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Education Programs using Small Aerospace Systems

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ABSTRACT

Several Space Clubs in Japan are planning to build small experiment rockets for education purposes. Space Club-Kansai is one of these clubs organized among university students and young engineers in private companies. This is an excellent mix to build small space systems such as small experiment rockets.

The first author started this kind of education nearly 15 years ago with some simple water rockets. They now emerged into High-Tech Water Rockets, Small Experiment Rockets, and Small Quasi-Satellites.

The paper describes the way how these programs evolved and their effects, and the system on which Space Club-Kansai is now working. Furthermore the authors discuss the possibilities of future development of these programs, which includes small satellites on orbit. Although these systems fly up to only 1 Km in the air at present, yet they give essential ideas of flying robots.

Space Club-Gifu flew the two stage rocket with one quasi-sat on board (July 2005), and Space Club Kansai flew a single stage rocket with two quasi-satellites on board (July 2006).

1.Introduction

The first small experiment rocket of Young Astronauts Club of Japan (YAC-J) came to France in 1992, when it was ISY(International Space Year). Since then, the authors have realized that these small systems together with other small flying robots such as High-Tech Water Rockets and a small unmanned aerial vehicle are suitable to educate young college students and engineers, especially system engineers (Ref.1). Furthermore, the way the launching campaign is held by Planete Sciences & CNES of France has presented a good example of encouraging creative young students and engineers to invent their own system concept. After YAC-J, the first author organized Space Club Gifu, in which he proposed the two stage rocket with a quasi satellite (UCG-05 Rocket). It flew in July, 2005 in La Courtine (Ref.2).

In the same year, Space Club Kansai was formed, and the single stage rocket (UCK-06) with two quasi satellites became under development. This paper describes UCK-06 rocket and their future development as a education tool. The launch was made at 17:43 of July 29th as shown in Fig.1.

Fig.1 Launch of UCK-06 Rocket in La Courtine

2. Intent of the Education Programs

In 1992, these programs were to stimulate young leaders in the Kakamigaha Chapter of YAC-J. The first author found that the rockets now prepared in several Space Clubs were the adequate bridge between elementary water rockets and actual space projects. For university students and young engineers, water propelled rockets are fun to feel propulsion systems and the Newton's dynamics (i.e. Action-Reaction). However, water rockets has much more potentials if it's connected to microelectronics such as sensors and microcomputers. These rockets are called as High-Tech Water Rockets. The High-Tech Water Rockets then lead to Small Experiment Rockets such as UCG-05 and UCK-06.

Major intent of this kind of programs is ;

'To stimulate young leaders and engineers for the long lasting activities of the clubs, and to lead them either to real space projects or flying robots.'

And they have the following potentials ;

1) Give young people the feel with space related technologies. 2) Give young people the feel with basics of rocket propulsion. 3) Create their own missions. 4) Manage a small system on their own. 5) Give young people the feel with microcomputers and sensors. 6) Communicate with people from different parts of the world.

Above all, these programs offer the opportunity for participants to stimulate creative minds, not the ability to follow some one else's rules.

3. Rocket Launcher Programs

3.1 Upgrading Levels

Small educational rocket programs may be divided into several different levels of skills, starting with a simple water rocket.

First Step (Initial Level)

・Elementary Level Water Rockets
  - With Pressurized Water Propellant
  - With Various Configurations
  - Flight Altitude less than 100 meters
  - Launched Easily and Frequently & Safe

Second Step (Middle Level)

・Higher Level Water Rockets (Hi-Tech Water Rockets)
  - With Various Payloads
  - With Pressurized Water Propellant
  - With Micro-Computers and Various Sensors
  - Flight Altitude up to 100 meters
  - Launched Frequently & Safe

Third Step (High Level)

・Creative Missions for Small Experiment Rockets
  - With Quasi-Satellites on board
  - With Solid Rocket Motors, Micro-Computers and Sensors
  - Flight Altitude up to 1 Km

Final Step (Ultimate Goal)

・Rockets reach Space with the altitude of more than 100 Km
  - Small active satellites
  - The Mix of Small rockets, Small satellites and On-Orbit-Servicing Technologies

3.2 High-Tech Water Rockets

Simple water rockets will not be discussed, since they are fairly common in many countries. The discussions will be started with High-Tech Water Rockets, in which the system is a little more complicated with microcomputers, sensors and simple mechanisms on board, than elementary water rockets. Working on these systems will lead students to higher system architectures and to a higher level of knowledge. They may even conceive various payloads controlled by a microcomputer. The electronic components may not be heavier than a few 100 grams. An example with a speed meter of a pressure sensor type with a microcomputer is shown in Fig.2.

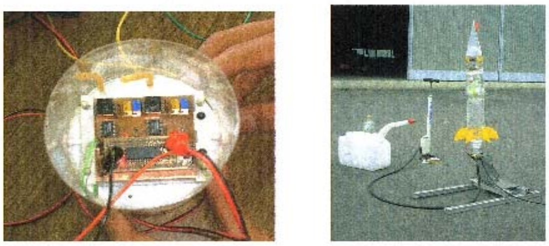

Fig.2 An Example of High Tech Water Rocket

Several other types of High-Tech Water Rockets can be conceived. Still the full potentials of this type have not been fully developed. Space Club Kansai is working on various types of this kind.

3.3 Small Experiment Rockets

These rockets are just in the doorway to real space programs, namely each team plans what they would like to and what they should do to realize their plan whatever their plan might be. Japanese team initiated this program with the support from ANSTJ (former Planete Sciences) as shown in Fig.3.

Fig.3 Small Experiment Rockets in 1992 and 1997 in France

Then, the CEES Rocket has been invented by the team in Kansai area of Japan, in which Liquid Nitrogen and Hot Water have been used as propellants. In the same year, UCG-05 Rocket was launched by Space Club Gifu in La Courtine. These rockets are shown in Fig.4.

Finally UCK-06 Rocket has been launched (Fig.1) by Space Club Kansai in 2006. This rocket was the first one built by Space Club Kansai. It was a single stage and had two quasi- satellites on board (Fig.5).

