PACE

Platform for Attitude Control Experiment

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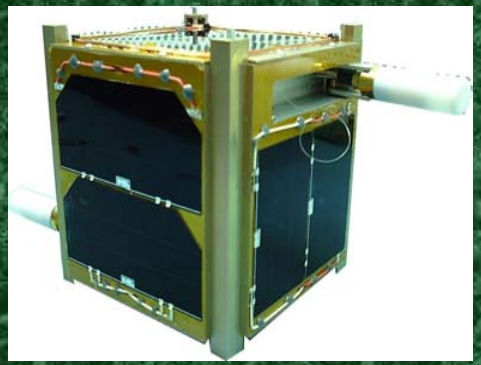
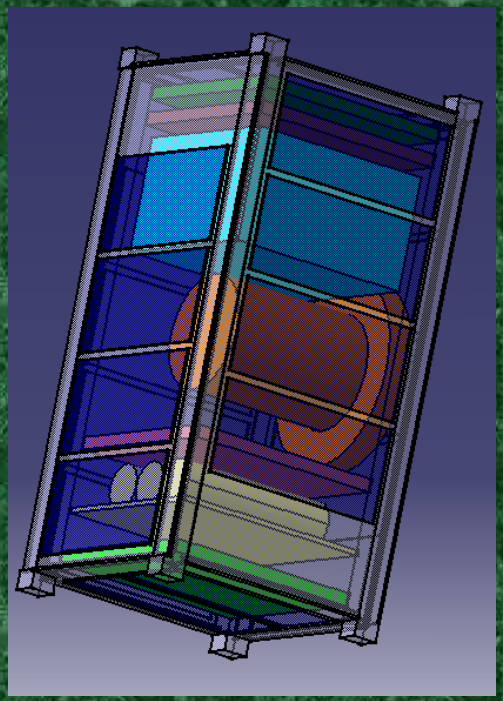
PACE website: www.iaalab.ncku.edu.tw/pace/

Introduction

- Significances of cubesat research
- Cubesat research in Taiwan
  - NSPO: YAMSAT (2001-2002)
  - NCKU: PACE (2003-)





