



# Upcoming Space Flight Opportunities

Cal Poly CubeSat Workshop  
Utah State University  
Logan, Utah

August 7-8, 2010

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## Overview

- Projects in Kentucky
- Present & new flight opportunities



## Projects in Kentucky

<u>Projects</u>	<u>Partner</u>	<u>Purpose</u>	<u>Launch Date</u>
Interorbital	Morehead	Test Flight	???? 2010
Interorbital	Morehead	Orbital launch	20??
UniSat	Univ. of Rome	Education	Fall 2010
PocketQub	Morehead	Micro Technology	Fall 2010
GlioLab	Univ. of Rome	Cancer research	Fall 2010
Rampart	AFRL/Others	Tech Demo	Spring 2011
NanoRacks	Morehead	MG - research	2011
QB50	International	Atmospheric R.	2013

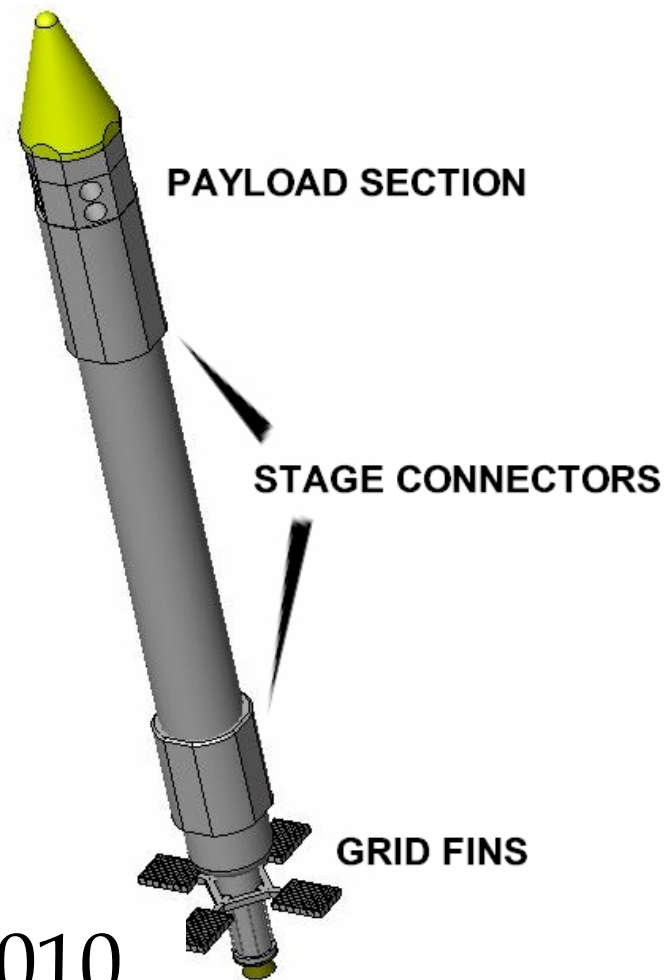
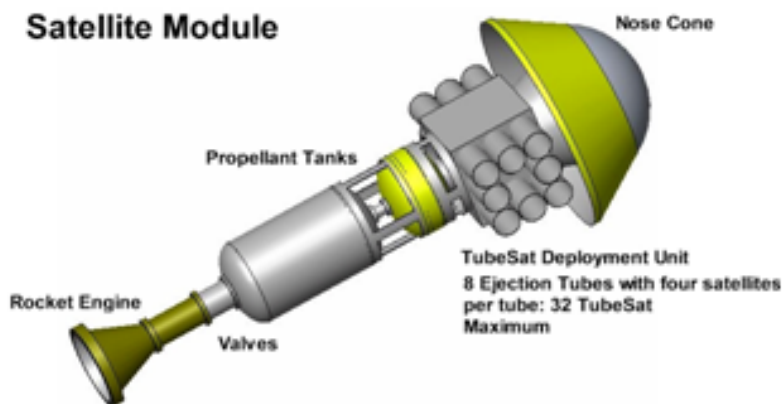


# Interorbital LEO TubeSat Launches



# Test Launch in Mojave

## Interorbital



Launch in Fall 2010



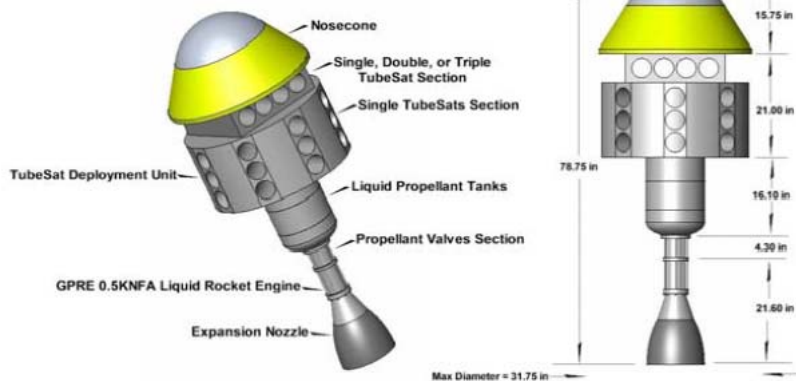
# ASL

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SPACE SCIENCE CENTER  
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## Orbital Launch

### Interorbital



## Launch in 2011



# University of Rome UniSat MR-FOD Launches



# UniSat

## LEO Sun Synchronous Orbit:

### Orbital parameters close to:

- Altitude ~ 700 km;
- eccentricity 0;
- inclination  $98,24^\circ$ ;
- local mean solar time of the ascending node first passage  
22 hours 30 min

