboard Eclipse Determination	No		Sun Point State	Waiting	
Accept Commands Since Boot	0		Latitude (degree)	37.41	
Reject Command Since Boot	3		Longitude (degree)	28.47	
Beacon Packet Number	121811700		Altitude (km)	540.867	

Subsystems			Temperature		Power	
Name	Reboot Counts	Status	C&DH	38.13	SOC (%)	95.28
C&DH	0	-	EPS	40.58	EPS UHF	5.99 V 44.0 mA
UHF	0	ON	Battery 1	27.43	EPS ADCS	12.05 V 192.0 mA
S band STXC	0	OFF	Battery 2	29.14	EPS PV0	1.82 V 4.0 mA
ADCS XACT	0	ON	UHF	22.00	EPS PV1	1.81 V 4.0 mA
GPS	-	ON	S band Last PA	-50.00	EPS PV2	1.91 V 4.0 mA
CIP	0	OFF	S band Last Top Board	0.00	Battery CHG	8.16 V -516.0 mA
Heater	-	OFF	S band Last Bot Board	0.00	Last EPS Sband	0.00 V 0.0 mA
CIP Command Status	0		CIP temp 1 (APU)	0.00	Last EPS CIP	0.00 V 0.0 mA
			CIP temp 2 (DCU)	0.00	Last UHF Tx Current	636.0
			CIP temp 3 (PMU)	0.00	Last Sband Tx Current	0.0
			ADCS Tracker Detector	34.40	CRC Check / Flag OK/7E	
			ADCS External	26.84	Connected	

Spacecraft powered on successfully into Safe mode.

3-axis attitude control successful!

Battery state of charge very healthy!

First flight data beacon received from SatNOGS (amateur radio network): T + 4 hours.

Automated Real Time Downlink



Feb 8 10:50 121773073.txt	Feb 10 21:07 121766525.txt	Feb 12 22:18 121760992.txt	Feb 15 09:40 121754304.txt
Feb 8 09:16 121773249.txt	Feb 10 21:06 121766527.txt	Feb 12 22:17 121760993.txt	Feb 15 09:40 121754305.txt
Feb 8 09:16 121773250.txt	Feb 10 21:05 121766528.txt	Feb 12 22:16 121760995.txt	Feb 15 09:39 121754306.txt
Feb 8 09:13 121773256.txt	Feb 10 21:04 121766530.txt	Feb 12 22:16 121760996.txt	Feb 15 09:39 121754307.txt
Feb 8 09:12 121773257.txt	Feb 10 21:04 121766531.txt	Feb 12 22:15 121760998.txt	Feb 15 09:38 121754308.txt
Feb 8 09:12 121773258.txt	Feb 10 21:03 121766532.txt	Feb 12 22:14 121760999.txt	Feb 15 09:38 121754309.txt
Feb 8 09:11 121773259.txt	Feb 10 21:03 121766533.txt	Feb 12 20:45 121761166.txt	Feb 15 09:37 121754310.txt
Feb 8 09:11 121773260.txt	Feb 10 21:02 121766839.txt	Feb 12 20:44 121761167.txt	Feb 15 09:37 121754311.txt
Feb 8 09:10 121773261.txt	Feb 9 21:17 121769210.txt	Feb 12 20:43 121761170.txt	Feb 15 09:36 121754312.txt
Feb 8 09:10 121773262.txt	Feb 9 21:16 121769211.txt	Feb 12 20:42 121761172.txt	Feb 15 09:36 121754313.txt
Feb 7 21:34 121774567.txt	Feb 9 21:16 121769212.txt	Feb 12 20:41 121761174.txt	Feb 15 09:35 121754314.txt
Feb 7 21:32 121774570.txt	Feb 9 21:15 121769213.txt	Feb 12 20:40 121761175.txt	Feb 15 09:35 121754315.txt
Feb 7 21:32 121774571.txt	Feb 9 21:15 121769214.txt	Feb 12 20:39 121761177.txt	Feb 15 09:34 121754316.txt
Feb 7 21:31 121774572.txt	Feb 9 21:14 121769215.txt	Feb 12 20:38 121761276.txt	Feb 15 09:34 121754317.txt
Feb 7 21:31 121774573.txt	Feb 9 21:14 121769216.txt	Feb 12 10:13 121762351.txt	Feb 15 09:33 121754318.txt
Feb 7 21:30 121774574.txt	Feb 9 21:13 121769217.txt	Feb 12 10:12 121762352.txt	Feb 15 09:33 121754319.txt
Feb 7 21:30 121774575.txt	Feb 9 21:13 121769218.txt	Feb 12 10:12 121762353.txt	Feb 13 10:02 121755574.txt
Feb 7 21:29 121774576.txt	Feb 9 10:39 121770395.txt	Feb 12 10:11 121762354.txt	Feb 14 20:19 121755808.txt
Feb 7 21:29 121774577.txt	Feb 9 10:38 121770396.txt	Feb 12 10:11 121762355.txt	Feb 14 20:18 121755810.txt
Feb 7 21:28 121774578.txt	Feb 9 10:38 121770397.txt	Feb 12 10:10 121762356.txt	Feb 14 09:51 121756986.txt
Feb 7 21:27 121774580.txt	Feb 9 10:37 121770398.txt	Feb 12 10:10 121762357.txt	Feb 14 09:51 121756987.txt
Feb 7 09:26 121775921.txt	Feb 9 09:02 121770577.txt	Feb 12 10:09 121762358.txt	Feb 14 09:50 121756988.txt
Feb 7 09:27 121775932.txt	Feb 9 09:01 121770579.txt	Feb 12 10:09 121762359.txt	Feb 14 09:50 121756989.txt
Feb 7 09:26 121775933.txt	Feb 9 09:00 121770580.txt	Feb 12 10:08 121762360.txt	Feb 14 09:49 121756990.txt
Feb 7 09:25 121775935.txt	Feb 9 08:59 121770582.txt	Feb 12 10:08 121762361.txt	Feb 14 09:49 121756991.txt
Feb 7 01:54 121780110.txt	Feb 9 08:59 121770583.txt	Feb 12 10:07 121762362.txt	Feb 14 09:48 121756992.txt
Feb 7 01:54 121780111.txt	Feb 9 08:58 121770584.txt	Feb 11 20:53 121763851.txt	Feb 14 09:48 121756993.txt
Feb 7 01:53 121780112.txt	Feb 8 21:23 121771888.txt	Feb 11 20:53 121763852.txt	Feb 14 09:47 121756994.txt
Feb 7 01:53 121780113.txt	Feb 8 21:22 121771889.txt	Feb 11 20:52 121763853.txt	Feb 14 09:47 121756995.txt
Feb 7 01:52 121780115.txt	Feb 8 21:21 121771891.txt	Feb 11 20:52 121763854.txt	Feb 14 09:46 121756996.txt
Feb 7 01:51 121780116.txt	Feb 8 21:21 121771892.txt	Feb 11 20:51 121763855.txt	Feb 14 09:46 121756997.txt
	Feb 8 21:20 121771893.txt	Feb 11 10:18 121764530.txt	Feb 14 09:45 121756998.txt
	Feb 8 21:20 121771894.txt	Feb 11 10:24 121765030.txt	Feb 14 09:45 121756999.txt
	Feb 8 21:19 121771895.txt	Feb 11 10:24 121765031.txt	Feb 14 09:44 121757000.txt
	Feb 8 21:19 121771896.txt	Feb 11 10:23 121765032.txt	Feb 13 20:33 121758483.txt
	Feb 8 21:18 121771897.txt	Feb 11 10:23 121765033.txt	Feb 13 20:31 121758488.txt
	Feb 8 21:18 121771898.txt	Feb 11 10:22 121765034.txt	Feb 13 20:30 121758489.txt
	Feb 8 21:17 121771901.txt	Feb 11 10:22 121765035.txt	Feb 13 20:27 121758495.txt
		Feb 11 10:21 121765036.txt	Feb 13 20:32 121758678.txt
		Feb 11 10:21 121765037.txt	Feb 13 10:02 121759671.txt
		Feb 11 10:19 121765040.txt	Feb 13 10:01 121759672.txt

- Spacecraft range: 522 – 2600 km.
- Automated tracking, flight data downlink, command uplink at NCU.
- Over 700 counts of flight data.

IDEASSat Thermal Performance (°C, 2020/01/24 – 02/15)

Good thermal isolation of batteries from surrounding subsystems.

Improvements needed in deployable solar panel hinge mechanism and solar panel PCB fabrication.

Exposed solar panels show extreme temperatures. Body mounted panel hotter.

Good heat conduction away from UHF transceiver through chassis interface.

Core avionics stack running warmer than expected.

