2024/060

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PRODEX OFFICE

Noordwijk, 5 February 2024

RNDr. Martin Ferus, Ph.D
J. Heyrovský Institute of Physical Chemistry
Czech Academy of Sciences, v.v.i..
Department of Spectroscopy
Dolejškova 2155/3
182 23, Prague, Czech Republic

Subject: Exchange of Letters - PRODEX Experiment Arrangement

Dear Sir,

With reference to the Institute Agreement signed by ESA on 5 November 2010 and by the Institute on 10 November 2010 we hereby send you the conditions of the PRODEX Experiment Arrangement between ESA and your Institute:

JH IPC - CAS, ESA Entity Code (to be used in ESA-P): 1000034713
Phone: +420266053204
Email: martin.ferus@jh-inst.cas.cz.

related to 4000143801 "EnVision VenSpec-H Electronics". The ESA representative for all administrative and contractual matters is Ms V. Dowson, and for all technical/scientific matters it is Mr T. Ridder.

The total price of the present arrangement amounts to € 505,032. All invoices should mention the European standard "IBAN" and "BIC" as bank account identifiers; failing to do so will block the settlement of the payment.

The term of the project shall be the time period 2 January 2024 through 31 November 2024.

I would appreciate if you could sign and approve the present letters and return one original to me at your earliest convenience.

I am looking forward to a fruitful co-operation,

Sincerely Yours,

V.D.

M. Lazerges
Head of the PRODEX Office

Received, accepted and signed by Institute: Place / date:

prof. Martin Hof — Digitally signed by prof. Martin Hof
Date: 2024.04.05 13:22:47 +02'00'

PRODEX EXPERIMENT ARRANGEMENT

ARTICLE 1: DEFINITIONS - PURPOSE OF THE ARRANGEMENT - APPENDICES

1 Throughout the present Arrangement, the terms laid down in the left column shall have the meaning set out opposite:

"Funds":	Maximum budget for the present Arrangement, as defined in Article 2
"Project":	Institute's project specified in Appendix 1, certified by the Agency's PRODEX Office as eligible for financial support according to the Financial Plan (Appendix 2) approved by the relevant Participating State
"Costs":	Allowable cost of these categories, incurred by the Institute in execution of the Project: - Labour cost - Operational costs as defined in Appendix 2 - Travel expenses - ....

2 By entering into the PRODEX Experiment Arrangement, hereinafter referred to as Arrangement or P.E.A., the Agency undertakes to reimburse the Institute certain costs incurred in the execution of the Project. The purpose of this arrangement is the detailed implementation of the said undertaking.

Any other arrangement or agreement by which the Institute undertakes to carry out the Project remains unaffected by the present arrangement, save that the Agency acquires hereunder the rights to access, to audit, and to obtain certain licenses in intellectual property rights; details are specified in Article 4.

3 The Institute may claim the Funds subject to the provisions set forth in Articles 2 through 4 below.

4 The Institute shall utilise the Funds and any part thereof exclusively for defraying, in due time, the Cost incurred during the term of the Project defined in Article 3.1 below.

5 Appendix 1 (Work Description) and Appendix 2 (Financial Plan) address the programme of work, schedule, deliverables and financial plan of the Project.

Appendix 1, Appendix 2 and Appendix 3 (PRODEX Experiment Arrangement Change Notice) shall form an integral part of this Arrangement.

ARTICLE 2: FUNDS AND PAYMENT

2.1 Funds

3. The above amount excludes profit for the Institute (not allowed) and value added tax on the costs charged to the Agency (so far as the Agency is exempted from VAT applied by the Agency's Member States).

4. The above amount is broken down into subtotals per cost category and/or per year as specified in Appendix 2 hereto.

2.2 Payments

1. Payments shall be made by the Agency in EURO to the account specified by the Institute. Such account information shall clearly indicate the IBAN (International Bank Account Number) and BIC/SWIFT (Bank Identification Code).

2. The Institute undertakes to provide further supporting documentation as required by the Contract, together with the electronic invoices and confirmations supporting the claims.

3. Any special charges related to the execution of payments will be borne by the Institute.

4. The Institute shall ensure that all invoices and confirmations are submitted for payment exclusively through the Agency's ESA-P system.

5. The Institute undertakes to adhere strictly to the instructions contained in ESA-P (including those for billing taxes and duties, where applicable) when submitting invoices and confirmations through the ESA-P system.

