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|  | <h1>REXUS/BEXUS</h1> <h2>Critical Design Review</h2> | Experiment Team: | CHAOS |
| | | Vehicle and Flight number: | BX35 |
| Location: CAU Kiel | | Date: 30.07.2024 | |
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Review Board Members:

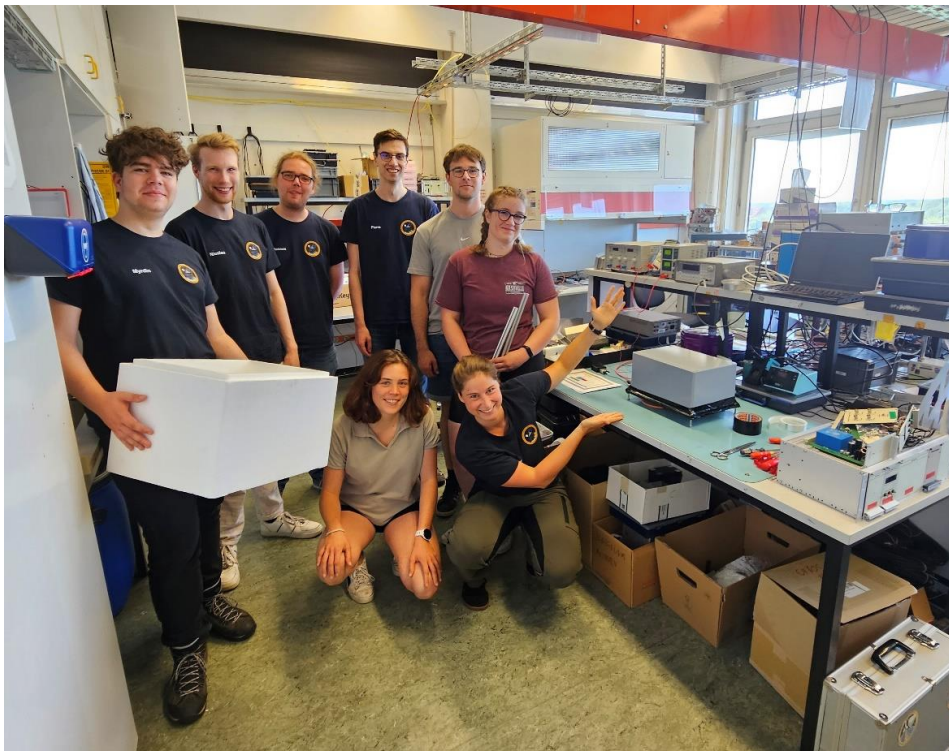
Steffen Calmer (ZARM)

Florian Leu (ZARM)

Experiment Team Members:

Ava Pohley (TL, present)
 Hannes Ebeling (TL, present)
 Pierre Bornfleth (present)
 Hannah Sophie Grimm
 Janna Martens (present)

Jasper Mess
 Justus Mickausch
 Clara Pittschellis (present)
 Nicolas Rohrbeck (present)
 Lars Rahn (present)









Review Result: pass

Next SED version V4 due to 26.08.2024

Summary of Main Actions for the Experiment Team:

1. Finish your Test Campaigns
2. Written down procedure for fastening process of the pressure vessel

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Explanation of the Report:

In the following document the board member comments are sorted by the chapters of the SED beginning with SED chapter 2. Comments are divided into RIDS and Remarks:

- **RID** (Review Items Discrepancy) is the mechanism used to record questions or identified problems and solutions arising from examination of the review documentation and discussion. They are issues, identified by a reviewer, that are not compliant with a requirement, a review objective or a design goal. A red RID will be followed up during the next project steps by the organizers and must be fulfilled by the team in order to pass the review.
- **Remarks** contain considerations a team should make and recommendations from the board members

IPR-Agenda


- Introduction Team, Board, Guests; Welcome
- Team Presentation
 - 15-30 Minutes (stand up or at the table presentation)
 - Mechanic, Electronic, Software, Project Planning, Tests
 - Experiment status and issues
- Discussion
 - SED
 - Mechanics (interface to the vehicle, thermal, structure, manufactory, accessibility, stiffness, materials, others)
 - Electronics (interface to the vehicle, boards, cables, connectors, manufactory, components (actors, sensors), interfaces (bus,I/O,uart), power management, others)
 - Software (states/modes, process flow, data flow, interfaces, implementation, Ground Station)
 - Project Planning (status, ordering, manufactory, delivery, availability of resources, time planning)
 - Tests (status, planning, results, configuration, preparation)
 - Campaign Preparation (shipping, requirements, special)
 - Others
- Hardware inspection, photos
- Tests
 - Communication tests will be performed between Ground Station and Experiment. At least dummy data shall be transmitted. For RX a service module simulator will be used and provided by ZARM.
- Tour to rooms, facilities, laboratories if applicable and time left.

A - Discussion

1 General

Remark: no IP-Adress for the TVW necessary (Hardline), IP-Address will be provided within the first version of the CRP

Remark: Housekeeping data of vacuum chamber will be recorded by Zarm and provided to the team after the test.

