



# S-1 Rocket Program

~the final stage in 2011~

**Team Kansai Rocket Club**

# Contents

- ☆ Summary of the S-1 Rocket Program
- ☆ Result and analysis of experiments
- ☆ Conclusion




### Propose of the experiments

The primary propose is **to identify the new leader and cultivate younger engineers throughout three years.**

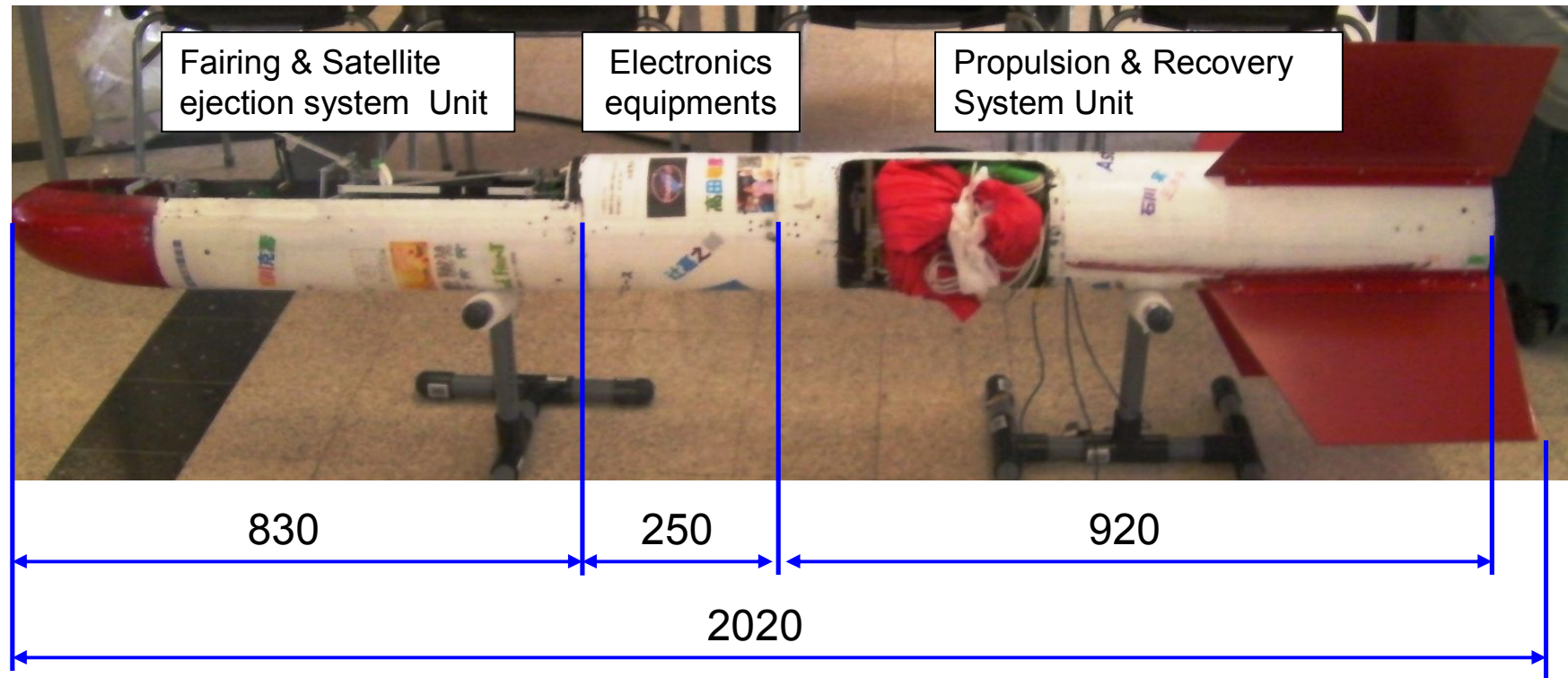
As to techniques, the purpose are as follows:

1. Deployment of 3 Sat and recovery them safety
2. Recording the Sensors (Acceleration, Video) in the Rocket.
3. Experiment of Internal Communication of the Rocket with the Xbee Wireless Modules.

## History of S-1 Rocket since 2009

	2009(S-1)	2010(S-1A)	2011(S-1A)
Basic Concept	as previously noted	as previously noted	the same as in 2010
Missions	1.Deployment of 3 Sat 2.Recording sensors data (GPS, Acceleration, Video, and Camera) in the Rocket.	1.Deployment of 3 Sat 2.Recording sensors data (GPS, Acceleration, Video, and Camera) in the Rocket. 3.Experiment of Internal Communication of the Rocket with the Xbee Wireless Modules 4.Installation of SH3 into the Rocket, the Microcomputer Unfamiliar to TKRC but High Performance.	1.Deployment of 3 Sat 2. <b>Recording sensors data (Acceleration, Video) in the Rocket.</b> 3.Experiment of Internal Communication of the Rocket with the Xbee Wireless Modules.
figures			
Results	Nominal!! ( Missions are not completed)	Could not be launched	Try again!!