PACE Features

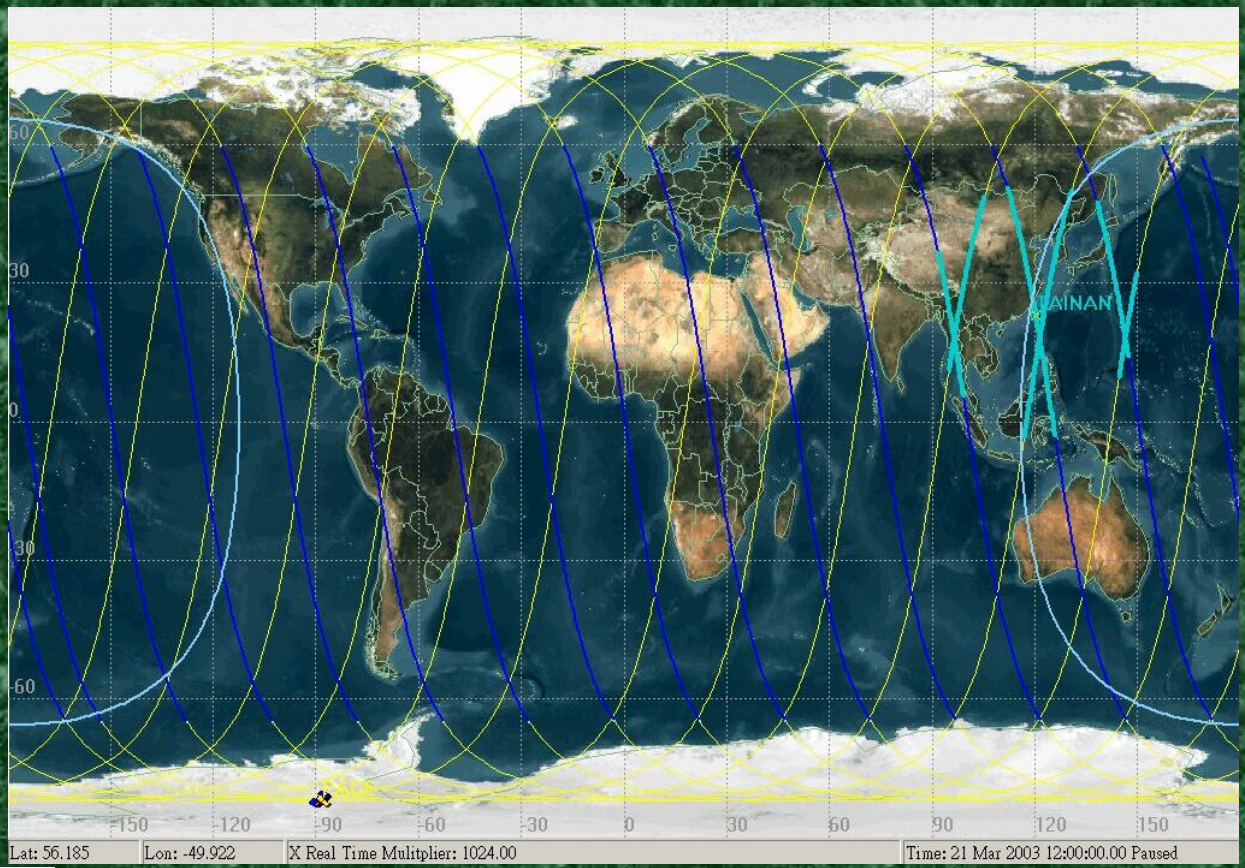
- Mass: Less than 2 kg
- Dimension: 100 x 100 x 200 mm
- ADCS Requirement : 3-axis stabilization
- Payload: MEMS temperature sensor
- Dual on-board CPUs
- TCS: Passive thermal control
- Operating Orbit (TBD):
  - Near-circular orbit 600 km , inclination 98º
- TT&C: Amateur Radio Communication;
  - Up/Down link: 433MHz , Data Rate: 1200bps
  - CW: 144 MHz band
- Power: Body mount solar array & Li-ion battery
- Satellite Life Time 2 months
- Launch Scheduled 2004-2005

Characteristics of the PACE

- A double cube design
- Three-axis stabilization for pico-satellites
  - Momentum biased wheel + magnetic coil
  - Sensor suite integration for attitude determination: magnetometer, gyro, coarse sun sensor
- Two CPU design
  - 8051-based CPU: C&DH and ADCS
- MEMS sensor technology demonstration
  - Temperature sensor
  - Coarse sun sensor