## Russian Dnper Launch



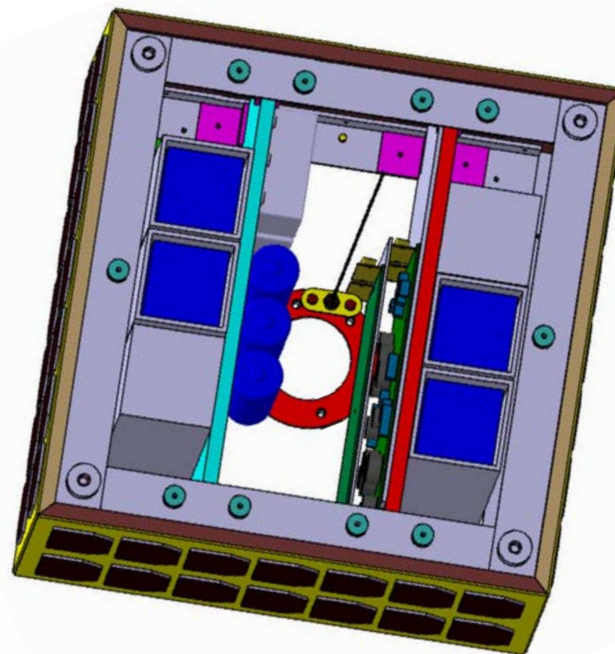
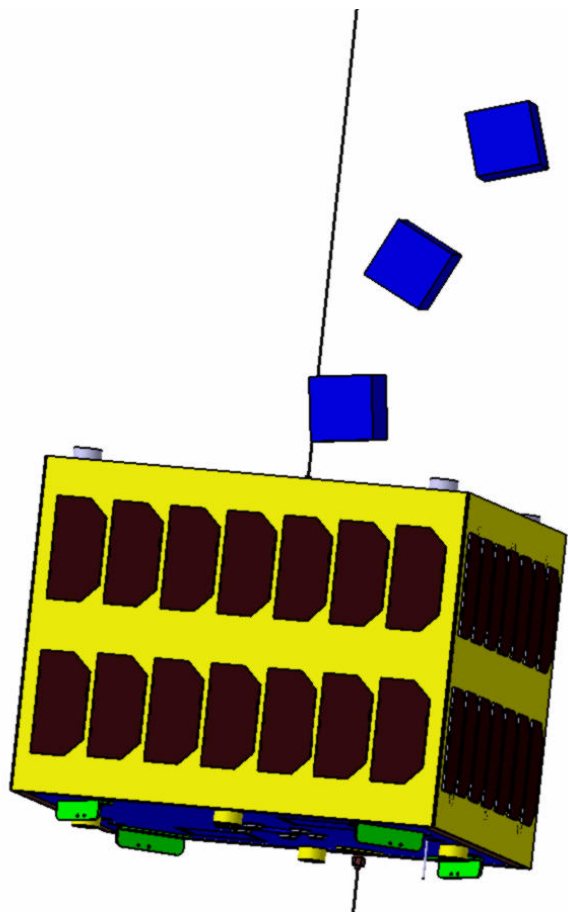