## The external view of S-1A



### System configuration of S-1A

Total length : 2m

Total weight : less than 13.0kg

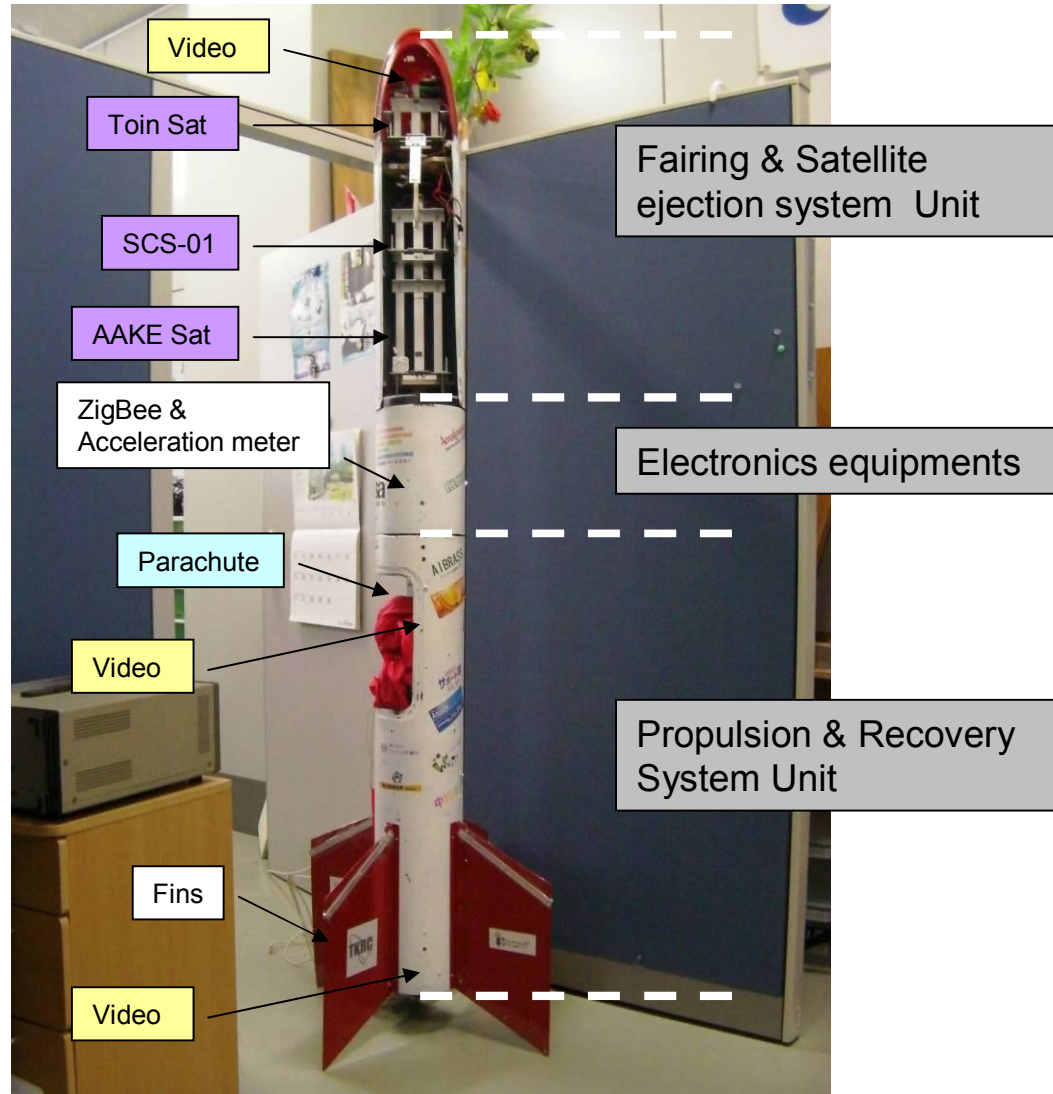
Payload : less than 3kg (three satellites)