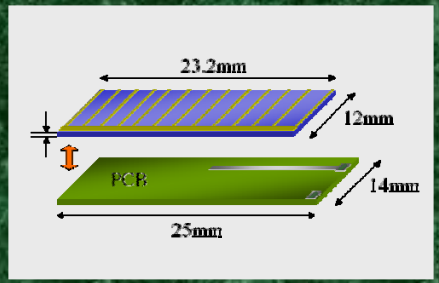
PACE Orbit

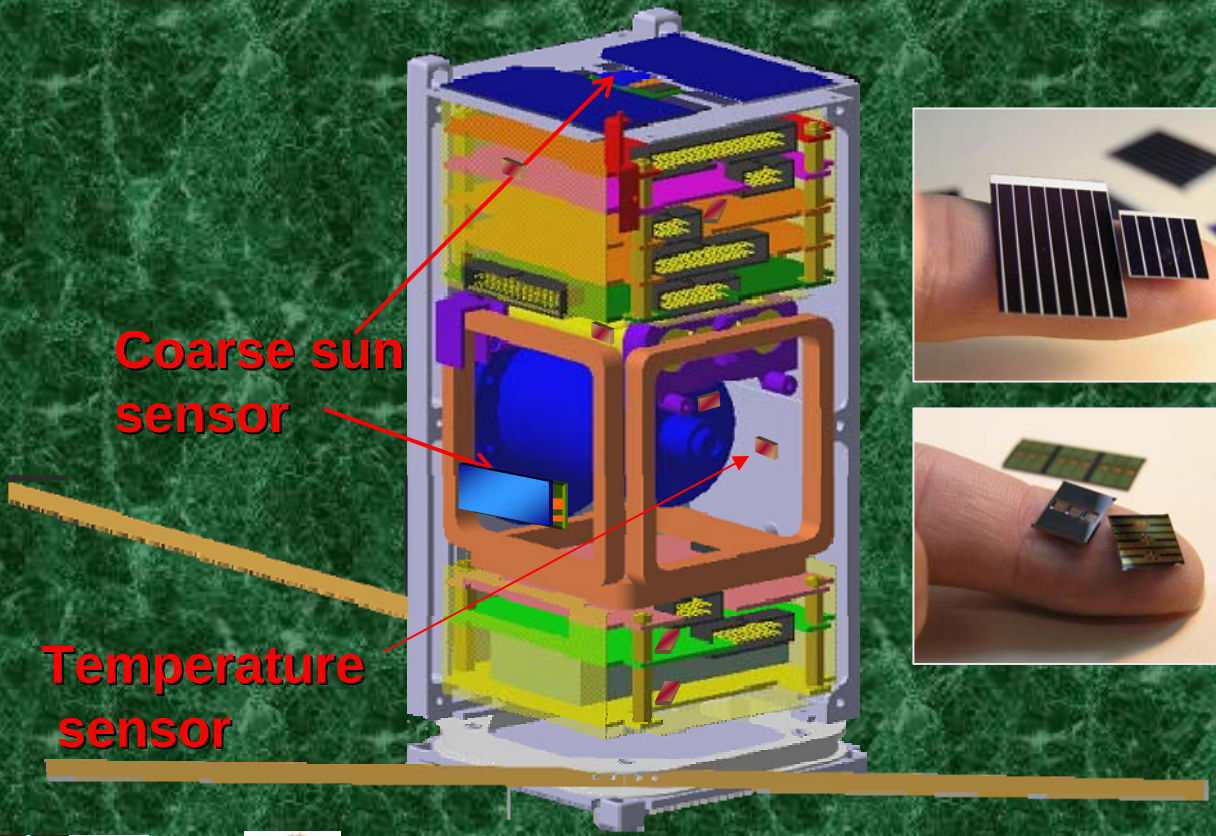
- Orbit altitude = 600 km, inclination = 97.79º
- Period = 96.69 min, mean contact duration = 657sec

