

**REXUS/BEXUS Cycle 17**

**Experiment**

**Proposal Form**





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| Your text should be understandable to scientists of various fields and engineers with a general scientific background.  Before you submit your proposal, please ensure that you have read the **REXUS/BEXUS User Manuals** and **Esrange Safety Manual** in detail.  To submit your proposal to ESA, please download this **Experiment Proposal Form** as a word file and ask your endorsing professor or academic supervisor to provide you with a formal **Letter of Endorsement.**  The forms and the documents are available at [www.rexusbexus.net](http://www.rexusbexus.net).  The completed **Experiment Proposal Form** and the **Letter of Endorsement** must be uploaded as separate pdf files to the ESA E-learning platform before the deadline. Instructions are available under <https://www.esa.int/Education/Rexus_Bexus/How_to_apply>  Please note that you are responsible for all aspects of your experiment (science, mechanical & electrical engineering, software, manufacturing, testing, etc.). The scientific scope and technical complexity of your proposed experiment shall match to your team’s skills and available resources (time, workforce, access to facilities, finances, support by professors and/or senior scientists, etc.). | | |
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| **Team/Short experiment name** | *E.g. the acronym of the full experiment title*  **SVAROG3** | |
| **Full experiment title** | **S**olar-sail **V**alidation at **A**pogee of sounding **R**ocket by **O**pening **G**uided **G**ossamer in micro**G**ravity | |

**REXUS**   **BEXUS**

Spinning with 4 Hz

Despun with Yo-Yo to about 0.08 Hz

*Note: if the experiment needs reduced gravity, you shall tick this box*

Not of importance for our experiment

Science & Organisation

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| **Team Information** |  |
| **Student team leader:** | *Include name, nationality, university, the field of study, level of study (bachelor, master or PhD), academic year, date of birth and any additional team roles of the leader if applicable.*  Name: Piotr Fil  Nationality: Polish  University: Imperial College London  Field of study: Plasma Propulsion  Level of study: PhD (2nd Year)  DoB: 27/07/2001  Additional team role: Simulations lead |
| **Contact information of team leader:** | *Include at least the phone number, email address and postal address.*  Email: [piotr.fil20@imperial.ac.uk](mailto:piotr.fil20@imperial.ac.uk)  Phone: +48 508 709 045  Address: |
| **Members of your team:** | *Include name, nationality, university, the field of study, level of study (bachelor, master or PhD), academic year, date of birth and expected team role(s).*  Matthew Acevski, British, Imperial College London, Space Plasma Physics, Year 3, 27-07-2001, Project Coordinator and Media Lead  Nishant Kildangan-Mathew, Indian, Imperial College London, EEE/EIE, Year 2, 2005-08-28, Electronics Team Lead  Shiki Vahaan, Singaporean, Imperial College London, Aeronautics, Year 4, Orbital Simulations Team Lead |