6. The Agency reserves the right to visit the Institute's premises and ascertain the progress of the work being performed under the Contract, prior to making the payment concerned.

7. ESA-P Information can be found at http://esa-p-help.sso.esa.int/. Any questions concerning the operation or operating status of ESA-P shall be addressed to the ESA Helpdesk (esait.service.desk@esa.int). Any questions concerning the latest status of due invoices can be addressed to the ESA Payment Officer (esa.payment.officer@esa.int).

ARTICLE 3: TERM OF THE PROJECT

1. Term of the Project shall be the time period stated in the cover letter.

2. Cost incurred outside said term shall not entitle the Institute any payment under this Arrangement.

ARTICLE 4: OTHER CONDITIONS

The ESA "General Conditions" (General Clauses and Conditions to ESA Contracts-GCCs), available from https://esastar-publication-ext.sso.esa.int (In: Supporting Documentation), shall apply, with the amendments or replacements set forth in the **Articles** of the Arrangement. The applicable General

Conditions shall be construed and interpreted with due regard to the specific nature of this Arrangement and its Article 1 in particular. The Institute signatory of the Arrangement (P.E.A.) shall be deemed the "Contractor" wherever mentioned in those General Conditions and in the rest of this document.

CLAUSE 1: APPLICABILITY OF CLAUSES AND CONDITIONS

The present General Clauses and Conditions to ESA Contracts (GCC) shall apply to Contracts placed by the Agency insofar as not stated otherwise in the relevant Contract. Furthermore, specific clauses and conditions may be set out or invoked in a Contract and its annexes and/or appendices. The annexes and/or appendices form an integral part of the Contract. **PART 1 of GCC is applicable with the following amendments.**

CLAUSE 2: APPROVAL AND ENTRY INTO FORCE

Offers and acceptances with regard to arrangements are not binding on the Agency unless approved in writing by its Director General or his authorised representative. For the purpose of this arrangement the authorised representative of the Agency's Director General is:

Dr. M. Lazerges,
Head of the PRODEX Office.
He is authorised by the Agency to sign the present arrangement on his behalf.

CLAUSE 5: THE PARTIES REPRESENTATIVES

The Agency shall have the right to check the performance of the Project, and for this purpose, the Agency nominates its representatives identified here below.

The Institute shall in this respect and in accordance with any relevant security regulations, give the representatives of the Agency access to its premises and shall give all other necessary assistance in order that they may fulfil their task.

All correspondence for either party shall be sent to the address and the representative in charge identified herein below, with a copy to the other representative(s) where any mixed nature of the matter so requires:

For the Agency to:	For the Institute to:
ESTEC P.O. Box 299 NL-2200 AG Noordwijk	The Institute's representative(s) is (are) as stated in the cover letter.
See cover letter.	See cover letter.

CLAUSE 17: N/A.

CLAUSE 28: PAYMENT

28.1 The following is added to clause 28.1 of the GCCs.
Within the limits specified in Article 2, the Institute may claim in arrears payment of the Cost incurred. The Agency shall effect such payment after receipt of the respective invoice, which must identify the cost category/ies concerned and bear a statement by the Institute's financial controller that the invoiced costs are fair and reasonable, do not include profit and have been

incurred exclusively in execution of the Project as defined in Article 1 and during the term specified in Article 3.
Any payment which is not the final payment of the contract is called "progress payment".

28.3 N/A

28.4.1 N/A

CLAUSE 30: (TERMINATION) GENERAL RULE

The following is added to clause 30, before the text in the GCC.

Notwithstanding any other provision of this Arrangement, the Agency shall have the right to terminate a Contract either wholly or in part by giving written notice by registered mail. This may include the case where the Participating State representatives having approved Appendix 2 demand the termination of the activities in writing.

CLAUSE 33: TERMINATION IN SPECIAL CASES

The following is added to clause 33, before 33.1

Notwithstanding any other provision of this Arrangement, the Agency may:

i) Cease to effect any payments not already fallen due under this arrangement in case of unsatisfactory progress within the Project, provided the Participating State representatives having approved Appendix 2 demand cessation of payments in writing;

ii) Cease to effect any payments in any of the following cases:
- a situation as per Clause 33.1 lit. a) of the General Conditions occurs;
- a situation as specified in Paragraph iv) below occurs.

iii) The Agency may require the Institute to return to the Agency payments effected under this arrangement if and to the extent an audit carried out by the Agency or by the relevant national audit authority reveals any incorrectness of invoices or unauthorised use of Funds.

iv) The Agency may require the Institute to return to the Agency all payments effected under this arrangement in case a situation as per Clause 33.1 lit. b) of the General Conditions occurs.

