QB50

An International Network of *50 CubeSats* in Low-Earth Orbits for *Lower Thermosphere* and *Re-Entry Research*

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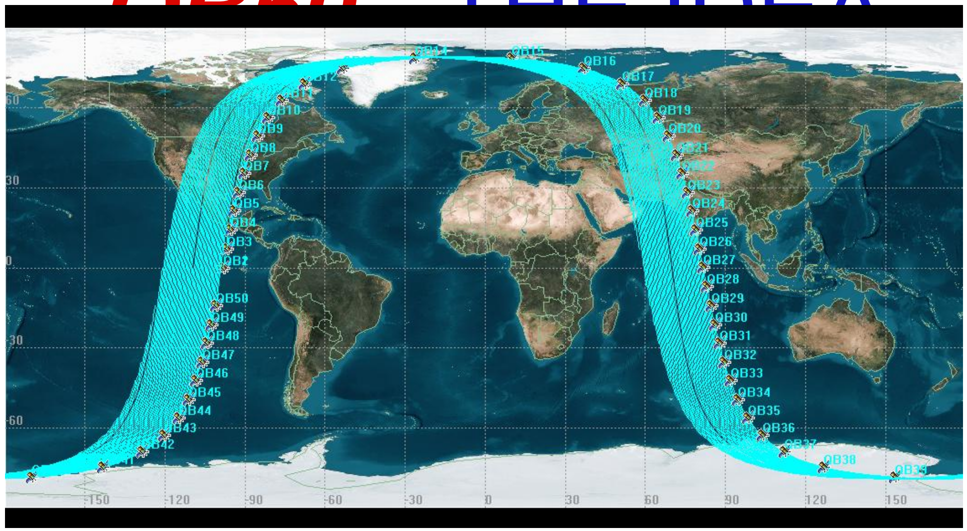
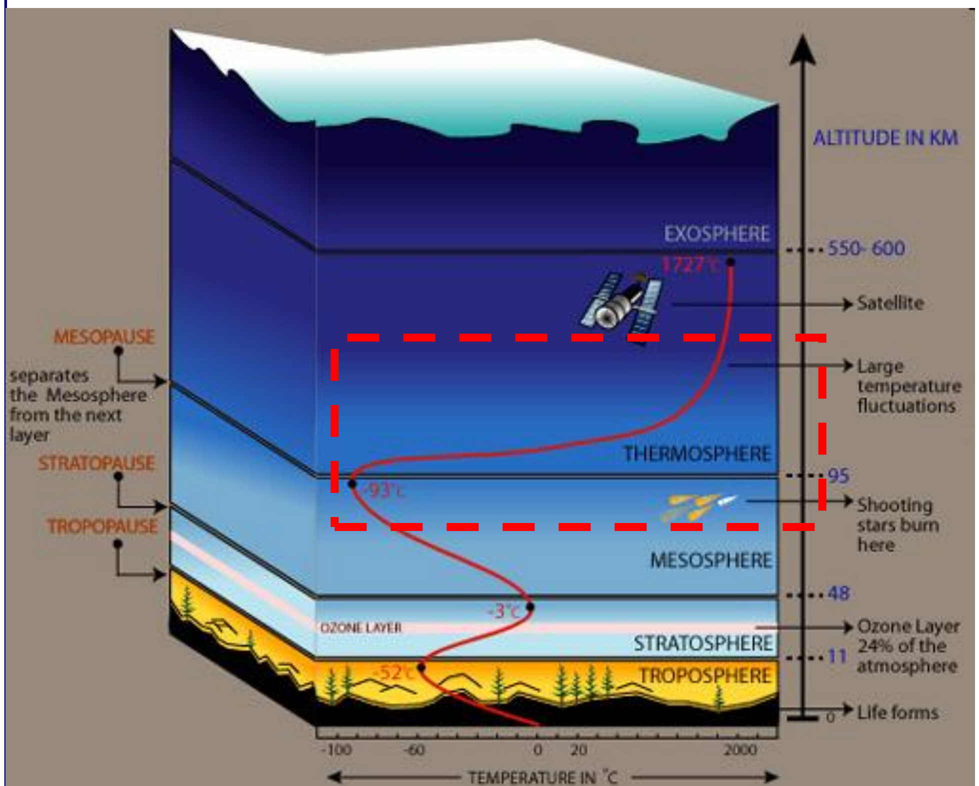
QB50 – THE IDEA



- A network of ***<u>50 CubeSats</u>***, launched at ~300km (Deployment sequence TBD)
- A network of ***<u>10000~20000 km</u>***
- Each performing in-situ measurements of atmospheric parameters
- Atmospheric data providing *<u>temporal</u>* and *<u>spatial</u>* variations
- Downlink using the Global Educational Network for Satellite Operations (*<u>GENSO</u>*)
- Mission duration: *<u>3 months</u>*, down to ~90km without the need for propulsion

QB50 – Studying Lower Thermosphere

90-300km: Why Lower Thermosphere?



