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CubeSats in Education and Society

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Space research

There is less resources available as world population increases. Space research contributes greatly

- To the efficient utilization of resources
- To the development of new resources

Space Technologies

In the service of society:

- Telecommunications,
- Audio and video broadcasting, TV,
- Distance education and health services,
- Environmental data gathering,
- Search and Rescue,
- Navigation,
- Weather forecast,
- Earth observations, sea and oceans,
- Cartography, surface observations,
- Agriculture, forest, water resources surveillance/management
- Security
- ……

Space Technology

- Contribute significantly to wealth creation and quality of life, both directly and in terms of technology spin-off to other sectors

International Power

- Become an important power in space technologies and have major contribution to the peacefull utilization of Space
- Requirements:
  - R&D and test infrastructure
  - Qualified human resources

CubeSat Project*

- The CubeSat Project was developed by California Polytechnic State University, San Luis Obispo and Stanford University's Space Systems Development Lab. The CubeSat program creates launch opportunities for universities previously unable to access space.

  With over 60 universities and high school participating in the CubeSat program, the educational benefits are tremendous. Students, through hands on work, will develop the necessary skills and experience needed to succeed in the aerospace industry. The CubeSat program also benefits private firms and government by providing a low-cost way of flying payloads in space, all while creating important educational opportunities for future leaders of industry.

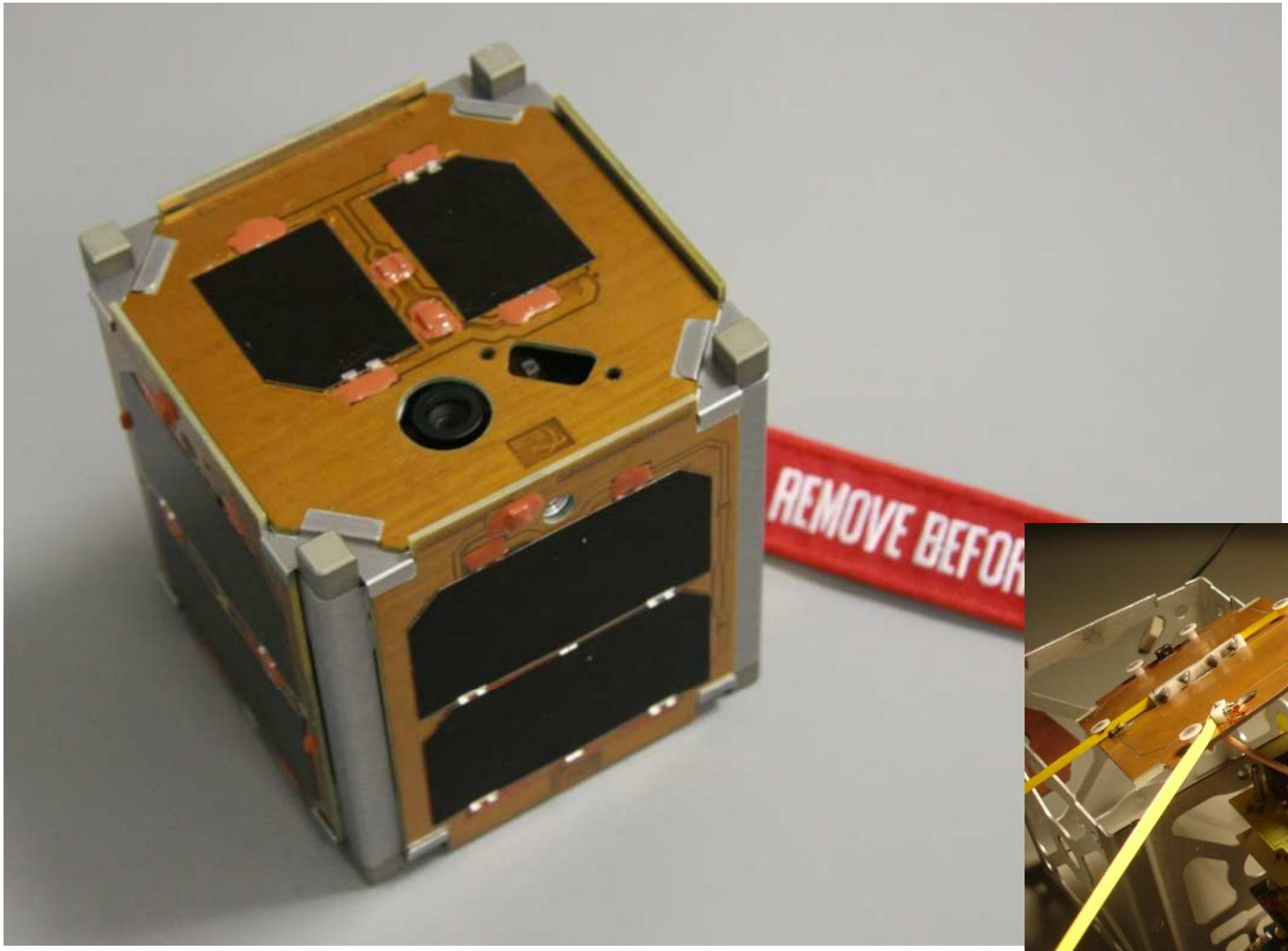
  The CubeSat program strives to provide practical, reliable, and cost-effective launch opportunities for small satellites and their payloads.