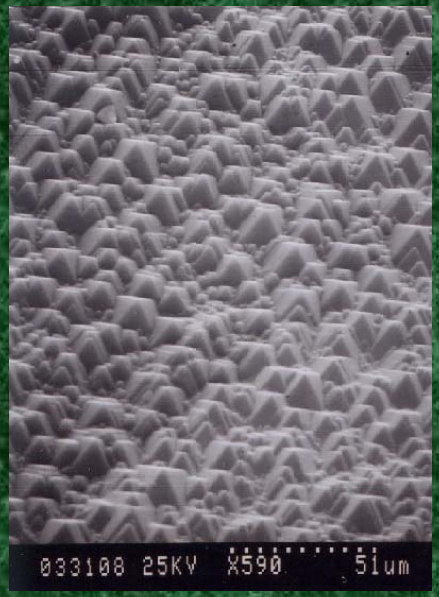


PACE Payload

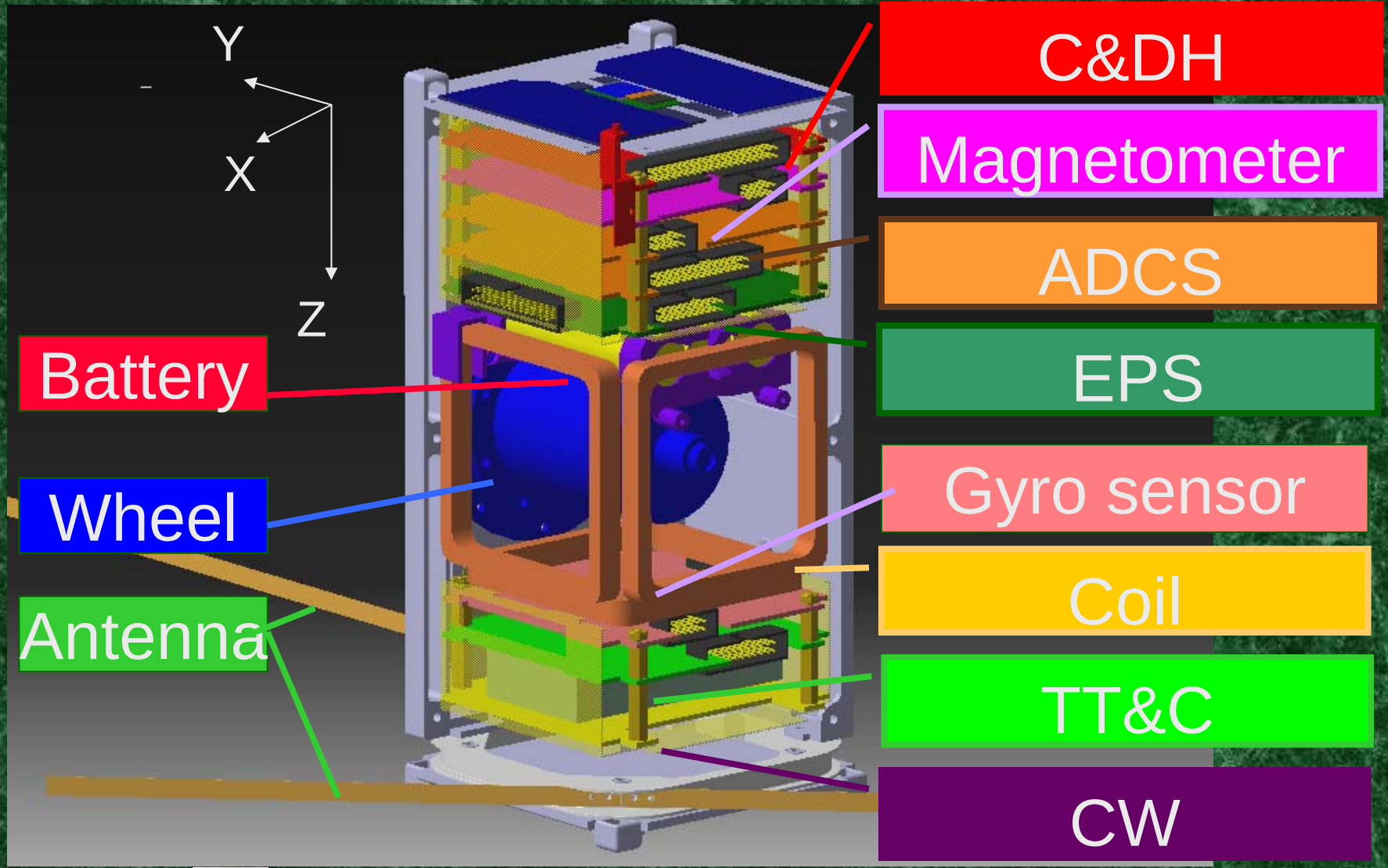
- PACE payload: MEMS sensor
  - Temperature sensor
  - Coarse sun sensor