- The ***least explored*** layer of the atmosphere
- Stratospheric balloons go 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 (lower thermosphere is too rarefied).
- In-situ measurements by sounding rockets in the mesosphere and lower thermosphere (MLT Region) provide only occasional (a few times per year) single point measurements

QB50 – Studying Lower Thermosphere

Advantages of a CubeSat Network

A network of 50 CubeSats in the lower thermosphere compared to networks in higher orbits has the following advantages:

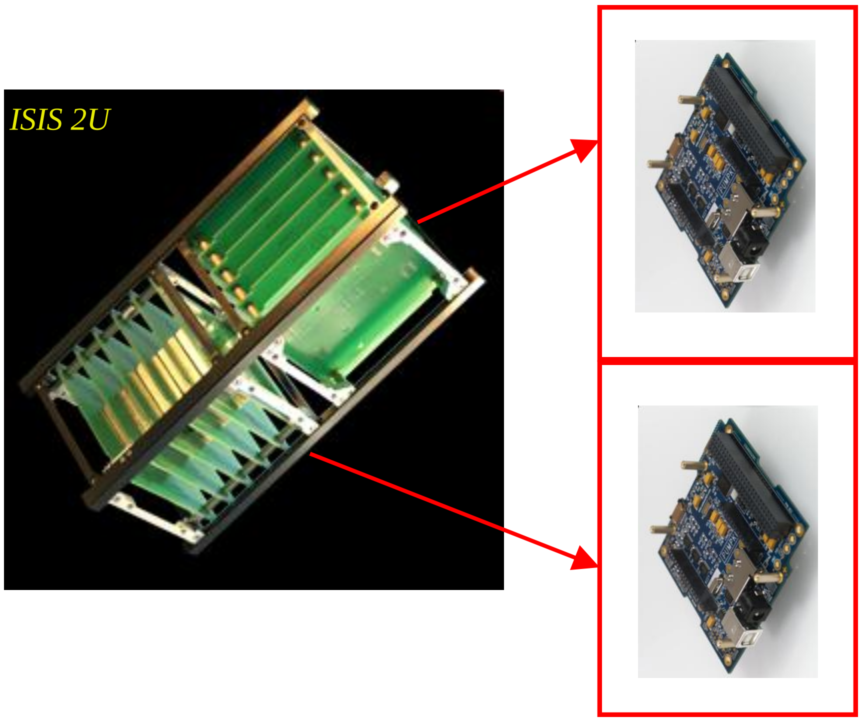
•The ***lifetime*** of a CubeSat in the envisaged low-Earth orbit will only be three months, i.e. much less than the 25 years stipulated by international requirements related to space debris

•A low Earth orbit allows ***high data rates*** because of the short communication distances involved

•In their low Earth orbits, the CubeSats will be below the Earth's radiation belts, which is very important because CubeSats use low-cost Commercial-Off-The-Shelf ***(COTS)*** components

QB50 - THE IDEA

On a Double CubeSat:



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 Package available for the CubeSat community !!

QB50 - THE IDEA

Advantages of the QB50:

The intention is to provide free of charge to the CubeSats participating in QB50 the

•launch vehicle

•custom-designed deployment system

•environmental testing at ESA – ESTEC (if requested)

•standardized sensors for the science unit

•launch services and interfaces to the launch vehicle authorities

•transport of the 50 CubeSats from ESA-ESTEC to the launch site

•CubeSat checkout testing during the launch campaign

QB50 – CubeSat Community

35 from Europe

2 Austrian, 2 Belgian,1 Czech, 2 Danish,

1 Estonian, 1 Finnish ,3 French, 4 German

1 Hungarian, 2 Dutch, 3 Italian, 1 Norwegian

1 Polish, 1 Portuguese, 1 Romanian, 1 Swedish

3 Spanish, 2 Swiss, 3 British

10 from United States

2 from Canada

3 from Japan

QB50 – CubeSat Community

CubeSat Teams will:

•*Supply the required documentation in a timely manner*

•*Participate in major project reviews*

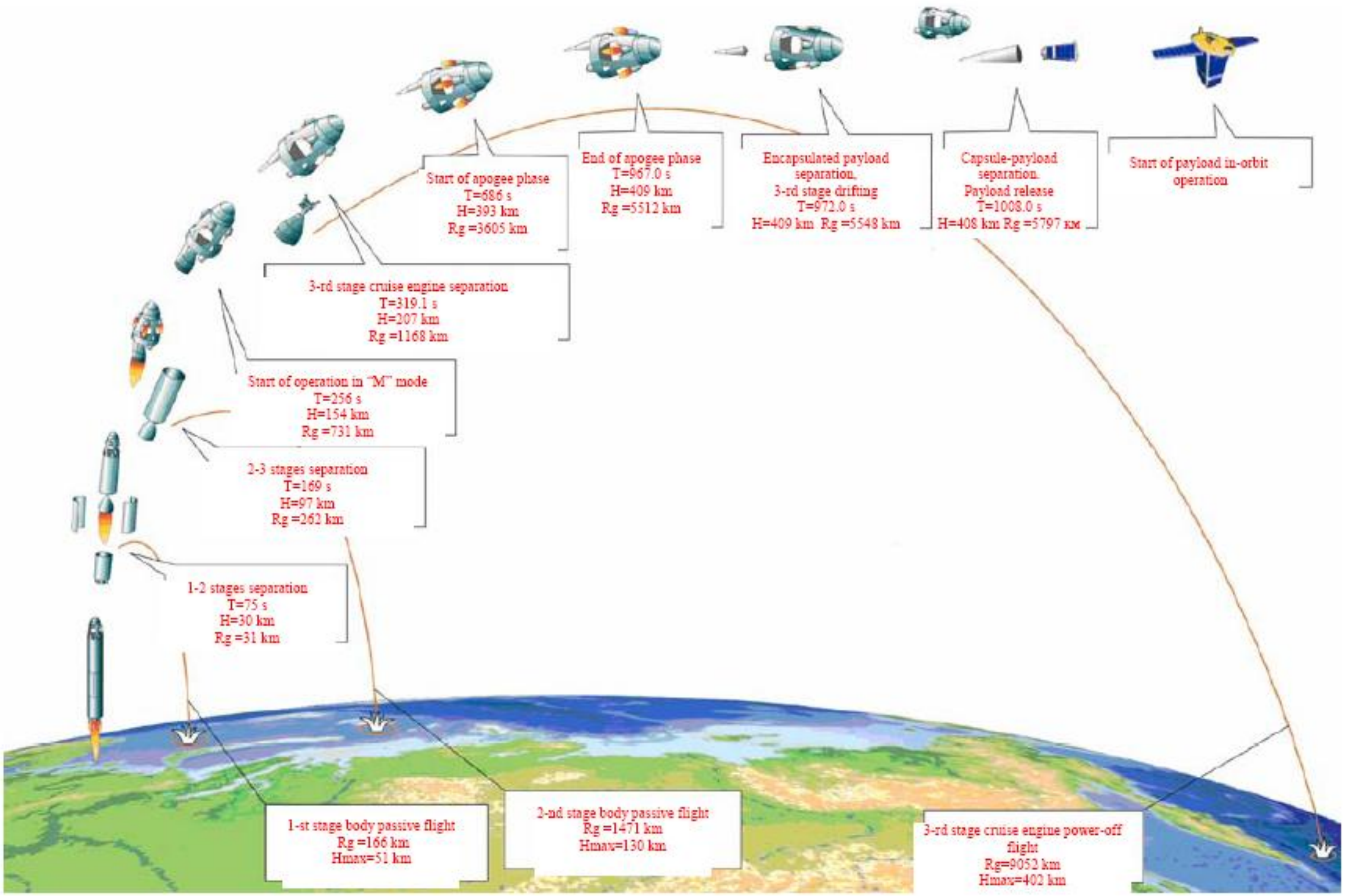
•*Support the test campaign (but not the launch campaign)*

•*Operate their CubeSats in orbit (expected lifetime is ~3 months)*

•*Provide calibrated science and selected housekeeping data to the QB50 Data Processing and Archiving Center at VKI*