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1.1 Presentation

Remark: Good presentation of current status, facilities and status of experiment hardware

1.2 SED (editorial)

- No comments!

2 REQUIREMENTS AND CONSTRAINTS

REMARK: Not all comments from PDR were followed

REMARK: P.2.1.: Base the requirements on your science and look for components based on the requirements.

REMARK: All requirements need verification.

REMARK: Include range, accuracy, and frequency for measurements.

REMARK: Missing design requirement regarding vibration and shock.

REMARK: Define an acceptable leak rate.

REMARK: 14kg is quite high, make the upper limit lower. The mass affects the altitude the balloon can reach.

REMARK: Design is what you need, constraint could be if your professor wants you to use a specific sensor.

3 PROJECT PLANNING

3.1 WBS

REMARK: The descriptions of work packages are not consistent with figure 3.1.

REMARK: Maybe mark which subtasks are completed in figure 3.1.

REMARK: Some groups only have one work package. Split it up and provide more details. If it is on the same person, it is easier to keep track.

3.2 Schedule



REMARK: good in time schedule – some tasks to do f.e. improvement mechanical interface, testing

REMARK: Don't plan on finishing work packages at launch campaign. Mechanical, software, and tests should be done before. Make sure it is clear in your schedule to have the respective deadlines in mind.

3.3 Resources

REMARK: all items delivered in time, no open orders, everything within budget

REMARK: Don't note ZARM only. DLR/ZARM

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3.4 Outreach

3.5 Risks

REMARK: Reduce the probability after testing e.g. TC02-1 / TC02-2.

REMARK: Use of High Voltage - reduce the risk due to testing; exp. gets to hot / to cold – current state: medium risk - should be improved

CDR follow up:

REMARK: High-voltage severity is 4 not 5. Maybe separate into pre-flight ground handling and recovery.

REMARK: Section 6 is meant for externals who don't care that much about your experiment. For them it is important what can impact personnel or gondola, mission, flight... other details go in section 3.

4 EXPERIMENT

4.1 Mechanics

RID: explain the sealing of the housing more in detail

RID: specific torque for the rods – reliable and repeatable process

REMARK: go more in detail – aerogel block fixation with springs, add pictures / technical drawings – good fixation of the aerogel block with leaf springs

REMARK: explain the fixation of the electrical components

RID: Since you already send out a lot, also provide the drawings in the SED.

CDR follow up:

RID: Explain the sealing of the housing in more detail, check for compliance and performance at the temperature expected.







REMARK: Concerns about the stiffness of the U-profiles since they have a cut out. Think about welding the two pieces.

REMARK: Specify the torque for the rods, make it a reliable and repeatable process.

REMARK: Go into more detail regarding the aerogel block fixation with springs. Add pictures and/or technical drawings.

REMARK: Explain the fixation of the electrical components.

REMARK: Structural integrity of long bolts is critical. Maybe lower the dampers into the bottom insulation, put experiment closer to the rails. Think about just mounting the experiment on the rails and then do foam housing around. Additionally, maybe use

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countersunk screws to mount directly to the baseplate and skip standoffs. Maybe do a FEA to make sure it holds all loads of the flight sequence.

REMARK: Missing justification on 10g if requirement on the loads is met.

REMARK: Show the mounting of all parts in the SED. Use schematics or similar and make it more visible.

REMARK: Descriptions on how to mount everything inside the box is missing in the SED. Make it more visible. Connections of shelves on L-brackets? Thicknesses? Bending radii? How is it manufactured? More information needed on the mechanical parts, good mix of explanatory CAD renderings and technical drawings.

4.2 Electronics

REMARK: hermetic D-Sub connector – do you use a specific one?

REMARK: el. Interface: Very good description and table

REMARK: good - grounding: clear grounding concept and description

REMARK: experiment setup: good description

RID: electronics design: It will be nice to have schematics beside the description. For better understanding

REMARK: Due to experience with very similar experiments, a detailed explanation is not provided /o.k. Kann man so Machen. Die Gesamtverlustleistung ist bekannt und constant.

Remark: Good grounding concept, keep in mind aluminium profiles and gondola is anodized. Check for sufficient electrical conductivity, use contact discs where necessary.

Remark: Up-/Downlink will be measured and verified by the team.

Remark: Sensors will be calibrated by the team in Kiel, no re-calibration at Esrange necessary.

CDR follow up:

REMARK: It would be nice to have the schematics beside the description for better understanding.

REMARK: The grounding concept is okay, but more details on how it would physically work on your experiment is needed.

REMARK: Is the power microcontroller the master? Seems like it from the text, make clear that it is only for the HV part.

REMARK: HV multiplier voltages is not mentioned in the SED, was already commented during PDR.







REMARK: How many pins, where what connected, interfaces? Provide more details in the SED, maybe exploded view of the stack.

REMARK: Missing description on physical interfaces of electronic parts.

REMARK: Power budget is not based. How much do your self-made boards draw? Give a break down and where your numbers come from. Your network, microcontrollers, converters all draw power and this needs to be included. Since this is also your only heating source and no active control exists this needs to be precise.