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| **What is the scientific and/or technical objective of your experiment?** | *This description should outline the scientific/technical question addressed, the assumptions made, and the research methods chosen to solve the question. Expected results should be stated.*  **We rank each objective based on their priority:**  **[A]** – Must achieve  **[B]** – Nice to achieve (but not essential)  **[C]** – Added luxury achievement  **Scientific Objectives:**   1. **[A] Investigate the reduction in rotation of the rocket airframe as a result of boom deployment.**   While performing deployment of a solar sail, the extended boom arms will increase the bodies moment of inertia which will reduce its rotation rate. This is very difficult to model given the complex shape of the rocket or CubeSat it is a part of.  In this experiment, we will use an accelerometer to accurately measure the change in rotation rate during our deployment to quantify exactly how much of a reduction in rotation rate our booms will cause. This can be used to build up a model of the rockets inertia which can be extended to future missions for modelling rotation rate changes in LEO.   1. **[A] Develop scaling law for required boom stiffness in high drag conditions.**   With REXUS, we have a unique ability to test solar sail boom dynamics under “high drag” conditions. Usually, this would be on no consequence to a deep space mission, but for LEO it would be interesting to see how the booms behave under conditions these conditions as it could simulate lower altitude LEO trajectories or how the booms would behave under re-entry.  This objective can be achieved by using an onboard camera to view the bending of the booms at a range of lengths during deployment and analysing the footage post-flight to derive a scaling law for the boom’s stability.  Furthermore, including a force sensor at the boom exit guides, we can measure the force that the booms is pushing onto the exit. This force is proportional to the friction that is acting on the boom as it deploys. We hypothesise that the microgravity conditions will act to reduce friction and make deployment faster and easier. This can be measured with these sensors as well as comparing deployment velocity to that on the ground.   1. **[C] Study sail membrane dynamics in high drag conditions.**   This is a similar objective to Objective S2 above. REXUS allows us the chance to see how solar sail mechanisms behave in high drag conditions. In the case of the sails, high drag will induce excess stress on the booms and the connection points which will be investigated using methods described in S1 above. However, the sails themselves will also likely deform which will have an impact on how many solar radiation is incident on the sail and how the sail interacts.  Here we will again use the onboard camera to view the sail deformation and attempt to derive a mathematical model of sail deformation due to drag by combining fluid dynamical simulations with our results. However, if our body is stored in the main body of the airframe, we will not be able to deploy a sail. This is NOT a critical objective as in microgravity, booms will not be affected by the weight of the sail, only the tension they generate. Which can be simulated with string or wire attached at the tips.  **Technical Objectives:**   1. **[A] Demonstrate deployment of solar sail booms in microgravity conditions to a minimum extension of 1m [B]. Aiming for 2.1m extension (to achieve a 3 x 3 m sail).**   This is **our key technical objective** for the REXUS campaign. Here, we aim to deploy a sail of size ~3 x 3 m after being ejected from the body / nosecone of the REXUS rocket. Given the approximate 2 minutes of microgravity, we aim to complete deployment within 40 seconds. Then 20 seconds observing how the booms deal with the microgravity + drag environment. Then 60 seconds for retraction of the booms. Note that these are MAXIMUM times, we will aim to complete all of these functionalities within a margin (TBD).  We will use a similar design to that developed in our BEXUS 36 campaign which utilises a four-boom single-spool configuration with spring loaded anti-blooming clasps and rolling exit guides. Preliminary testing has been sufficiently reliable, and the main test of this design will be completed in October 2025 on the BEXUS 36 launch test in near vacuum conditions at ~25km in altitude.  A deployment of our solar sail just before apogee of the REXUS rocket would represent the first microgravity deployment test of a student solar sail ever. This would also be a significant milestone in Project Svarog’s development of a space-ready solar sail.   1. **[B]** **Integrate all necessary solar sail avionics into a single PCB stack.**   This objective is not crucial to flight as only the electronics required to power the internal motor system for deploying the booms and some sensors will be necessary. However, it would represent a significant test of our avionics design to be able to develop a PCB stack that can withstand the violent ascent of a sounding rocket and maintain functionality. This is a crucial step to developing space-ready electronics as it is likely our future solar sail payload will be transported to space by an orbital rocket.  The integrated onboard electronics will be packed into a 4U section and be capable of delivering power to the CubeSat, receiving communication from the ground station, recording data / footage of the deployment and storing this data.   1. **[B] Develop composite booms**   Composite booms represent the pinnacle of solar sail boom technology. All solar sails developed by experienced space agencies use these booms for their extreme rigidity, lightweight frame and compact folding.  The aim would be to develop four lenticular booms made of carbon fibre composites which are capable of folding into a singular spool (similar to the Svarog2 single spool design). This should dramatically reduce the weight and friction within the spool compartment, making deployment, retraction and integration much more efficient.   1. **[B] Develop internal power system for supplying power to experiment.**   This is a new technical objective which will be a vital aspect of a future LEO launch for a future Svarog spaceshot mission. In order to communicate with our satellite, we would need a radio receiver to capture and interpret commands from a ground station. This would be used to communicate to the CubeSat when it should eject from the rocket and when it should start / stop deployment. This is not a “MUST HAVE” objective as all necessary communications for this REXUS experiment could theoretically be done via sensors and electrical timers. |