Nose : GFRP

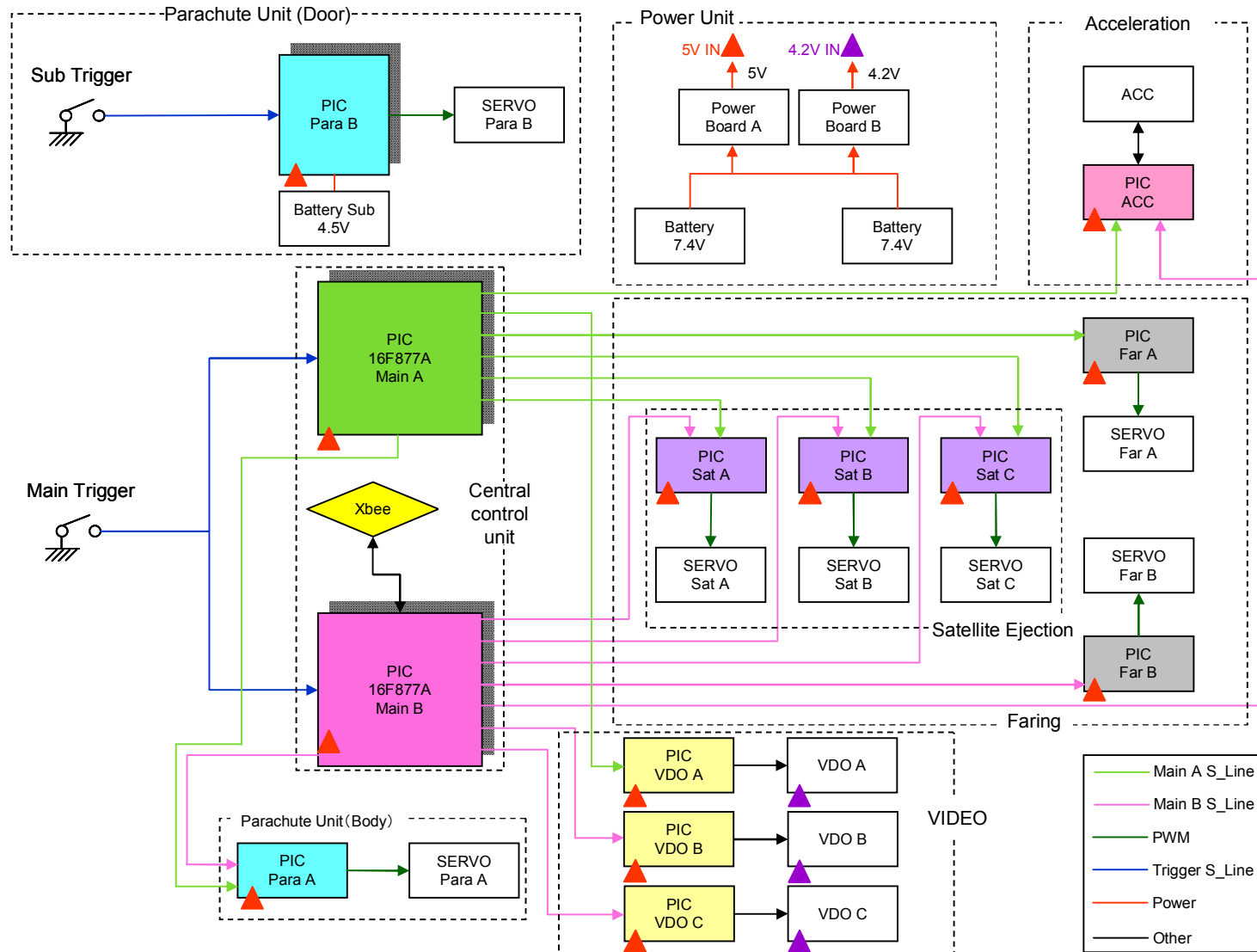
Body : CFRP

Fins : CFRP (t=2)

## Specifications of S-1A



## Block Diagram



# Mass Properties

name	distance from the top(mm)	mass (kg)	momentum (mm*kg)
Nose	90	0.50	45
Toin Sat	90	0.50	45
Souki Cube Sat	180	0.50	90
AAEK Sat	360	1.00	360
Electric component	425	0.70	298
Body tube	1000	3.90	3900
Parachute	665	2.00	1330
Fins	1500	0.90	1350
Motor (mount)	1700	2.68	3400
total	978	12.68	10818



## Stability Analysis

### STABILITO

Language: English

Rocket	
Name	Maiko-han
Club	TKRC
Type	Experimental Rocket
Weight	11 kg without motor
Center of Mass	1055 mm without motor
Total length	2000 mm

Nose Cone	
Height	260 mm
Shape	Parabola (rounded)
Diameter	180 mm
Ref. Diameter	180 mm

Skirt/Shrink 1		Skirt/Shrink 2	
L			
D1			
D2			
Basement			

Fins	
m	400 mm
n	280 mm
p	120 mm
E	240 mm
Thickness	2 mm
Number of fins	4
Basement	1660 mm
Diameter at Fins	180 mm

Motor	
Type	8 : Pro54-5G (e)
Basement	1515 mm
Thrust	800 N
Total Impulse	2060 N.s

Launch Pad	
Length	4 m
	53 m/s <sup>2</sup>
	0.4 s

	Loaded Motor	Empty Motor	Without Motor
Motor Mass	1.68 kg	0.69 kg	-
Motor CoM	250 mm	240 mm	-
Rocket Mass	12.68 kg	11.69 kg	11 kg
Rocket CoM	1149 mm	1096 mm	1055 mm

	XCp	Cnα
Fins	1802 mm	16.2
Nose Cone	130 mm	2.0
Skirt/Shrink 1	0 mm	0.0
Skirt/Shrink 2	0 mm	0.0

Stability for rocket with fins  
Version 2.2 single-fin stage  
Fill-in yellow cells only

Criteria	Experimental Rocket	
Lift-Off	20 m/s	-
Finesse	10	35
Cnα	15	40
MS	2 D	6 D
MS*Cnα	40	100