Fig.4 Small Experiment Rockets in 2005

It had more than 10 microcomputers (PIC16F877As), and each computer had a simple job such as a timer, a A/D converter, and a servo motor driver. The authors found this architecture has a good expansion capability as a building block and can be maintained easily since the computer board is small and standardized.
Unfortunately, it flew for only approximately 2.4 seconds after lift -off. Then it disintegrated when it suffered the deceleration g of the motor cut-off. However, the flight gave many valuable data to be transferred to the year of 2007.

Fig.5 Assembly Work of UCK-06 Rocket

In UCK-06 program, two separate groups worked on their satellites. One of them is the group of college students (KSE-Sat), and the other high school students (TOIN-Sat). The latter formed a new team in their school (Fig.6), and will study rocket & satellite technologies This scheme was the first try in Space Club Kansai, and will be kept in that way as long as the basic design of UCK-06 is followed. Two or three satellites will be on board in the successor of UCK-06.

Fig.6 **<u>Members of TOIN Rocket Club</u>**

One of the two quasi-satellites were ejected from the rocket and landed on the land close to the launcher (Fig.7). Although its parachute was not successfully deployed, still the digital camera on board the satellite was functioning after the flight.

Fig.7 **<u>Quasi-Satellite after the Flight</u>**

Space Club Kansai will work on the same system again to complete the system. All the necessary considerations and redesigns are under way for the next year. This rocket and the fundamental functions of quasi-satellites will be well defined in 1 or 2 years. To verify the components, High -Tech Water Rockets will be used, if the component is not heavy.

4. International Exchange Programs

Planete Sciences and CNES of France gave Space Club Kansai the chance to join the launching campaign. In return, Space Club Kansai has sent the automatic launching equipment for water rockets. Beside this, YAC-J, Space Club Gifu, and Space Club Kansai, all had close relation with La Reunion. Especially, Space Club Kansai is discussing the possibility of development of one satellite with a French high school of La Reunion in 2007 (Fig.8). The both parties agreed to have a joint program the next year. UCK-06 rocket has the convenient architecture to have the exchange programs. Quasi-satellites are one and the distributed small computers are another. Probably a Reunion-Sat will be on board on UCK-06A in 2007. The most of the UCK-06 Rocket configulation will be retained for the following years. Other interested parties will be able to participate in UCK-06 system by supplying either a quasi-satellite or a sensor.

Fig.8 **<u>The Team from La Reunion</u>**

5. Future Scope

This education program includes three major areas, namely launchers, quasi-satellites and international exchanges. In the launcher area , Space Club Kansai is working on the Small Experimnt Rocket (UCK-06 Rocket). This rocket had two small quasi-satellite sysutems on board. Although UCK-06 Rocket and its quasi-satellites are still in its infantry, this system has the growth capability in the architecture. Namely each microcomputer deals with single function as described earlier, and new sensors or driving mechanisms can be easily incorporated in the sytsem. Furthermore, separate groups will be able to work on their own quasi-satellite or sennsors with different missions.

As to the international exchange, there has been continuing exchange with France and Ile de La Reunion for quite some time. Space Club Kansai has the intension to keep this relation even in the rocket project itself. As disscussed above, UCK-06 system fits into these exchange programs. Some subsystems may be worked in the different part of the world and then assembled together at launch site.

Finally, these Small Experiment Rocket and Quasi-Satellites has the growth capability toward a system on orbit. As to the transportation, a small two-stage-to-orbit (TSTO) vehicle would be the choice, and quasi-satellites will be modified to small satellites by using space qualified parts. Of course more analytical work will be required. Then these satellites will be combined with On-Orbit Servicing Technologies (such as assembly robots technologies). Iin this manner, the affordable, reconfigurable, and reliable system on orbit will be realized. It is specially true if the advance of micro-electronics is incorparated.

6. Conclusions

Space Club Kansai has just launched Small Experiment Rocket (UCK-06). In July 2006. Although the club could not complete the system, all the necessary information to renew the system was obtained. The rocket has a growth capability to accept international exchanges, and to prepare for future systems on orbit, if it is combined with On-Orbit Servicing Technologies. Space Club Kansai will keep on going to complete the system.

Acknowledgements

This is the third paper of the first author, and covers his activities over last 15 years. During this period, many people and organizations supported this endeavor. They are; Ms. Tomoko. Akiha of YAC-J, Mr. Guy Pignolet of CNES, Mr. Marc Zirnheld of Planete Sciences, Mr. Christophe Sicluna of Planete Sciences, Mr. Nicolas Chaleroux of Planete Sciences, and other people from Planete Sciences and CNES. My family, Kuniko, Kenichiro and Takako also supported him in many ways.
The authors would like express their sincere gratitude to all these people.

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UCK-06 ROCKET PROJECT

(Quick Review Report)

August 18. 2006

Uchu Club-Kansai (UCK)


UCK-06 Rocket
Space Club Kansai
Launched on July 29th,17:43
La Courtime, France

1． Concept Summary

1） Name ： UCK-06 Rocket, The Single Stage Reusable Rocket by Uchu Club-Kansai
（UCK： The Abbreviation of Uchu Club－Kansai）

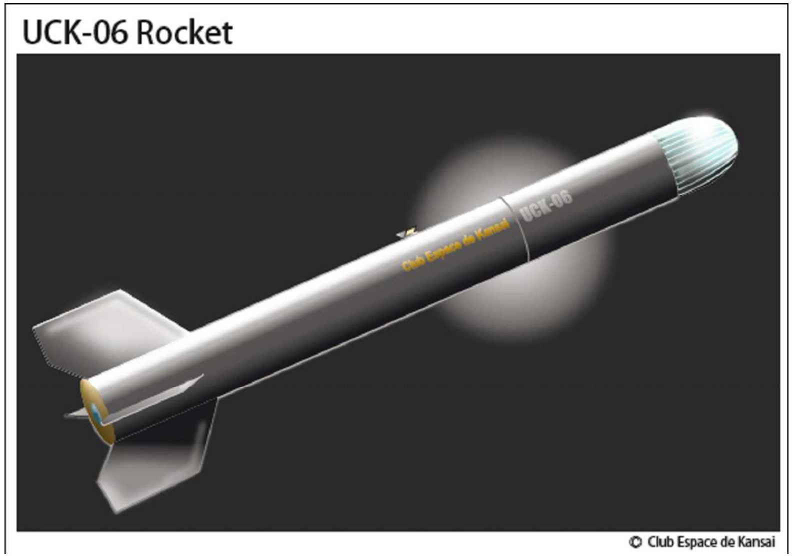
2） Purpose ： Education of Young Space System Engineers
Familiarization of Robot System Engineering
International Exchange with French Counterparts