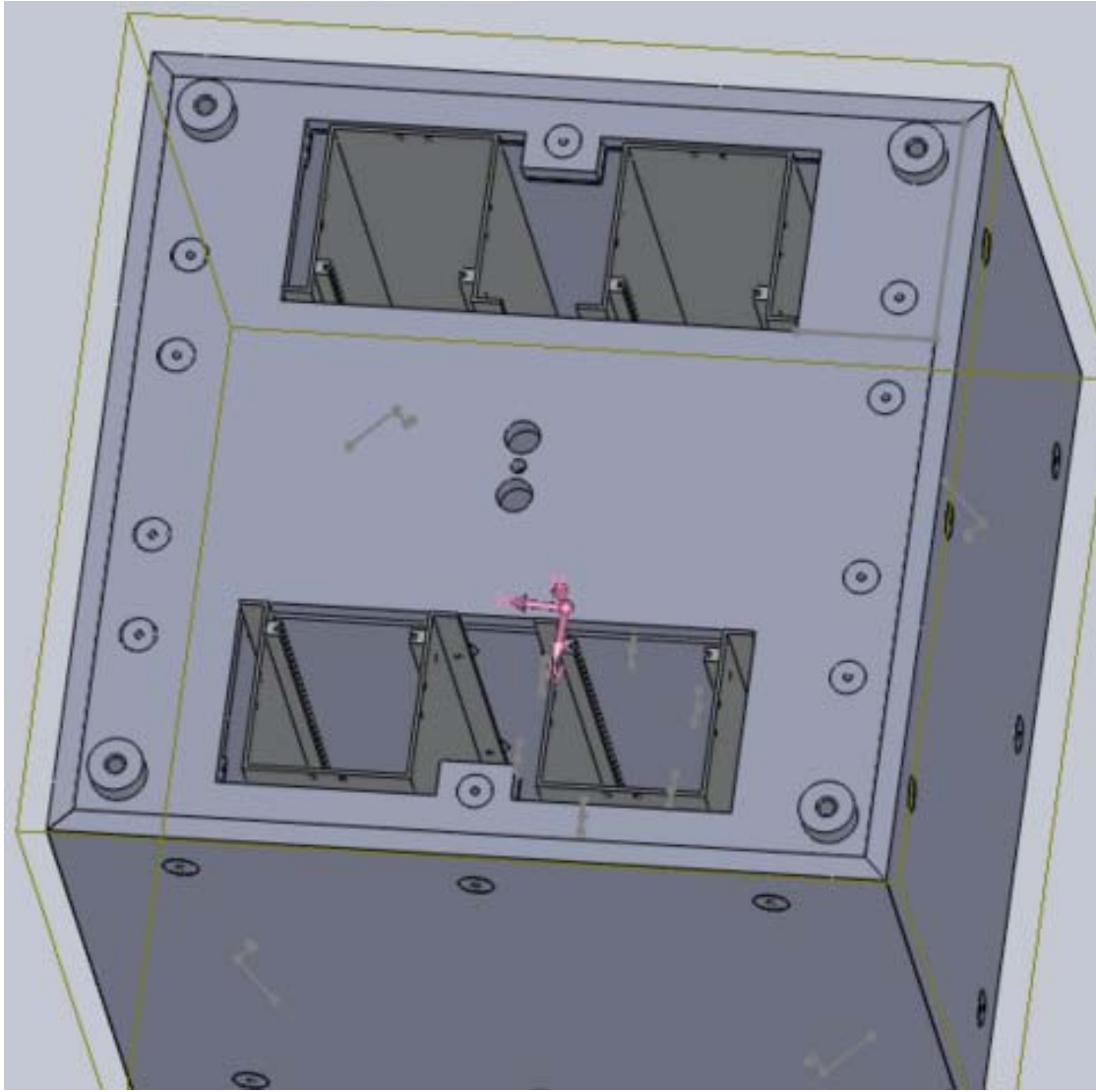
# ASL

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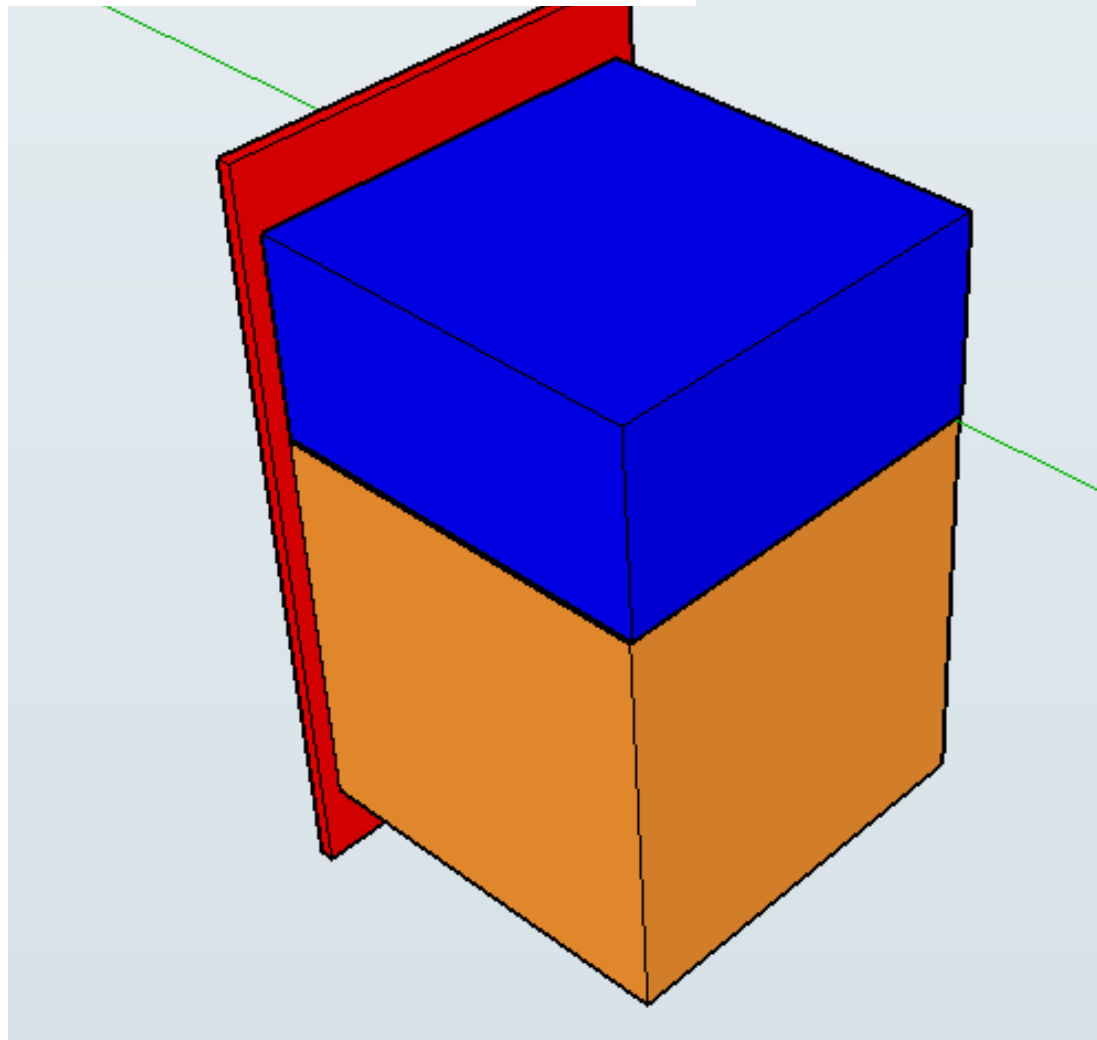
## OUR PAYLOAD