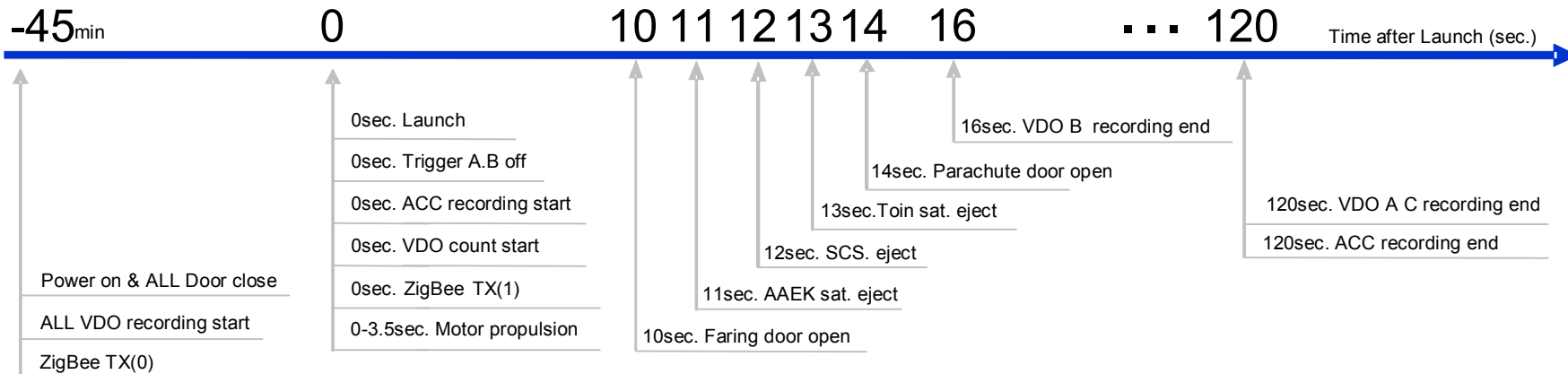
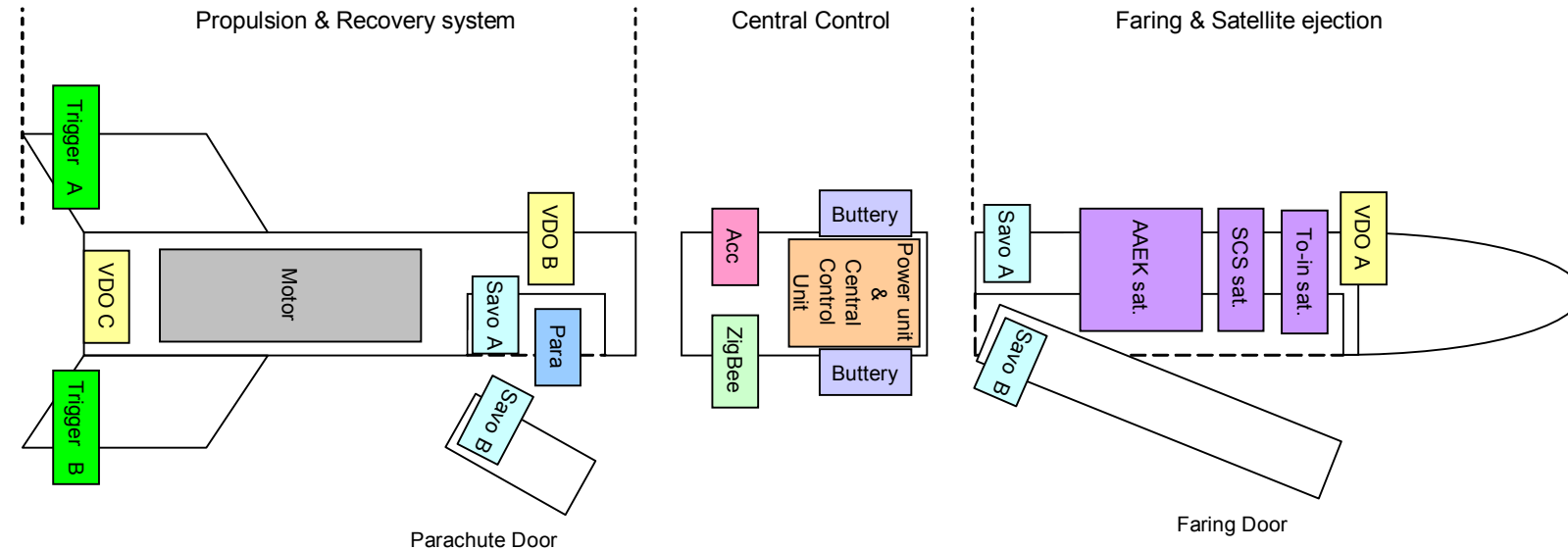
  

Results	2011/8/21	
Lift-Off	~20.6 m/s	OK
Apogée	~709 m	
Culminat°	~12 s	
Finesse	11.1	OK
Cnα	18.2	OK
XCp	1618 mm	
MS	2.61 D	OK
MS*Cnα	47.4	OK

Conclusion	STABLE
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## Sequence



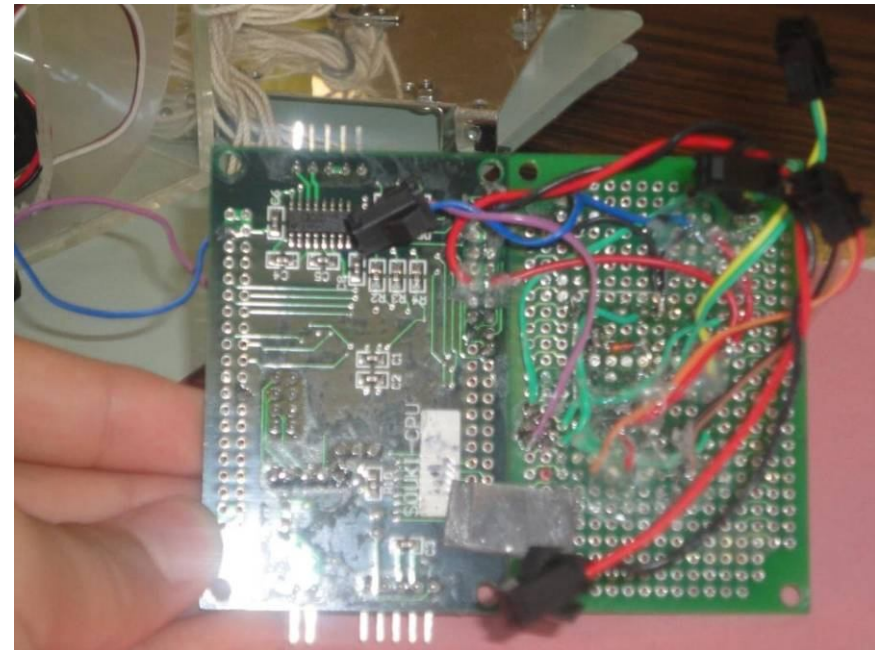
Power has to be retained at least 45min

# Toin Sat

Toin Sat which could not have been launched the last year has nearly completed. The missions of this satellite are to take a picture and get a movie by using Camera and Video.