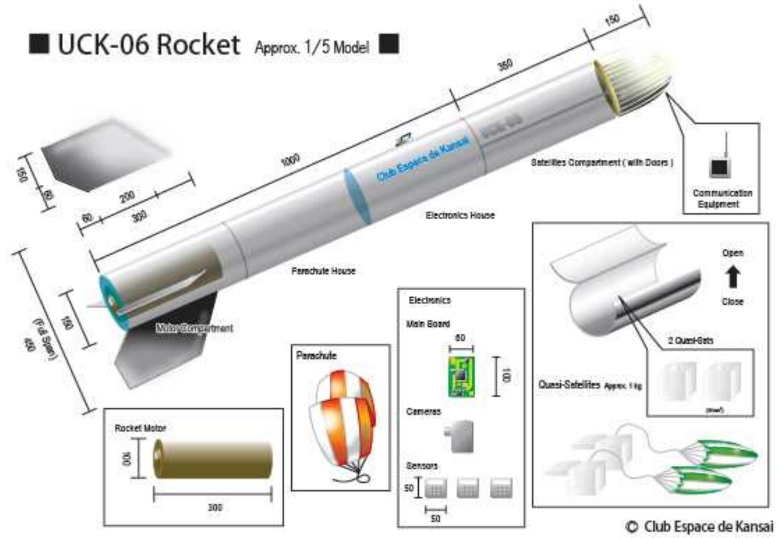
3） Launch Date ： 22-30 July, 2006, Launching – July 29, 2006 17:43

4） Launch Site ： La Courtine、France

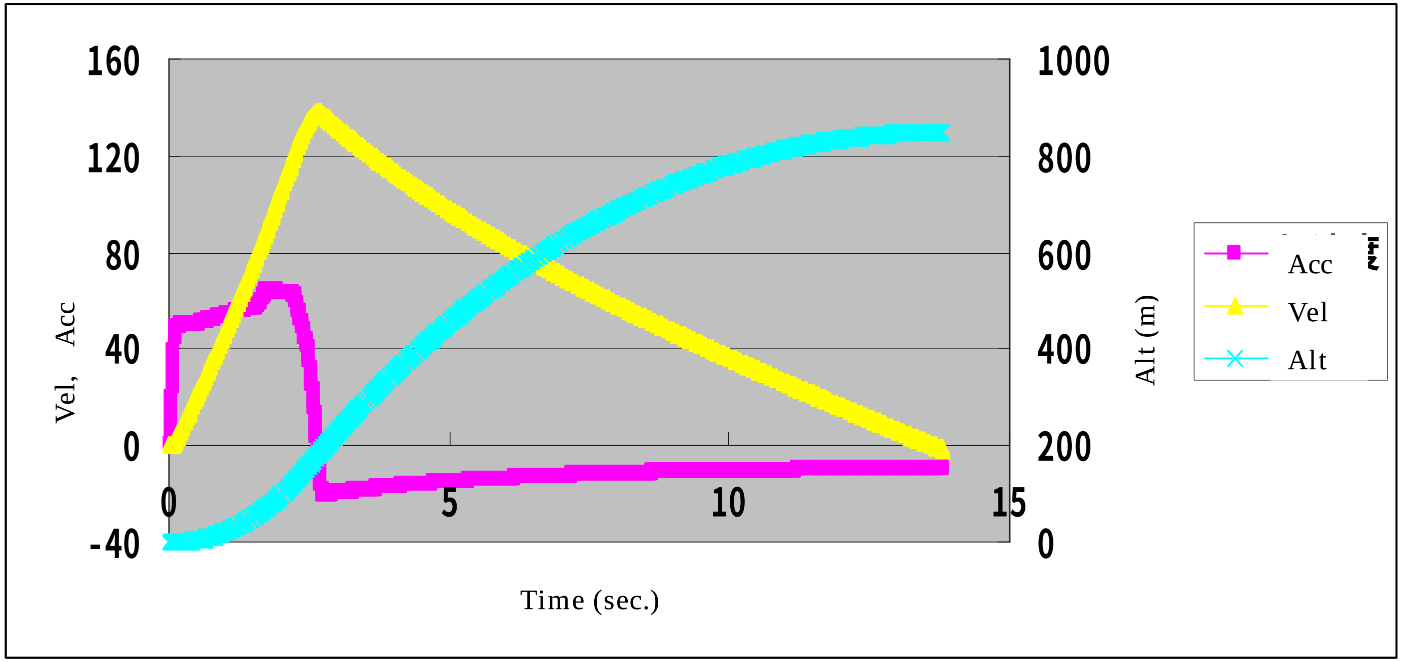
5） Team Members ： Students, Young Engineers, Entrepreneur and university staff in Kansai Area

6） System Architecture ： Single Stage Rocket（Approx. 12 Kg including the rocket motor、Reusable）
Quasi Satellites（2 units- 0.5 Kg each, Precursor for small satellites which will be launched to the space in the future）
Sensors（Video, Digital Camera, Speed meter, Accelerometer, Attitude Monitor etc）
On-board Computers（Supervised Control by a main computer, Distributed small computers）





<u>UCK-06 ROCKET Configuration</u>



Flight Trajectory : Altitude, Velocity & Acceleration vs Time

UCK-06 Rocket Major Characteristics

Items		Description	Suppl.
Rocket	Size	150φ x 1500mmL、Maximum Dimension 510φ	
	Weight	7Kg ＋ 3.7Kg（Propulsion Chamois）	
	Max. Altitude	Approx. 800m	
	System	Single Stage, Equipment Unit, Distributed Computers, Satellite Deployment	
Quasi-Sat	Size	90 x 90 x 90mm	
	Weight	Approx. 0.5 Kg x 2	
	Function	Monitoring Vegetation, Landing on a planet, Landscape Measurement, Small Robots etc	
Sensors	Video	Monitoring the deployment of Quasi-Sats & the status of the rocket	
	Digital Camera	Status of the rocket	
	Speed Meter	Utilizing the pressure sensors	
	Acceleration	Monitoring the flight conditions	
	Attitude Mon.	Preliminary measurement of rocket attitudes	
Computers		Distributed Control by a main & small computers Standard Architecture	