| **Are you planning to fly an existing REXUS/BEXUS experiment?** | *If yes, what will be the improvements?*  **Yes**  This experiment is a continuation of the Svarogn experiment series which is working to develop solar sail technology.  In the first Svarog experiment which flew on BEXUS 34, we developed our first prototype which contained a rudimentary four spool configuration with metallic booms and a completely external electronics box.  In Svarog2 which was supposed to fly on BEXUS 36, we developed a fully integrated Solar Sail CubeSat which contained a single spool deployment mechanism, a dedicated internal electronics compartment, and separated sail chambers. Through ground testing we were demonstrating full functionality of the experiment on many occasions during the launch campaign. However, deployment in-flight was not achieved due to a non-nominal balloon launch causing rapid loss of altitude, meaning the BEXUS 36 experiment was never completed.  In SVAROG3, we actually aim to scale back the mechanical complexity of our experiment in favour of focusing on the investigation of a few core objectives which are imperative for the progression of our project. The technical objectives will revolve around the development of new boom material (carbon fibre composites), an internal PCB stack and an internal power source. The science objectives will all mainly be observing the behaviour of our experiment in microgravity: observing how the boom deployment is affected and how the rotation of the rocket is scaled down by our deployment.  This implementation of our technology will represent a massive step towards consolidating the key design features we have be working with over the last two BEXUS campaigns into a more professional and reliable form factor. Most of the mechanical features we plan to fly will have already been tested in the BEXUS 34 or 36 campaigns. This reduction in mechanical complexity will allow us more time to consider the intricacies of subsystems which need further development while still allowing us to achieve new scientific objectives on the REXUS mission. |
| **Why do you need a rocket / a balloon?** | *Clarify why your experiment cannot be done on ground and needs a rocket or balloon flight environment.*  *Provide a brief justification to implement this mission on a balloon or a rocket as opposed to other ground, air- or space-based platforms.*  Solar Sails require a large surface area for deployment. In our case, for a 3x3m sail that would be 9m2. Since our ultimate objective is to send our solar sail to space, we require tests in microgravity and near-vacuum conditions. There are no ground-based facilities accessible to students on Earth that allow for us to complete a deployment test of this kind. REXUS would allow us to achieve such a task with adequate time to complete a full deployment without interruption. |
| **What flight characteristics do you require?** | *If you need a rocket:*   * *Does your experiment require a reduced gravity environment?* * *What are the expected duration of the phenomenon and the minimally acceptable duration of the reduced gravity period? Note: maximum of* ***120 seconds*** *of reduced gravity conditions of approximately* ***10‑2g*** *may be available depending on the composition of the payload.* * *What is the optimal altitude or altitude range for your experiment?* * *Specify if you require any other flight characteristics.*   *If you need a balloon:*  *- What is the optimal altitude for your experiment?*  *- What is the minimum float time to perform your experiment?*  *- Does your experiment require daylight? If so, for what duration/part of the flight?  If part of the flight should be in the night/dawn/dusk, please also state this, but note that these flight conditions cannot be guaranteed.*   * *Specify if you require any other flight characteristics.*   *Note: Ejections from the BEXUS balloons are not allowed.*  For flight on REXUS:   1. Yes, the core technological and scientific objectives require microgravity to be validated. 2. The main stages of our experiment are: deployment, observation at maximum deployment, and retraction. The estimated times for each of those stages are as follows:    1. **Deployment**: Min 20s, Max 45s    2. **Observation**: Min 5s, Max TBD (Ideally we would have as much “Observation” time as possible, but it is entirely dependent on how quickly we can deploy and retract)    3. **Retraction**: Min 30s, Max 60s    4. **Total Experiment time**: 120 seconds maximum. 3. For us, the higher the altitude the better as it will reduce drag on our booms, but **as a minimum requirement – 80km**. This comes from preliminary calculations which show the drag induced by the air density on the sail at this altitude will roughly equal the force of gravity when at rest on the ground. 4. N/A |
| Where did you get the idea from? | *E.g. research programme at your university, already performed a similar experiment, scientific publications, books…*  Project Svarog has been a recurring experiment with the REXUS/BEXUS program, having completed two BEXUS campaigns already. The Project Svarog mission is inspired by the developments of solar sailing from space agencies like NASA and JAXA with their ACS-3, Lightsail 2 and IKAROS solar sail designs.  The idea for this specific experiment was born during participation in BEXUS 36, as we realise in order to create a CubeSat capable of surviving Low Earth Orbit (LEO), we will need to perform a deployment test in microgravity and develop our own CubeSat dispenser. REXUS will act as the platform to perform a test as close to space as it is possible for this stage of our project. |