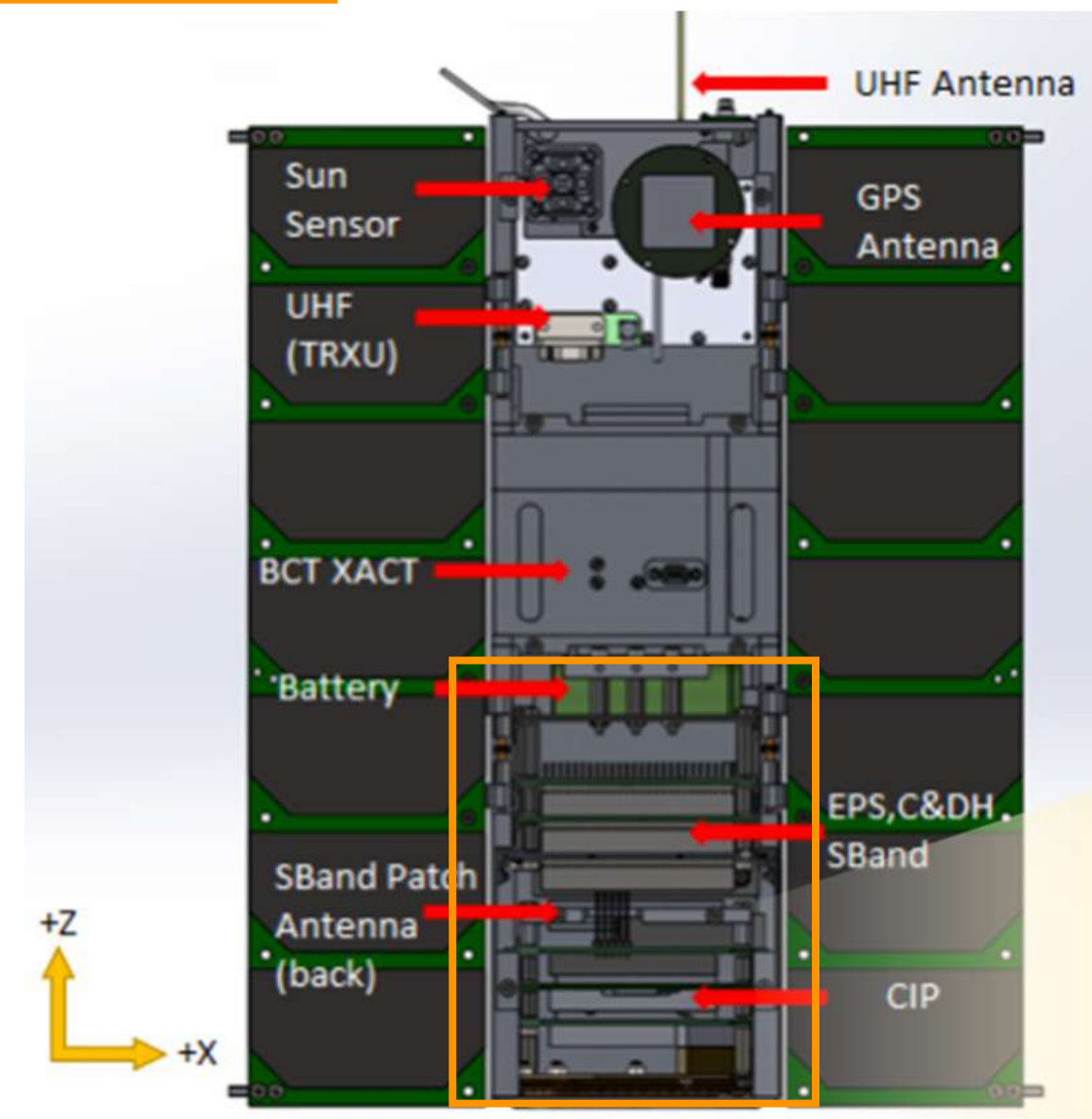
Battery Op Limit
 Battery Tvac
 Battery Predicted
 Battery 2 On Orbit
 Battery 1 On Orbit

PV Op Limit
 PV Tvac
 PV Predicted
 PV2 On Orbit
 PV1 On Orbit
 PV0 On Orbit

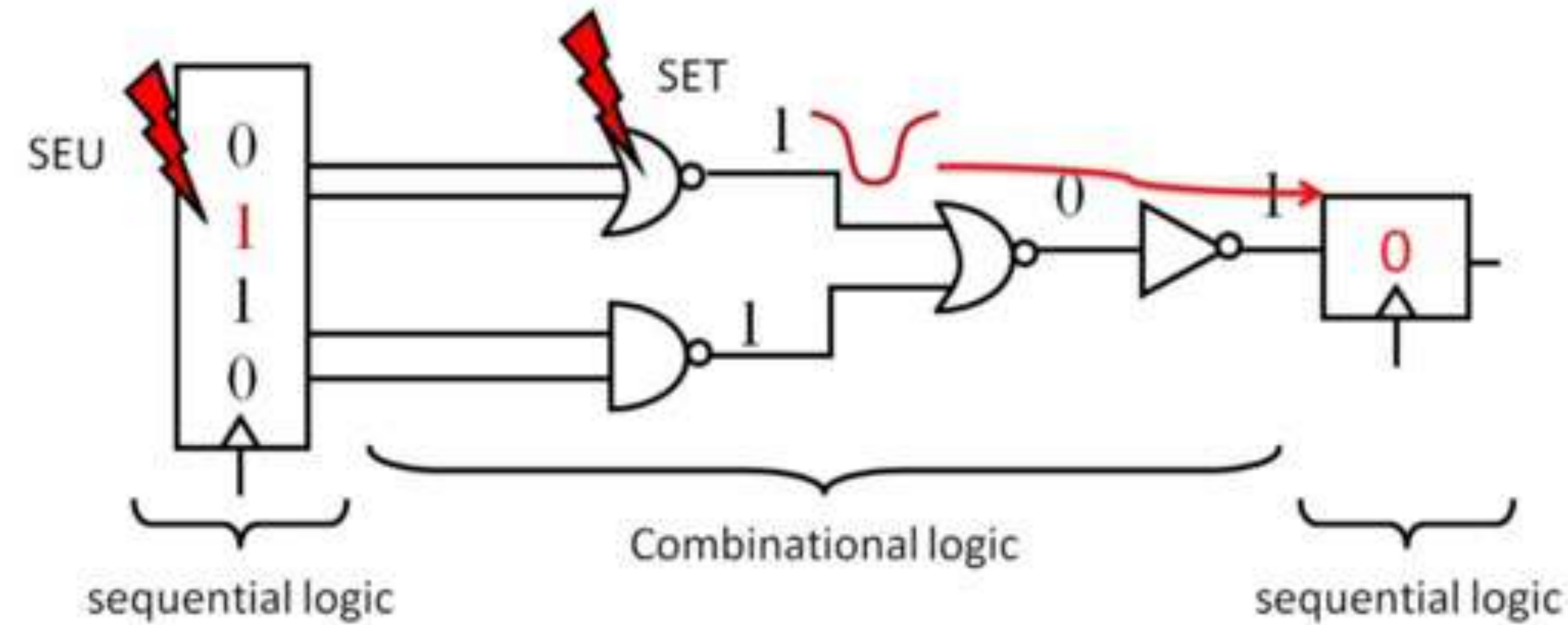
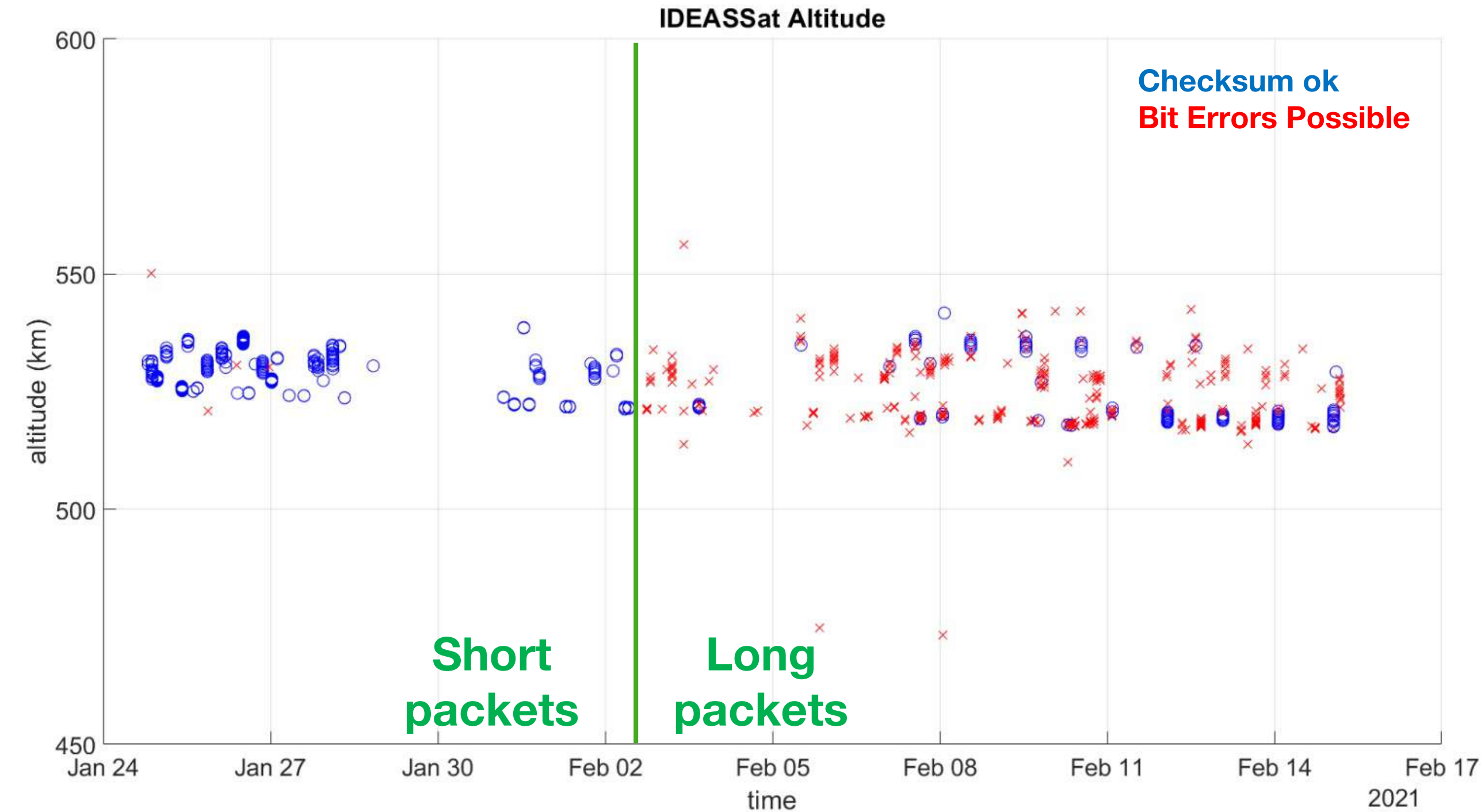
UHF Op Limit
 UHF Tvac
 UHF Predicted
 UHF On Orbit