2．System　Description

2－1　Major Architecture

Items		Description	Items		Description
Fuselage	Structure	4-1/4 1mmt Aluminum shell	Communication	Tx / Antenna	None
	Fins	4-Plywood＋aluminum skin 0.1mmt		Rx / Antenna	Localizer
	Motor Mount	MC Nylon　2ea			
	Equip. Inst.	MC Nylon　4ea			
	Nose	GFRP			
	Dummy Motor	Wood, Bolt, weight 3.7 Kg			
			Power	Battery	NiCd
Computer	Type	Distributed			
	Main	PIC16F877As			
	Sub	PIC16F877As			
			Quasi-Sat	Size	Less than 90 x 90 x 90mm
Sensors	Speed Meter	Utilizing pressure sensors		Weight	0.5Kg x 2 ea
	Acc Meter	Up to 10Gs		（TOIN　Sat）	Digital Camera
	Video	1 ea			
	Digital Camera	1 ea		（KSE　Sat）	Video Camera、GPS Receiver
	Att. Monitor	1 ea, linear CCD			

2－2 Weight Summary

2006/07/19

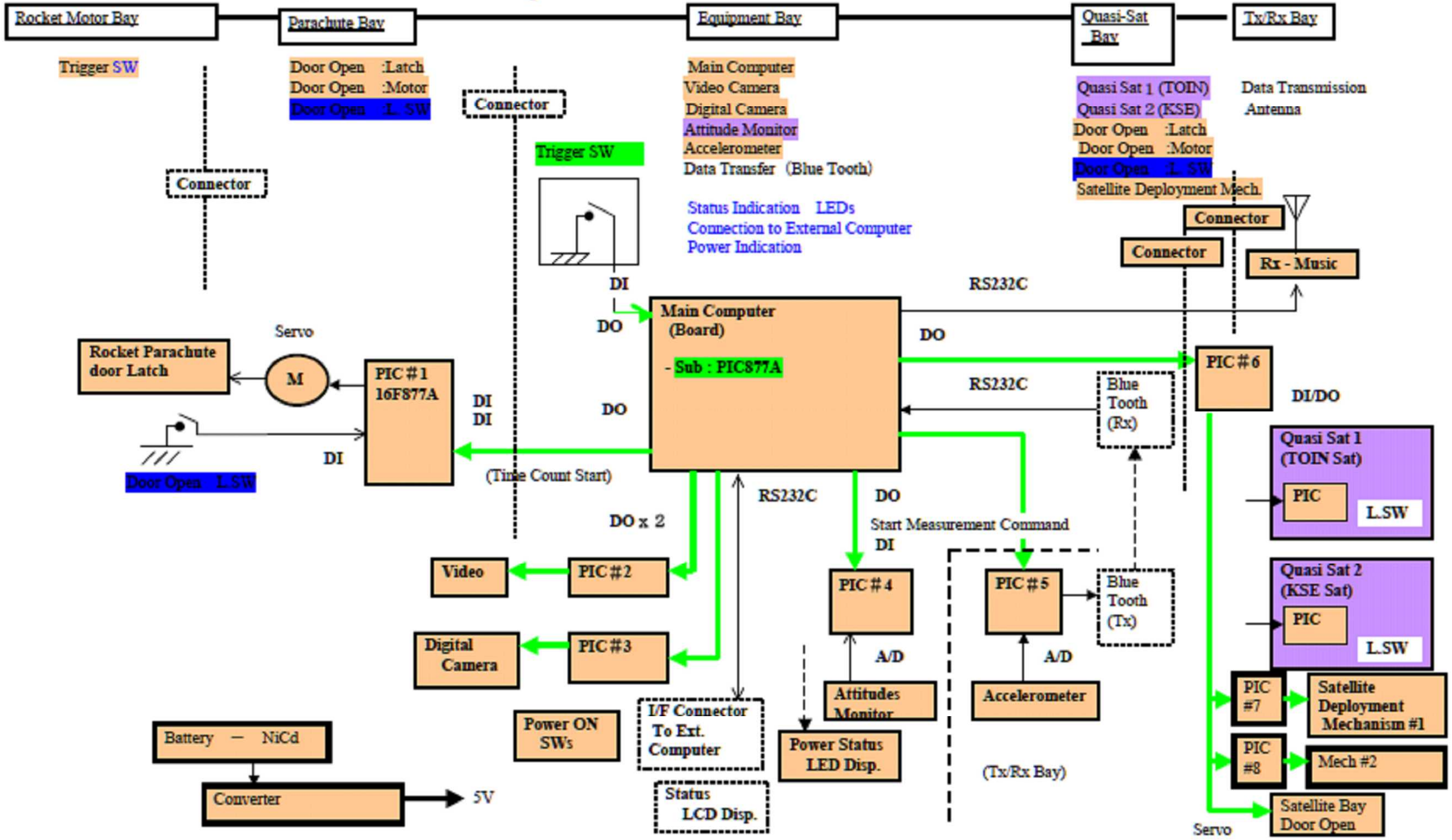
Items	Weight(g)	Description
Quasi-Sat	1000	90x90x90mm 2 ea, 0.5Kg ea
Satellite Deployment System	100	Mechanism driven by a motor
Nose	540	150x150φ GFRP1mmt
Structure	1500	1350x150φ 4 aluminum shells, 1mmt
Fins	600	250x（400＋250） aluminum 2mmt 4 ea
Parachute	1250	
Parachute Door	50	
Parachute Installation	120	
Parachute Door Motor	50	
Rocket Motor	3700	Chamois empty weight 2700g
Rocket Motor Mount	120	
Rocket Motor Fairing	70	
Equipment Installation	330	3 ea
Video Camera	200	Che-ez! Moviex III 3.2M Pixcels
Digital Camera	200	AVOX PRM-300EB
Computers	600	Main George 300MHz, PIC16F877s
Wiring	300	
Main Battery	300	
Fasteners	300	
（Total Weight）	11330	Target: Max14000g（2670g allowance）

