# BEXUS

**Experiment Integration Progress Review**



## 1. REVIEW

**Flight:** BEXUS 26

**Experiment:** TUBULAR

**Review location:** IRF Kiruna / Sweden

**Date:** 23 / 24 July 2018

### Review Board Members

1. Stefan Krämer (SSC)
2. Grzegorz Izworski (ESA)

### Experiment Team Members

| | |
|---|---|
| Natalie Lawton | Emily Chen |
| Hamad Siddiqi | Emil Nordqvist |
| Gustav Dyrssen | Erik Fagerström |

## 2. GENERAL COMMENTS

### 2.1. Presentation

- Good Presentation. Good status update.

### 2.2. SED

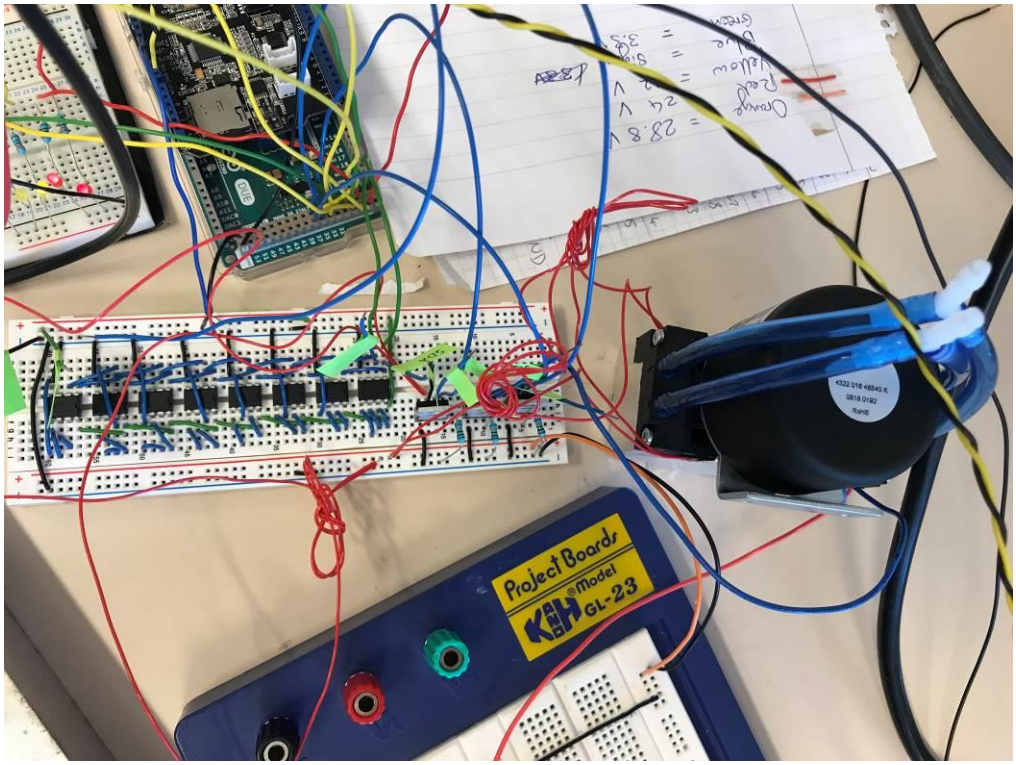