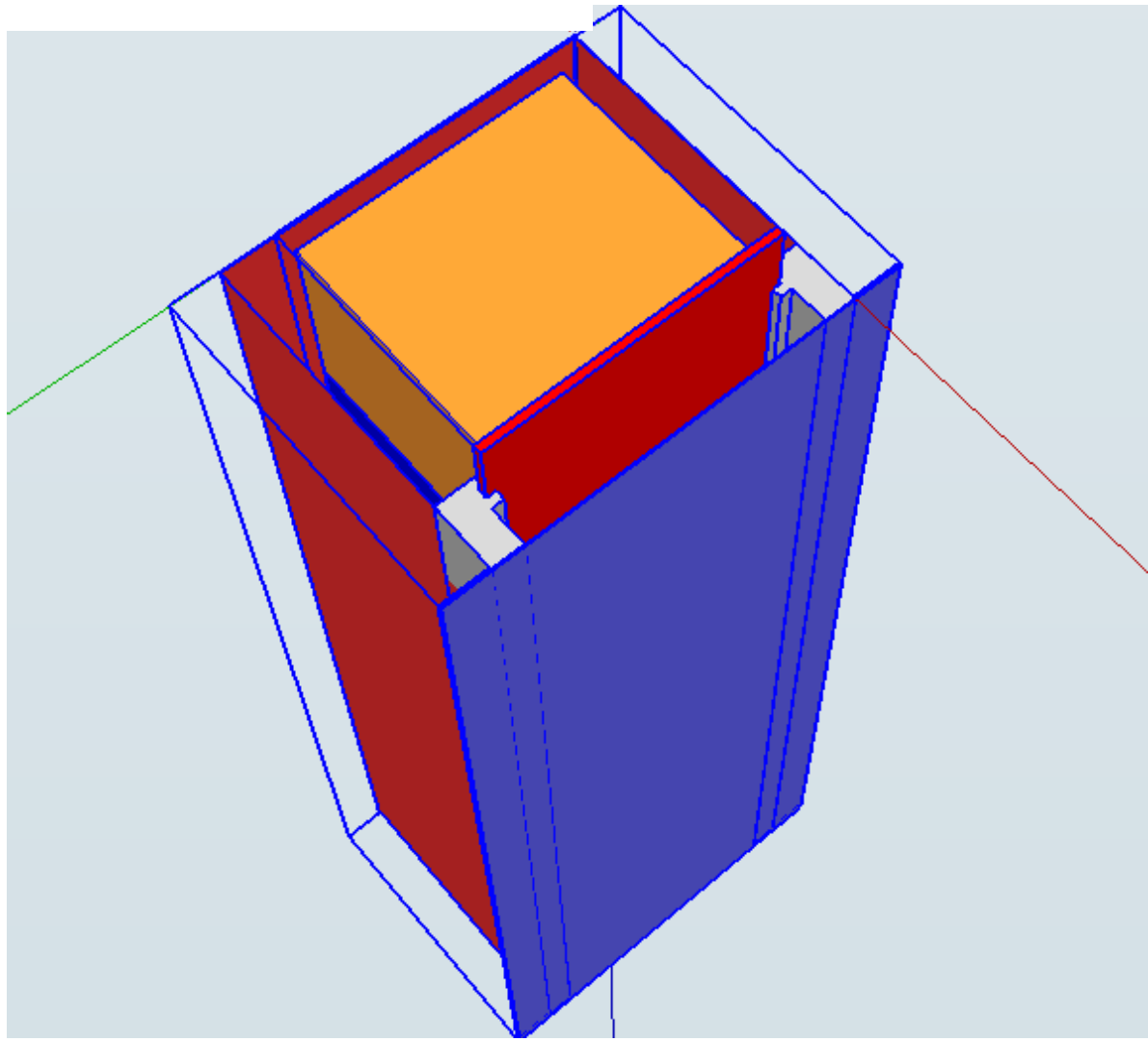


# PocketQub w Deorbiter





# MR-FOD Launcher



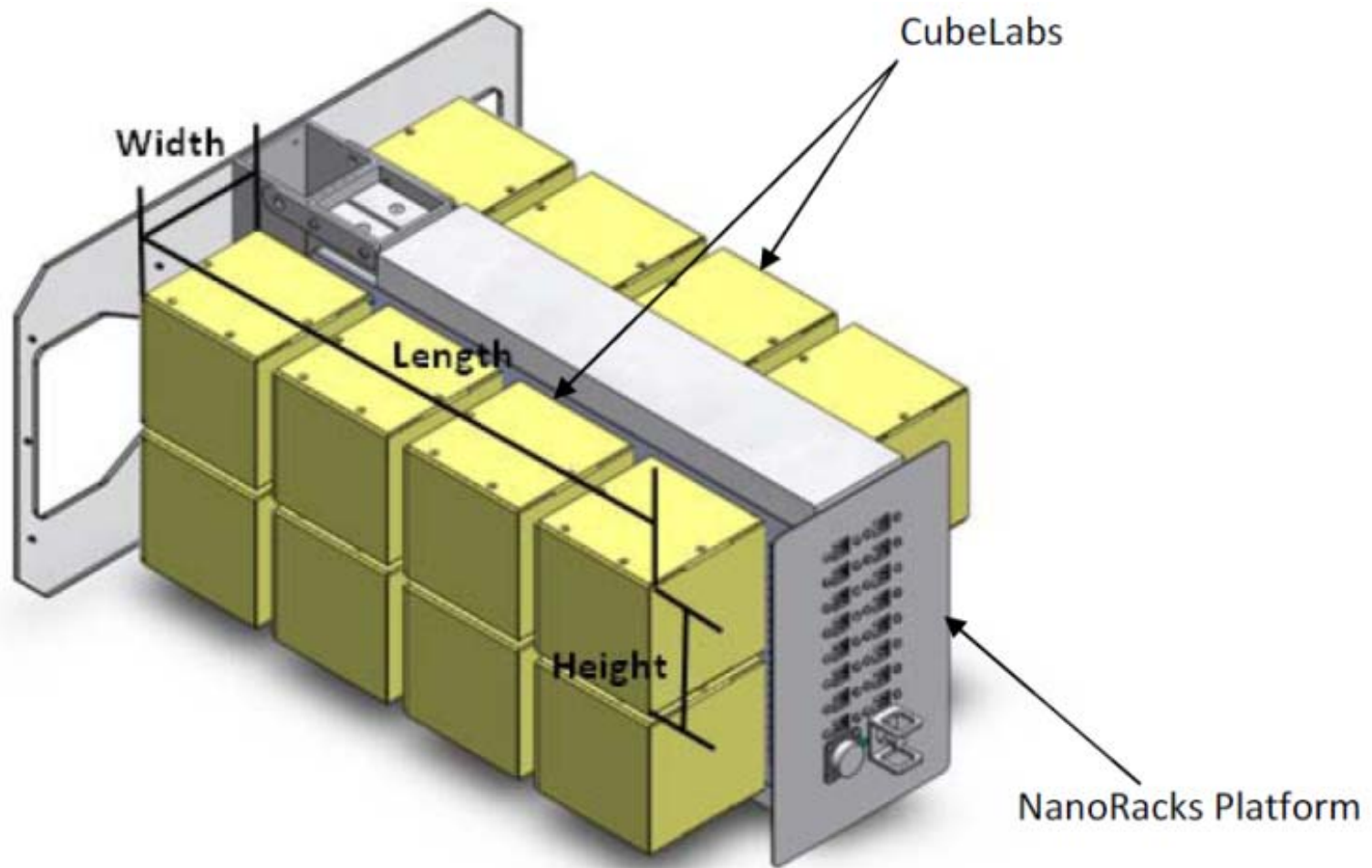