2－3 CG Positions

Items	Weight(g)	X Position (cm)	Sum (g・cm)	
Quasi-Sat	1000	115, 125	120000	
Satellite Deployment System	500	117.5	58750	47000
Nose	540	140	75600	
Structure	1500	68	102000	
Fins	600	10	6000	
Parachute	1250	60	75000	
Parachute Door	50	60	3000	
Parachute Installation	120	30	3600	
Parachute Door Motor	50	30	1500	
Rocket Motor	3700	18	66600	
Rocket Motor Mount	120	35	19425	
Rocket Motor Fairing	70	0	0	
Equipment Installation	330	70	23100	
Video Camera	200	85	17000	
Digital Camera	200	85	17000	
Computers	600	80	48000	
Wiring	300	50	15000	
Main Battery	300	85	25500	
Fasteners	300	50	15000	
(Total Weight)	11730		692075	Sum/W = 59.0cm

Ref: The base of the rocket

(2006・05・28、 Revision C : 2006/07/17) **UCK-06 Rocket Blockdiagram**



2－6 Flight Sequence

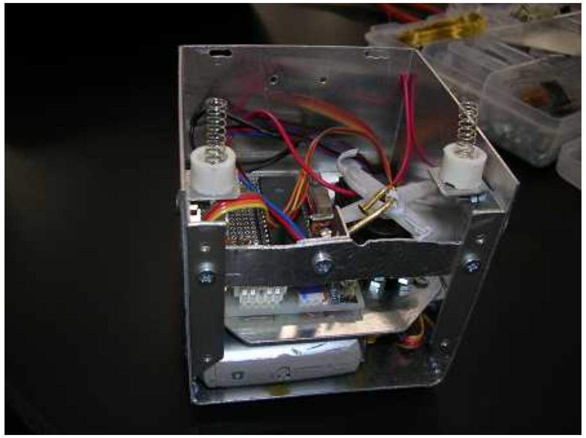
(Basics)

- The first priority is to recover safely the rocket itself. Therefore the parachute for the rocket will be deployed when the speed of the rocket is nearly zero.
- The second satellite (KSE Sat) will be deployed 2 seconds earlier than the deployment of the rocket parachute.
- The first satellite (TOIN Sat) will be deployed 2second earlier than the deployment of the second satellite. This satellite deploys its own parachute 1 seconds after the separation from the rocket to avoid the collision with the rocket.
- The satellite bay door will be opened 8 second after the lift-off.

(The sequence is very critical and it may be changed)

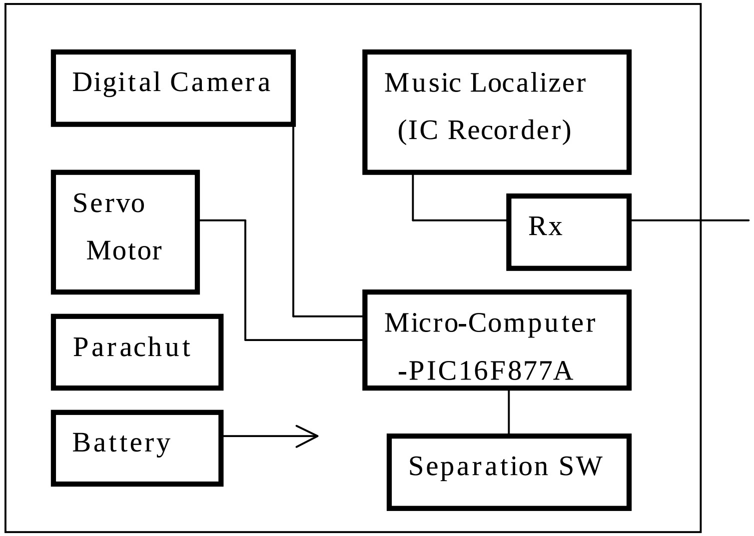
	(Time)	(Altitude)	(Speed)
1. Lift-Off	0 Seconds	0 meter	0 meter／second
2. Satellite bay Door Open	8	650	60
3. No.1 Satellite (TOIN Sat) Deployment	9	700	40
4. No.2 Satellite (KSE Sat) Deployment	11	800	20
5. Rocket Parachute Door Open	13	850	0

TOIN-Sat



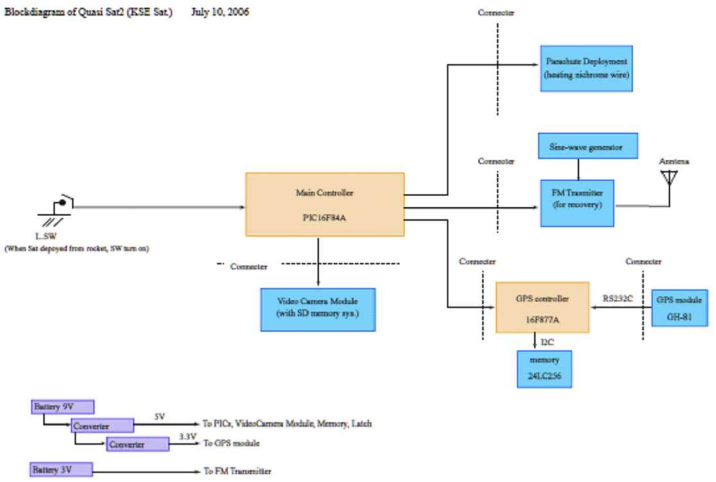
Major Specifications;

- Size　90 x 90 x 90 mm
- Weight　　approx.　500 grams
- Mission　　Digital Camera, Music Localizer



Block-diagram

KSE-Sat



Major Specifications :

- Size 90 x 90 x 90 mm
- Weight approx. 500 grams
- Mission Video Camera, GPS receiver

Weight Summary (494 grams)

Parachute	43 grams
Video Camera	36
GPS Receiver	35
PIC	22
Power Supply	17
Battery	75
Structures & Fasteners	266