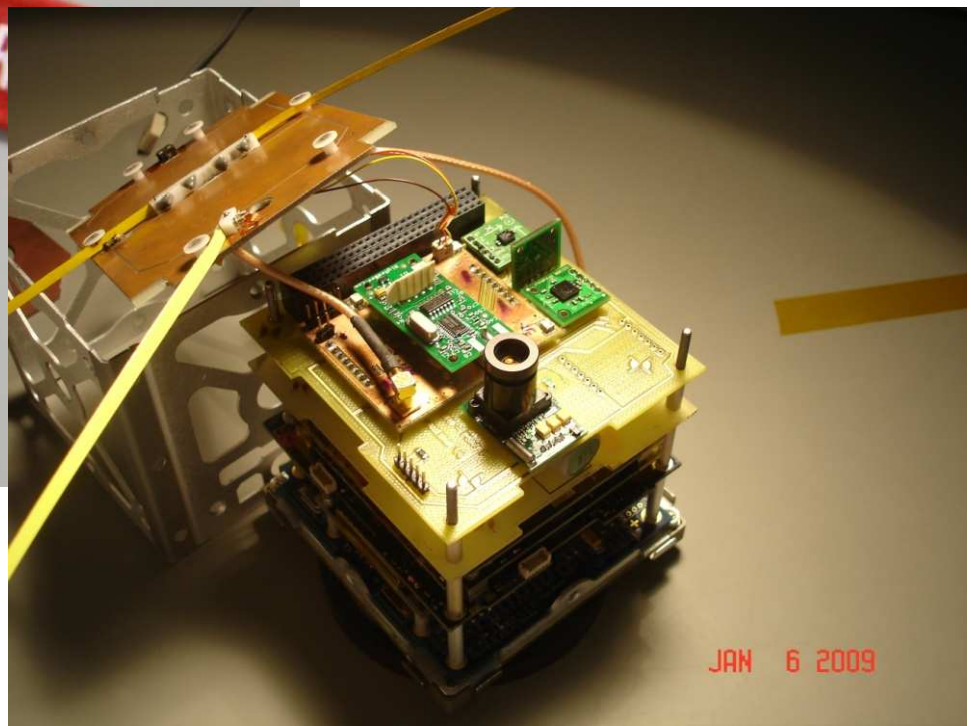
*www.cubesat.org

Disruptive Technology

- CubeSats just a short while ago considered only for educational purposes are now on the way to become a disruptive technology revolutionizing the space activities.
- Strong support for CubeSat Projects by NSF in USA and FP, ESA in Europe (QB50)
- All Major Aerospace companies now have involved in CubeSat projects

ITUpSAT1



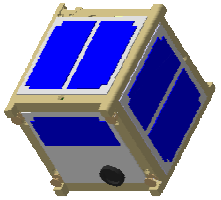


ITUpSAT1

- ITUpSAT1 (Istanbul Technical University PicoSATellite) is the first pico-satellite designed, manufactured and tested in Turkey.
- The initial aim of the satellite was to give students experience over the whole lifecycle of a space mission, beginning from preliminary design to operations.
- Launched and placed in orbit on September 23rd , 2009.
- First Turkish made satellite, a cubesat, ITUpSAT1
- Same for switzerland, SwissCube

ITUpSAT1

- Student designed spacecraft from ITU.
- Comply with CubeSat standart
- Project consideration and proposal 2005
- Started 2006 (ITU and TUBITAK support)
- Launch September 23, 2009
- Single Satellite itself costs about $0.2 million
- Infrastructure and support: $1 million
- Main objective: Low resolution (640x480 pixels) imaging.
- Secondary objectives: Passive magnetic stabilization and inertial data capturing.



Satellite Clasification(Mass)

- Large satellites: > 1 ton (Turksat 3A)
- Medium size: 500 kg – 1 ton
- Small satellites: 100kg - 500kg (Göktürk II)
- Micro satellites : 10kg – 100 kg (UoSAT-1)
- Nano satellites : 1kg – 10 kg (Delfi C3)
- Pico satellites : 0.1kg - 1kg (İTÜpSAT1)
- Femto satellites : < 0.1 kg