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| **Describe your experiment** | *This part should link the scientific objective(s) to the experiment. Explain how you are going to fulfil the scientific goal.*  SVAROG3 looks to develop a solar sail deployment mechanism with a fully integrated PCB stack and internal power source. On REXUS, we want to demonstrate a rapid deployment of four carbon fibre composite booms to a length of 2.1m (which would represent a final sail area of 3 x 3 m = 9 m2), observation of their behaviour in microgravity, and then retract the booms, **all in microgravity conditions**. These technical objectives represent key milestones in our projects progression and takes us a step closer to developing a space-ready satellite.  The frame of the experiment itself will be in a “CubeSat-like” form factor, where the internal electronics and power system will take us no more than 4U of space (20 x 20 x 10 cm) and the deployment mechanism will sit on this frame. Given we will likely not include a sail compartment, the spool compartment will likely take up a further volume of 20 x 20 x 5 cm. This cuboid frame will have a diagonal diameter of ~28.2 cm and so will be fit to the inside airframe via a “cage” which should be screwed to the inside of the airframe and attach to the outside of our cuboid chassis.  The experiment can be separated into three key stages:   1. **Deployment** 2. **Observation** 3. **Retraction**   In our Svarog2 experiment, our ground testing revealed that we were able to achieve all three of these objectives (although this was never confirmed on flight due to the non-nominal launch). However, both deployment and retraction were quite slow, taking roughly 10 minutes each to complete. This was because we prioritised high torque over exit velocity to better guarantee a full deployment could be achieved.  In SVAROG3, we hypothesise that the microgravity conditions combined with the lighter, more space efficient carbon composite booms will drastically reduce friction, allowing for a much faster deployment and retraction. We will also aim to optimise the design of the spool compartment to further reduce friction.  The experiment will start with an electronic timer which is started at the moment of launch, this timer will trigger the opening of four hatches at the boom exits to allow them to extend beyond the airframe when the rocket enters microgravity conditions. After completion of the boom extension to 2.1m, the observation period will begin, here we record the booms with two onboard 360o cameras which stick through two holes in the airframe on opposite sides of the rocket. This footage will be analysed on the ground post-launch to observe how the booms wobble and droop in microgravity. Finally, after this phase, the booms will retract fully, allowing the airframe to retain form and re-enter without risk to the parachute.  In post flight, footage, sensor readings and internal analysis of the experiment will be used to assess the success of the launch. Success will be determined based off the quality of the footage, the extent of deployment, the survivability of the internal chassis, mechanisms and avionics, and strength of correlation of data from sensors with or against our hypotheses. |
| What data do you want to measure? | The key data we want to record are:   1. **Footage of deployment / retraction**   This can be used to observe the “quality” of deployment or retraction (how much flection or rotation is in the booms) which can be later analysed with an image processor to accurately measure boom deformation.   1. **Footage of booms at constant fully extended length**   Similarly to the data above, footage can be analysed to observe boom flection and mobility at full extension.   1. **Force / friction applied to booms**   This is to test our hypothesis that microgravity will reduce friction on the booms and improve deployment efficiency.   1. **Temperature of key electronic components**   On a number of occasions in the BEXUS 34 and 36 campaigns, we experience overheating on our components due to the vacuum conditions reducing convective cooling. Monitoring temperatures of key electronic components is key to checking possible failure mechanisms within the onboard electronics.   1. **Deployment length via internal sensor readings**   A failed objective of the BEXUS 36 campaign was to precisely measure the deployment length via an internal Hall-sensor on the motor to measure the number of rotations and thus deduce the length of the boom outside the CubeSat. For future LEO launches which will likely not feature an onboard camera, a working and reliable sensor for this is imperative for experiment functionality.   1. **Deployment velocity**   This will help assess our hypothesis that boom deployment and retraction efficiency can be improved by microgravity.   1. **High resolution measurements of acceleration on components due to rocket lift off.**   This would allow us to quantify direct specifications to build future components to when preparing for a LEO launch in an orbital rocket. |
| How do you want to take measurements? | To achieve **data requirement 1 and 2** we would require:   * 2x 360o cameras mounted on opposite sides of the rocket inner airframe with a whole cut out for the lenses (Model TBD) * Note that we need to investigate which cameras are optimal for this purpose   These cameras can also act as a redundancy for data requirement 5 and 6 via post flight analysis of the footage and individual frames.  To achieve **data requirement 3**, we would require:   * 4x force sensors placed on the underside of the boom exit guides (model TBD)   To achieve **data requirement 4**, we would require:   * 5x Commercial Off The Shelf (COTS) temperature sensors (LMT87LPGM) which were used in both BEXUS 34 and 36.   To achieve **data requirement 5 and 6** we can use:   * 1x Internal hall sensor for measuring motor rotations * The external cameras as redundancy   To achieve **data requirement 7**, we require:   * 1x IMU sensor (MC6470). This is the model tested successfully on BEXUS 34. |
| Describe the process flow of your experiment. |  |
| What do you plan to do with your data after the flight? | Data will first be downloaded off the onboard data storage (either via SD cards or NVMe SSD storage) and dedicated cameras.   1. The footage will initially be analysed to assess the success of deployment and retraction. 2. The body of the experiment chassis will then be assessed for any potential damages or deformations. 3. All sensors will have their data analysed via a python data science package to plot sensor readings over time. 4. Footage can be re-used for outreach events and future promotions of the team. |