# GlioLab

## ISS Microgravity Research



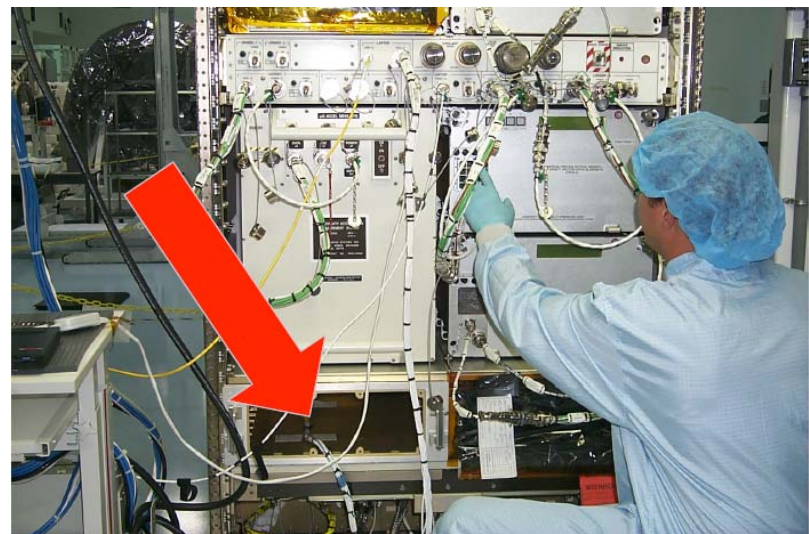
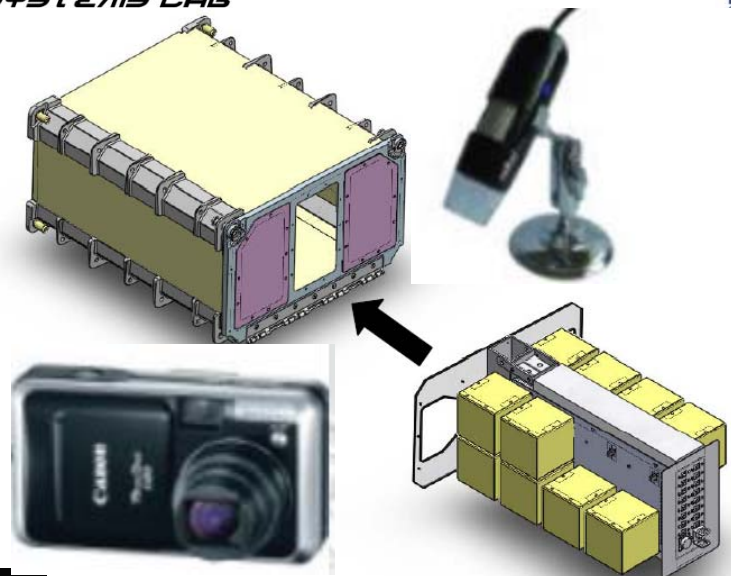
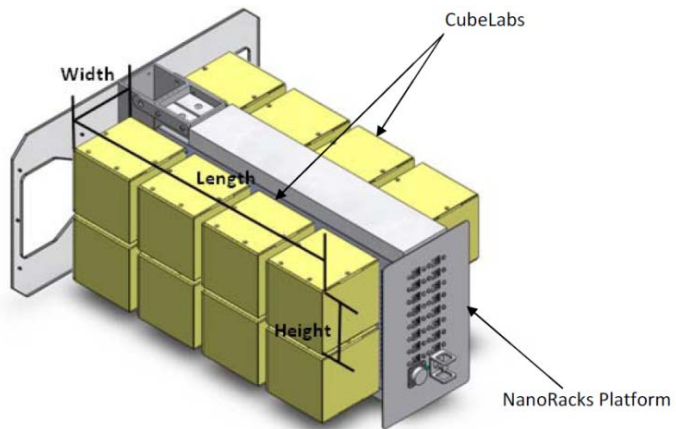
# NanoRacks





