Microsatelliti

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THE ROUTE OF "GETTING THERE FIRST"

Not only large facilities, however, have a discovery potential, like in today HEP at accelerators

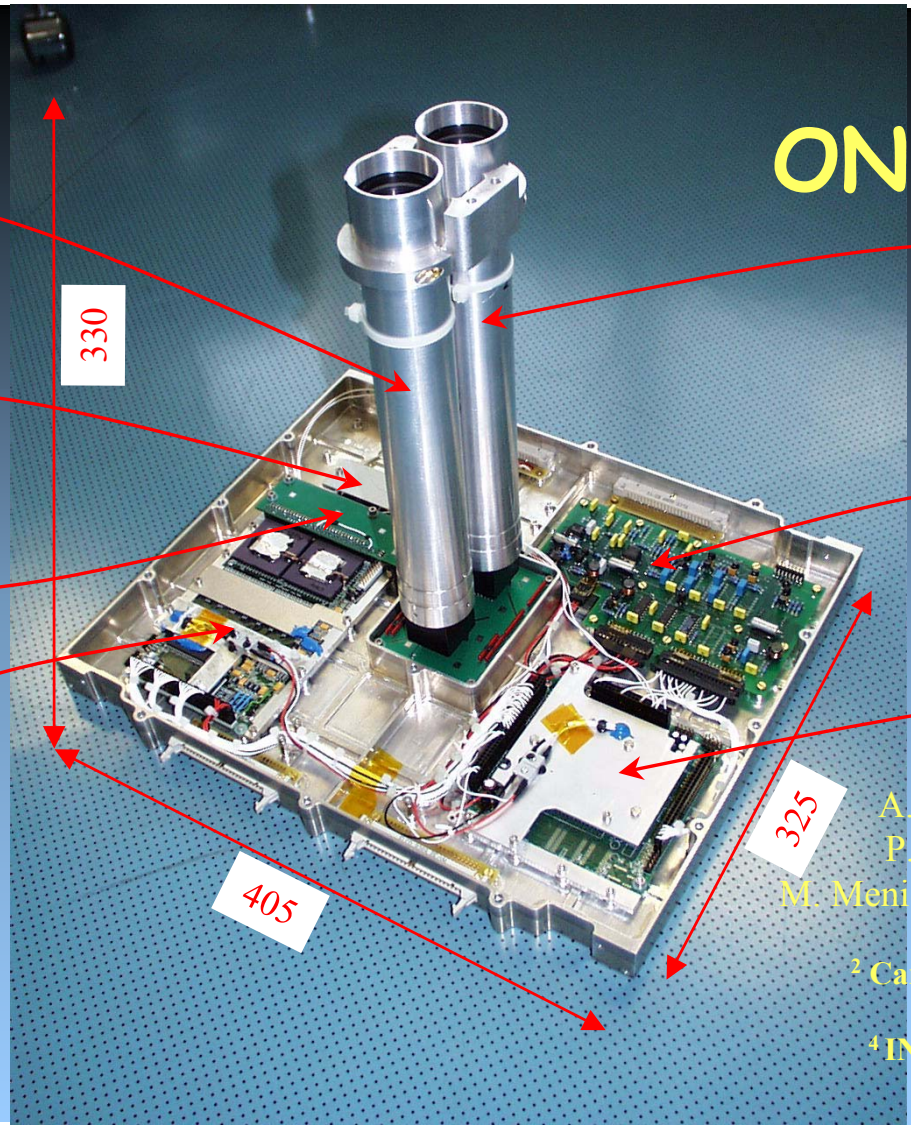
Clever, small experiments, using new or "*first time used in space*" technologies continues to give rise to fantastic surprises like at the time of Van Allen

How much a micro satellite (<100 kg) or nano satellite (10 kG) would cost?

NOME DEL SATELLITE	VETTORE	COSTO	PESO	DIMENSIONI
SUNSAT	Delta II	1,95MEuro	62,4kg	450x450x600mm
BREMSAT	STS60	3,5MEuro	63kg	500mm Dia
TiungSat-1	Dnepr	7,3MEuro	50kg	360x360x690mm
POSAT	Ariane V59	2,1MEuro	50,5kg	352x356x670mm
Cerise	Ariane V102	17,4MEuro	50kg	600x300x300mm
Tsinghua-1	Kosmos-3M		50kg	690x360x360mm
TMSAT	Zenit	9,8MEuro	150kg	690x360x360mm
Clementine	Ariane V124	18MEuro	50kg	690x360x360mm
SNAP-1	Kosmos-3M	1,5MEuro	6.5kg	non disponibile
CHPSAT	Delta 2 7320-10	12MEuro	45kg	non disponibile
SPASE	Shuttle	2,5MEuro	35kg	non disponibile