3. Team Members

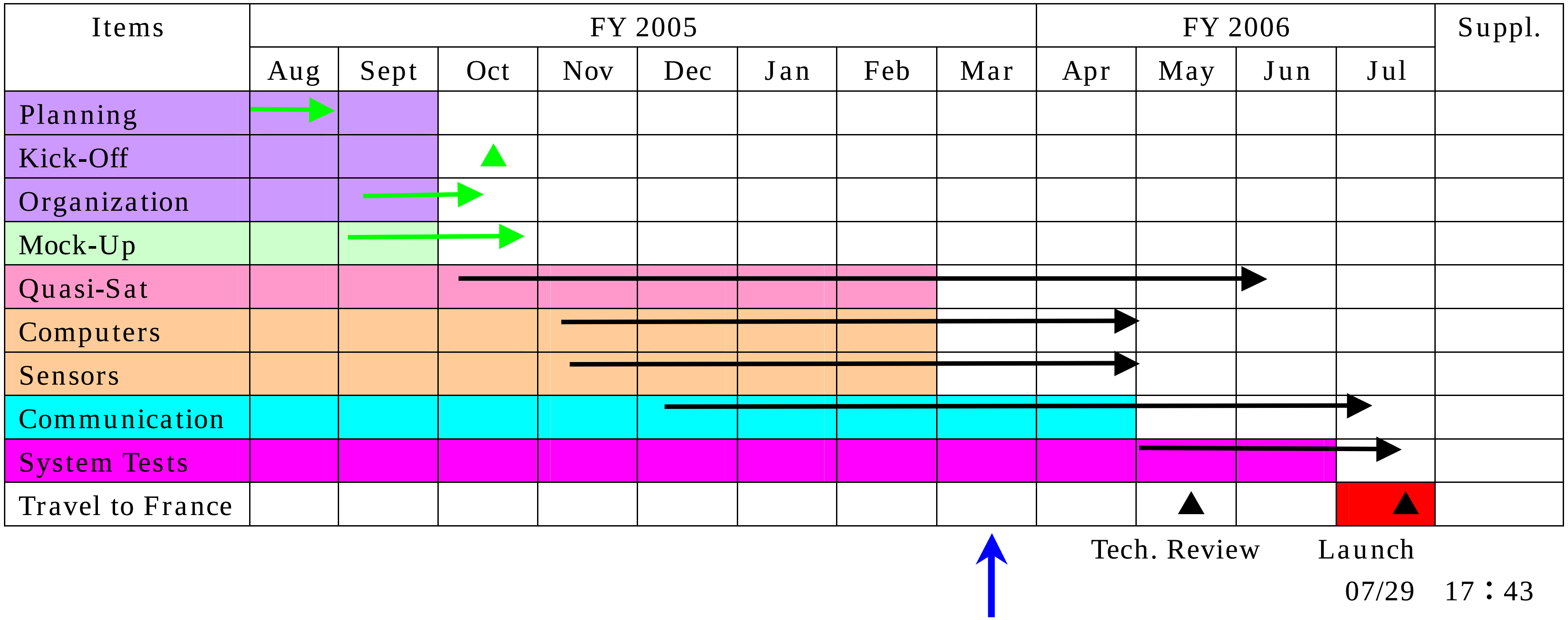
Space Club-Kansai

Program Organizer	Professor Okubo, Osaka Prefecture University
Advisors	Professor Azuma, Professor Marutani, Ms. Ikeda
Project Leader	Dr. Ogimoto
Organizing Members	Mr. Naemura, (French Mission Leader)
	Mr. Shimoda, Mr. Wakabayashi
Cultural Exchange Group	TBD
	Student Union (KSE)
Engineering Group	
System Design	Mr. Sugii (CPU)
	Mr. Mineyama (CPU)
Quasi-Satellites	Mr. Mizuno (Toin)
	Mr. Shiokawa (KSE , Quasi-Satellites), Mr. Ikema (KSE)
	Ms. Saito (KSE), Mr. Ishikawa (KSE), Mr. Minematsu (KSE)
Equipment	Mr. Sakata (Mechanism)
	TBD (Communication)

NB） Toin = Toin Senior & Junior High School
KSE = Kansai Space Explorers, Student Union

4. Schedule

Development Schedule



5. What Happened to UCK-06 Rocket & Related Recommendations

5.1 Flight Analysis

1) UCK-06 Rocket has been launched Properly, at 17:43 of July 29, 2006 (July 30, 0:43 Japan Time). However, there are scratches on the leading edges of 3 fins, approximately at the same locations. It was suspected that the rocket fins touched the launching tower. Furthermore it may have caused its destruction in the air.
2) 2 seconds after the lift-off, the break-up occurred.
3) The break-up occurred at the altitude of approx. 100m. The break –up components are Nose (including satellite compartment), Main Body, Fins, Door for the Parachute and etc. Nose and Main Body continued to climb up to several hundreds meters.
4) After several seconds, Main Body was coming down with the parachute not fully deployed. Doors and other small parts were seen to fall.
5) Digital Camera & Video Camera received the shock at the lift-off and possibly became inoperative. The accelerometer & the speed meter (pressure sensors) were cut-off from the power supply 2 seconds after the lift-off.
6) It was suspected from the deformed shape of the fins that the flutter (aerodynamic vibration) of 4 fins (made of 2mm thick aluminum plates) deformed the main body and separated from the body 2 seconds after the lift-off. Furthermore the body suffered the great force at this moment, and most probably the electronics were destroyed at the same moment. The estimated speed was approx. 90 meter /sec.
7) As to the 2 Quasi-Satellites, TOIN Sat has been deployed safely and touched down on the near-by ground of the launcher with its digital camera working, and KSE-Sat was possibly destroyed by the collision with Main Body just after the ejection.

5.2 Recommendations

1) As a whole, the structure and mechanism were rather premature.

2) The doublers should be adopted to the opening of the satellite compartment & the parachute bay. Furthermore the structure between the bays should be reconsidered.

3) The mechanisms (especially door latches) should be packed in an unit, and the movement of the element is expected to be in the plane perpendicular to the thrust axis (to resist the forces at lift-off & cut-off of the thrust). Although the deployment of the Quasi-Sats was performed properly, the direction of the deployment should be paid attention (not in line with fins) and the size of the opening should be as small as possible.

4) The installation of electronic equipment had not posed problems if the flutter had not occurred. However, generally speaking, more cautions should have been paid to shock and acceleration (launch environments).

5) The wiring was not properly done this time because of the premature designs and the lack of time. Wirings and connectors should be securely attached to the wall.