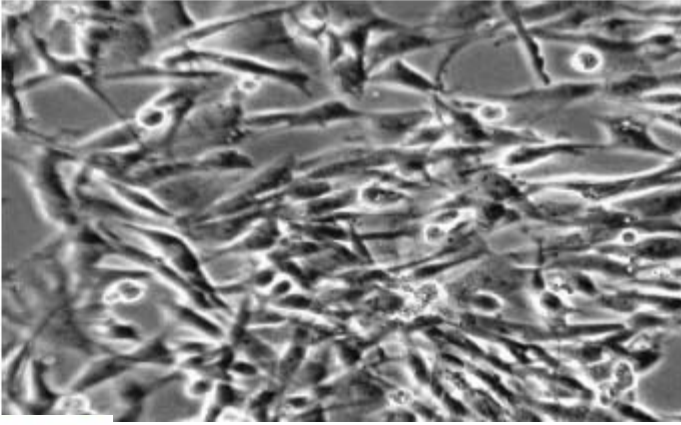
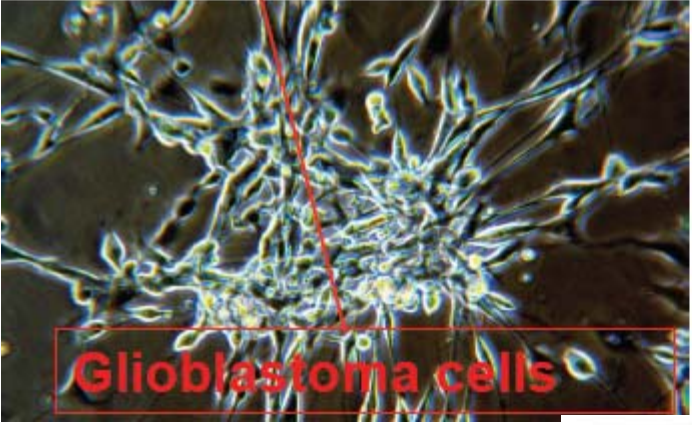
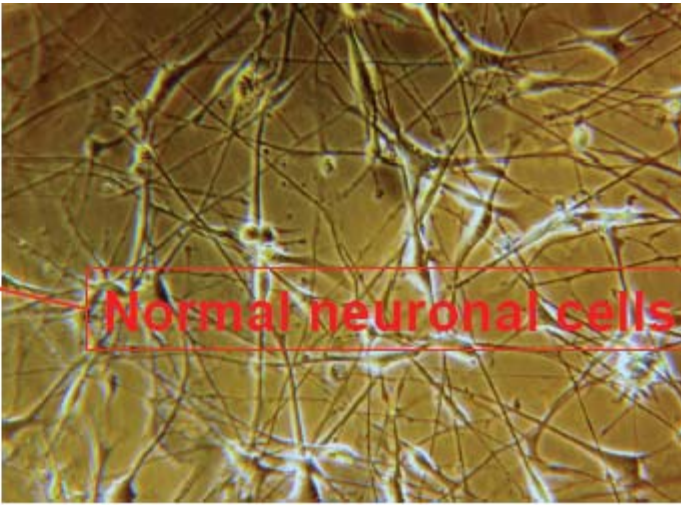
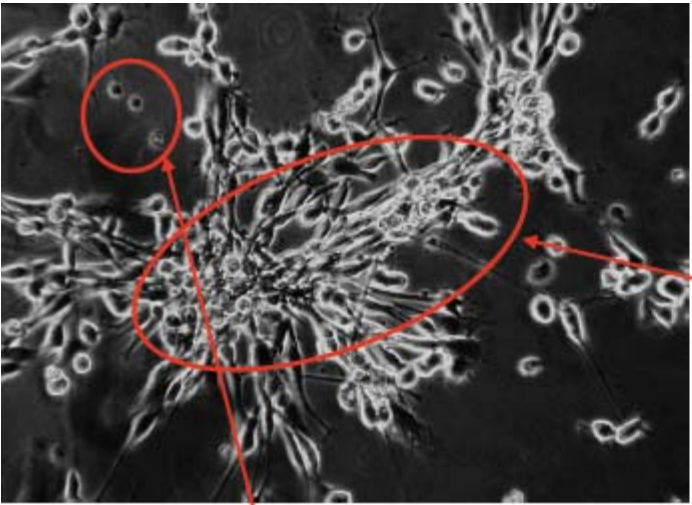