EPS Op Limit
 EPS Tvac
 EPS Predicted
 EPS On Orbit

CDH Op Limit
 CDH Tvac
 CDH Predicted
 CDH On Orbit



Anomaly: Probable Single Event Upset (SEU單事件翻轉)

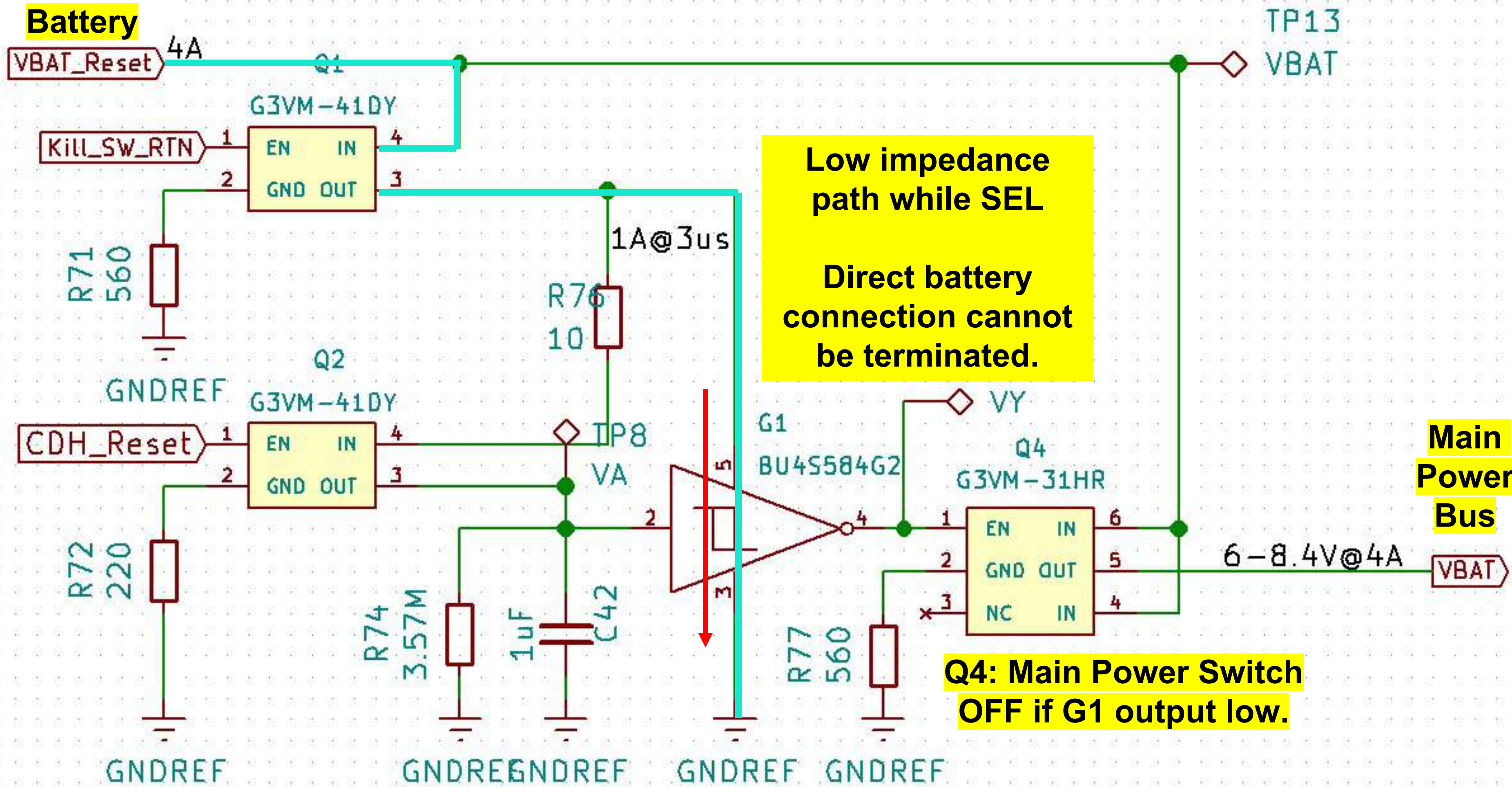


CDH

CDH Reboot Count : 0
 CDH Command Accept Count Since Boot : 0
 CDH Command Reject Count Since Boot : 28
 CDH Last Command APID :

SEU resulted in FSW parameter change without command.
 Error Correction Code needed for FSW variables, especially those logged to non-volatile memory.

IDEASSat EPS Main Power Bus Circuit

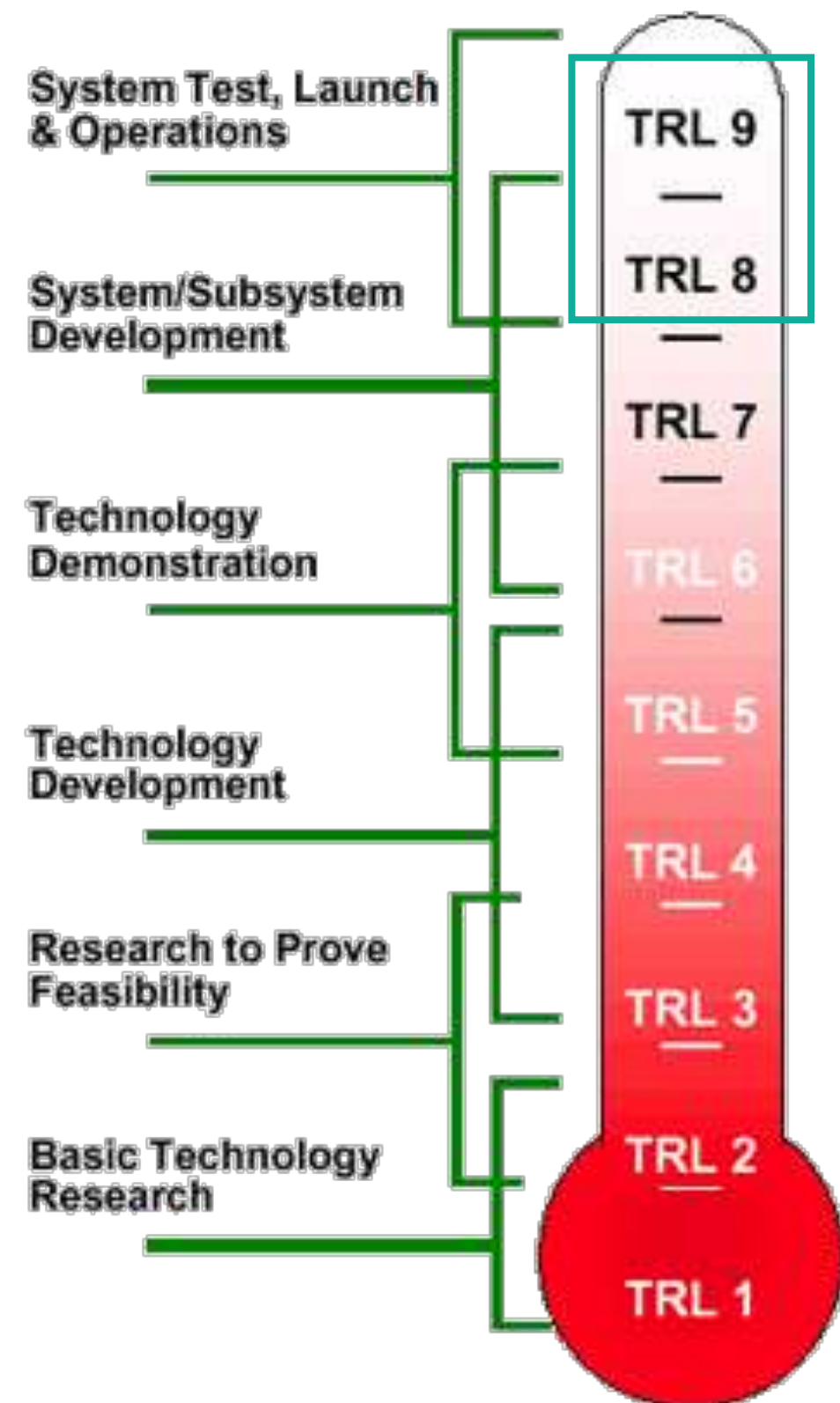


- COMM blackout for 1.5 months at T+22 days. Flight data downlinked after recovery used to identify cause.
- G1 CMOS IC at risk of single event latchup (SEL) from energetic ion strike, which will power down entire spacecraft until cleared.
- SEL cannot be cleared until sufficient discharge of battery.
- EPS redesigned to include overcurrent protection for SEL recovery.