- No comments

### 2.3. Hardware

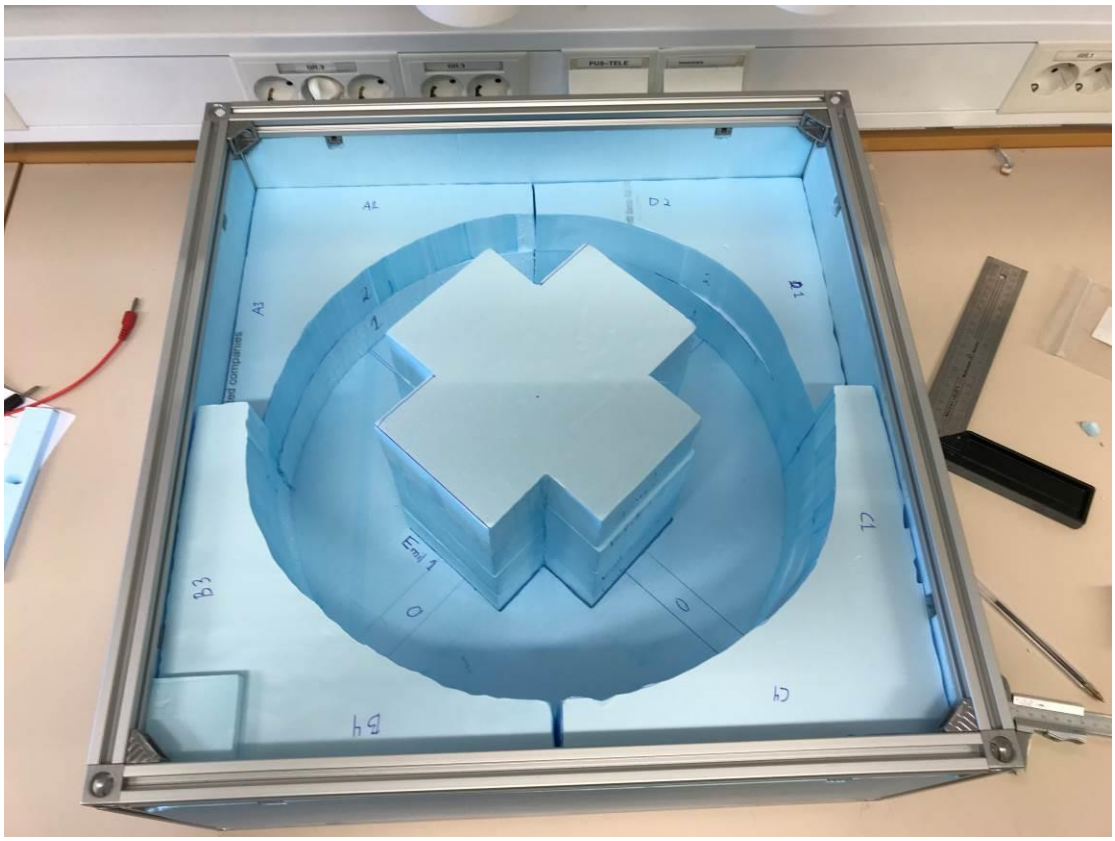
- Mechanics
  - Almost components are in house.
  - The Outer Structure made of BOSCH Profiles is mounted
  - Some parts of the insulation are cut and assembled
  - Pneumatic system not yet assembled since parts just arrived at the day of IPR.
- Electronics
  - PCB order has been send out to Manufacturer.
  - Breadboard finalised and working
    - Running Pump via Ground Station
    - Switching valves ((LED as place holders for Valves)
    - Heaters