MEGSAT 1 e 2

AURORA ON MEGSAT-2



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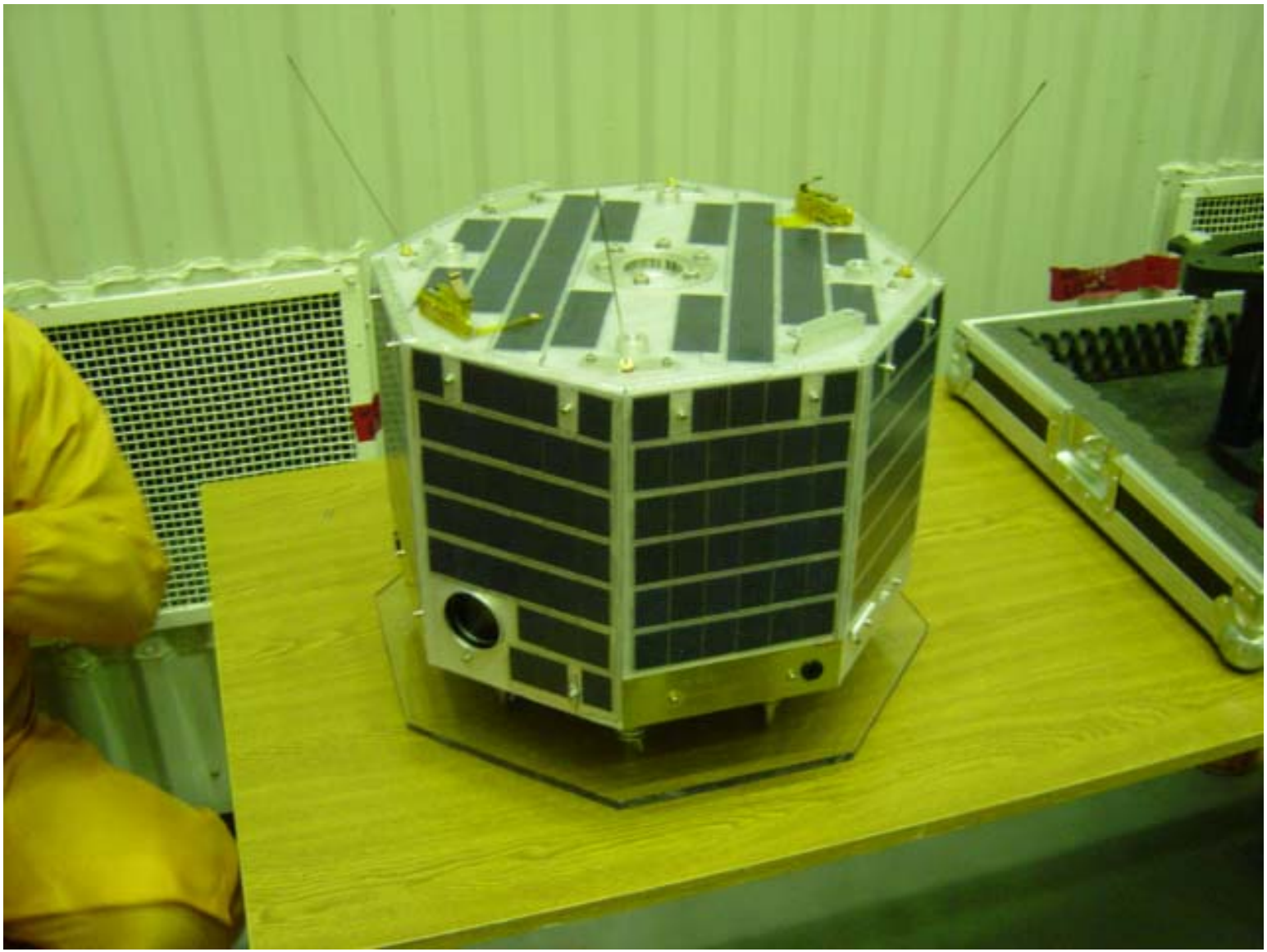
UNISAT 1 e 2



Unisat 2 during integration @ Baikonur

Unisat 2 integration @ Baikonur (Univ. La Sapienza)


Orbital

Multiple head launch of UNISAT 2 together with other 5 microsatellites

8-12- 2002

Who can build a cheap micro/nano satellite ?

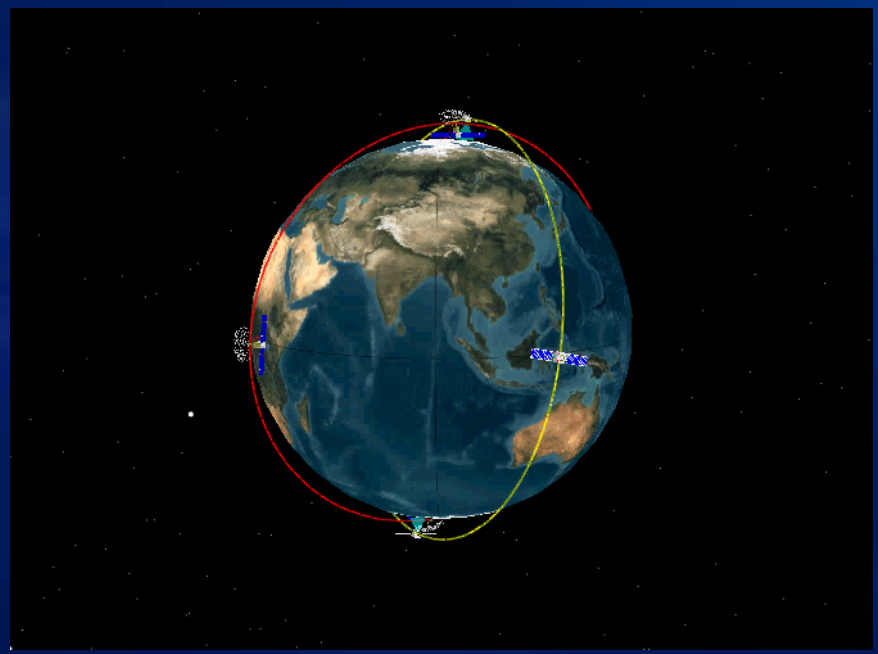
Universtities + Research Centers +Small Hightech industries