CLAUSE 34: APPLICABLE LAW

The arrangement shall be governed by the laws of the country of residence of the Institute.

CLAUSE 35: DISPUTE RESOLUTION

The arbitration proceedings referred to in Clause 35.2 shall take place in the capital city of the country of residence of the Institute.

PART II OPTION A of the GCC is applicable with the following amendments:

CLAUSE 37.1: Deliverables are identified in the specific section of Appendix 1 (Deliverables).

CLAUSE 39: Clause 39.2 lit. a) is not applicable.

CLAUSE 40: Clauses 40.4 to 40.6 are not applicable.

CLAUSE 41: Cancelled and replaced by the following.

CLAUSE 41: USE OF INTELLECTUAL PROPERTY RIGHTS

Use/Licensing

41.1 All Intellectual Property Rights arising from work performed under the Agency Contract shall be available to:

a) The Agency to use on a free, worldwide licence for the Agency's Own Requirements (such licence to be granted by the Contractor as set out in the standard licence which the licensee shall be entered into if required);

b) Participating States and Persons and Bodies to use on Financial Conditions for the Agency's Own Requirements (such licence to be granted by the Contractor as set out in the standard licence which the licensee shall enter into if required);

c) Any Third Party on Market Conditions to use for purposes other than the Agency's Own Requirements providing the Contractor agrees such use is not contrary to its Legitimate Commercial Interests.

41.2 For the avoidance of doubt the term "use" for the purposes of software includes use to operate, integrate, validate, maintain and modify software developed under the Agency Contract.

41.3 Where the Contractor relies on its Legitimate Commercial Interests, unless specified in the Contract it shall demonstrate those interests continue to apply every 3 years or within any other timeframe specified in the Contract.

CLAUSE 45: N/A unless specified in Appendix 1 under "Evaluation of Technology".

CLAUSE 46: Fees – cancelled. Replaced by the following.

"The Contractor shall not be required to pay a fee to the Agency if it sells a product, application, or result developed under the Agency Contract or if it licenses or assigns Intellectual Property Rights arising from work performed under the Agency Contract".

CLAUSE 47.9: N/A

Personal Data "Controller to Controller" Annex (the "PDCC") of the European Space Agency ("ESA" or the "Agency")

This "Controller to Controller" Annex governs the processing of Personal Data exchanged by the Parties, acting as separate Controllers, in the frame of the Contract. Such Annex forms an integral part of the Contract. In case of conflict between the terms and conditions of the Contract and the terms and conditions of this Annex, the terms and conditions of this Annex shall prevail.
This Annex survives the expiration or termination of the Contract for as long as the Personal Data are protected by the Data Privacy Regulations.

1. DEFINITIONS

The following specific definitions apply:

(i) "Agreed Territory" (of Processing) means:
  a) ESA Member States, as they are listed in the ESA website at URL: http://www.esa.int/About_Us/Welcome_to_ESA/New_Member_States;
  b) European Union;
  c) countries recognized by the European Commission as ensuring an Adequate Level of Protection of Personal Data under the European Union's legal framework.

(ii) "Data Privacy Regulations" means respectively:
  a) ESA PDP Framework, i.e. the Personal Data Protection Framework applicable to ESA and available on ESA website at URL: http://www.esa.int/About_Us/Law_at_ESA/Highlights_of_ESA_rules_and_regulations
  b) the Personal Data protection laws and regulations applicable to the Contractor in the Agreed Territory of Processing which provide an Adequate Level of Protection under the ESA PDP Framework (e.g EU Regulations in the field of personal data protection, including but not limited to Regulation (EU) nr. 2016/679).

(iii) "Personnel" means:
  a) with respect to the Contractor: any employee, agent or representative acting under the responsibility of the Contractor or, if subcontracting is permitted, of Contractor's subcontractors;
  b) with respect to ESA: any employee, agent or representative acting under the responsibility of ESA (e.g. staff members and seconded agents, consultants experts or employees of third parties).