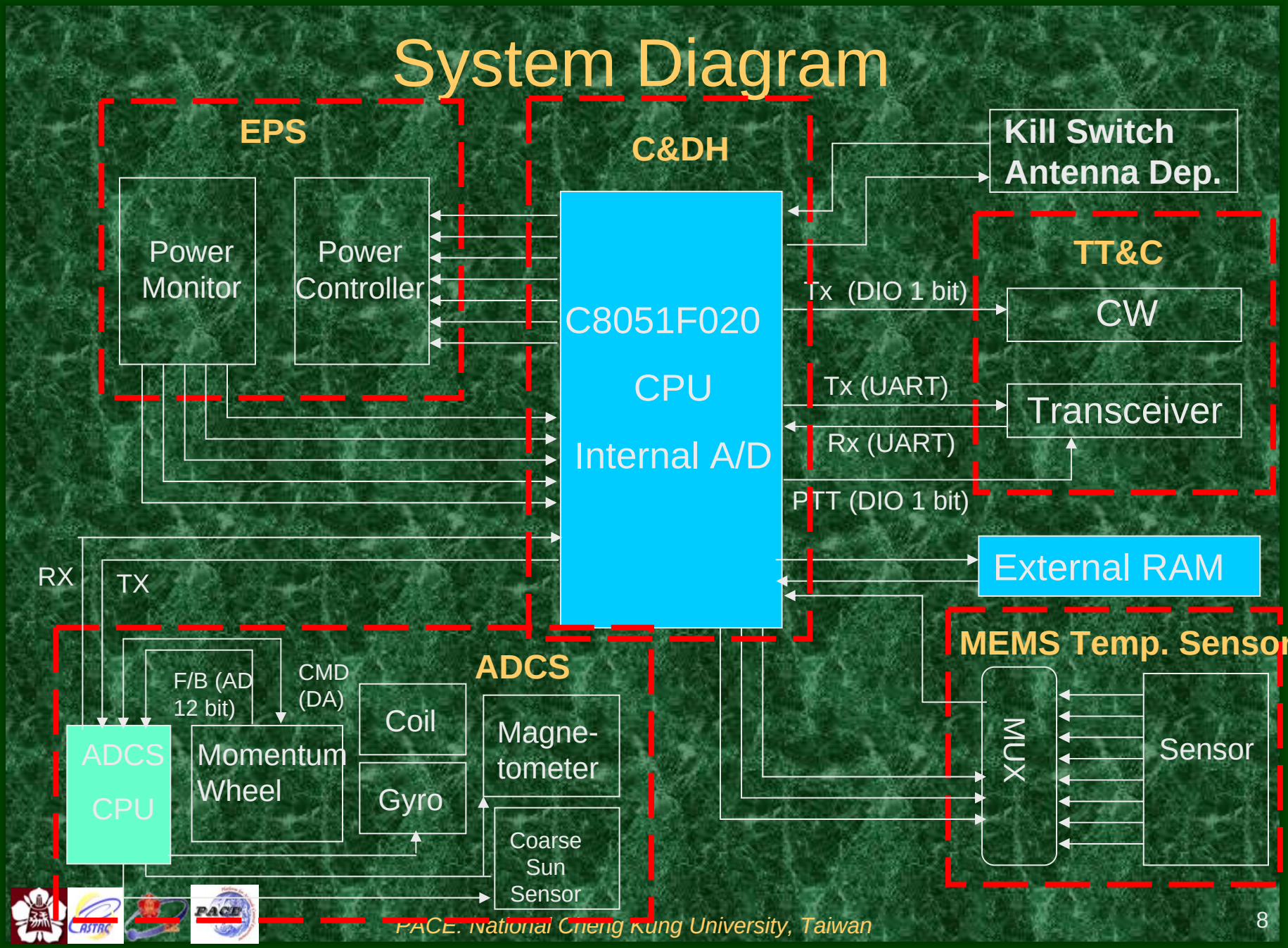




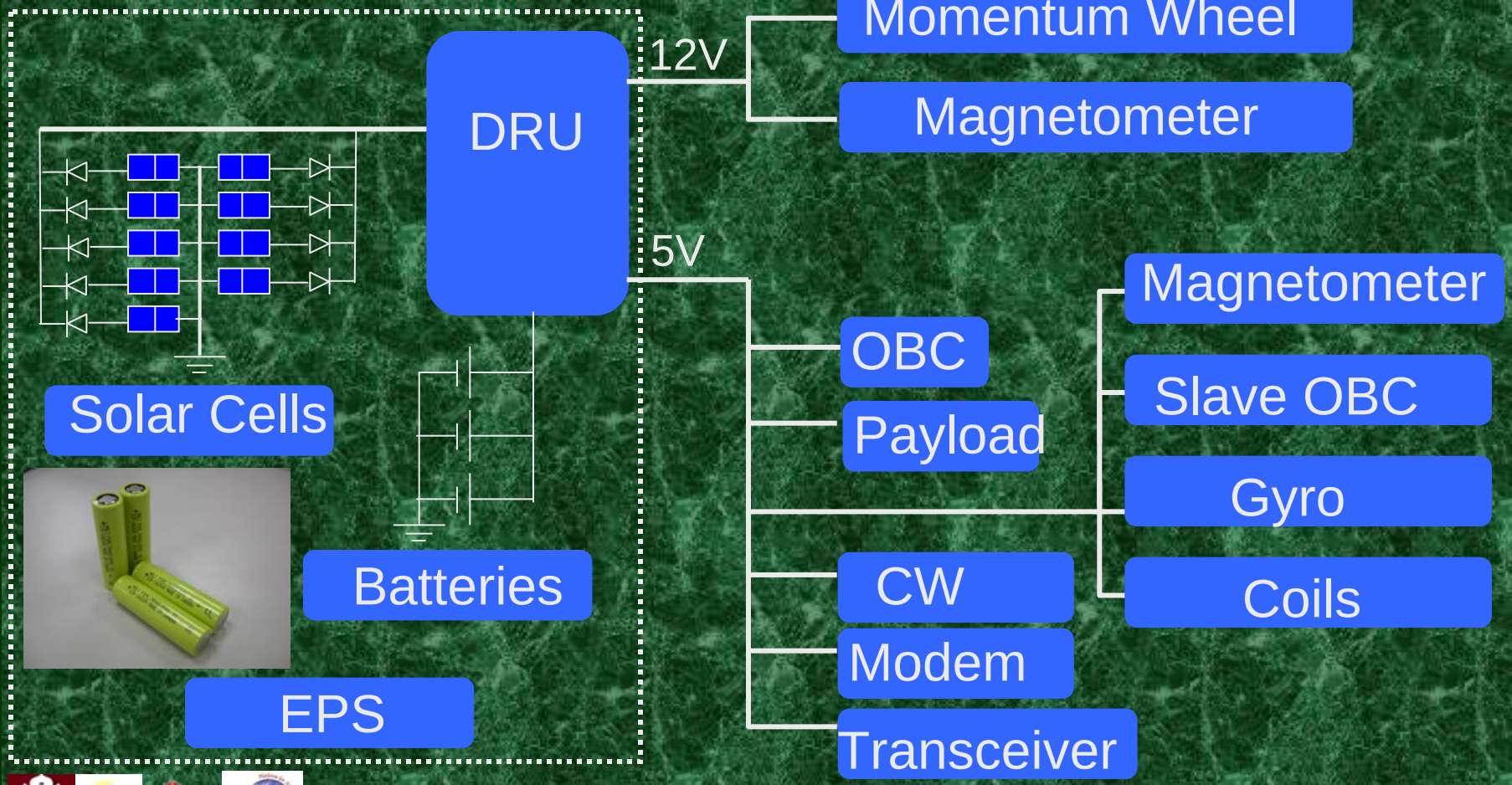
PACE Configuration