•*Secure the funding for the development of their CubeSat*

QB50 – Launching & Deployment



SHTIL

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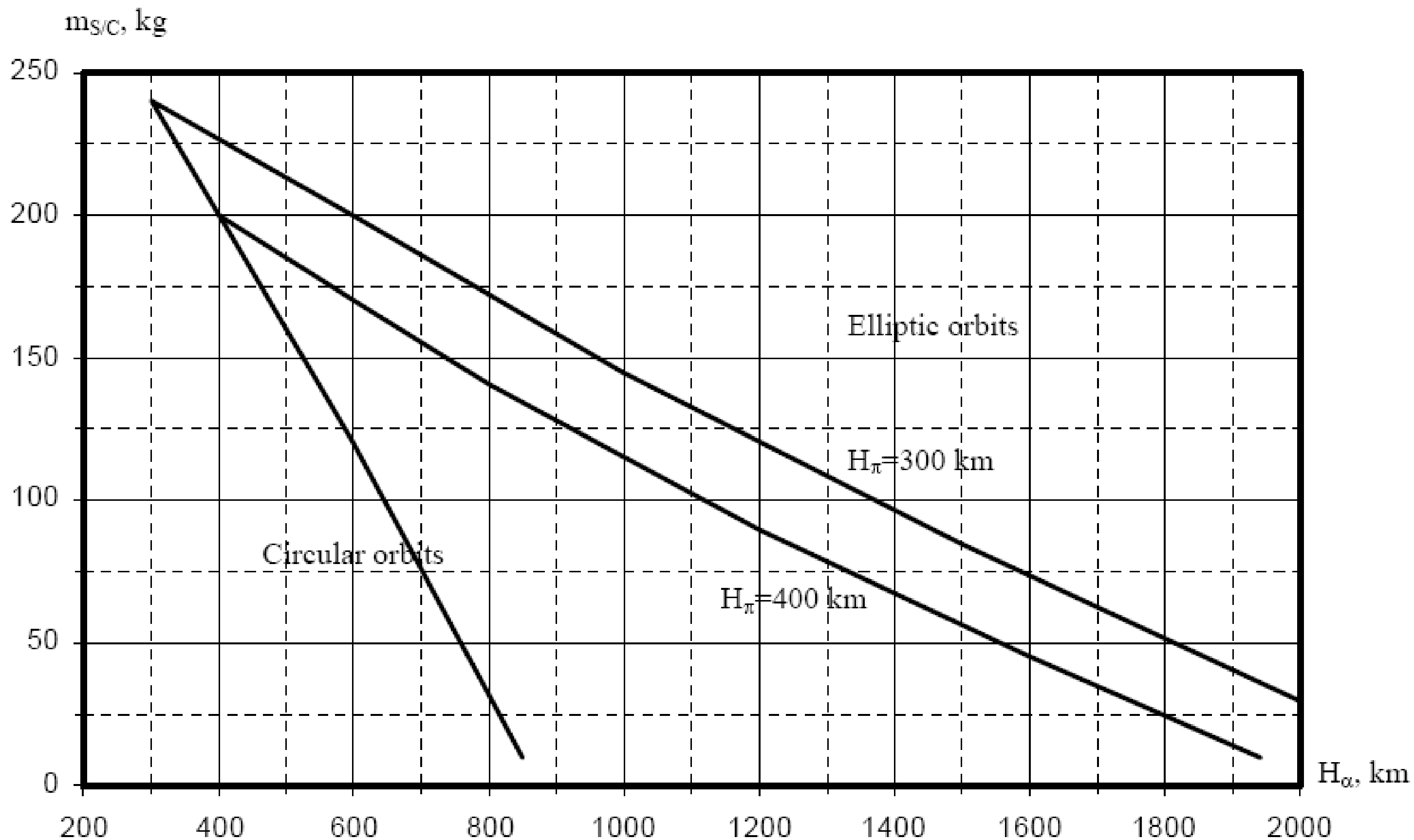
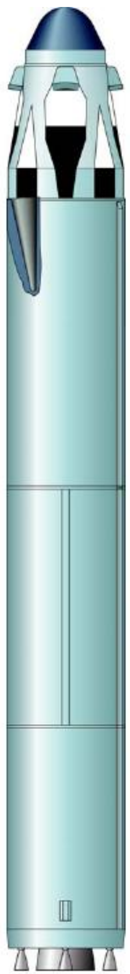
QB50 – Launching & Deployment