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| **Organisation of your project** | *How will you organise/distribute work within your team? Please note that you are responsible for all aspects of your experiment (science, mechanical & electrical engineering, software, etc.)*  There will be a **central leadership team** which includes:  **Project Lead** – Piotr Fil  **Project Coordinator** – Matthew Acevski  **Mechanical Lead** – Aditya Shankar  **Electronics Lead** – Nishant Kildangan-Mathew  **Software Lead** – Piotr Fil (Temporary)  **Orbital Simulations Lead** – Shiki Vahaan  **Media and Sponsorships Lead** – Matthew Acevski (Temporary)  These people will supervise various sub-teams within project Svarog which includes:  **STRUctural and Mechanisms (STRUM)** – Responsible for design, manufacturing, simulating and testing the structures and mechanisms of our solar sail technologies.  **Electronics (HEAT)** – Responsible for the design and integration of electronics, sensors and data management.  **SoftWare and InterFace Technology (SWIFT)** – Responsible for the development of data analysis scripts, user interfaces and general software implementations.  **Media And SponsorShips (MASS)** – Responsible for researching sources of funding for the project, general outreach, and corresponding media for the REXUS campaign.  **ORBital Simulations (ORBS)** – Responsible for the development and investigation of possible viable trajectories for a future LEO solar sail (Note that this team has little to no involvement with our BEXUS/REXUS campaigns but the team members often help the other teams). |
| Can your team members commit to the project for the duration of the programme cycle? If not, please indicate any plans for handing over the project/team roles. | The core leadership team is committed to the project for the duration of the REXUS campaign with the exception of Matthew who may be completing his PhD in Autumn 2026. If he does complete his PhD at this time, a new project coordinator will be appointed at least 6 months in advance and an appropriate hand-over will be organised.  The current software and media / sponsorship lead roles are currently open, and we will be promoting members to these roles by December 2025. A requirement for these roles will be commitment to the project for the duration of the REXUS cycle. |
| Do institutes and/or senior scientists scientifically and technically support you? | *Please indicate the name of the institute(s) and senior scientist(s). Every experiment must have an endorsing professor.*  Yes, we are supported by three supervisors within Imperial College London:  **Dr. Aaron Knoll** (Imperial College London, Department of Aeronautics, Reader in Spacecraft Engineering and Plasma Propulsion)  **Prof. Matthew Santer** (Imperial College London Department of Aeronautics, Professor of Aerospace Structures)  **Prof. Jonathan Eastwood** (Imperial College London, Department of Physics, Professor of Space Physics and Co-chair of the Space, Security and Telecoms school of convergent science) |
| Do you have access to a workshop or a laboratory that meets your experiment's fabrication and testing needs? |  |
| Do you have all the material and equipment needed for your experiment? If not, how do you plan to obtain it? |  |
| How do you plan to finance your expenses? |  |
| Who else will support you (sponsors, others)? |  |