Best example: University of Surrey (UK)

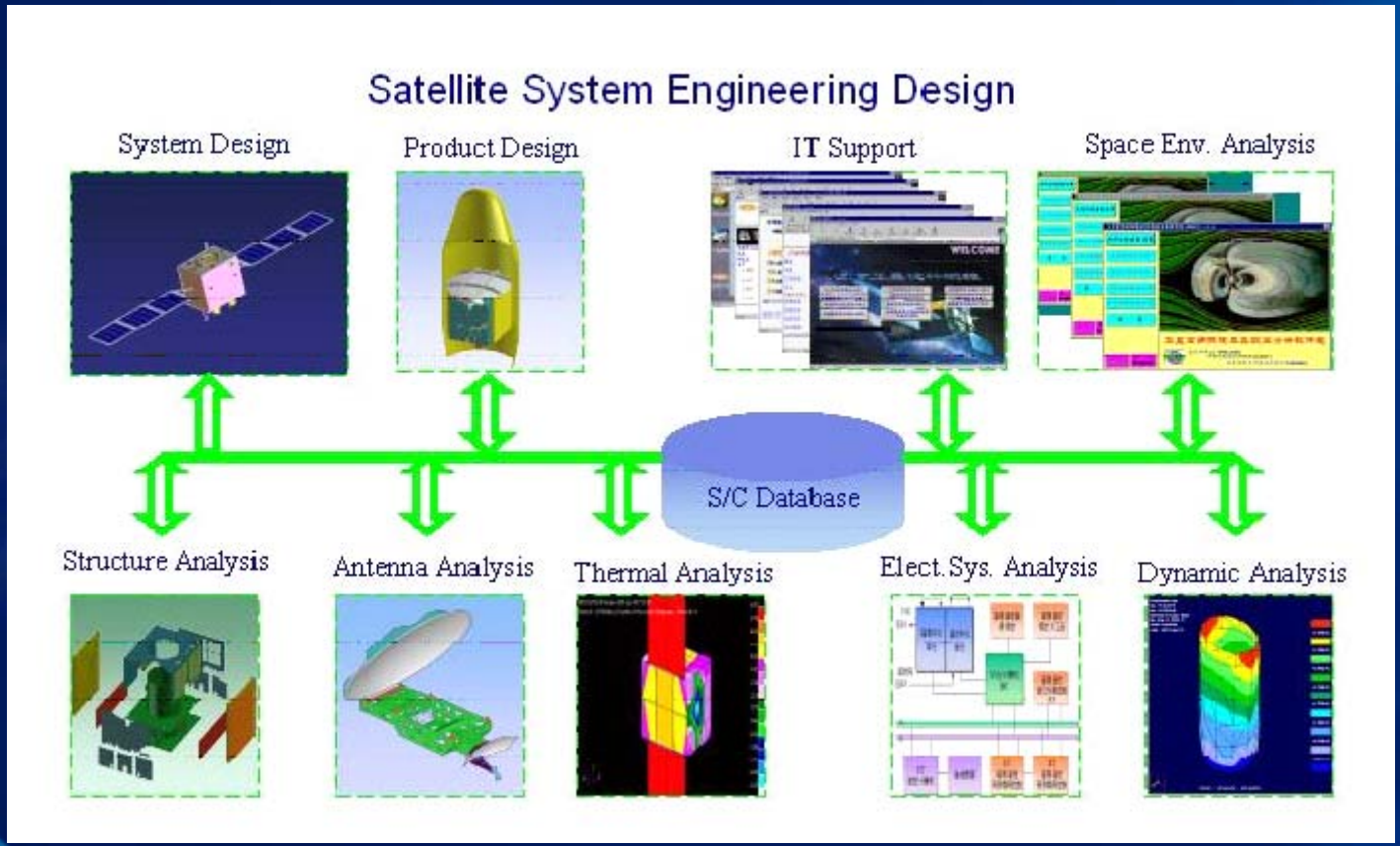
Most recent example : China CASC

Programma microsatelliti della Cina

Chines program on small&micro satellites



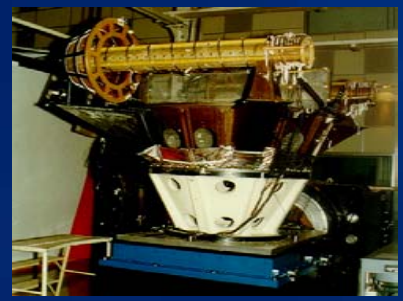
Facilities&infrastructures



Facilities&infrastructures

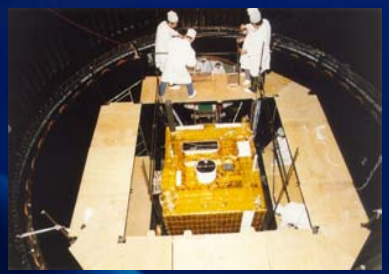
EMC Lab

Dynamic analysis

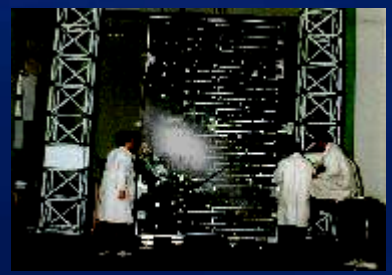


Dynamic test lab

CAD Lab



Thermal Lab



SAG Lab

Antenna Lab

Simulation Lab

Quality Management

- Integrated system of Quality assurance
- Based on 40 years' experience of Chinese aerospace