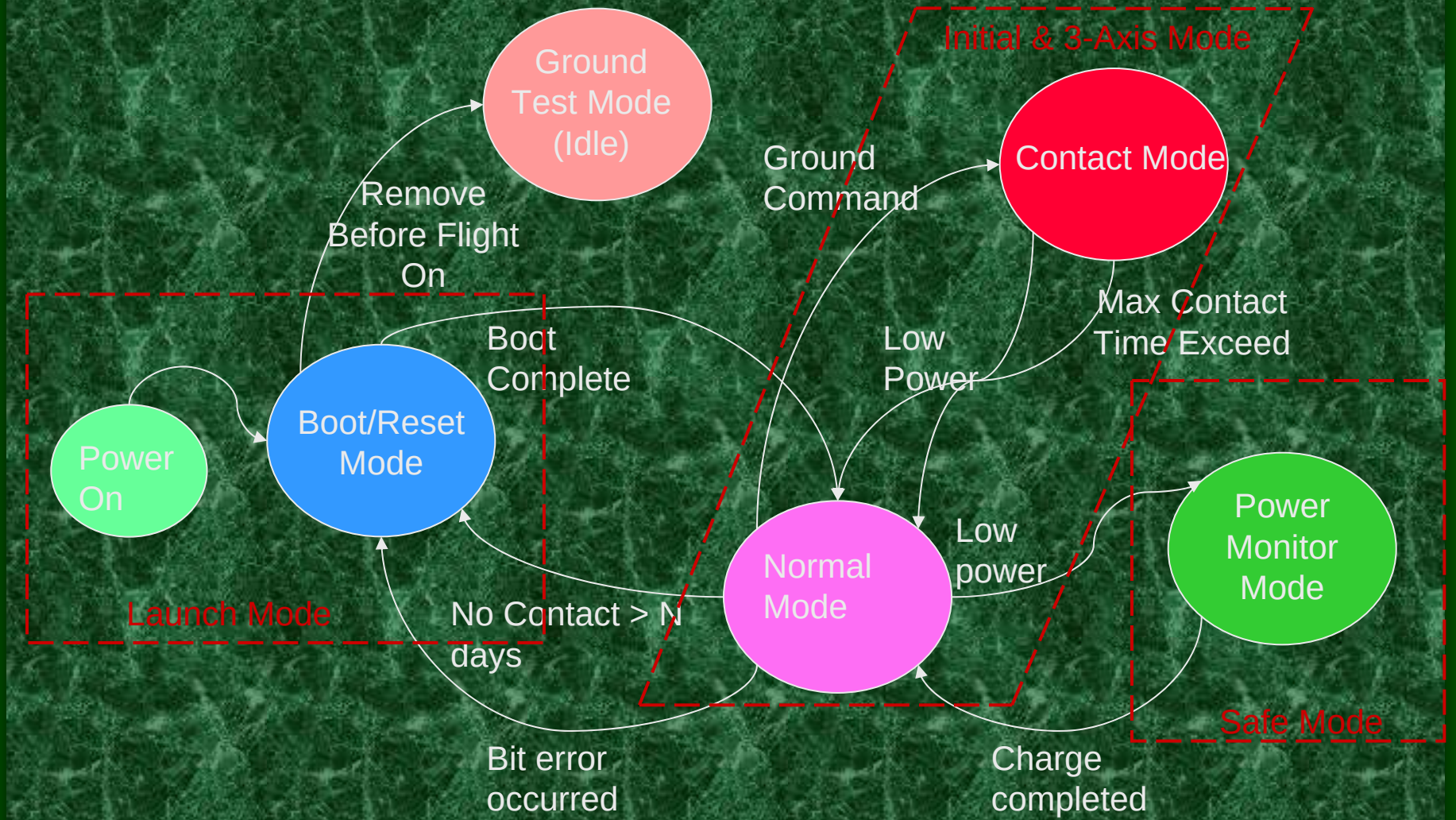
System Diagram



EPS

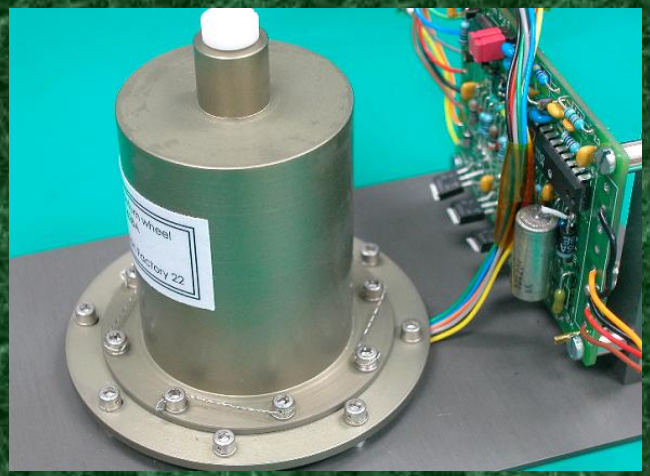

DRU
12V
5V
Momentum Wheel
Magnetometer
Solar Cells
Batteries
EPS
OBC
Payload
CW
Modem
Transceiver
Magnetometer
Slave OBC
Gyro
Coils