The payload mass versus the altitude of an orbit inclined 78.9°

(above the mean Earth radius Rmean=6371 km)





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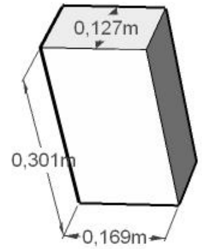
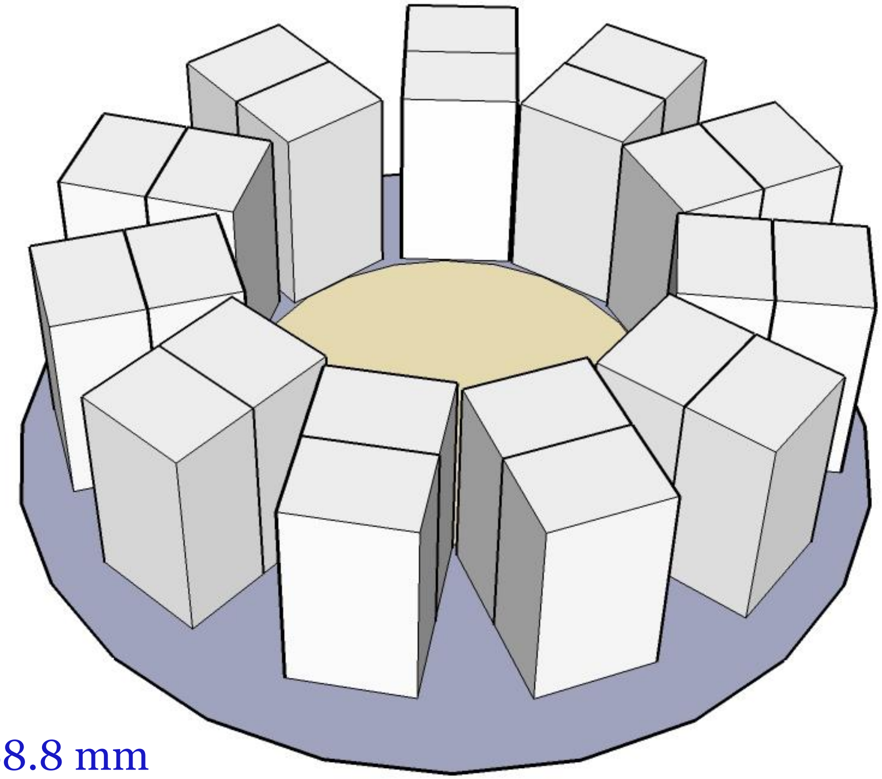
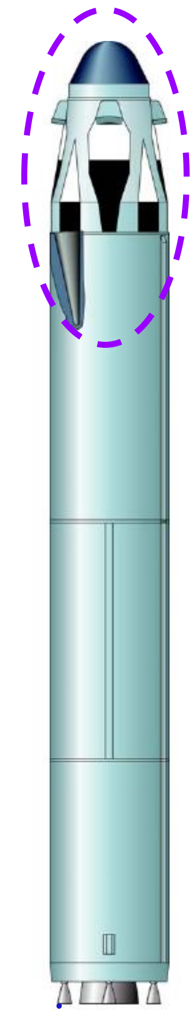
QB50 – Launching & Deployment Option 1







Deployer dimensions:

For a double CubeSat unit

Outside Envelope: 300.6 x 126.2 x 168.8 mm

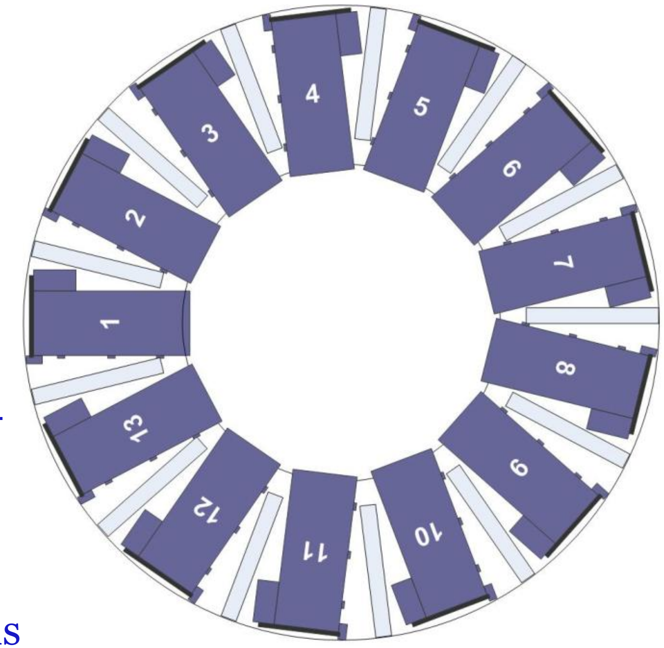
Total Mass: 2kg + 1.7kg = 3.7kg

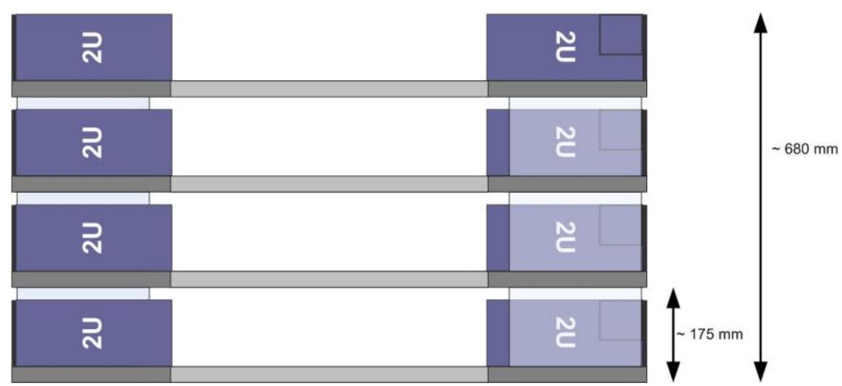
Platform 2 & 3:

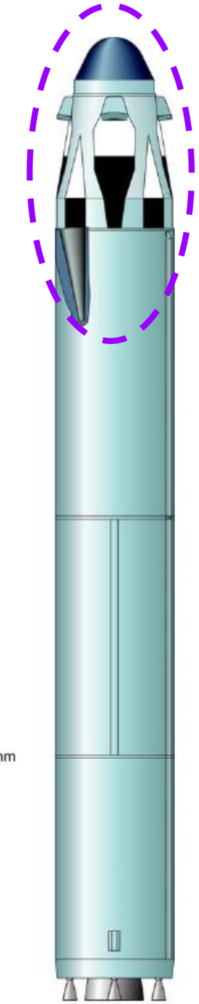
22 CubeSats on one platform

The central 600mm diameter is for the engine

QB50 – Launching & Deployment Option 2







Alternative Radial Deployment:

13 deployers on each platform

50 deployers on four platforms

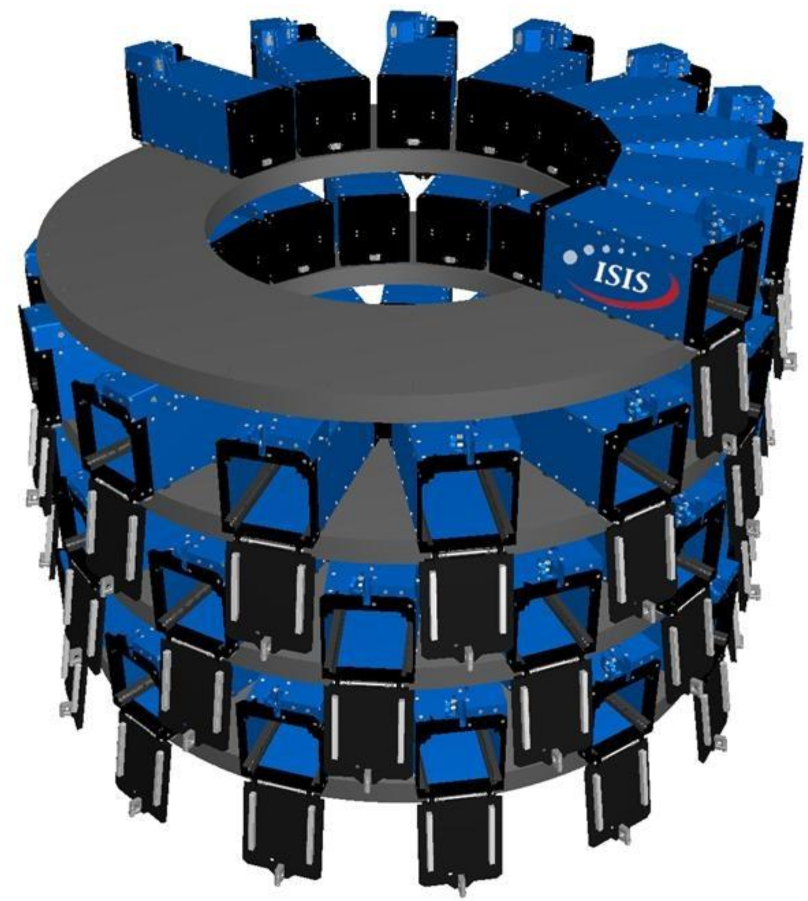
Possibility to deploy in different directions