Lesson Learned:
 Total dose affects overall lifetime, but Single Event Effects are a matter of probability.

Conclusions

Technological Readiness Level (TRL)



- **Design:** Spacecraft functions were capable of ensuring excellent power, link, and thermal margins, as well as 3-axis attitude control, two way communication, and return of flight data on orbit. Modifications to self-developed EPS necessary for single event latchup protection.

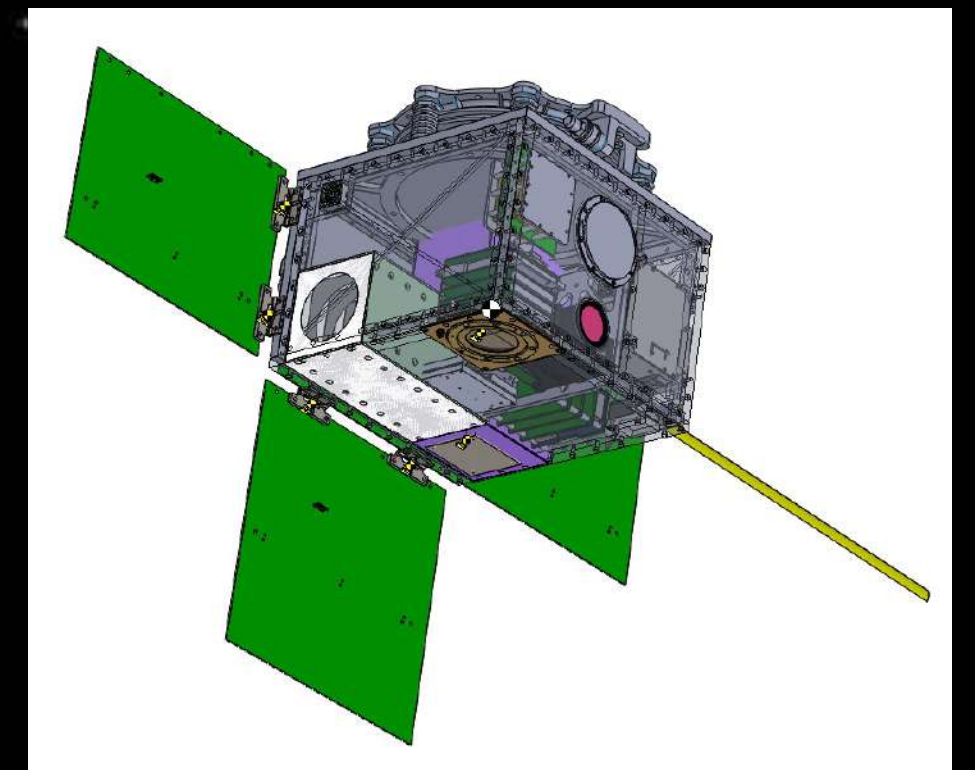


- **Workmanship:** Spacecraft survived launch environment, successfully activated and operated autonomously on orbit.

NCU self-developed avionics (on-board computer, electrical power subsystem, structure) are now flight tested and TRL 8 – 9.

Work being performed to improve robustness of self-developed avionics to allow for reliable operation over at least 1 year.

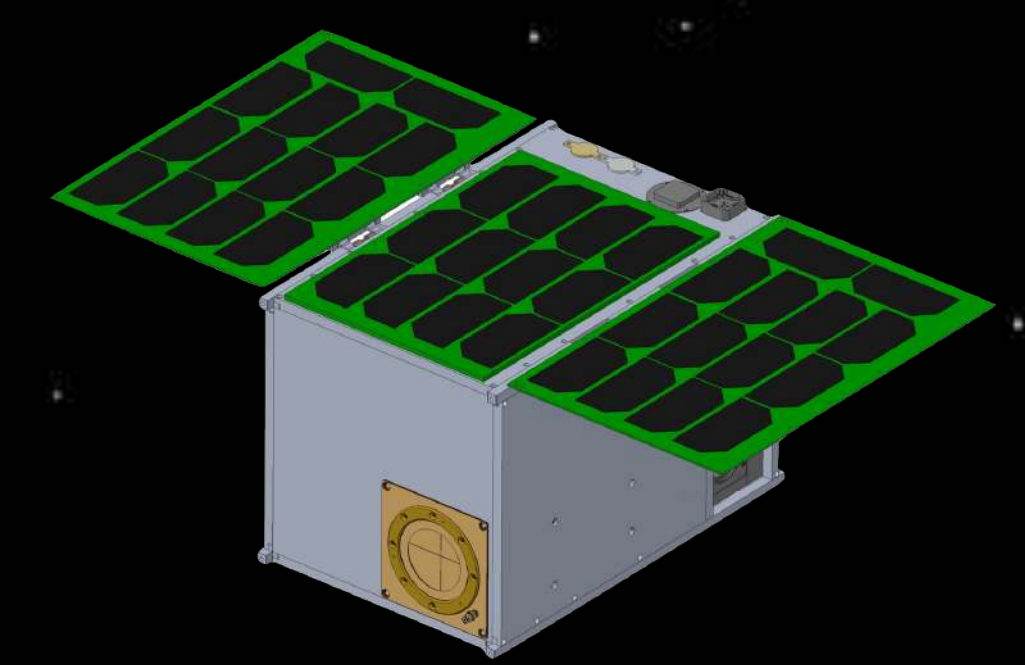
Our Spacecraft Fleet



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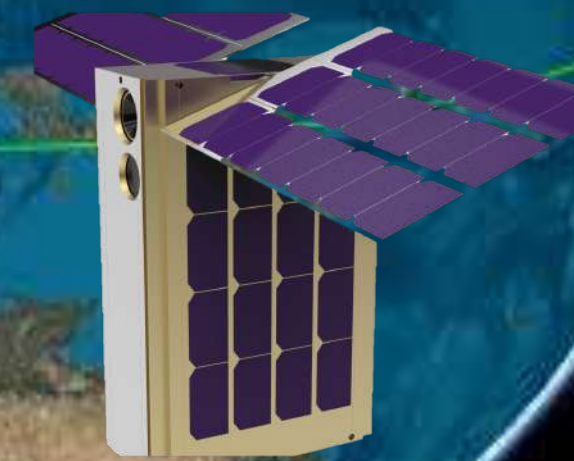
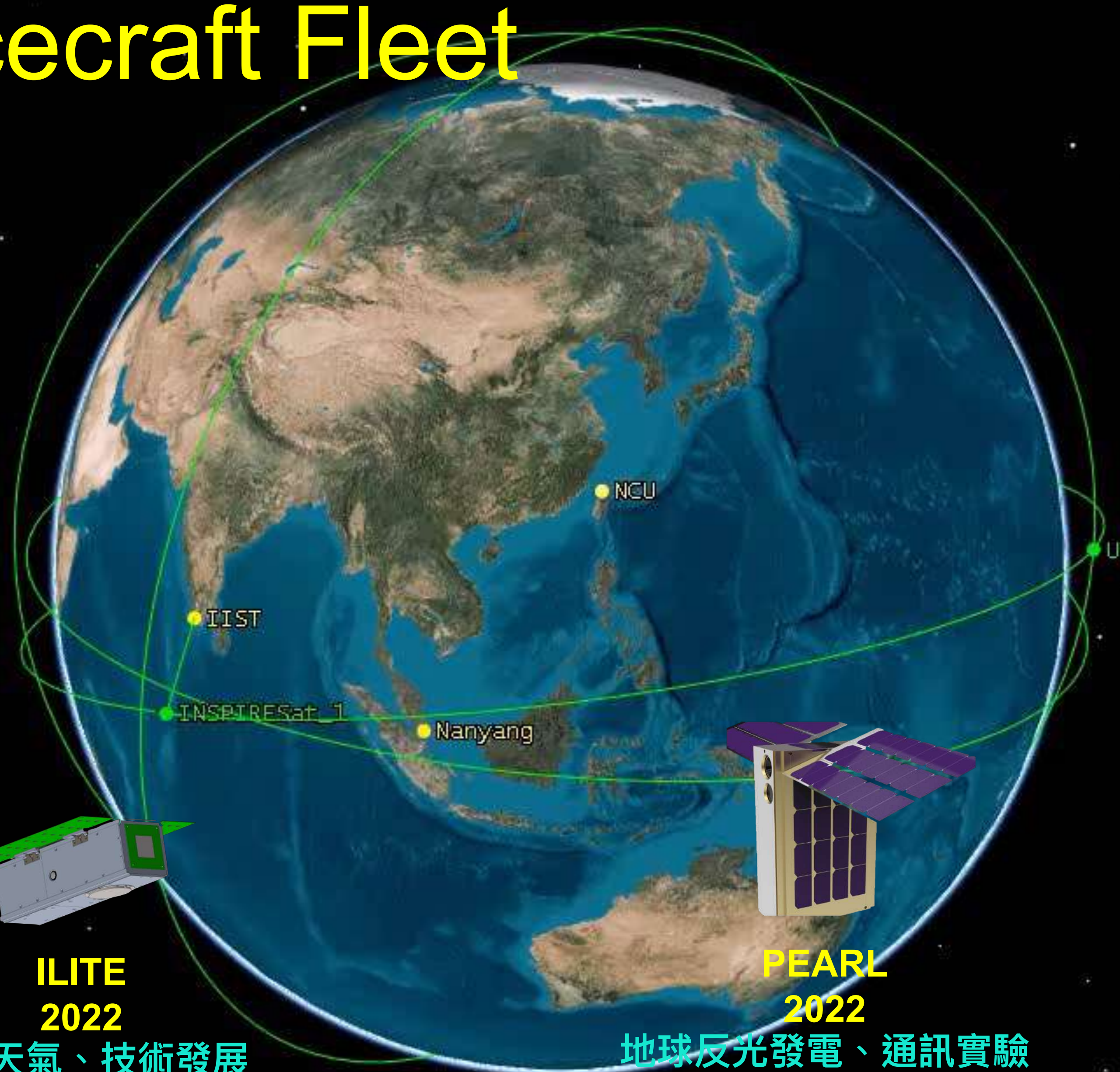
太空天氣、遙測、極低軌道
國際合作整合