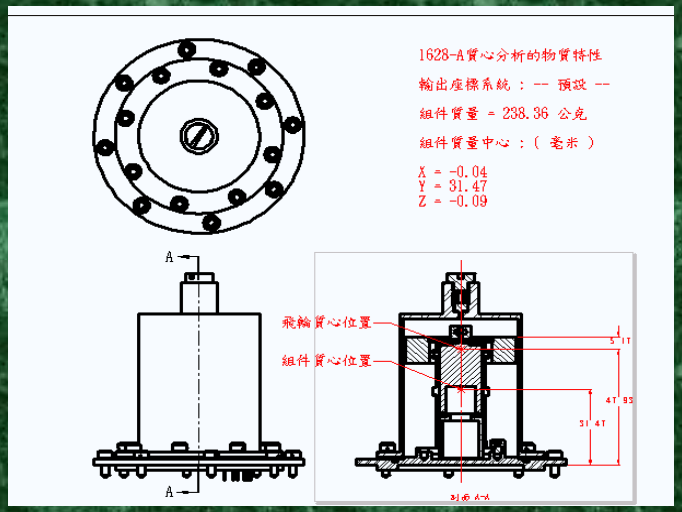
PACE Operating Mode

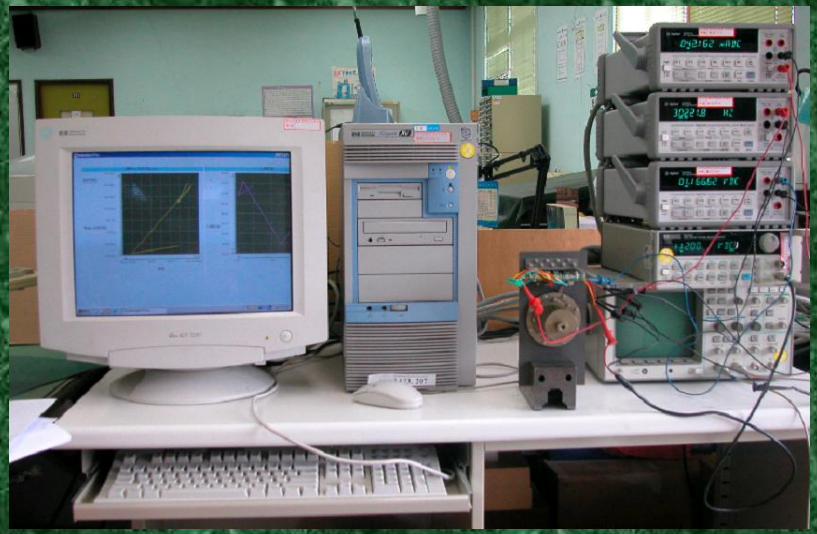


Momentum Wheel

- A momentum wheel is developed for the 3-axis control of the PACE.







PACE ADCS

Orbit information

IGRF Model

Magnetometer

Gyro

Coarse Sun Sensor

Attitude Determination Kalman filter

S/C Dynamic

Disturbance Torque

Attitude Control System

ω_Body

Φ, θ, Ψ

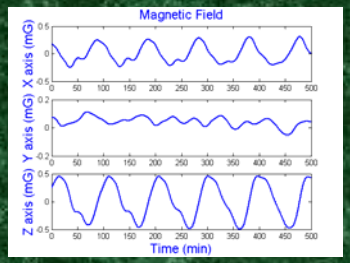
B_Body

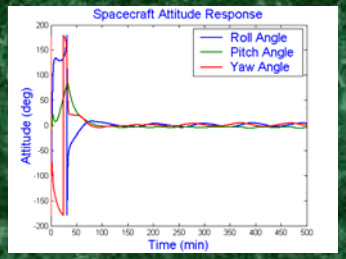
ω_measured

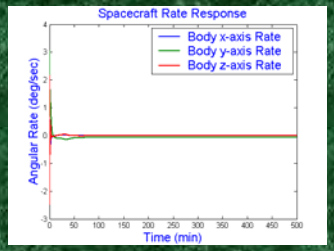
Θ_measured

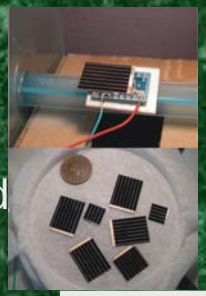
ω_estimated

Θ_estimated









Summary

- Taiwanese Cubesats

Cubesat	YAMSAT	PACE
Development	2001-2002	2003-
Developer	NSPO	NCKU
Size/Weight	Single cube, 1 kg	Double cube, 2 kg
Technology demonstration	system engineering	3-axis control
C&DH	One CPU	Two CPUs
Payload	Microspectrometer	MEMS temp sensor

Thank you