- Power supply

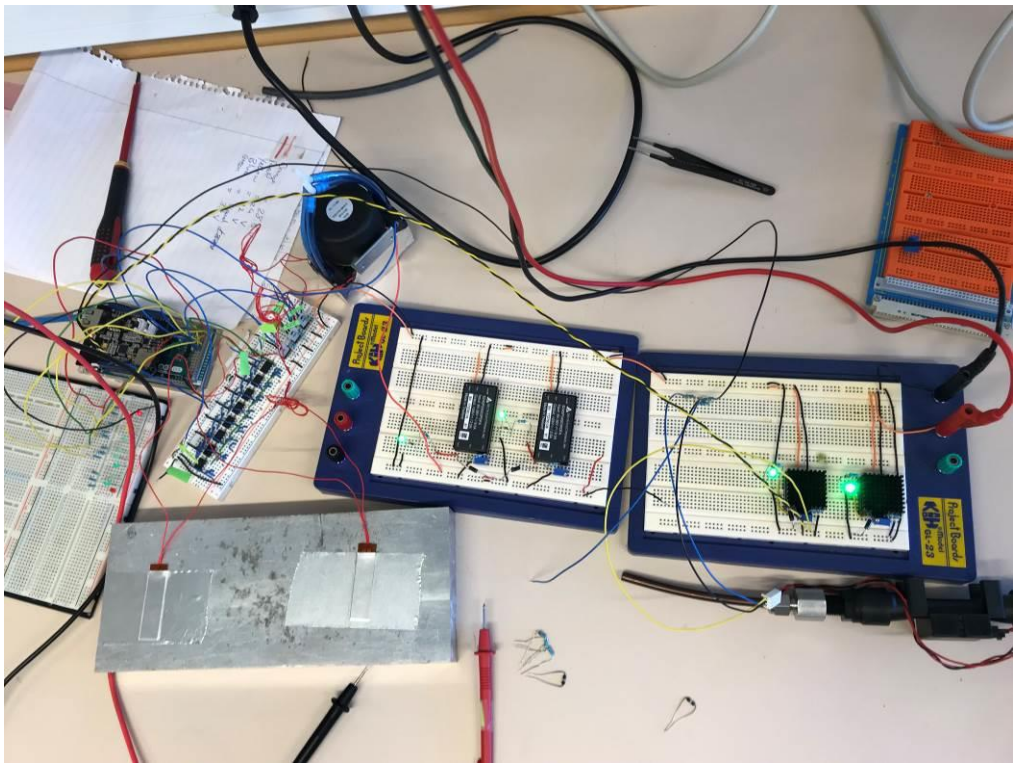
## 3. PHOTOGRAPHS



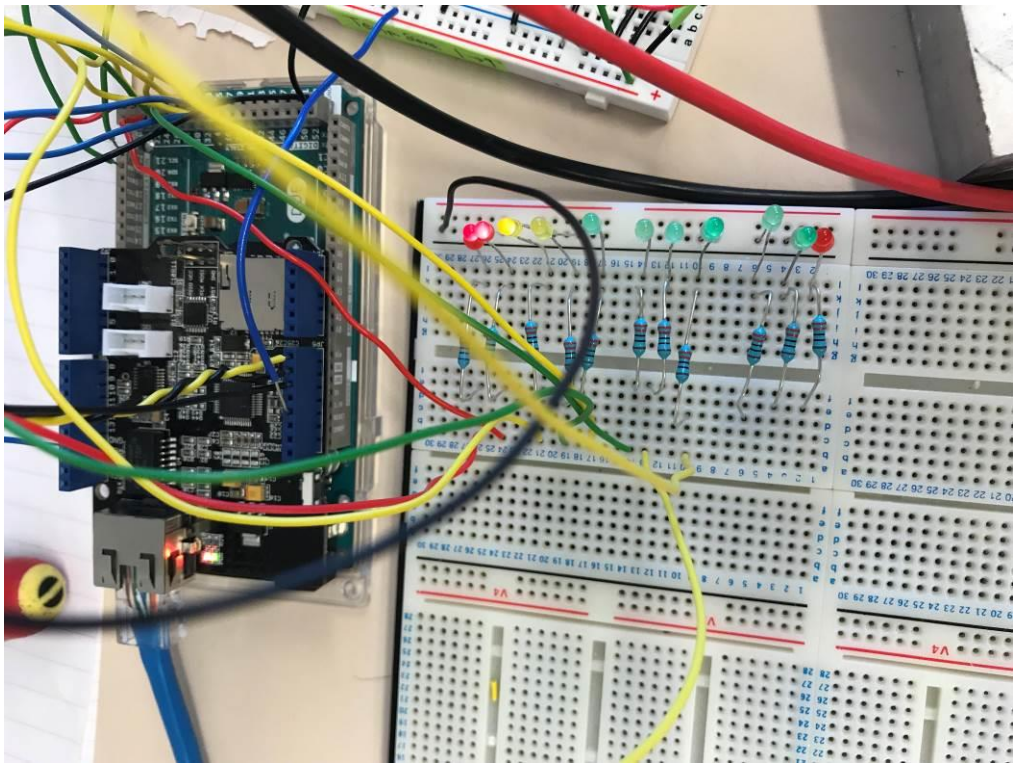

Picture 1: Pump and Temperature sensors on breadboard



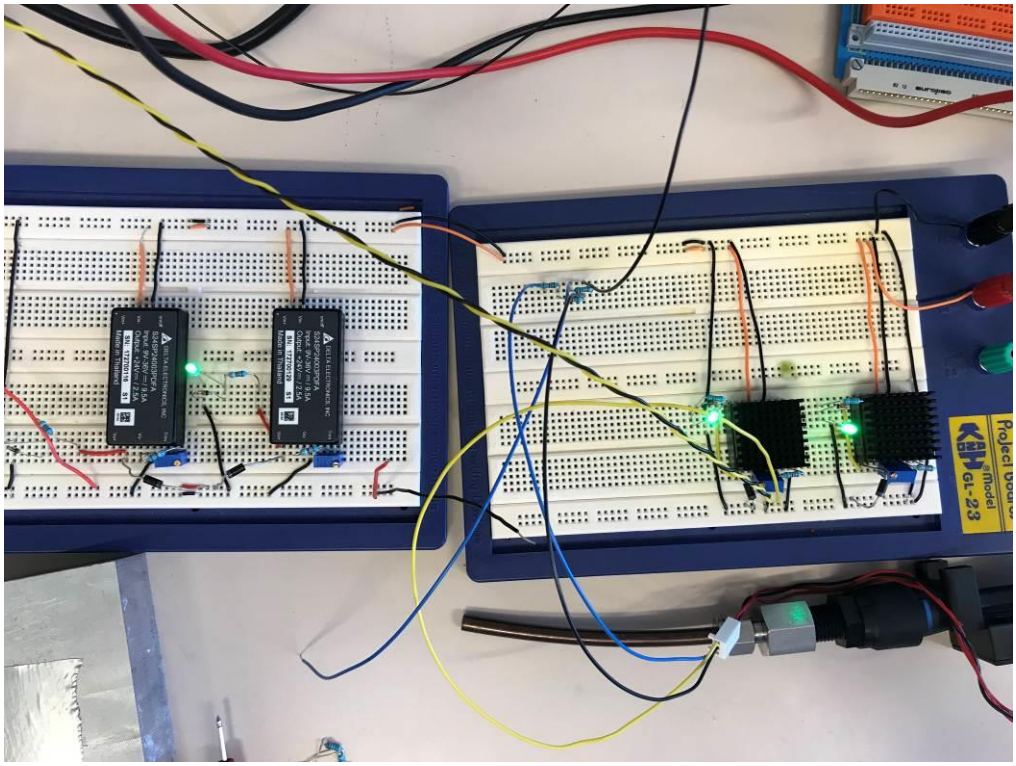
Picture 2: Frame for Air Coil including insulation material



Picture 3: Power Supply for two voltage levels on breadboard and heaters mounted to alumium block heat sink.



Picture 4: LED as placeholders for valves



Picture 5: DCDC converters on breadboard

## 4. REVIEW BOARD COMMENTS AND RECOMMENDATIONS

## 4.1. Science

- Check for suitable cleaning procedures. Cleanliness is highest priority when you manufacture and
  - Clean your tools with IPA before use
  - Clean your workspace (IPA, Aceton) thoroughly!
  - Use Gloves (powderfree !)
  - Check, if you can use the pressured air in your lab or if the system is oiled.
    - Un case of doubts, use Dried Air or Nitrogen from the bottles
    - Implement a filter on the low pressure side to avoid contamination of particles from the bottle.
  - Use standard cleanroom wipes
  - Keep the working area free from other people
  - Keep the tubes close with Kapton tape and away (boxed) from access of other people. As long the system is still open, use gloves and wipe off the ends and parts before assembly.
  - Consider flushing the system with IPA / Aceton after assembly. Leave the fluid inside the system for some hours to resolve the residual grease or oil.

## 4.2. Requirements and constraints (SED chapter 2)

- No comments

## 4.3. Mechanics (SED chapter 4.2.1 & 4.4)

- All components are in house except of:
  - Some fittings (Swagelok) for sample bags
  - Double sided tape
  - Sheet metal
  - Rail nuts
  - Pressure Sensor (ordered)
- All Tubing and fittings, valves have arrived
- Start assembling pneumatic system as soon as possible
  - Take your time for bending and fit checking. Avoid stress on tubing and fittings, it might introduce leaks!
  - Use contraction loops in straight tubes.