## GlioLab





# Cancer Growth Research

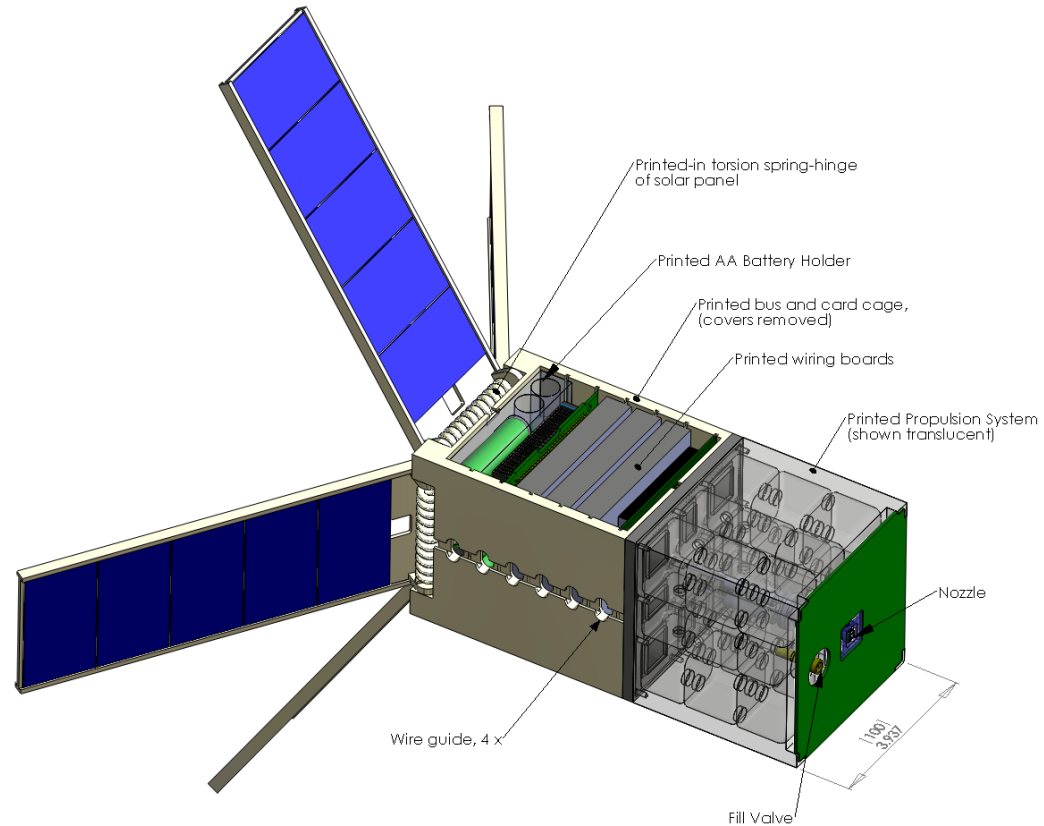
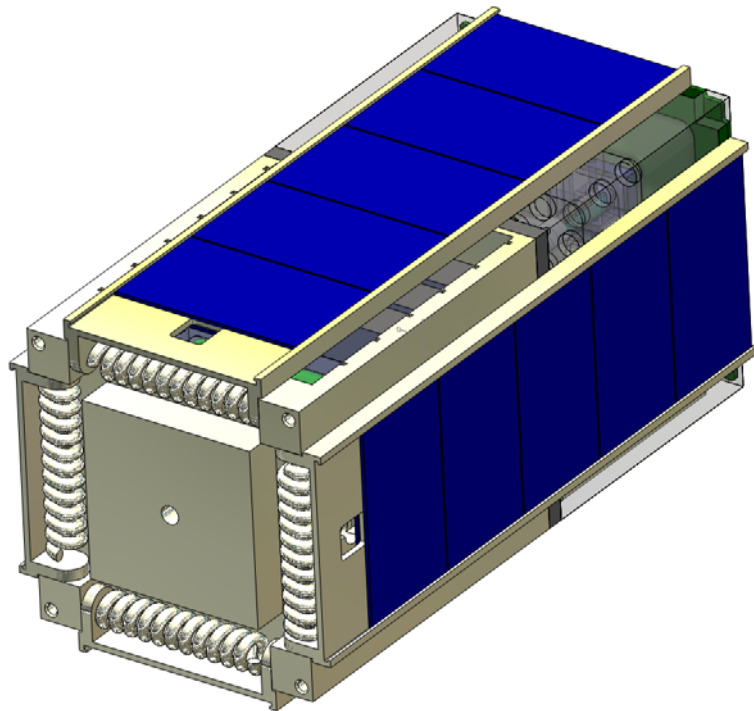






# RAMPART POPACS Technology Demonstration

## Rampart



Technology Demonstration  
Launch: Spring 2011



# QB50

## International LEO

### Atmospheric Research



## **QB50**

An international network of 50 double CubeSats for **multi-point, in-situ, long-duration** measurements in the lower thermosphere and for re-entry research