National Small-Sat Research Center

- Approved by government in 2001
- Investment : 20million USD
- Small and micro satellites development & applications

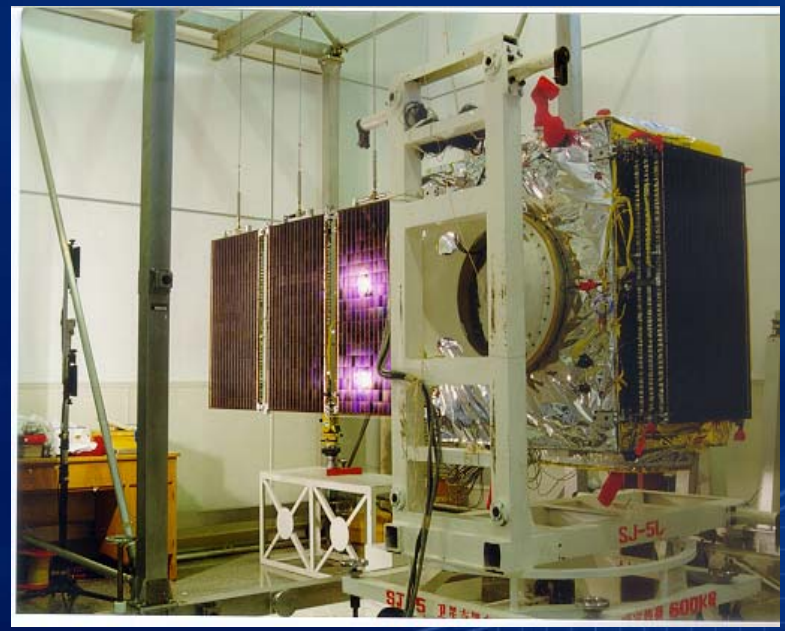
Small&min satellite System engineering and related technology Research

