The QB50 Program, the first CubeSat Constellations doing Science

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Overview

What is QB50?
Objectives
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CubeSat Community
Selection Schedule
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Launch Schedule
Special Announcement
What is 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.
QB50 - THE IDEA

• A network of 50 double University built CubeSats sequentially deployed
(1 CubeSat every orbit or every 2 or 3 orbits)

• Initial altitude: 330 km (circular orbit, i=79°)

• Each performing in-situ measurements of atmospheric parameters

• Downlink using the Global Educational Network for Satellite Operations (GENSO)
QB50 – Studying Lower Thermosphere

90 – 330 km: Why Lower Thermosphere?

- The least explored layer
  
  Ignore Sphere

- Stratospheric balloons too low

- Remote-sensing by ground based lidars and radars up to 105 km too low

- Remote-sensing by Earth observation satellites in higher orbits (600 – 800 km) too high

- In-situ measurements by sounding rockets in the MLT too little data
QB50 - Bus

On a Double CubeSat (10 x 10 x 20 cm):

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 – Advantages
The *lifetime* of a CubeSat in low-Earth orbit will only be three months

Allows *high data rates* because of the low altitudes
CubeSats will be below the Earth’s *radiation belts*, can use (COTS) components

QB50 – Sensor Selection

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

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

QB50 – Orbital Dynamics

*To be determined:*

*These questions will be addressed by the Orbital Dynamics Working Group* (ODWG)
**QB50 - Technology Demonstration**

In addition the MLT network it is the intention also to included also:

- Some Single CU for Universities
- Some Triple CU for in orbit techno demonstration such as:
  - Debris Mitigation strategies such as solar sail / inflatable systems / tethers
  - Propulsion systems
  - Micro G or others
A 5 x 5 m, 3 kg, **deployable** sail is being developed to fit in a 10 x 10 x 30 cm CubeSat and will be used in a demonstration mission to be launched in late 2011.
QB50 – VKI Re-EntSat Re-entry

- 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 – Launch Vehicle

- Custom-designed deployment system
- CubeSat checkout testing during the launch campaign
- Launch services and interfaces to the launch vehicle authorities
- Environmental testing at ESTEC (if requested)
- Transport of the CubeSats from ESTEC to the launch site
QB50 – Launching & Deployment

**SHTIL 2.1:**
Better fairing
More volume (~ 1.8 m³)

Can handle 50 2U-CS deployers
(volume ~ 0.35m³)

And Solar Sail
(volume ~ 0.1m³)
### QB50 – CubeSat Community

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This table is not an ‘allocation’, it is only an ‘assumption’ for planning purposes.

The final selection of the CubeSats will be made in November 2010, based on proposals by the CubeSat teams submitted in response to a Call for Proposals.

Administration – Morehead State
Letters of Intent have also been received from universities in the following countries:

Australia
Chile
China
Peru (a collaboration of 5 universities)
Puerto Rico
Taiwan
Vietnam

Likely participation also by universities in the following countries:

Egypt
India
Israel
Russia
South Africa
Turkey
QB50 – Schedule

17-18 Nov 2009  First QB50 Workshop at VKI

13 Sep 2010  Issue by VKI of the Call for Proposals for QB50 CubeSats

1 Nov 2010  Deadline for submission of CubeSat proposals to VKI, including letters of funding

1-15 Nov 2010  Proposal clarification period

15-22 Nov 2010  Evaluation of proposals by a Selection Committee and recommendation of selection of 50 CubeSats + 5 backup CubeSats

24 Nov 2010  Selection of 50 + 5 CubeSats by the QB50 Steering Group

29 Nov 2010  Notification of selection to CubeSat PIs
QB50 – Tentative US Proposal Requirements

1. Teaming of one experienced university with one inexperienced university. Deliver one 2U.
2. Select 12 teams.
3. Suggest teams not be in same states.
4. Funding from NASA Space Grants?
5. Funding from NSF?
6. Funding from NanoSat program?
QB50 – Tentative US Selection Criteria

TBD
# QB50 – Launch Costs

## U.S. Stihel Payloads

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QB50 – Schedule

11 Oct 2010 Meeting of the SSWG at VKI - space science
18 Oct 2010 Meeting of the ODWG at VKI - orbital dynamics
25 Oct 2010 Meeting of the GFWG at VKI -

3 Feb 2011 09:00 – 16:00, Second QB50 Workshop at VKI
3 Feb 2011 16:00 – 20:00, Parallel meetings of the SSWG, ODWG and GFWG
4 Feb 2011 09:00 – 12:00, Parallel meetings of the SSWG, ODWG and GFWG
4 Feb 2011 13:00 – 17:00, Steering Group meeting
Schedule for selected CubeSats

Jan 2011-Dec 2012  *CubeSat development at universities*

Sep 2011  *Shipment of the standardised sensors for atmospheric research from ESTEC to universities*

Nov 2012  *CubeSat mass dummies delivery to ESTEC*

Jan-Feb 2013  *CubeSat flight models environmental testing at universities*

Mar 2013  *CubeSat flight models delivery to ESTEC*
Launch associated activities

Mar 2013       Launch campaign preparation workshop at ESTEC

Apr 2013       Shipment of CubeSat flight models to the launch site

May-Jun 2013   Launch campaign

End Jun 2013    Launch
Morehead State University & the University of Rome

Provide **free** one PocketQub launch

PocketQub must be ready for flight delivery – November 1, 2010.

Who is eligible? – internationally – anyone (individual or group)

Orbit – 700 km, sun synchronous

Must have 25yr deorbit capability

Contact: Bob Twiggs RJTwiggs@gmail.com
Thank You

Questions?