UVSQSat



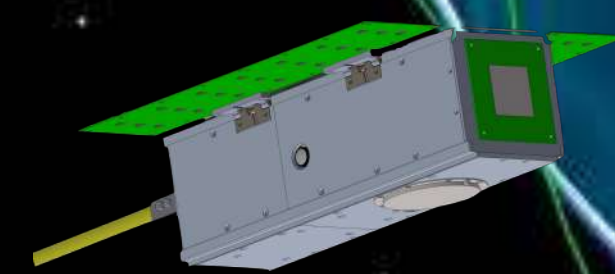
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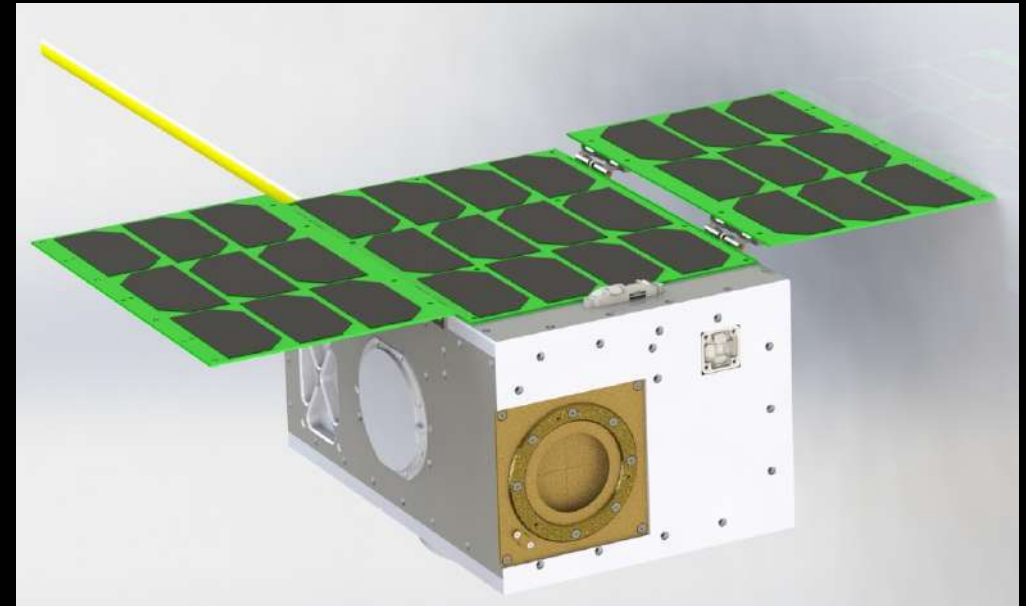
ILITE
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太空天氣、技術發展
自主整合



IDEASSat-1
2021

太空天氣、技術發展
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INSPIRESat-1
2022

太空天氣、技術發展
國際合作整合

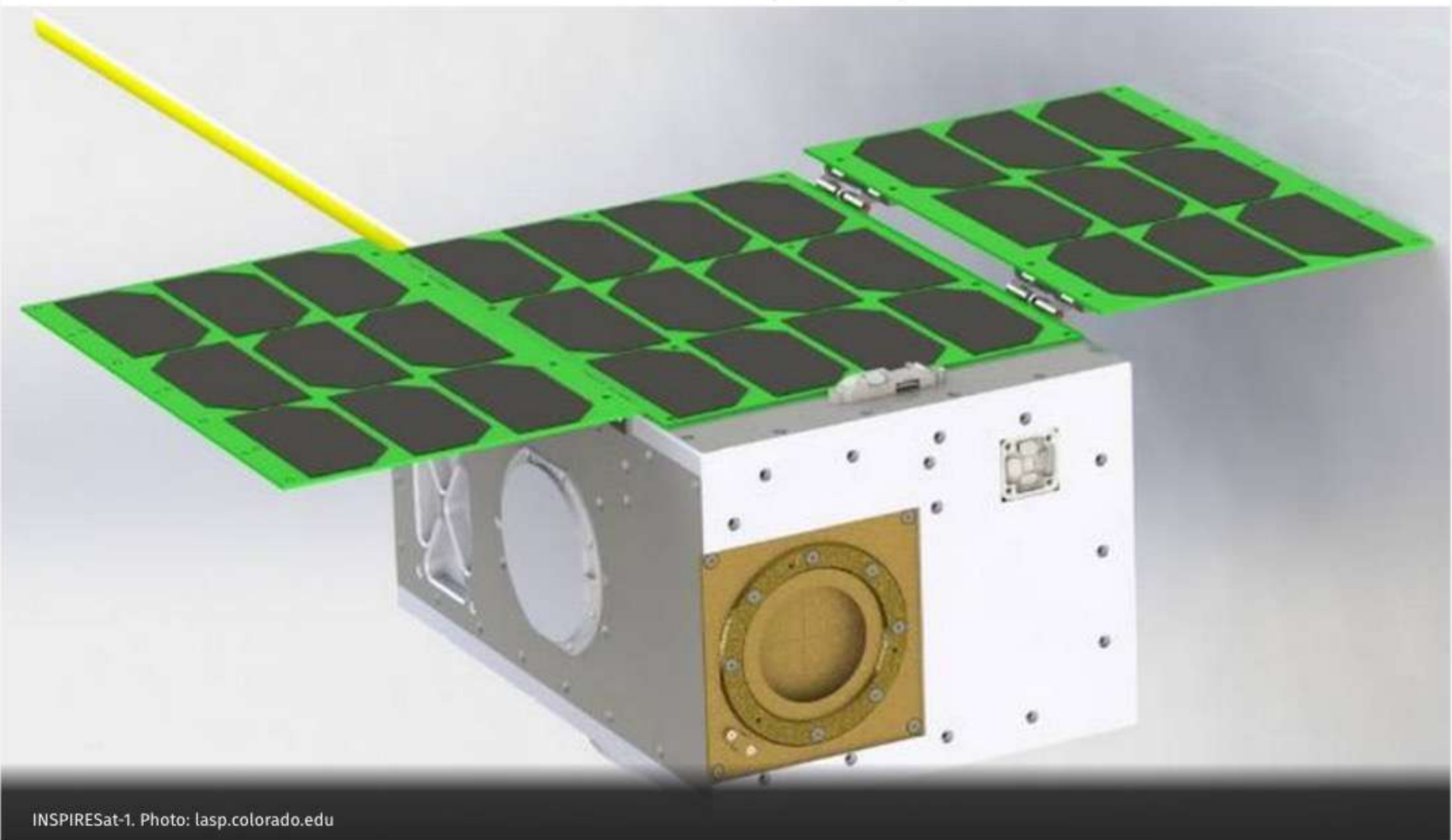


INSPIRESat-1 primed for launch, says Indian Institute of Space Science and Technology

Tiki Rajwi

THIRUVANANTHAPURAM, SEPTEMBER 04, 2021 19:02 IST
UPDATED: SEPTEMBER 04, 2021 19:18 IST

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INSPIRESat-1. Photo: lasp.colorado.edu