View of the Toin Sat

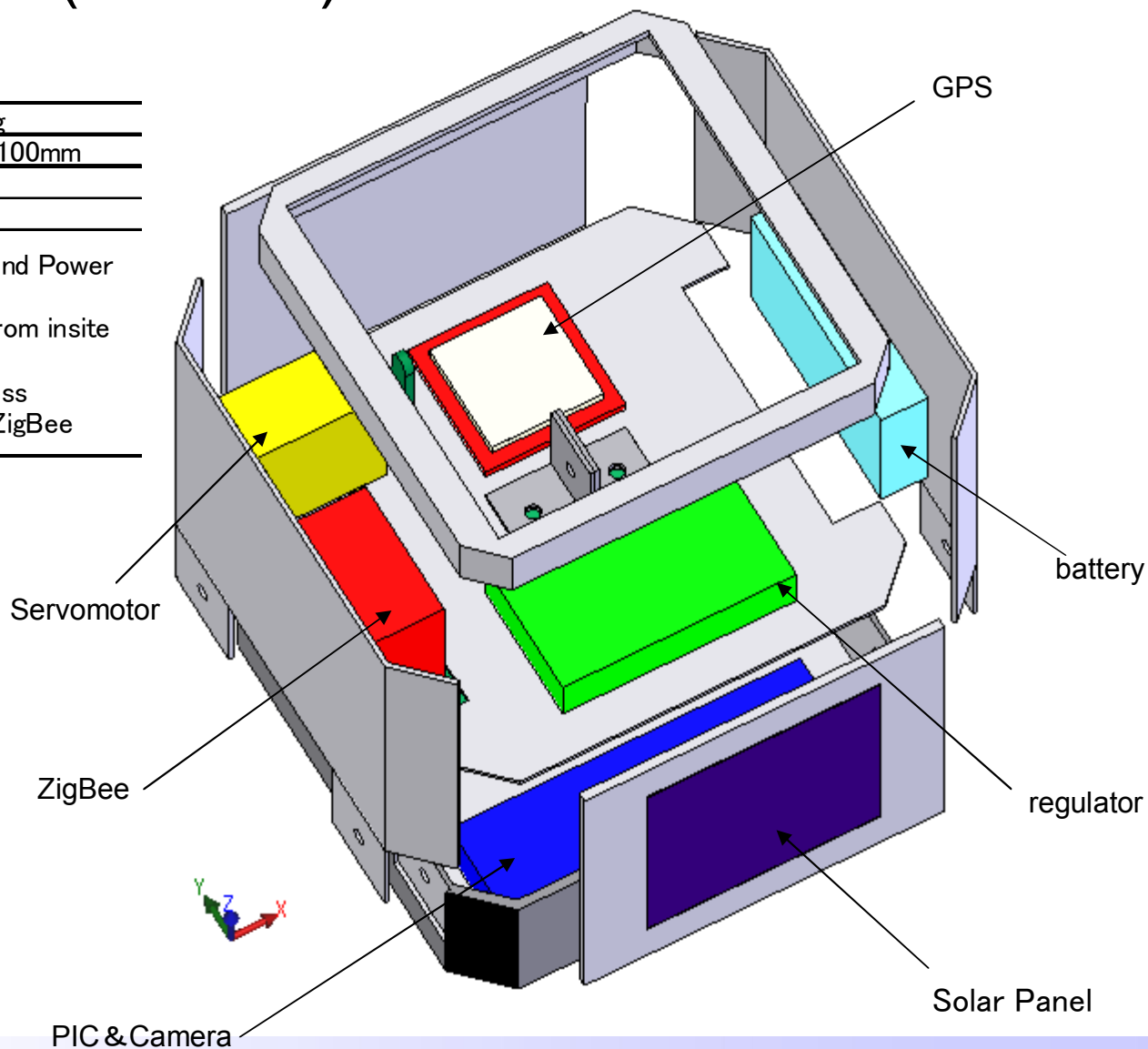


Electronics components

## Souki Cube Sat-01 (SCS-01)

Specifications of SCS-01

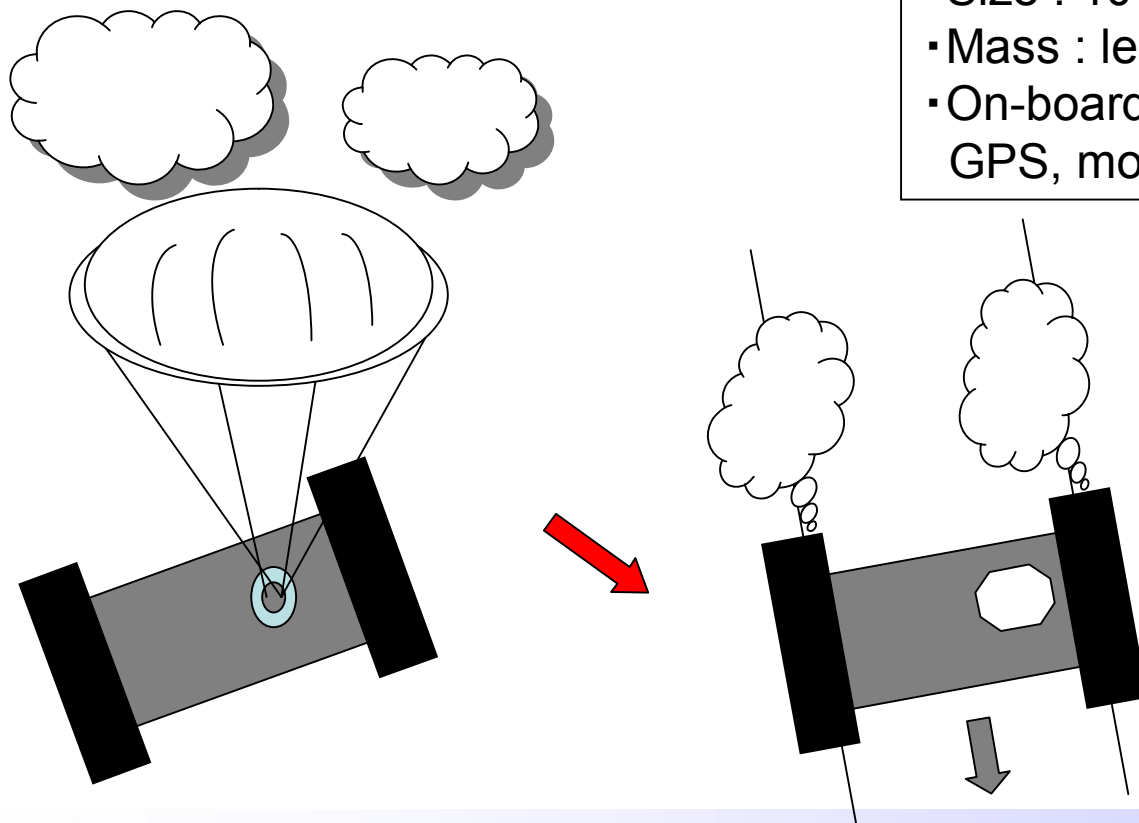
mass	less than 1kg
Size	100mm × 100mm × 100mm
Altitude	1000m
Rocket	S-1A
Missions	(1) To establish Bus and Power system for CubeSat (2) To take pictures from insite Camera (3) To establish wireless connection system by ZigBee



## AAEK Sat

Out of view

1. After ejection and landing, AAEK will move in advance to it's destination by GPS.
2. Location information obtained from GPS will be recorded to SD card.



- Size : 10 × 10 × 20 (cm)
- Mass : less than 1kg
- On-board equipment : microcomputer  