Small&min satellite System design, AIT, and experiment

Small&min satellite orbit support

Small&min satellite related technical service, training and consultation

Small&min satellite application R&D and service



National Small-Sat Research Center

National Small-Sat Research Center

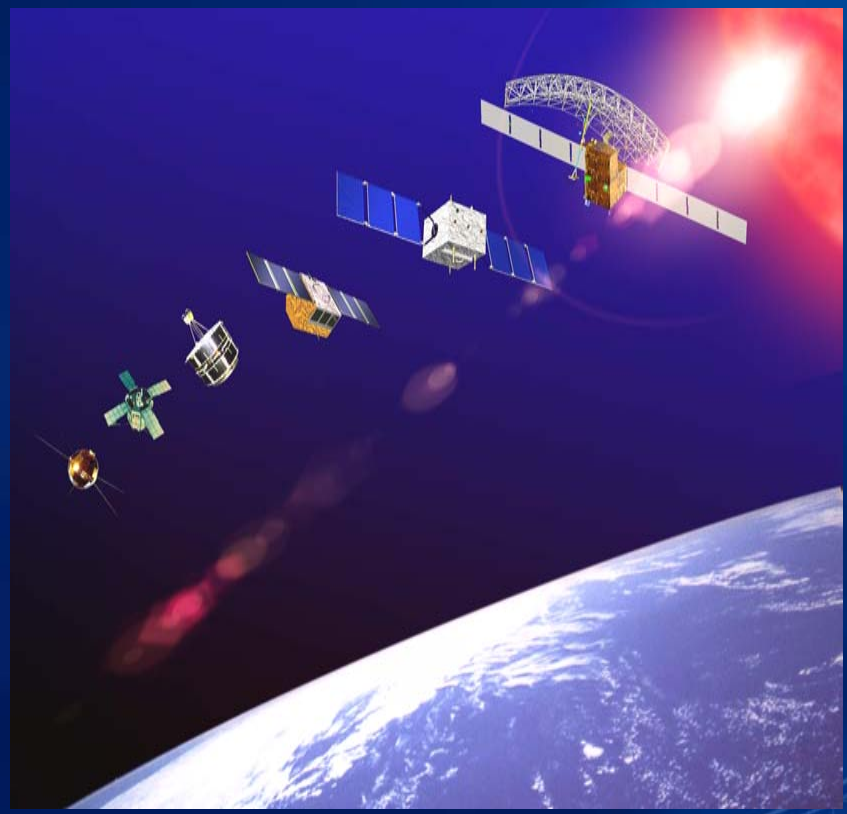
Satellite AIT Hall

Thermal/Vacuum test chamber

Satellite electronic test room

Product catalogue

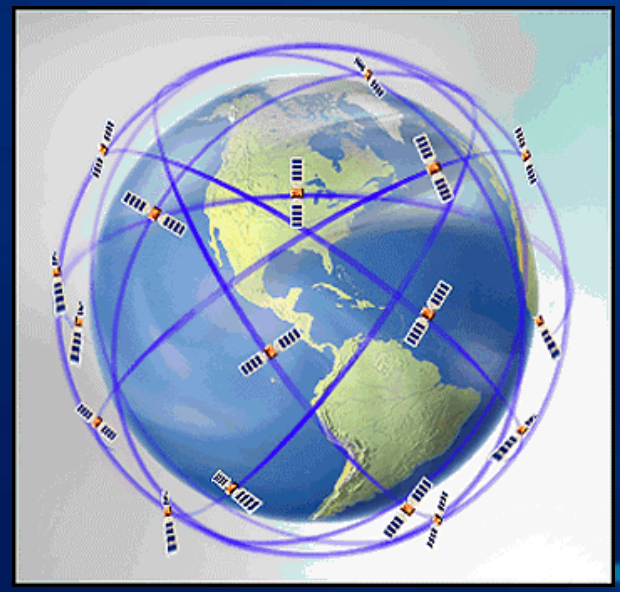
- Small satellite
- Micro satellite



About small satellites

CAST968, CAST2000 bus can be applied in different kinds of missions from LEO and MEO orbits, the weight of satellites ranges 300-900kg.

- Earth Observation
- Space Science
- Communications
- Navigation
- Technology Demonstration&Verification
- Other Applications



SJ-5 MISSION

SJ-5, is the first satellite based on CAST968 platform and was successfully launched on May 10, 1999. The main user of SJ-5 is Chinese Academy of Science.

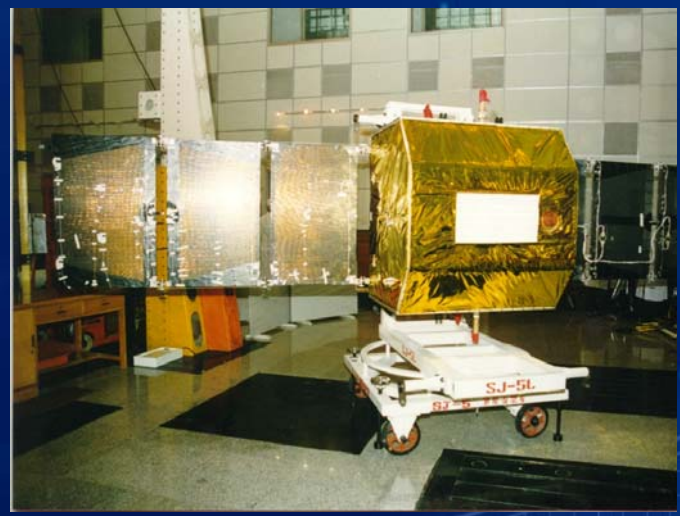
PAYLOAD：

- Space Radiation Environment Monitoring and SEP (SEU, SEL, SEB…) Protection Strategy ;
- Space Fluid Science Experiment;

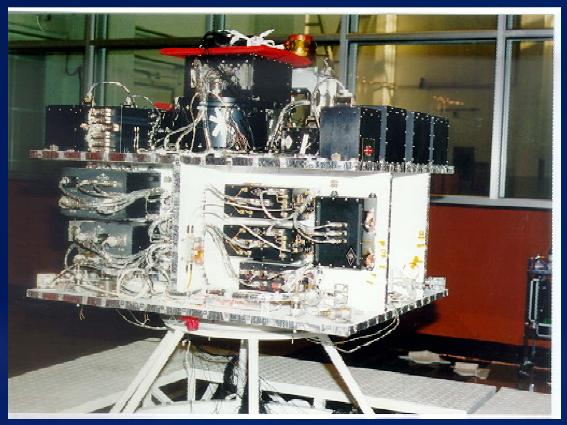
.

PLATFORM:

- New Technology Verification;

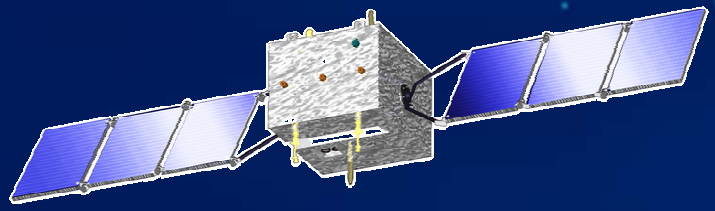


SJ-5 MISSION

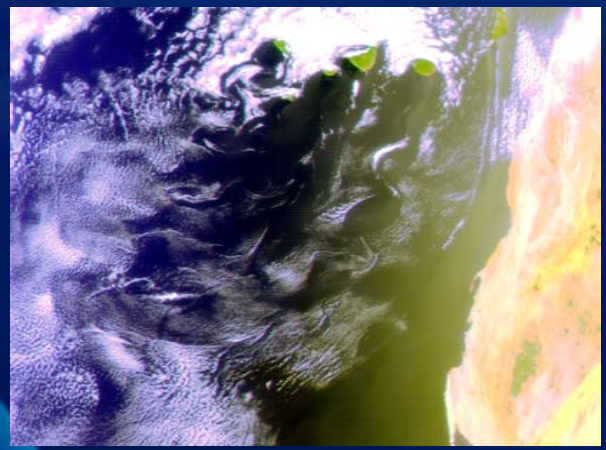


Item	*Specifications*
Mass:	298kg
Size of satellite body:	1.1m x 1.2m x 1.04m
Orbit:	870 km SSO orbit
Period:	102min
Output power of solar array:	340W(BOL); 300W(EOL)
Attitude control mode:	Sun-pointing three-axis stabilization; Sun-pointing spin stabilization
Accuracy of control:	±5°
Accuracy of stabilization:	<0.05°/s
Spin rate:	~4rpm
Attitude measurement accuracy	<±4°
TTC system	S-band TT&C

HY-1 MISSION



HY-1 was developed for China Ocean Administration, and launched with FY-1D on a LM-4B launch vehicle in May 2002. HY-1B is under building.