A collaborative effort by Laboratory for Atmospheric and Space Physics at the University of Colorado Boulder in the US, National Central University, Taiwan, Nanyang Technological University in Singapore and IIST, the small satellite is set to blast off aboard ISRO's upcoming PSLV mission

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Science Dravidian language family is 4,500 years old: study

Science CSIR-CCMB working on improving diagnostic methods to check for Omicron variant

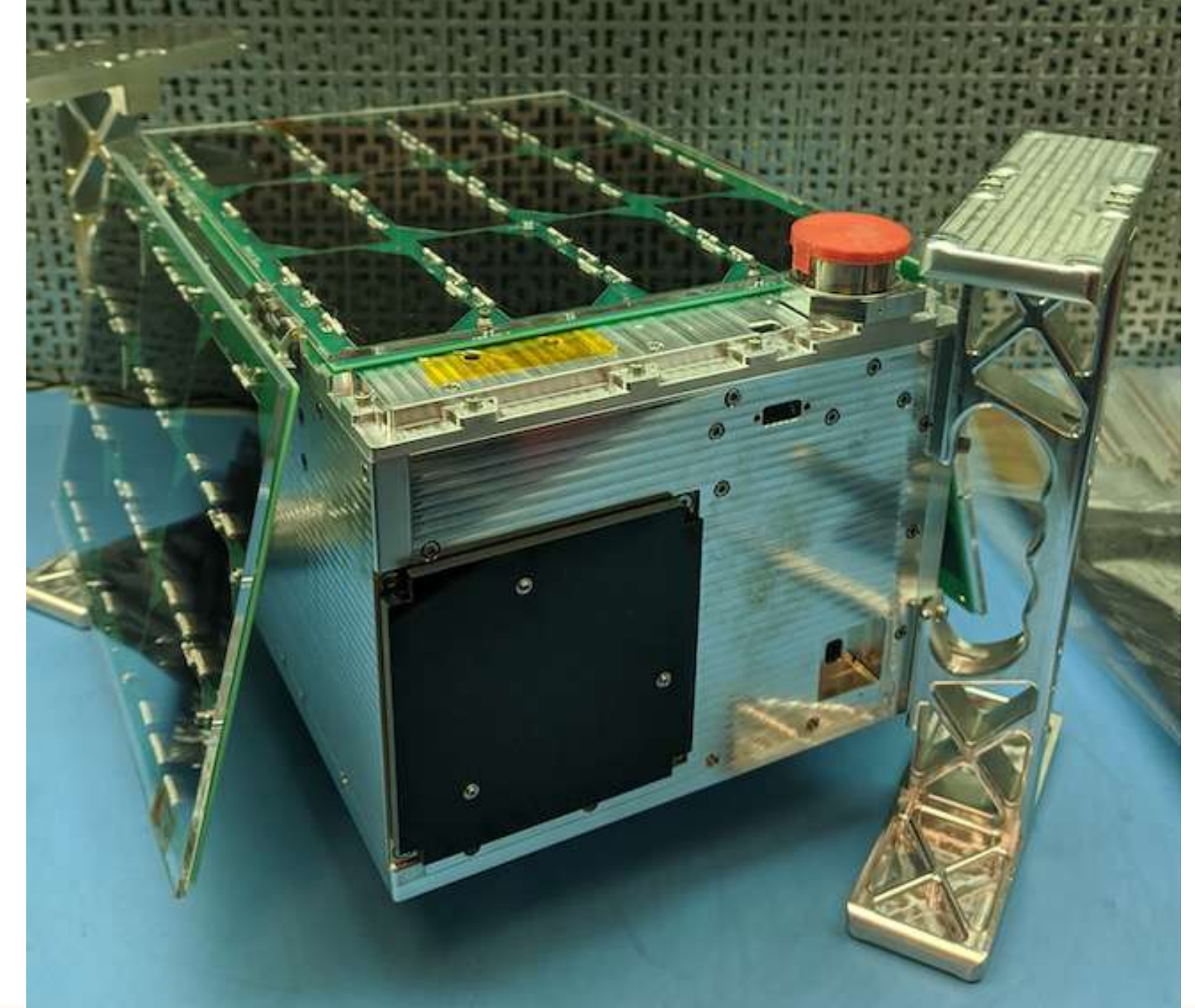
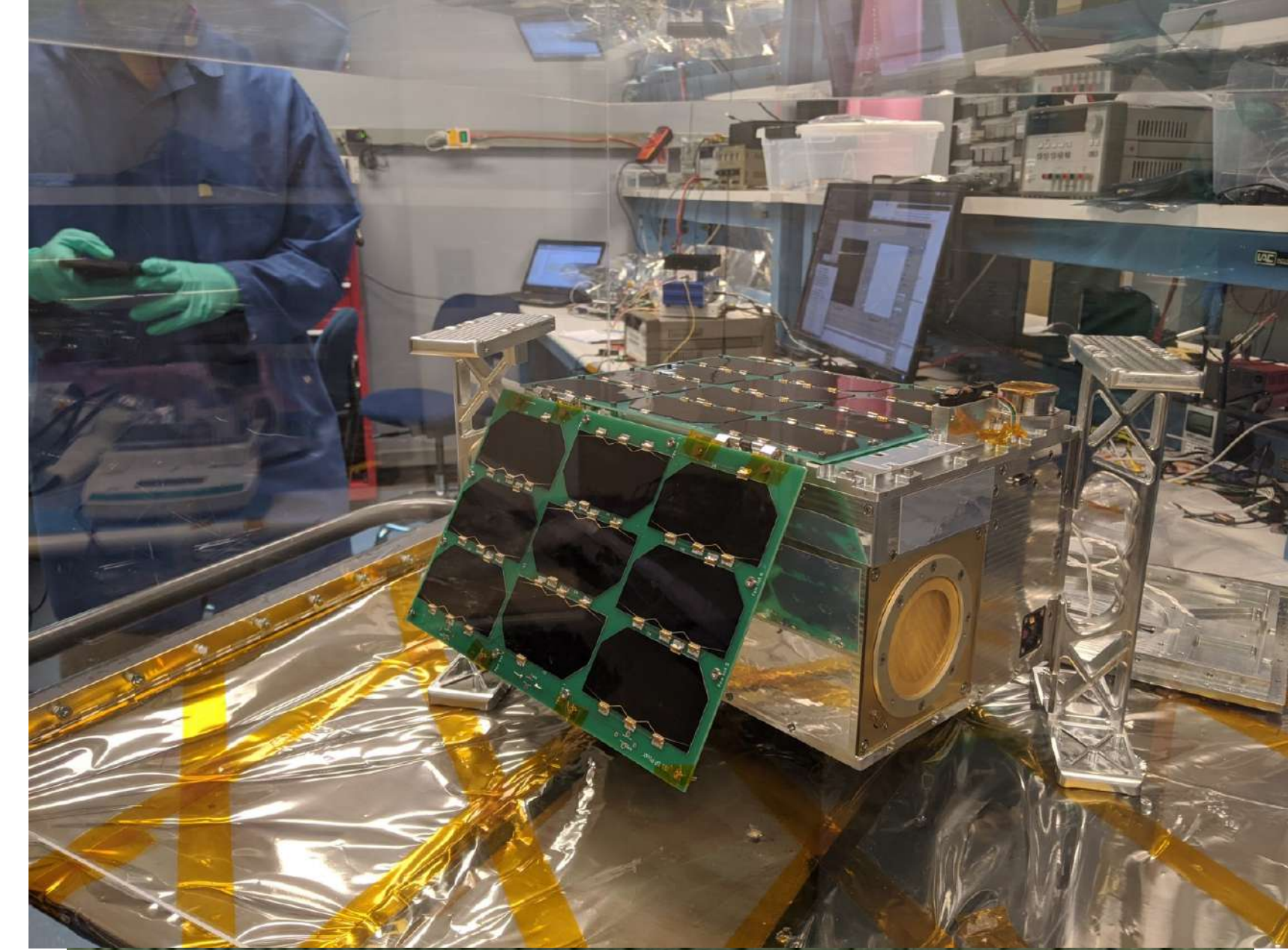
Science Was Omicron designated a variant of concern in haste?