GPS, motor, camera, gear box



# Summary of the flight and experiments

The flight was very beautiful before apogee, however the parachute could not be opened, as a result ballistic flight.

These result of experiments are as follows . . .

1. Deployment of 3 Sat and recovery them safety

→ Success (100%)

2. Recording the Sensors (Acceleration, Video) in the Rocket.

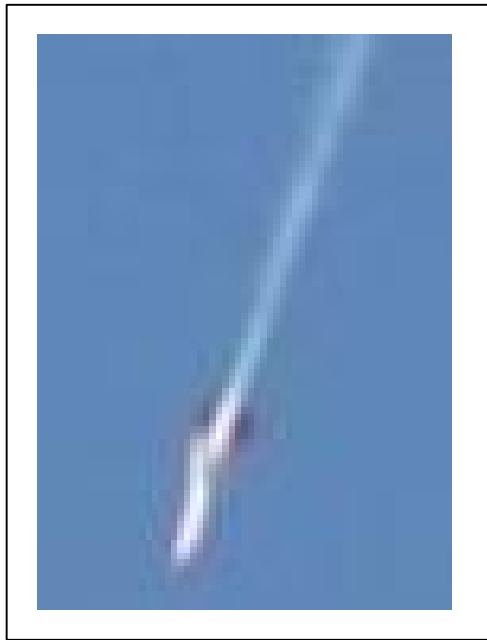
→ failure (0%) . . . Why?

3. Experiment of Internal Communication of the Rocket with the Xbee Wireless Modules.

→ Success (60%) . . . Why?

## The analysis of the flight

Faring door open (t=11)



Parachute door didn't open (t=18)



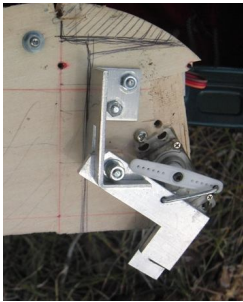
Take off (t=0)