## 4.4. Electronics and data management (SED chapter 4.2.2, 4.2.3, 4.5 & 4.7)

- PCB order has been send out to Manufacturer.

- Have at least one or two spare boards ready
- Interface cable between AAC and CAC: Use self-made cable with PTFE insulation and D-Sub connector.
- Check if you have the opportunity to crimp the D-Sub connectors
- Solder according to the course you got at ESTEC.
- Test the full setup on your breadboard including all valves while you wait for the PCBs
    - Check each component on its own in the circuit and document it
    - Measure the current for the different modes

## 4.5. Thermal (SED chapter 4.2.4 & 4.6)

- Thermal setup with passive insulation looks ok. Will be verified by test and eventually improved

## 4.6. Software (SED chapter 4.8)

- Ground Station is running and the breadboard is fully operated via Ethernet
- The I2C and SPI I/F have to be verified
- All functions of Ground Station Operational mode and Manual mode work and have been verified
- The reconnection after communication loss is verified
- Status of valves and components are reflected on GS GUI
- Revise your S/W before uploading and mark your OBC with S/W version
- Team decided to continue with FAT 32 File system. Test this in a dedicated test and try to generate errors by e.g. power loss. Repeat the test many times!
- Calibrate your sensors, Temp and pressure. Calibrate all hardware spares and have the baseline measurements saved.
- Label your components

## 4.7. Verification and testing (SED chapter 5)

- Calibrate your sensors, Temp and pressure. Calibrate all hardware spares and have the baseline measurements saved.
- Testing Schedule and progress is reasonable. Document the results well.

## 4.8. Safety and risk analysis (SED chapter 3.4)

- Consider the risk of contamination during the different stages of the project
    - Manufacturing
    - Testing
    - Transport

- campaign

### 4.9. Launch and operations (SED chapter 6)

- Have Swagelok caps as RBF on your tubes for CD and later provided to Recovery crew.

### 4.10. Organisation, project planning & outreach (SED chapters 3.1, 3.2 & 3.3)

- Plan for implementation and testing is reasonable and achievable. Nevertheless, stay ahead of your planning.
- Deadline for finished and tested experiment is the first week in September for the testing campaign at FMI in Finland.
- Distribute small work packages to get stuff done

### 4.11. End-to-end Test

- Breadboard test with all functions and Ground Station was successfully performed
  - Placeholder LEDs instead of valves verifying the function of electronics and software
  - Pump function verified
  - Communication to ground station verified
  - Read out of I2C and SPI communication based temperature sensors not yet possible
  - Pressure sensor is to be delivered and verification of function pending
  - Heater function verified

## 5. FINAL REMARKS

### 5.1. Summary of main actions for the experiment team

- Look into the I2C and SPI libraries for sensor communication and make them work

### 5.2. Summary of main actions for the organisers

- Have frequent tele conference between Mentor and team.

### 5.3. IPR Result: pass / conditional pass / fail

- **Pass**

### 5.4. Next SED version due

**SED_v4-0: 4th October 2018**

## 6. INTEGRATION PROGRESS REVIEW – IPR

Experiment documentation must be submitted at least five working days (the exact date will be announced) before the review (SED version 3). The input for the Campaign / Flight Requirement Plans should be updated if applicable. The IPR will generally take place at the location of the students' university, normally with the visit of one expert.

The experiment should have reached a certain status before performing the IPR:

- The experiment design should be completely frozen
- The majority of the hardware should have been fabricated
- Flight models of any PCB should have been produced or should be in production
- The majority of the software should be functional
- The majority of the verification and testing phase should have been completed

The experiment should be ready for service system simulator testing (requiring experiment hardware, electronics, software and ground segment to be at development level as minimum)

**Content of IPR:**

- General assessment of experiment status
- Photographic documentation of experiment integration status, with comments were necessary
- Discussion of any open design decisions if applicable
- Discussion of review items still to be closed
- Discussion of potential or newly identified review item discrepancies
- Discussion of components or material still to be ordered or received by the team
- Clarification of any technical queries directed towards the visiting expert
- Communication and functional testing (Service system simulator testing and E-link testing for REXUS and BEXUS respectively)