Science The legacy of Srinivasa Ramanujan

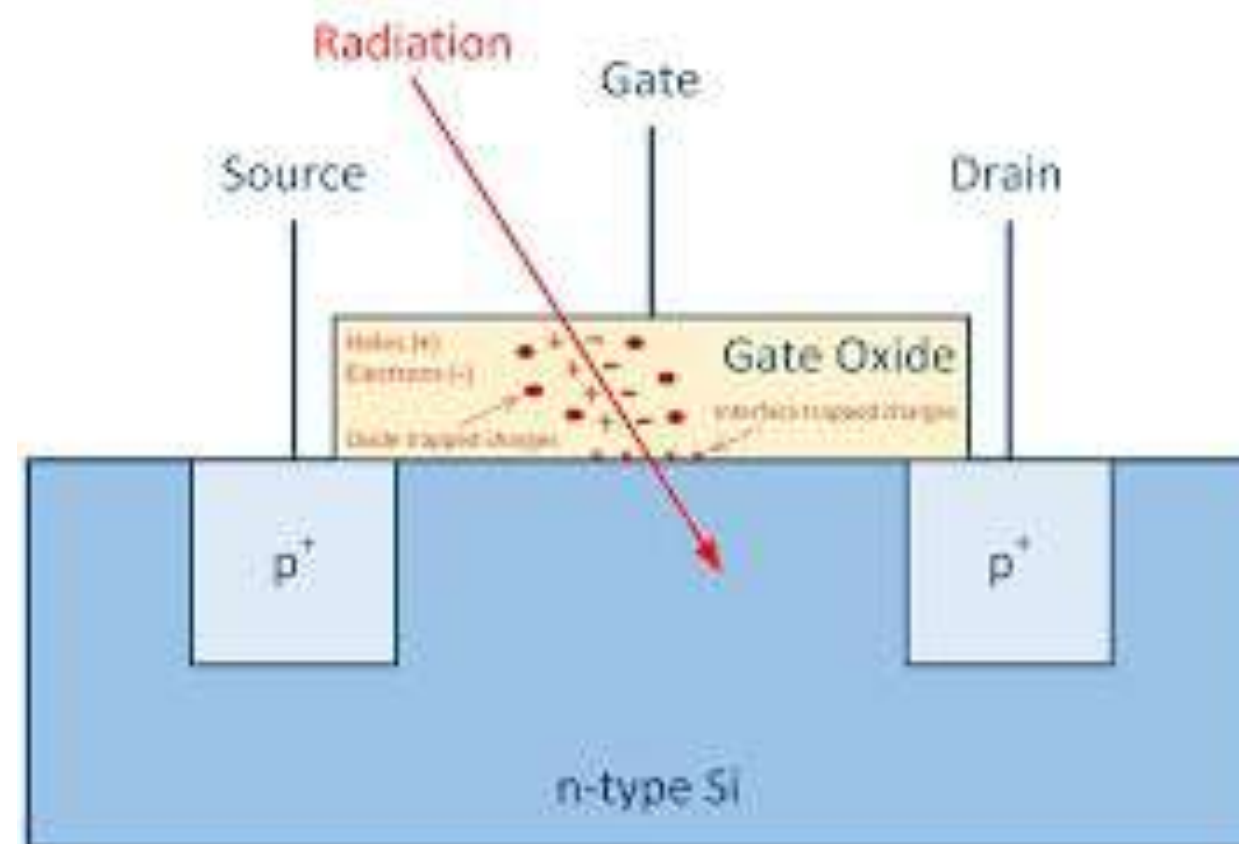
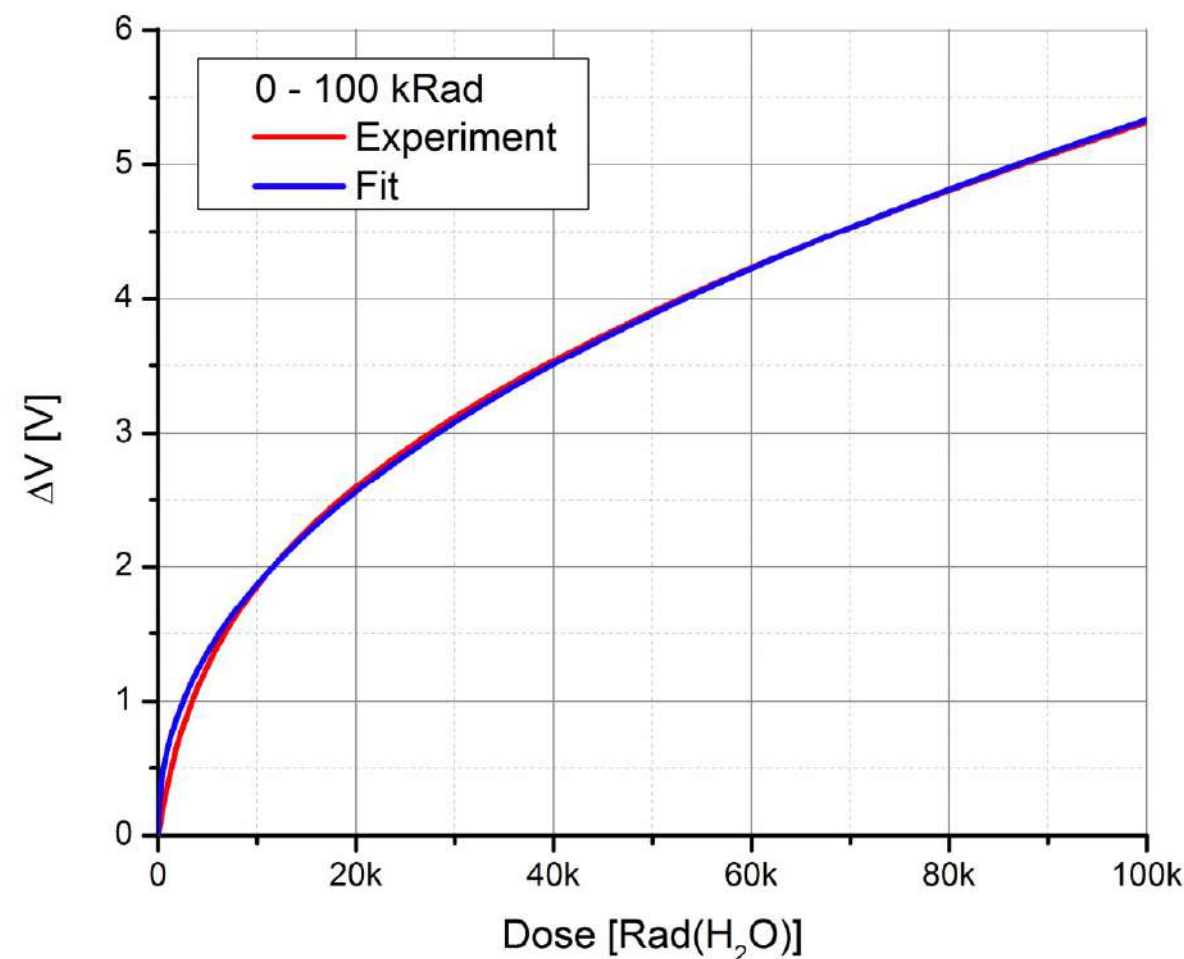
Science Science Quiz: On the Sun