Launch, Beacon

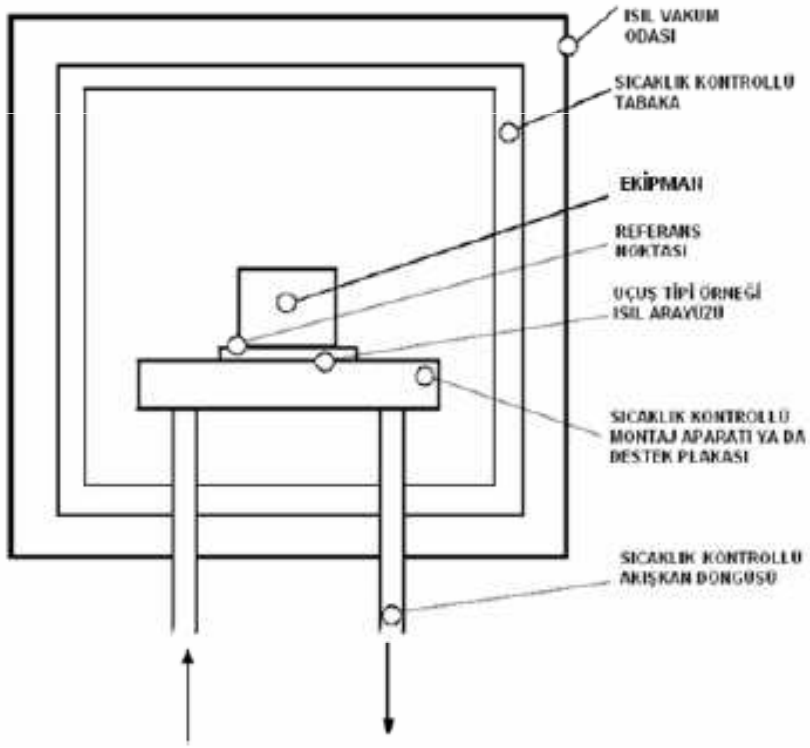
SATELLITE IN A BOX

Benefits-Education

- Applied education: plan, design, produce, test, integrate, launch, observe a spacequalified actual satellite during education
- Establish design, manufacturing and testing infrasturcture
- Space project: higly motivated students, individuals
- Multidisciplinary research teams at universities
- Raise qualified and experienced Space Engineers for aerospace industry
- Increase national capability in satellite technologies

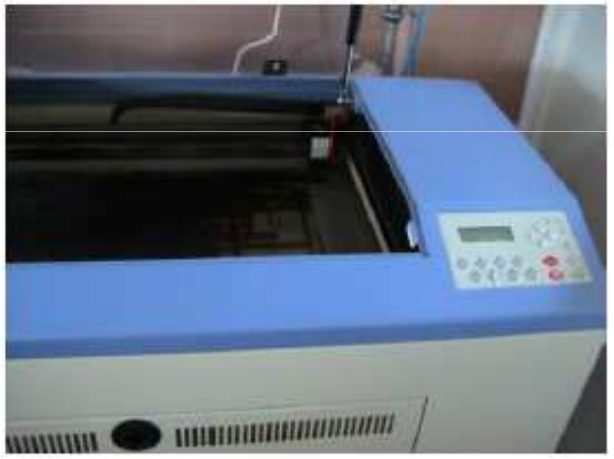
Clean Room – Integration and Test

TVAC



Şekil 5.1 Isıl Vakum Döngü Odası Temsili Gösterimi

Testing and Production Infrastructure in ITU



Benefits

- Interdisplinary research , between people, groups, companies, departments, faculties... never get together before
- Low cost technology test bed
- High technology at very low cost in the service of society
- Very high impact on society and the news, TVs, web sites
- Create space awareness among people
- Interaction with elemantary and high schools

Effects on Society

- First satellites of countries, Turkey, Swiss,..
- High spirits in society
- Social networking sites: FACEBOOK
- Radio amatuers track and record beacon signals
- TAMSAT, Turkish Amateur Satellite Technologies Organization (AMSAT-TR).


USTTL

Design contest for CubeSat Beacon

Project student comment

- ITUpSAT1 was the only project who gave me pratical experience both in undergraduate and graduate level. Turkey has a very young and inexperienced space industry. This project has facilitated the transition to the practical life and has increased my intellectual level. Now I have great confidence in what I do. Besides, when considering the very high butgets involved in the space research and industry, the level of achievemnets both people and knowledgewise with such a modest budget and relatively little time is very gainly.

Project student comment

- Before I began to work in ITUpSAT1 project I was just an ordinary electronics engineer. As I worked in this project I have realized what we can do as an individual and society. It was a small but important step and I was part of it.

Outcomes

- Accounting for space debris in project planning, compliance with UN regulations
- A new job sector: entrepreneurship, student level, Pumpkin, ISIS, Clyde Space...
- Underdeveloped, developing, developed, every nation wants to built a satellite: CubeSat,
- To reach space is a realm of possibility for everyone...

Conclusions

- Continous financial support for sustainable space education with hands on experience,
- Keep the interest of students alive
- Improve greatly infrastructure and HR
- Involve, educate and train SMEs in space technologies and spacequalified production
- International collaborations