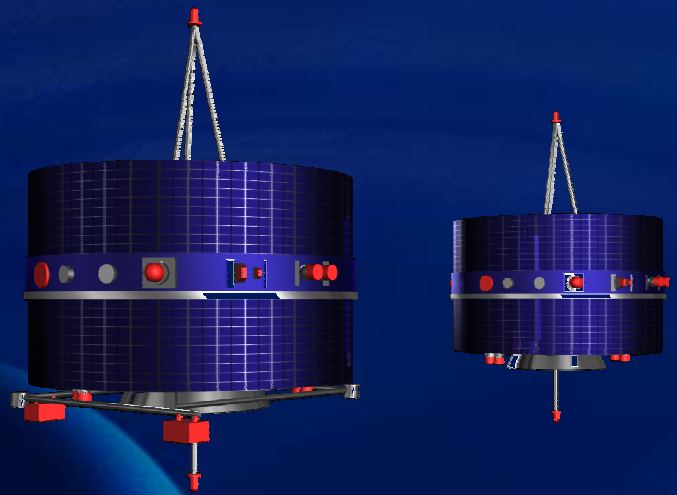


Item	*Specifications*
Orbit:	**798km SSO**
Mass:	**360kg**
Size of satellite body:	**1200mm×1100mm×1008mm**
Sea color scanner: **Number of band:** **resolution/ Swath width:**	 **10** **1100m/1600km**
CCD camera: **number of band:** **resolution/ Swath width:**	 **4** **250m/500km**
Data transmission:	**X Band**

Double Star MISSION

TC-1/2(Double Star Plan) is cooperated with ESA in order to detect magnetic storms in space, sun activities, and other disaster phenomenon in space.

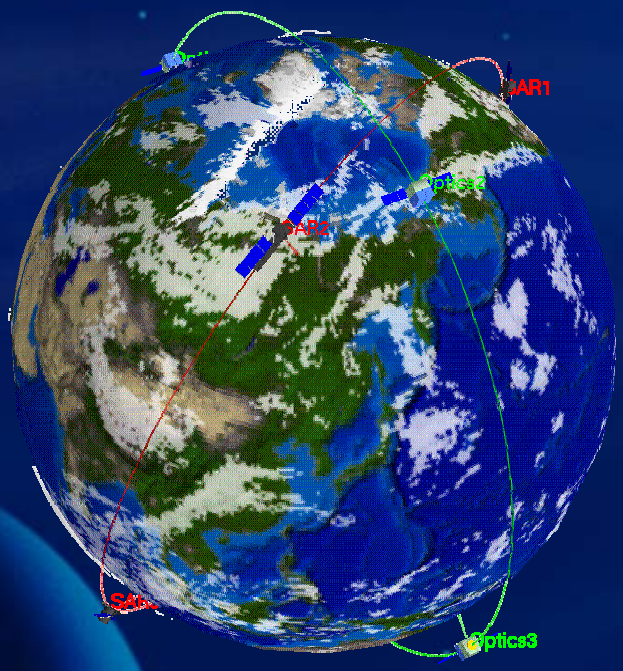
TC-1 was lunched in Dec. 2003, TC-2 was lunched in July.2004. They united Cluster Ⅱ of ESA to form a constellation of 6 satellites.



Item	*Specifications*
Weight of Satellite:	**~330kg**
Size of satellite body:	**Φ2100×1480 mm³**
Orbit: **Near Equatorial Satellite:** **Polar Satellite:**	**Large Ellipse Orbit** **Perigee: 500km,** **Apogee: 60000Km,** **Inclination: 28.5°** **Perigee: 350km,** **Apogee: 25000Km,** **Inclination: 90°**
Power: **Output power of solar array:**	**Body-mounted solar array, Silicon solar cell** **280W(BOL)/230W(EOL)**
Attitude control:	**Spinning, Accuracy of attitude control: <5°**

Small Satellite Constellation

Disaster and Environment Monitoring and Forecast Small Satellite Constellation



Phase A

Two optics satellites and one SAR satellite, The average revisit period is 32 hours, and the average global coverage time is 48 hours.

Phase B

Establish an 8 satellites constellation with 4 optics satellites and 4 SAR satellites. The average revisit period is 12 hours, and the average global coverage time is 24 hours.