6) It was recommended that each bay should have the separate power supply to avoid the power failure. Sensors should be redundant if the mass budget is allowed.

7) The material of the parachute should be something like silk, instead of synthetic. Its method of deployment should be reconsidered.

8) The fins should have shorter spans and longer cord length, and have high rigidity. It was recommended that material with high rigidity & high damping (structural damping) should be used, such as plywood. Simple aluminum plates are the worst choice.

UCK-06 Rocket Project Summary

1.Date : 2006/07/22（Sat.）—08/02（Tue.）

Launch — 7/29（Sat.） 17:43 in France

7/30（Sun.） 00:43 in Japan

2.Site ： La Courtine, France

3.Team Member ： Core Team 4 persons

Lycee TOIN 8 (7/26-8/02)

KSE 3

Supporters 8 (7/26-8/02)

Total 23 members

4.Achievements ：

1) The Quasi-Sats have been deployed after 400-500m of flight. The system will be improved in the following years.

2) The team (including engineering, manufacturing, & management) was created in a very short time span.

3) The presence of Kansai & Osaka TOIN has been demonstrated in the campaign through the cultural exchange with France.
It was decided to have the joint program with the members of La Reunion next year.

4) The most parts of the rocket have been recovered, and the details of the flight will be examined.

5) Above all, all the members had the great experience and returned safely

6) We are at the point to start working continuously on UCK-06 Rocket, and to join the campaign regularly.