# What happened? ~Why parachute door could not be opened?~

## (Analysis result)

1. Latch parts had opened because latch parts had moved.
2. Parachute didn't go out because it had folded.



1. Latch part.



2. Folded parachute.

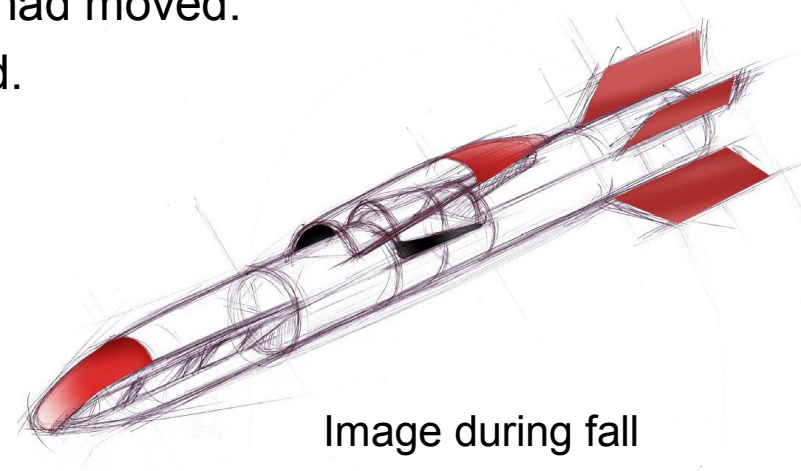
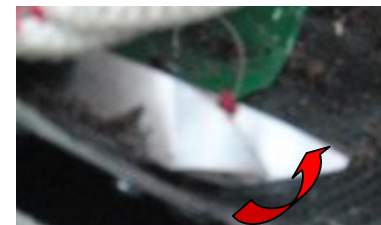


Image during fall

## (Consideration)

When the fairing door open later, fairing door is on the parachute door.

Fairing door should hold parachute door.



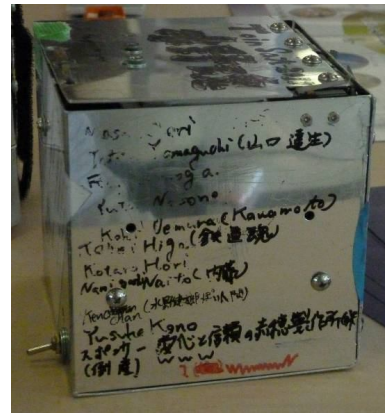
Bending





# Result and analysis of three satellites

## 1. Toin Sat



Out view of Toin Sat from SCS camera

Toin sat was separated from rocket safety and then the parachute could be opened as known SCS camera date.

But, no data could be taken. This reason are as follows....

- The power became power-off during flight due to some reason, because the power SW was located "off" when the satellite was discovered.

- According to post analysis, about parachute, could be opened high-handedly not electrical but mechanical. Because their servo motor was not moved from default position.

# Result and analysis of three satellites

## 2. Souki Cube Sat(SCS-01)

### Mission

1. To establish Bus and Power system for Cube sat

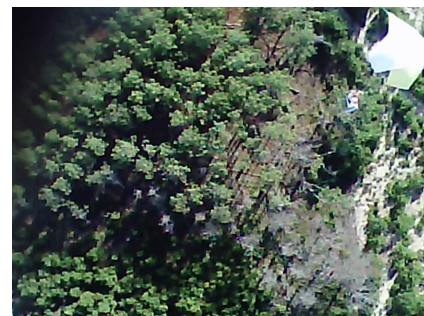
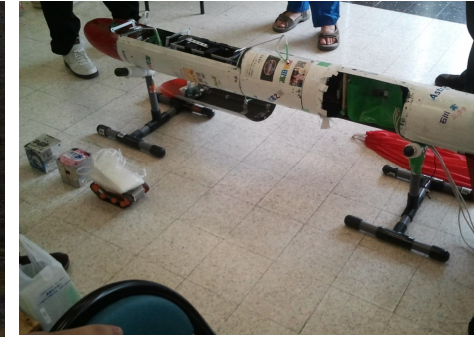
→ Success

2. To take video from inside camera

→ Success

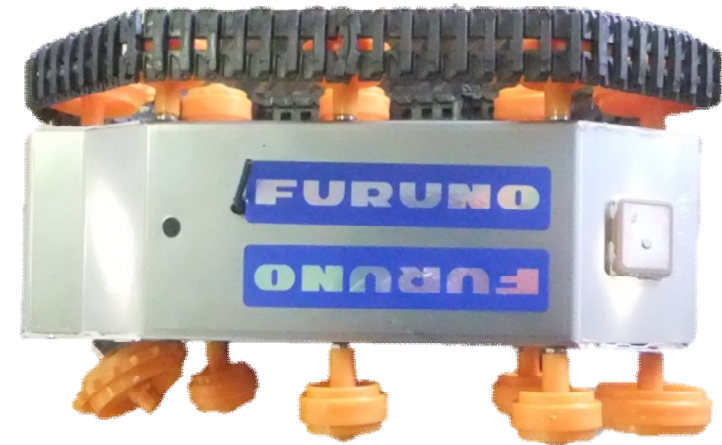
3. To establish wireless connection system by ZigBee