*J. Muylaert, R. Reinhard, C. Asma*

The 4S Symposium

Funchal, Madeira, Portugal

31 May – 4 June 2010



# QB50 - THE IDEA



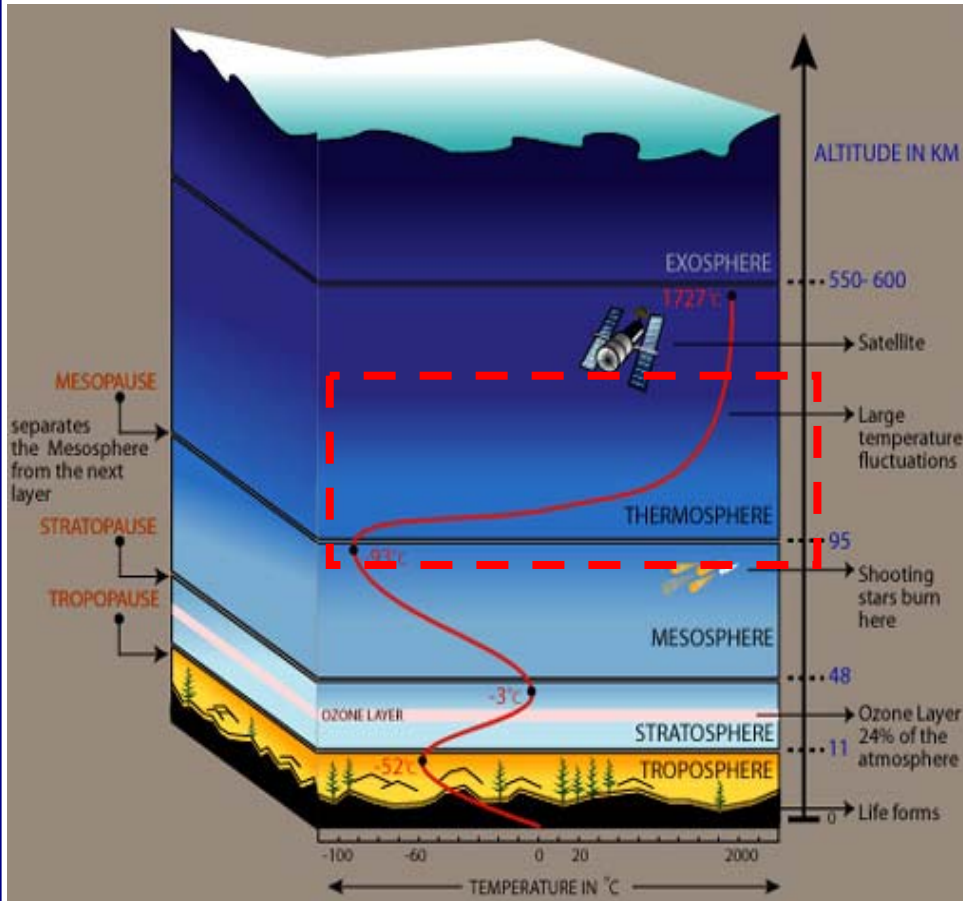
- A network of ***50 double CubeSats*** sequentially deployed (1 CubeSat every orbit or every 2 or 3 orbits)
- Initial altitude: 330 km (circular orbit,  $i=79^\circ$ )
- Each performing in-situ measurements of atmospheric parameters
- Downlink using the Global Educational Network for Satellite Operations (***GENSO***)

# QB50 – Studying Lower



## 90-330 km: Why Lower Thermosphere?

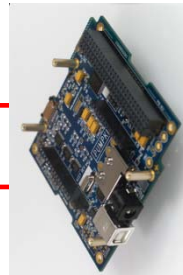
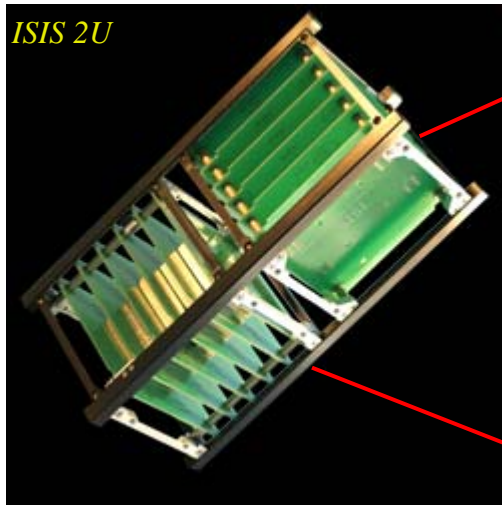
- The *least explored* layer
- Stratospheric balloons up to 42 km max.
- Remote-sensing by ground based lidars and radars up to 105 km.
- Remote-sensing by Earth observation satellites in higher orbits (600 – 800 km) only observe constituents in the troposphere, stratosphere and mesosphere (MTL too rarefied).
- In-situ measurements by sounding rockets in the MLT Region provide only a few times per year single-line data





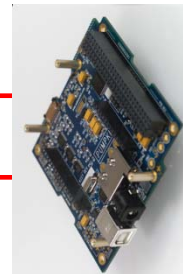
# QB50 – MLT research

On a Double CubeSat (10 x 10 x 20 cm<sup>3</sup>):



## Science Unit:

*Lower Thermosphere Measurements  
Sensors to be selected by a Working  
Group  
Standard sensors for all CubeSats*



## Functional Unit:

*Power, CPU, Telecommunication, IMU,  
GPS  
Optional Technology or Science Package  
Universities are free to design the  
functional unit*

# QB50 – Sensor Selection



***Mission objective:*** to make multi-point, in-situ measurements of the neutral component in the lower thermosphere

## **Examples for sensors/instruments:**

- *FIPEX sensor for measurement of atomic oxygen*
- *Atmospheric density measurements*
- *Miniaturized neutral mass spectrometer*
- *Accelerometers*
- *Gyroscopes*
- *Thermocouples / Thermistors / Resistance temperature detectors*
- *GPS*

*Selection of the standardized sensors for in-situ measurements will be made by the **Sensor Selection Working Group** (SSWG) in 2010*





# QB50

QB50, an international network of 50 CubeSats for multi-point, in-situ measurements in the lower thermosphere and re-entry research

## Possible U.S. Stihel Payloads

		<u>Edu</u> <u>Costs</u>	<u>Non Edu</u> <u>Costs</u>
1.1U Tech Demo	6 ea	\$25k	\$50k
2.2U QB Sats – Atmospheric Research	8 ea	\$30k	\$60k
3.3U Tech Demo	<u>6 ea</u>	\$90k	\$180k
		20 ea	



# Present Launch Opportunities



# Launch Opportunities with Morehead & Collaborators

PocketQubs

UniSat

Fall 2010

4 launch slots ~ \$8k + deorbitor

NanoRacks

ISS

Every 3-4 months

Education \$25/1U - 3 months on ISS





# Future Launch Opportunities



## Launch Opportunities with Morehead & Collaborators

Roma - NextSat?? PocketQubs & Payloads	Russian Dnepr	2012
Roma - NextSat?? PocketQubs & Payloads	Russian Dnepr	2013
VKI - QB50	Russian Stihel	2013/14
Roma - NextSat?? PocketQubs & Payloads	Russian Dnepr	2014



# Conclusions