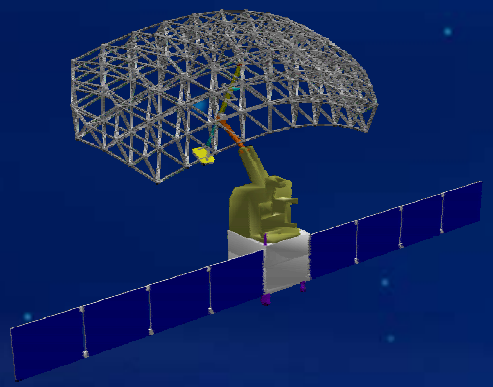
Earthquake Monitoring and Forecasting with micro-satellite is under consideration

Optical Small Satellites

HJ-1A and HJ-1B

Item	*Specifications*
Super-spectral imager	
Spectral bands (μm):	0.45-0.95
resolution / Swath width:	100m/50km
DCS	Receive: 401MHz; Transmit: 460MHz
Wide-coverage CCD Camera	
Spectral bands (μm):	0.43-0.52,0.52-0.60,0.63-0.69,0.76-0.9
Ground pixel resolution:	30m
Swath width:	360×2km
Infrared Camera	
Spectral bands (μm):	0.75-1.10,1.55-1.75,3.50-3.90,10.5-12.5
Ground pixel resolution:	150m(Near and middle infrared) 300m(Thermal infrared)
Swath width:	720km
Orbit:	~650km SSO
Weight:	~470kg
Size of satellite body:	1200mm×1200mm×980mm

SAR Small Satellite



HJ-1C

Item c	*Specifications*
Orbit:	~500km SSO
Weight:	~850kg
Size of satellite body:	1400mm×1400mm×3800mm
Working frequency:	S band
Ground resolution:	20m
Swath width:	100km
Attitude and Orbit Control:	three-axis stabilization
Accuracy of pointing:	three axes ≤0.3°
stabilization:	three axes ≤0.001°/s
Power:	900W(BOL)/554W(EOL)
Design Life:	3 years

About Micro satellites

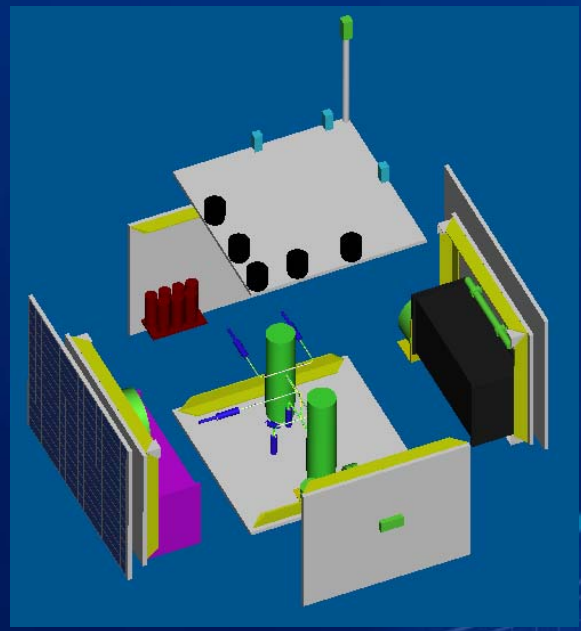
Three kinds of micro satellite bus are under development aiming to satisfy different missions including Satellite Constellation and Formation Flight.

- 30－60kg level micro satellite ,50w for payload
- 80－100kg level micro satellite,100w for payload
- 100－150kg level micro satellite, 200w for payload
- Attitude control accuracy ranges as 1°/2°; 0.2° -0.3 ° / 0.5°; 0.05° / 0.1° aiming to different mission request

To form 30kg-150kg Continuative spectrum of micro satellite products, the payload focus on science exploration, experiment and others (such as GPS gravity field measurement) .

Characteristics of Design

- Function Design & System Integration
- System Design and Overall Optimization
- Satellite Network and House Keeping
- Multi-functional Structure
- Public Box with PCB
- Miniature Sensors and Light Structure
- Concept of Flexible Platform

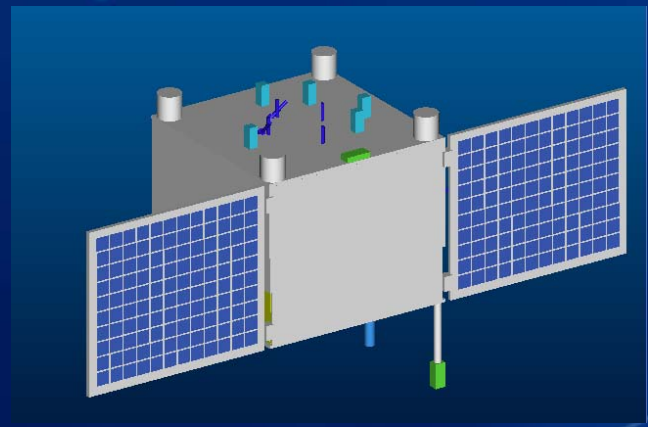


MS-1 micro satellite

- Total mass: <100kg
  - Payload: ~30kg
- Orbit: SSO
  - Orbit height: 500km-800km
- Attitude and orbit control
  - 3-axis stabilization
  - Attitude determination: 0.2°~0.3°
    - Easy to be extended 0.05°

  Power:
  - Solar array: ~180W
  - For payload: >100W

The MS-1 is planed to launch in 2005.