QB50 – Launching & Deployment Option 3

Radial Deployment:

14 2 Units ISIPODs for each platform

i.e. 3.5 platforms arranged so as to allow adapter doors to be opened

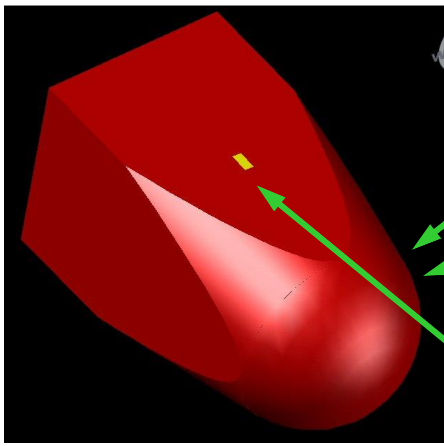


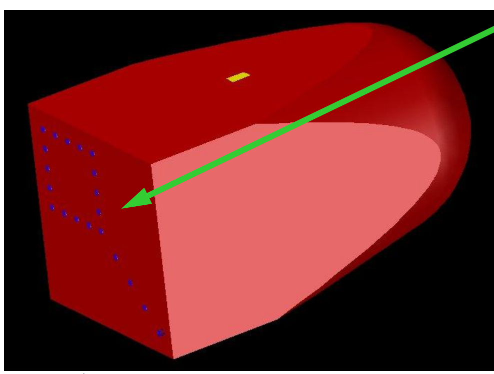
VKI ReEnt-Sat – Concept

Atmospheric Re-Entry Flight Data

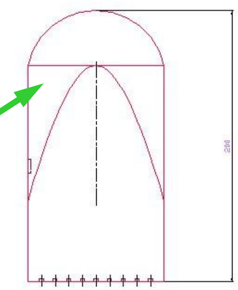
Flight data for Debris/Disintegration Tool (RAMSES) Validation

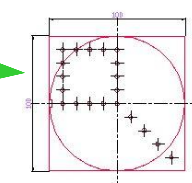
ReEnt-Sat to survive until ~70km (TBD) altitude





- Light ablative material as thermal shield
- Temperature & Pressure measurements on the thermal shield
- Skin friction measurements on the side
- Base flow measurements
- Materials experiment (tbc)
- Blackout experiment (tbc)





QB50 – von Karman Institute

The von Karman Institute for Fluid Dynamics (VKI) will provide:

- *Identification of the funding sources for the launch vehicle,*
- *Interface with launch vehicle authorities and launch campaign,*
- *Support to the selection of the standardized sensors for MLT and perform the CubeSAT re-entry research,*
- *Perform orbital dynamics sensitivity runs, and comparison of model predictions with actual CubeSat re-entry data,*
- *Provision of a CubeSat to the QB50 Network,*
- *Management of the QB50 Data Processing and Archiving Centre,*
- *Organization of a* ***QB50 Workshop on 17-18 November,***
- *Maintain QB50 website:* ***http://www.vki.ac.be/QB50***

QB50 – Schedule

Near-Term Schedule:

•*Letters of Intent (LoI) by interested CubeSat teams (5 received already)*

now to 1 Nov 2010

•*Call for CubeSat proposals, 15 Dec 2009*

•*Deadline for submission of proposals, 15 Jan 2010*

(~10 page proposal)

•*Selection of 50 CubeSats, 31 Jan 2010*

(plus 5 back-up CubeSats)

•*QB50 Project Kick-Off Meeting at VKI 4 May 2010*

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Goal:

•*Launch of 50 CubeSats End 2011-Mid 2012*

WORKSHOP

17-18 Nov 2009

www.vki.ac.be/QB50

For Info please contact VKI Jean Muylaert