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| **Outreach Programme** |  |
| Describe your outreach programme for before, during and after the REXUS/BEXUS flight campaign. | *How are you planning to present your experiment to the public? E.g. newspaper, local radio, webpage, social media, presentation at the university…*  *The execution of an outreach programme is mandatory!* |

Experimental Set-up & Technical Information

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| **Mechanics** |  |
| Describe your experimental set-up. | *Describe and outline the preliminary set-up of your experiment. Include at least a sketch or block diagram of the experiment (CAD drawings are optional).* |
| Estimate the dimensions and the mass of your experiment (kg and m). | *For REXUS: Do not include the rocket structure (module and bulkhead) into the mass budget.*  *For REXUS: State which module size is proposed (120, 220 or 300 mm) or if the experiment is located in the nosecone.* |
| Indicate the preferred position of your experiment: | *REXUS:*  Indicate your experiment's orientation and the rocket's preferred position: module or nosecone section. Do you need access to the outside environment? Holes? Hatches?      *BEXUS:*  Define the preferred position in the gondola, inside and external units. Do you need access to the outside environment? |

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| **Electrics/Electronics** |  |
| Will you need the 28 V DC power supply from the REXUS service system or power from the BEXUS gondola, respectively? |  |
| Will you need (additional) batteries? What do you need for charging? | *Qualified batteries are listed in the REXUS and BEXUS User Manuals.* |
| Estimate the electrical consumption of your experiment (Ah or Wh). |  |
| Do you use any equipment with high inrush currents? If so estimate the current (A). | *E.g. Motors may need high inrush currents which exceed the nominal allowed current limit.* |
| Do you need auxiliary power? Do you need a separate umbilical? | *Auxiliary power for charging or consumption before launch is not standard.  Mention here whether you need auxiliary power and why.* |
| Use of uplink and downlink: | *Please indicate expected data rates for uplink and downlink.*  *Please note: In addition to onboard storage, it is mandatory that you downlink housekeeping/scientific data during the flight. On BEXUS, an uplink is also available throughout the flight. On REXUS, an uplink is not normally available during the flight but should be used during ground testing.* |
| REXUS only: Do you need to use the REXUS TV Channel? | *There is only one TV channel available, so only one experiment can use it at any one time and a maximum of three experiments can be connected. Why should one be your experiment? At what stage of the flight do you need it and for how long?* |
| Provide an event timeline, including the experiment actions during flight, such as timer or telecommand events. | *Describe your event timeline from start of countdown.* |

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| **Environmental Questions & Safety Issues** | *Please note that some of the aspects questioned below may require additional explicit approval from the organisers.*  *If you believe aspects of your design may cause safety or environmental concerns you are invited to contact ESA before submitting your application.* |
| Does the experiment use wireless devices? | *E.g. Wifi (WLAN), Bluetooth, infrared, data transmitters. Describe the type of devices and frequencies used.*  Yes, Radio frequency transmission |
| Does the experiment create any disturbing magnetic or electrical fields? | No |
| Do you expect to use high voltages in any part of your experiment? | *Please indicate the voltage, its use within the experiment and any expected protection devices.*  No |
| REXUS only: Does your experiment eject anything from the rocket? | *Note: number and size of holes/hatches in a module are limited. Please refer to the REXUS User Manual.*  Possibly yes, the ejection would either be from the top of the airframe or the underside of the nosecone. This can be discussed further as we do not need to fully eject (see previous discussion). |
| Is the experiment sensitive to light? | No |
| Is the experiment sensitive to vibrations? | Possibly yes |
| Does the experiment generate vibrations? | *E.g. Vacuum pump, rotating devices…*  Yes, inclusion of high torque motor for deployment of booms and ejection mechanism may generate vibrations. |
| Will you use any flammable, explosive, radioactive, corrosive, magnetic or organic products? | *Specify any products you will use with any of these characteristics.*  Possibly small magnetic products as part of electronics setup. Nothing that would affect other experiments. |
| Will you use a laser? | *Which class? Is the laser path securely contained?*  No |
| Is your experiment airtight? Are parts of your experiment airtight? | *Yields to a pressurized experiment (1 bar) when the vehicle reaches higher altitude with lower pressure values.*  *This question should remind you that there will be a very low ambient pressure environment for your experiment.*  No |
| Are there any hot parts (> 60°C)? | *Mention any parts besides electronics that heat up.*  No |
| Are there any moving parts? Are the moving parts reachable? | *This is important for the preparation before launch. Access to the experiment will be discussed with EuroLaunch. E.g. a tappet is used for a moving part.*  Yes, extendable booms arms. When spooled they are not reachable without disassembling the CubeSat. The motor that powers the booms will also rotate from within the CubeSat. |
| Do you need any pressure systems from EuroLaunch before launch? | *If you know that you need, for example, a pressurized nitrogen-bottle for your experiment before launch, please mention it here. All pressurized bottles will be handled by EuroLaunch personnel.*  No |
| Is there any aspect in your experiment which you believe may be viewed as a safety risk by others (regardless of whether you will mitigate this risk in your design)? | Booms when extended could interfere with parachute deployment. |

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| **Is there any potential business or downstream application of the experiment?** | *Provide a description of any potential business or downstream application of the experiment. E.g., if the experiment sensor proves reliable in high-altitude conditions, it could be integrated into commercial UAVs or nanosatellite platforms for continuous air quality assessment.*  *Note: this field is for statistical purposes. It will not be taken into account for the experiment selection.*  Potential development into fully integrated LEO CubeSat used in private launch. |
| **Additional comments** | *Is there any -information that is of importance for your proposal and not addressed above.*  If invited to selection workshop, we can provide a letter of recommendation from our supervisor. |

*Drawings can be inserted below and referenced in the above table.*