5.Photos ：

（UCK-06Rocket）

（Chris-san in Osaka）

（Assembly in La Courtine）

（Before Launch）

（Fitting to the Launcher）

（Install the Igniter）

（Lift-Off）

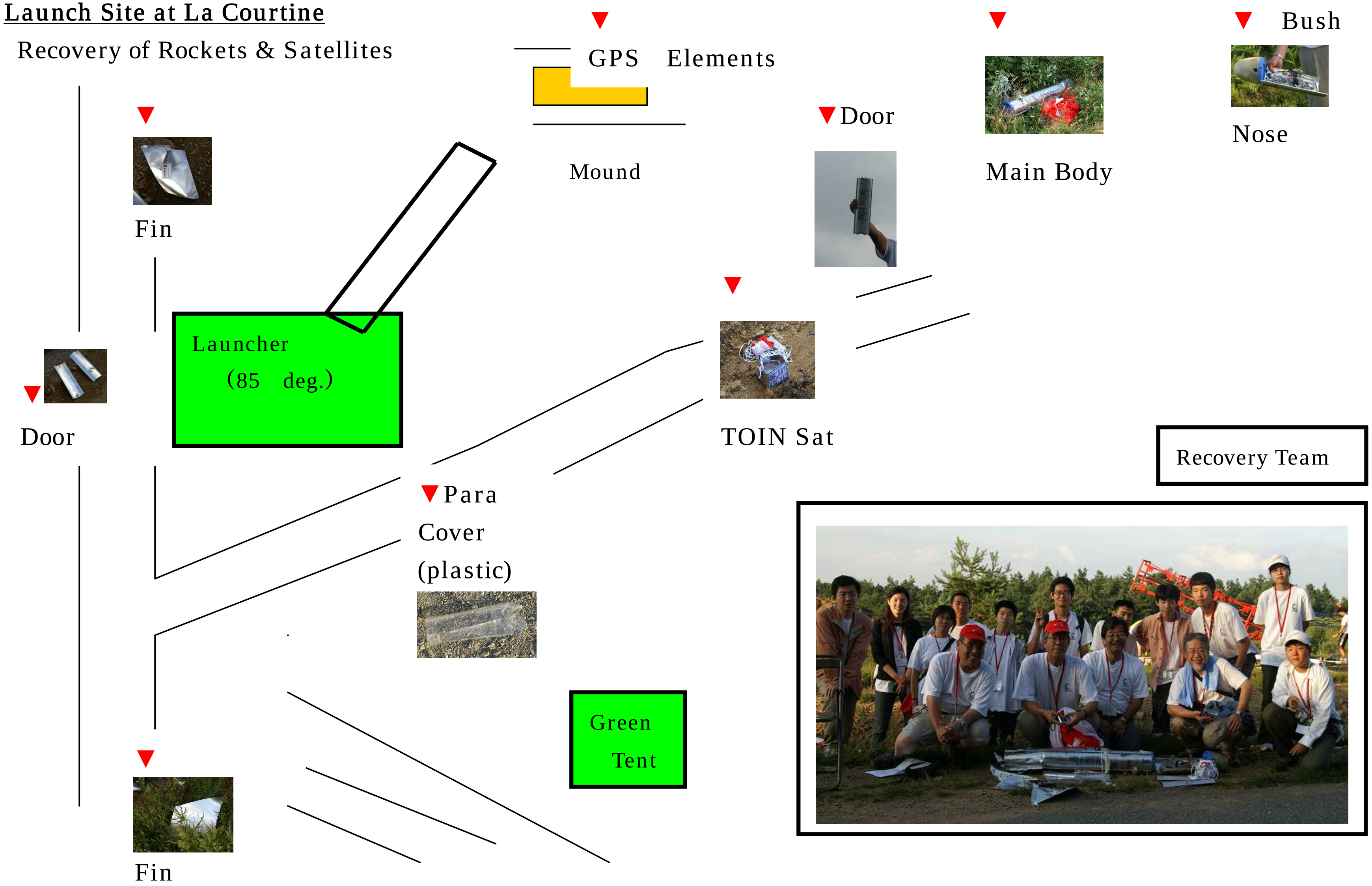
Operation Procedures

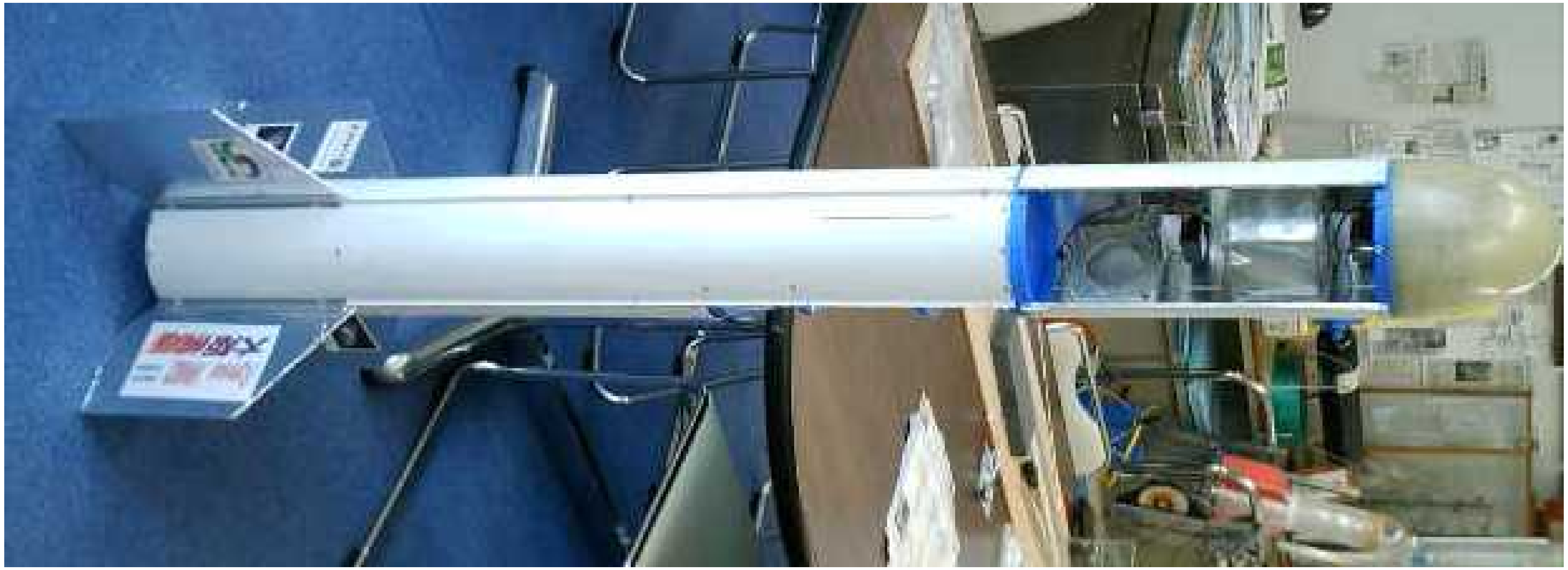
No.	Time Line	Category	Items		Time required	Operator
1	H-433	Preparation (Camp)	Functional test		60min	ALL
2	H-373		Prepare satellites,tools, and batteries		60min	ALL
3	H-313		Install new batteries	Digital camera	15min	Kaori
4				Video camera		
5				Sound		
6	H-298		Assemble the rocket		60min	Naemura
7	H-238	(Tent at launching site)	Prepare satellites	TOIN Sat	15min	TOIN
8	H-223			KSE Sat	15min	KSE
9	H-208		Visual check	Doors	15min	Naemura
10				Parachute		
11				Satellites		
12	H-193		Functional test	8sec - Open the doors for the satellites	30min	ALL
13				9sec - Deploy TOIN Sat		
14				11sec - Deploy KSE Sat		
15				13sec - Open the parachute door		
16	H-163		Assemble whole the system		15min	Naemura
17	H-148	(at the ramp)	Visual check		5min	Naemura
18	H-143		Ramp compatibility	Install the rocket into the ramp	15min	Naemura
19				Check the I/F with the ramp		
20				Remove the rocket from the ramp		

21	H-128		Make sure the power is off		5min	Kaori
22	H-123		Everybody out from the ramp		15min	Naemura
23	H-108		Install Chamois to the rocket		20min	PE
24	H-88		Install UCK-06 in the ramp		10min	Naemura
25	H-78		Install trigger wire to the ramp		10min	Naemura
26	H-68		Visual check		5min	Naemura
27	H-63		Insert ignator		15min	PE
28	H-48		Lift tre ramp		15min	PE
29	H-33		Turn on the power		5min	Naemura
30	H-28		Check theLED	the red LED for Power	1min	Naemura
31	H-27			the green LED for Trigger SW	1min	
32	H-26			the red LED for the parashute door	1min	
33	H-25		Go back to the green tent with the pyrotechnique engineers		15min	Naemura
34	H-10	Countdown	Release the safety key (pyrotechique enginnners)		5min	PE
35	H-05		Start the countdown (10 to 0)		5min	Naemura
36	H-00		Ignition and lift off		0min	Naemura

Launch Site at La Courtine

Recovery of Rockets & Satellites





UCK-06 Rocket — Overall System

TV News – NHK

Nov. 17, 2005　Creation Core Higashi Osaka

Exchange with Lycee Pierre Poivre of La Reunion

Feb. 28, 2006　Creation Core Higashi Osaka

Osaka TOIN High School
Rocket Research Club 2006・05・16

(Inspection by Mr. Christophe sicluna 2006•05•28)

(Asahi.com,　TOIN 2006/06/20)

（Installation of TOIN Sat）

（Mission Team & Supporters）

（Supporters of Space Club Kansai）

(Future project with Lycee Pierre Poivre, La Reunion)

Fusée UCK-06

Japon

Lancement

29 juillet 2006 17 :43
La Courtine - France

Club Espace de Kansai

Spécifications

Mission　：
Observation de la Terre
Quasi-Satellites
(TOIN-Sat et KSE-Sat)

Dimensions : 15cmϕx150cm
Masse　：12　Kg
Type　：Mono-étage
Altitude　：　environ0.8Km
Equipement　：
Accéléromètre
Capteur de Vitesse
Capteurs d’Attitude
Vidéo et photo numérique

Partenaires

UNICS Company Ltd.
OKURA Electronics Co.Ltd
Lycee TOIN
SHUEI Co.Ltd
KUNUGIZA Co.Ltd
Osaka-Higashi Trust Bank
Kitchen Kabocha
Pro-USE Co.Ltd
Sheriff Co.Ltd
DAM Corporation
Yoshino Kinzoku Co.Ltd
Nissin Ind. Equip. Co.Ltd
Kanaya-Autome Co.Ltd
Wakasa Reserch Lab. Co.Ltd
Science Sainte Rose
Planète Sciences
CNES
Ambassade de France au Japon

■ UCK-06 Rocket Approx. 1／5 Model ■