SwissCube Project

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Outline

• Project and science objectives
• Preliminary mission assumptions
• Project organization (participants + schedule)
• Test and model philosophy
• Conclusion
Project Objectives

- **Goal is to have a Swiss Cubesat in orbit by 2008**
  - Satellite and ground segment defined, designed, built, tested and operated by students
    - Multi-disciplinary, multi-lab, multi-university collaboration
    - Strong educational aspect: student/industry ties, ESA/NASA development phases and standards
  - Budget:
    - ~ $ 200 k (including launch) over 2.5 years
    - already gathered 2/3 of budget
  - High visibility project for Swiss universities and industry partners since it would be the first Swiss satellite launched

- **Two mission objectives:**
  - Science: characterize variability of Nightglow phenomena in intensity and altitude
  - Technology: test and qualify a new Single Photon Avalanche Detector

- **Primary success criteria:** Deliver a fully tested cubesat to launch site

- **Secondary success criteria:**
  1. Launch, close RF link and download telemetry
  2. Receive Science data and characterize operations
Science Objectives

- **Science Objectives:**
  Take comprehensive measurements of the NightGlow Phenomena over all latitudes and longitudes and over a period of 3 months (primary mission) to 12 months (extended mission)

- **Measurements in the 75-110 km altitude with [5] km spatial resolution**

- **Measure two to three bands of emissions in the spectral range of [550 – 880] nm with spectral resolution less than [1] nm**
  - Preliminary bands: 558, 762 and 840 nm

- **Detector**

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**FIG. 3.** Picture of the CMOS-high-voltage SPAD. The circular SPAD and the quenching resistor can be seen on the right-hand side. The low-voltage and the high-voltage parts of the comparator can be seen as well.
Preliminary Mission Assumptions

- **Launch**: DNEPR or VEGA launch vehicles
- **Orbit**: Most likely Sun-synchronous
- **Inclination**: ~ 97 - 99°
- **Orbital Altitude**: ~ 400 - 1000 km
- **Orbital period**: ~ 90 - 105 min
- **Eclipses**: ~ 30 % of orbital period
- **Avg. power**: ~ 1.5 W
- **Mean pass duration**: ~ 10 min
- **Data downlink rate**: ~ 1 kbps
• Key SwissCube subsystem responsibility is spread across several labs and universities. Current partners:
  - EPFL: 10 labs
  - Université de Neuchatel: 3 labs
  - HES Sion: 1 lab
  - HES Yverdon: 2 labs
  - HE-ARC: 1 lab

• Executive Board includes industry sponsors and university representatives

• External reviewers include Swiss industry representative and ESA partners
• Most of the work will be done by the students
  - Concurrent engineering environment
  - Multi-center communication via video conferences

• In each lab one scientific staff is leader of a given subsystem, supervises the student projects on that topic, coordinates with engineering team and provides continuity over time.

• System Engineering Team (SET) provides oversight and coordination.

• Each subsystem will have an expert mentor in industry.
### Project Schedule

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#### Phase A
- Feasibility study, design trade-offs, preliminary design and specifications

#### Phase B
- Design refinement, component tests, breadboards, system and subsystem level specifications

#### Phase C
- Detailed definition, EM tests, interface specifications

#### Phase D
- Flight production, integration, subsystem and system tests

#### Phase E
- Launch and ops

### Timeline

- **2006**: Various tasks, including preliminary requirements review, preliminary design review, critical design review, and qualification review.
- **2007**: Tasks include detailed definition, EM tests, interface specifications, and flight production, integration, subsystem and system tests.
- **2008**: Tasks focus on launch and operations.
Preliminary Test Schedule and Philosophy

The SwissCube is a relatively high-risk low-cost development, but testing will parallel as much as possible a high-reliability mission to ensure success.

Model Philosophy:
- Set of breadboards/mockups in Phase B (Functional Models)
- Engineering Models in Phase C
- Qual Model and Flight Model in Phase D (prototype approach)

Compliant with ECSS as much as possible.
Conclusions

• Today’s programmatic challenge
  - Efficient transfer of information between students over the different phases of development

• Today’s technical challenge
  - Current payload asks for relatively tight pointing and stabilization requirements, and volume requirements
  - System studies and trades are on-going to find solution

• Need for communication with YOU
  - Assume that a great deal of information already exists
    • Parts list, what worked, what didn’t?
  - Experience of Cubesat developments within a university environment
    • What worked, what didn’t?

• Conclusion
  - Starting project in a multi-university environment
  - All advices, sharing of experience are welcome!