REMARK: Which power regulator are you using?

REMARK: Give details in the SED about the interface between the e-box to detectors.

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REMARK: Ethernet to DSub – give more details in the SED.

REMARK: consider coating your HV board.

REMARK: For flight heritage: describe the interfaces and characteristics but you don't have to go into detail regarding its design (reference the old SED or similar where it is described). Of course, you have to understand it to handle it and fix errors.

REMARK: Section 4.6.5 mentions ethernet on the HV board. Please make sure your block diagram is updated.

REMARK: In section 4.6.7 it is not clear what the nominal end voltage of the HV multiplier is.

4.3 Thermal

REMARK: Thermal box low pressure resistant? -> yes, it's a proven concept

CDR follow up:

REMARK: Define the thermal critical components.

REMARK: Please also add diagrams shown in the presentation to the SED or mention in the according place that it is uploaded.

REMARK: Your concept is very dependent on testing. Think about how you would tackle different test outcomes, plan options ahead.

REMARK: Prove thermal resistance of the sealing in the expected environment.

4.4 Software

REMARK: Groundstation almost ready; Backend ready, frontend in development

CDR follow up:

REM: Experiment Shut down is controlled via pressure sensor logic. Make sure to have possibility to manually and remotely overwrite logic in case of sensor malfunction.

5 VERIFICATION AND TESTING

5.1 Verification Matrix

REMARK: Voltage variation test necessary at EAR ~ 32-22V







REMARK: robust Test against power cycles

REMARK: Team would like to repeat and confirm the pressure Test T-01 at ZARM TVV

CDR follow up:

REMARK: Use not only review but also test for performance requirements.

REMARK: The experiment must be on during vibration test and maybe connected to the ground station.

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6 LAUNCH CAMPAIGN PREPARATION

RID: safety risk – SF01 not clear, there are differences between the outside and inside pressure sensor

REMARK: launch site req. should be improved

REMARK: preparation and test activities at estrange should be improved – more detailed WPs

REMARK: good - Timeline Event T-300 can be verified by the team

Remark: 6.1.4 Define who is responsible for providing the respective tool.

Remark: 6.4 Complete the recovery Sheet, add pictures and locations of connectors, screws etc. so that recovery team can fulfill those tasks.

Remark: 6.1.5 Do not use „around two hours”, define a concrete float time.

Remark: Table 6.8: Define a certain value for air pressure limit inside housing.

CDR follow up:

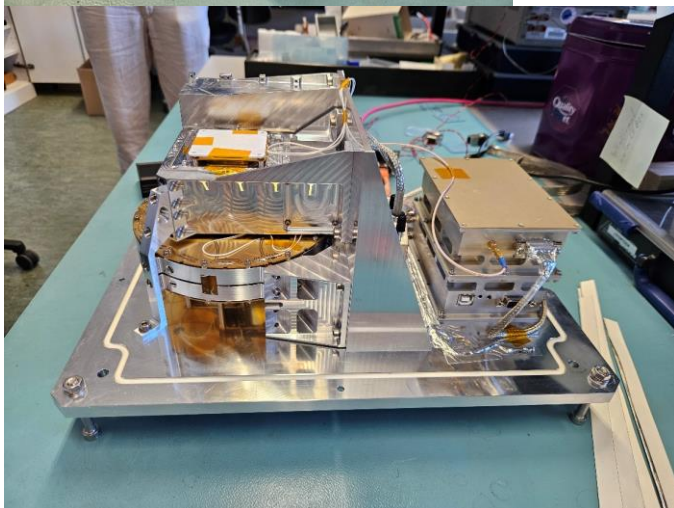
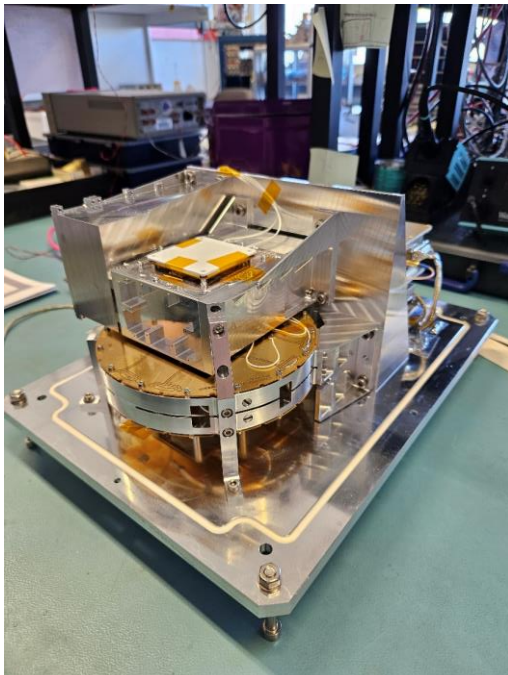
REMARK: Give the position of the centre of gravity in numbers.

REMARK: Provide IP number and addresses, peak power and current (both).

REMARK: Dare to state flight requirements more clearly and demanding.

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B – Hardware Inspection





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