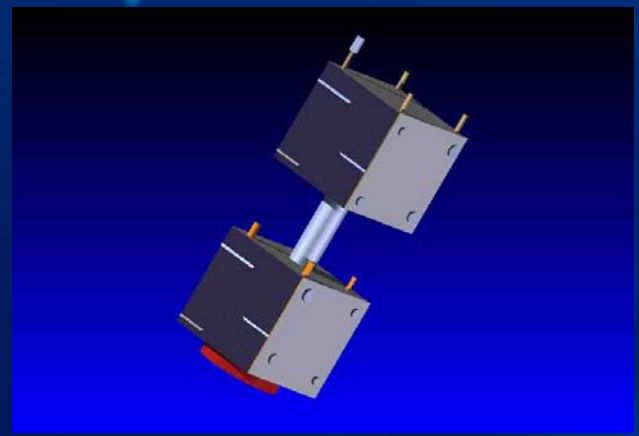


MS-2 micro satellite

- Total mass: <50kg
  - Payload: ~20kg
- Orbit: SSO
  - Orbit height: 500km-800km
- Attitude and orbit control
  - Gravity gradient stabilization
  - Attitude determination: 2°~3°

Power:

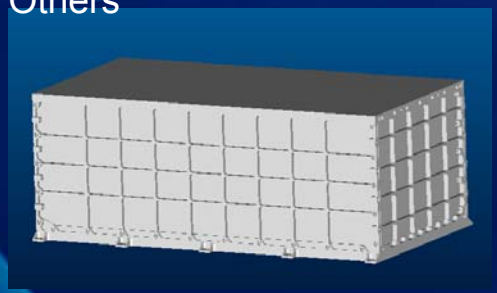
- Solar array: ~80W
- For payload: >50W



Miniature parts for micro satellite

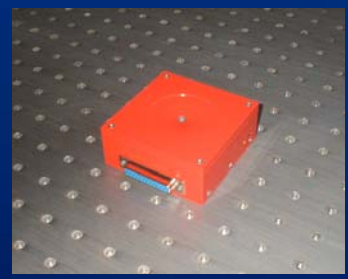
DFH is developing independently or in cooperatively with Chinese famous institutes &universities in miniature space quality parts, such as:

- Pubic box with PCB in charge of overall electronics and data handling.
- Lithium battery
- Mini Momentum Wheel
- Optical Gyro
- CMOS Star tracker
- CMOS Sun sensor
- Others



Public box with PCM

Attitude control Module in public box



CMOS Sun sensor

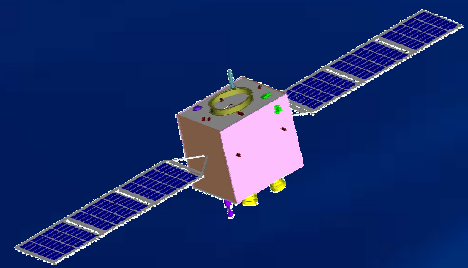
Microwave network

Cooperation suggestion

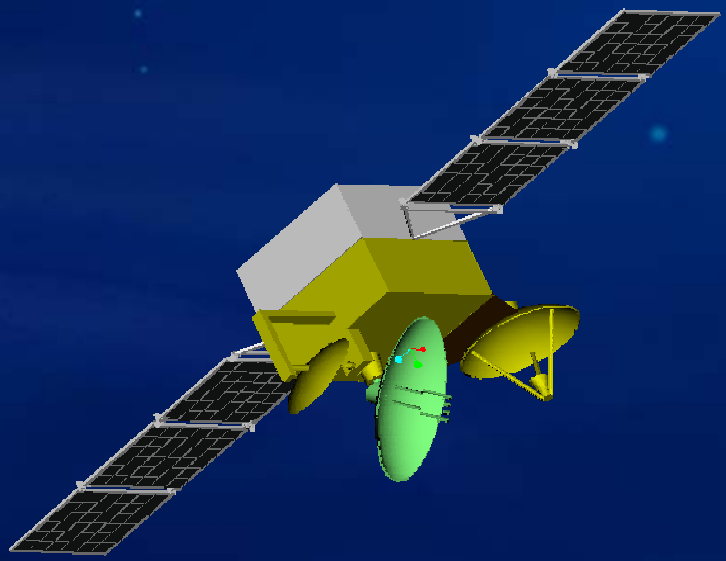
DFH is willing and open to any kinds of cooperation with INFN partners

The possible cooperation we suppose:

- Develop together the micro satellites
- DFH provides satellite bus with Italy's payload and AIT .
- Explore customers together.
- More



Thank you!



Examples of Astroparticle physics on a micro/nano satellite

1- accurate monitoring of Earth Magnetosphere overshort period of times (geophysics, earthquakes effects) ;
2- background fluorescence light monitor for EUSO or OWL like experiments;
3- development of binocular or multiocular optics for OWL class of experiments;
4- gravitation test using Bec on a Chip;
5- very precise time measurement and relativity tests;
6- testing of new type of detectors for high precision spectroscopy (superconductive junctions
7- test of GEM type polarimeters
8- ……..

→Accelerators experiements needs test beams

→ Space Observatories needs cheap/fast access to space

Conclusion

- The universe is the current frontier for new exciting physics
- Space is a privileged reference frame to study the universe
- Very large, powerful facilities will bring us to new frontiers in knowledge
- Small satellites, would allow us to reach the most abitious goal set by major satellites, both testing new technologies and educating a new generation of laboratory oriented astroparticle physicsts

……and hopefully bringing us some big surprises