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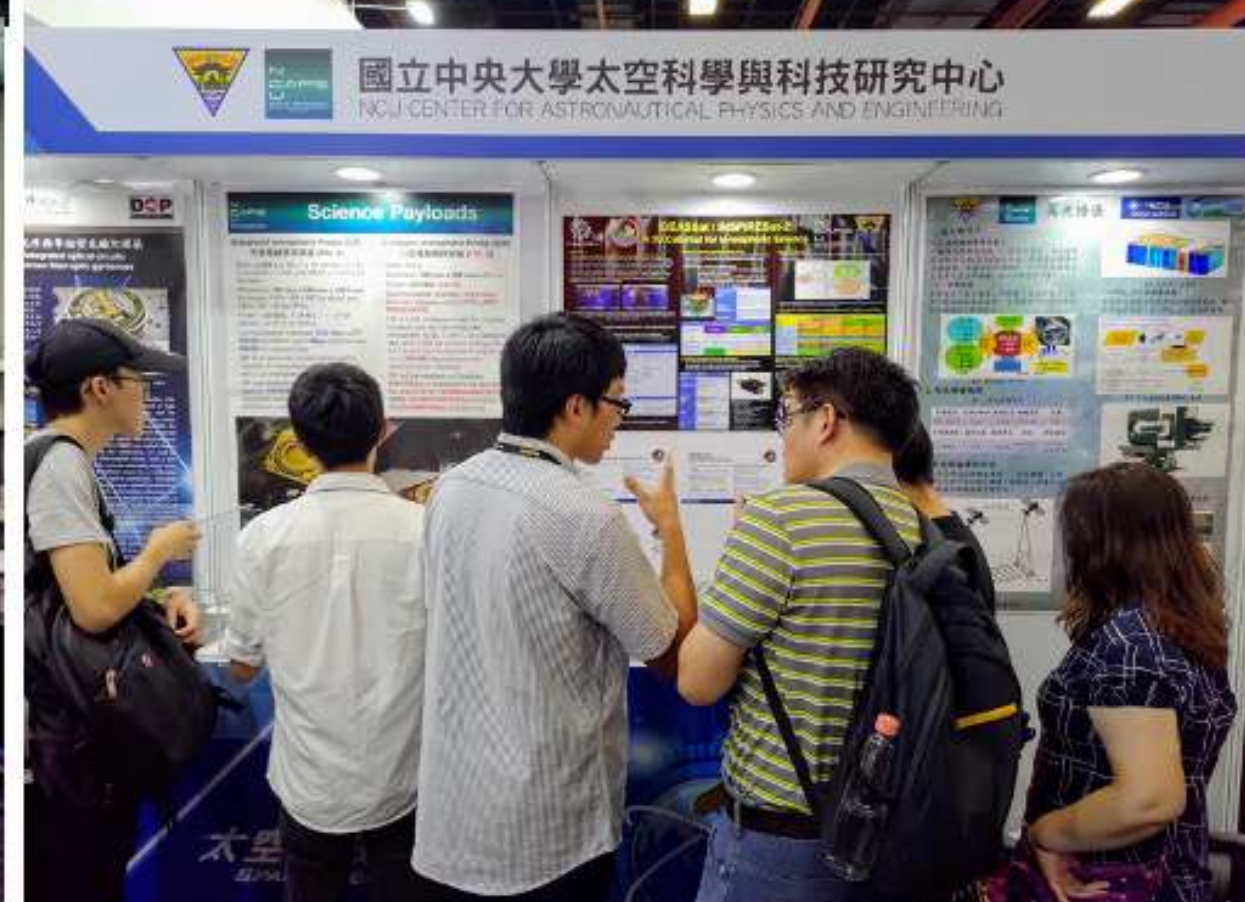
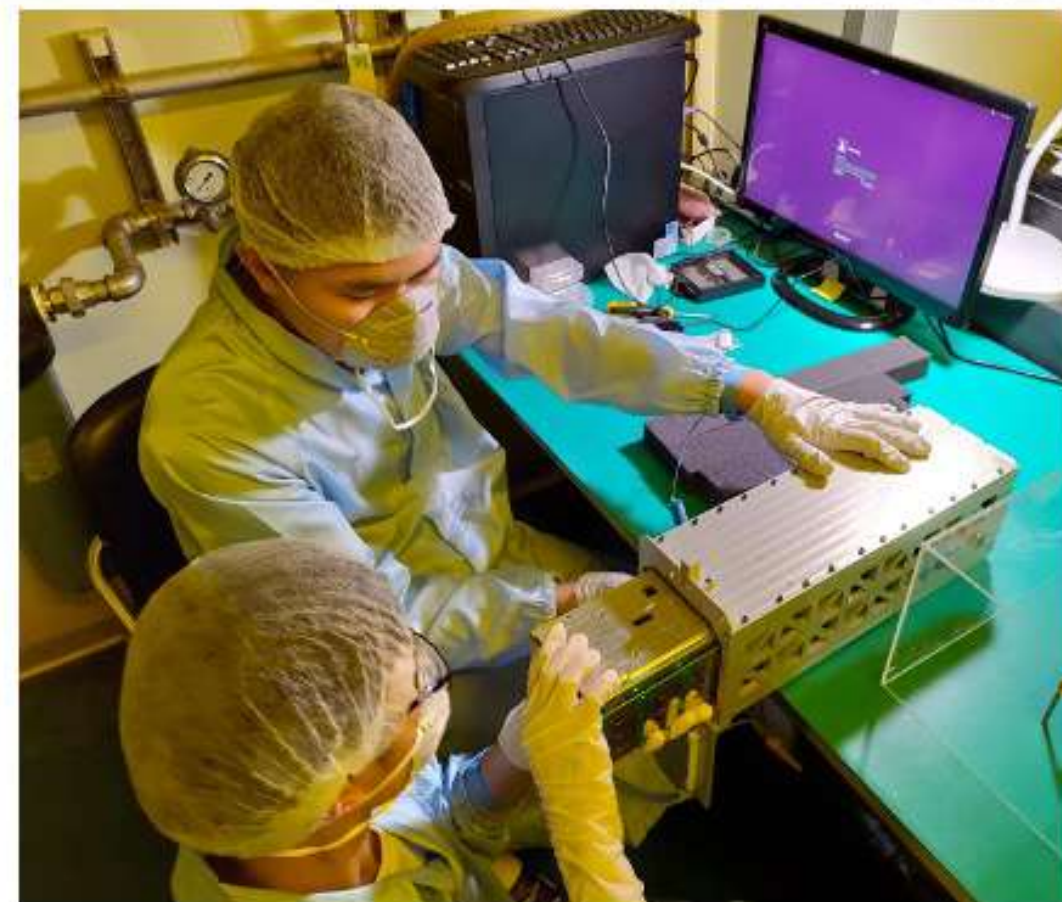
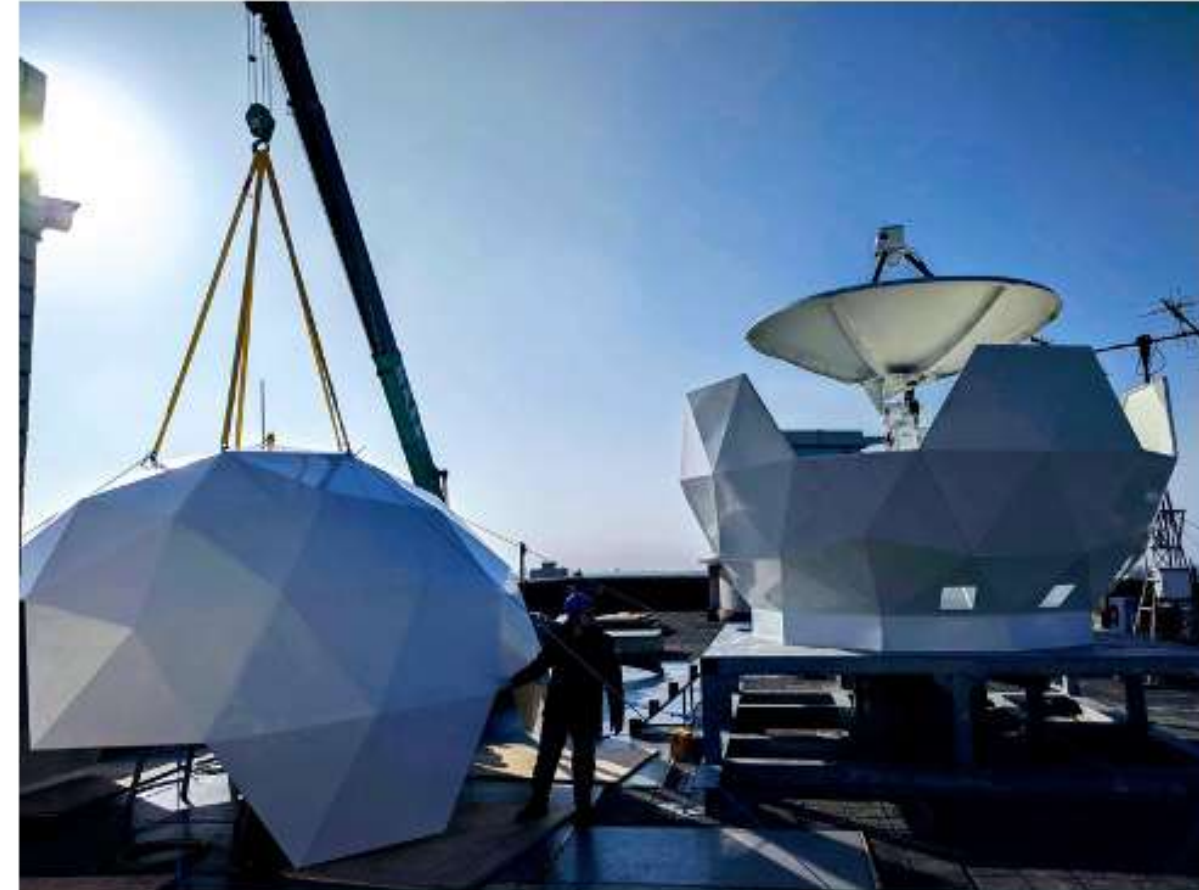
Taiwan's First Lunar Landing Opportunity



- Partnership with HelioX Cosmos (陽翼先進科技) and SpaceBD to participate in lunar orbiter and landing mission.
- Developing Deep Space Radiation Probe radiation dosimeter payload to measure deep space radiation environment and provide hands-on learning opportunity to students, leveraging IDEASSat avionics development experience.
- Launch: 2023 Q4.

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References

- SMC-S-016, Air Force Space Command, SPACE AND MISSILE SYSTEMS CENTER STANDARD TEST REQUIREMENTS FOR LAUNCH, UPPER-STAGE AND SPACE VEHICLES:
<https://apps.dtic.mil/sti/pdfs/ADA619375.pdf>
- JESD57A: Test Procedures for the Measurement of Single-Event Effects in Semiconductor Devices from Heavy Ion Irradiation: <https://ntrs.nasa.gov/api/citations/20160014892/downloads/20160014892.pdf?attachment=true>
- MIL-STD-1541A, Electromagnetic Compatibility Requirements for Space Systems.
- MIL-STD-883-1 TM1019.9, Test Method Standard for Microcircuits.
- NASA Electronic Parts and Packaging Program:
<https://nepp.nasa.gov/>
- NASA GSFC-STD-7000, GENERAL ENVIRONMENTAL VERIFICATION STANDARD (GEVS) For GSFC Flight Programs and Projects:
<https://standards.nasa.gov/standard/gsfsc/gsfsc-std-7000>
- NASA MSFC-SPEC-1238, THERMAL VACUUM BAKEOUT SPECIFICATION FOR CONTAMINATION SENSITIVE HARDWARE:
<https://standards.nasa.gov/standard/msfc/msfc-spec-1238>
- NASA/TP—20210021263: State-of-the-Art Small Spacecraft Technology:
https://ntrs.nasa.gov/api/citations/20210021263/downloads/2021_SOA_final_508_updated.pdf