→ Success



# Result and analysis of three satellites

## 3. AAEK Sat



### The spot where a rover fell

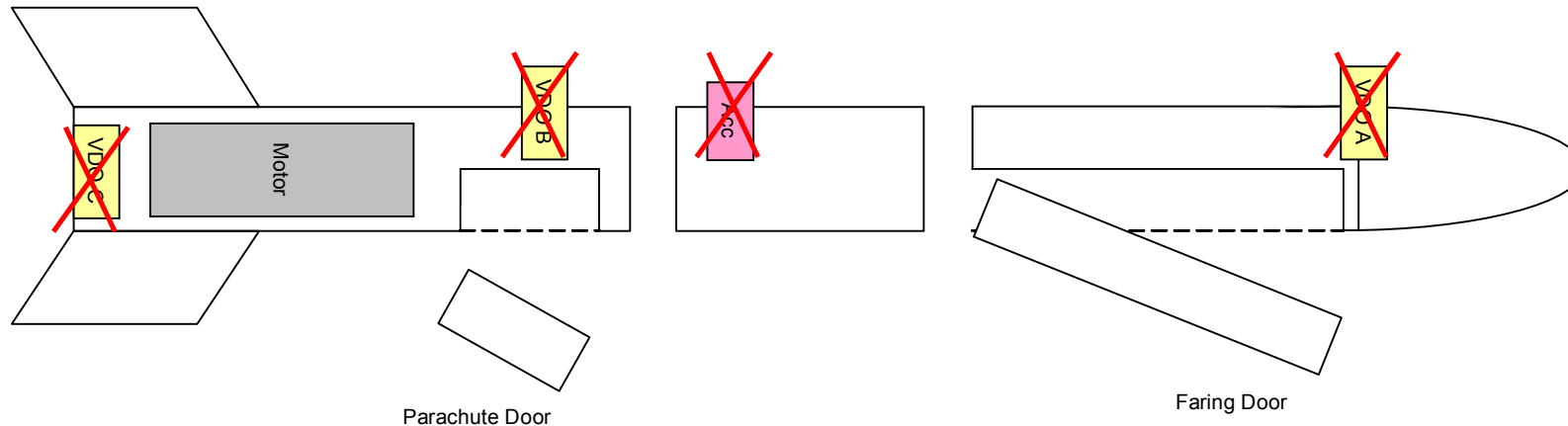
- The spot is the root of tree
- parachute rise
- damage condition of wheel

By collided with upper of tree, it can expect program works in a height of about 6 meters from ground.

- When the inside of a mechanism is checked, there is also almost no damage. However, joining sections, such as a case and a battery box, were loosening. It is thought that it loosened at the time of discharge or a fall collision.
- The log of acceleration and pressure has been received after the launch only for a moment.

### After fall damage condition

# Result and analysis of Sensors and Video



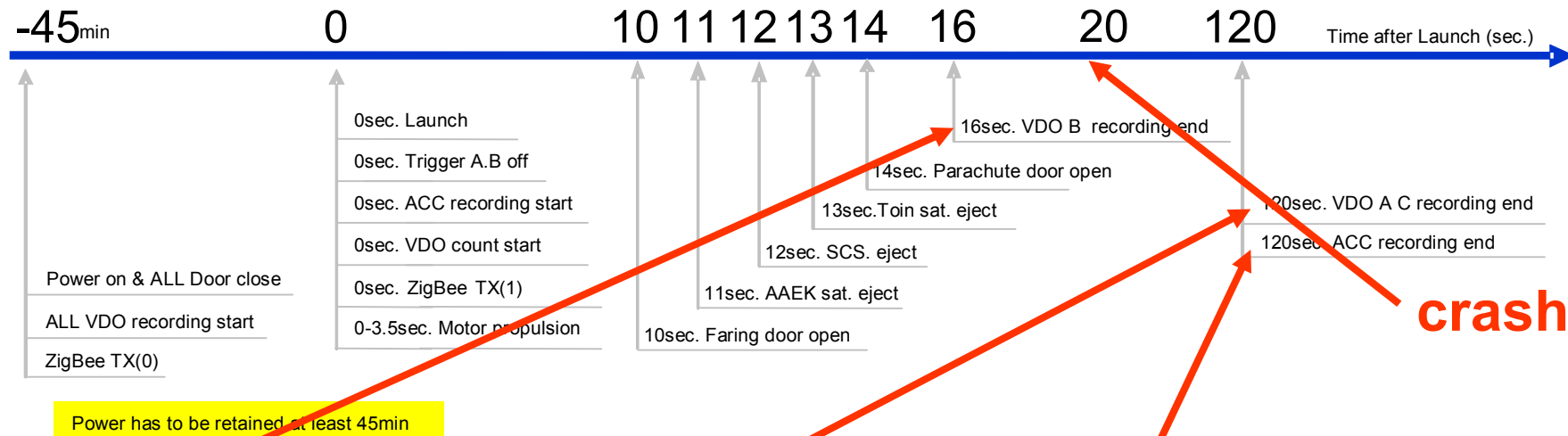
No data could be taken from sensors and video which were installed in the rocket.

# Result and analysis of the Xbee Wireless Modules

The Xbee wireless modules was used for start signal of the SCS camera. Actually, the camera was moved and recorded after launch.

But there is no authority because there is no record in the rocket.

## Cause of a lost data



### VDO B

Camera will start shooting after power up. After missing 16 seconds to finish shooting the trigger. Shooting ended in crash. But it was unable to save slams into the ground during storage. Therefore left with only the zeros date. In addition, the sequence may be shifted because you were expecting to work until about two seconds is a time lag from when a signal is sent to the specifications of the camera itself.

### VDO A.C

Camera will start shooting after power up. After missing 2 minutes to finish shooting the trigger. However, the rocket crashed 20 seconds. Because, the camera crashed during filming, could not be saved.

### ACC

Data acquisition started simultaneously with the rocket launcher to exit after 2 minutes. The data was acquired, the acquired data was bogus. The pursuit of the cause.

## Achievement ~What we studied?~

- It is satisfaction that we all could see S-1A launch even bariatric flight.
- Three satellites could be ejected and recovered safety.

But...

- No data could be got from rocket because main power became power-off before the record is completed due to the crush.
- The time for reaching apogee was shorter than expectation approximately 2sec. .
- The opening of the parachute door was encumbered by the fairing door.

The main power and vital power for example parachute had better separate.

# C'SPACE2012~2014



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STEP 1 2011/2012	STEP 2 2012/2013	STEP 3 2013/2014