With respect to terms used with capitals in this Annex (e.g. "Controller", "Personal Data" etc.) but not defined above, reference is made to the definitions set forth in the Data Privacy Regulations applicable according to Article 2 below.

2. GENERAL

2.1 Each Party is individually and separately responsible for complying with the level of protection resulting from its Data Privacy Regulations in relation to Personal Data, being recognised that:

a) the Contractor is governed by the Personal Data protection laws and regulations applicable to the Contractor in the Agreed Territory of Processing, which provide an Adequate Level of Protection under the ESA PDP Framework (e.g. EU Regulations in the field of personal data protection, including but not limited to Regulation (EU) nr. 2016/679).

b) ESA is governed by PDP Framework, i.e. the Personal Data Protection Framework applicable to ESA and available on ESA website at the URL: http://www.esa.int/About_Us/Law_at_ESA/Highlights_of_ESA_rules_and_regulations

2.2. The Parties are considered separate Data Controllers of the Personal Data, with each Party being able to determine the purpose and means of Processing the Personal Data under its control in accordance with its privacy statement.

2.3 The Personal Data exchanged by the Parties in the frame of this Contract will only be processed for:

a) the performance of the Contract, including implementation, management, monitoring, audits and the fulfilment of the obligations set out in this Annex;
b) the management of the relationship of the Parties in relation to the Contract, notably for administrative, financial, audit or for communication purposes;
c) the compliance with any legal or regulatory obligation to which a Party is subject;
d) the compliance, in case the performance of the Contract requires access to the Parties' premises, with the health, safety and security requirements, legal or regulatory obligations applicable to the respective Party in such matters.

3. PERSONAL DATA EXCHANGED BY THE PARTIES

In the performance of this Contract each Party may disclose to the other Party data which may qualify as "Personal Data" under its Data Privacy Regulations as follows:

a) the Agency shall communicate to the Contractor only the Personal Data concerning ESA representatives/contact persons including name, work address, email and telephone numbers;
b) the Contractor shall communicate to the Agency only:
   (i) Personal Data concerning the Contractor's representatives/contact persons including name, work address, email and telephone numbers;
   (ii) Personal Data concerning the Contractor's key Personnel, including title, name, work address, email, telephone numbers, education, professional experience, description of the person's job and responsibilities and the precise assignment of the person to the activity under the Contract.

4. PARTY'S OBLIGATIONS

4.1 Each Party is individually and separately responsible for complying with the level of protection resulting from its Data Privacy Regulations in relation to Personal Data, including the collection and update of the Personal Data that it communicates to the other Party, the lawfulness and the quality of such Personal Data and for the means by which they were collected. Should the legal basis for the collection of the Personal Data cease to exist or the quality of the Personal Data be affected, the Party will inform the other Party without undue delay.

4.2 The Parties shall preserve the rights and legal remedies of the Data Subject as recognised and protected in the Data Privacy Regulations applicable respectively to each Party. In particular, the Data Controller which disclosed the Personal Data to the other Party will respond to enquiries from Data Subjects and, as the case may be, from any competent authority concerning the data processing of the relevant Personal Data.

4.3 In case the Parties engage Processors to support their internal operations, including the Processing of the Personal Data exchanged, it is the responsibility of that Party to ensure that its Processors assume obligations consistent with the Data Privacy Regulations applicable to the respective Party, in order to guarantee an adequate level of protection of Personal Data.

4.4 The Party having received the other Party's Personal Data under the Contract shall Process such Personal Data only in the Agreed Territory of Processing.

5. DATA RETENTION

5.1 The Parties shall not retain or process the Personal Data exchanged longer than is necessary to carry out the purpose described in Article 2.3 herein, unless required otherwise:

a) under the Data Privacy Regulations, (e.g. in the frame of audits, inspections and incidents) or
b) under the Party's statutory obligations.

5.2 The retention period shall be defined in the privacy notices of the Parties.

5.3 All Personal Data must be, effectively destroyed/deleted upon expiration of the retention period, unless conservation of such data is required for compliance with any legal or regulatory obligation to which the Party having received the Personal Data from the other Party is subject.

6. CONFIDENTIALITY

The Parties shall ensure the confidentiality of the Personal Data processed by protecting them against unauthorized or unlawful access, acquisition, use and disclosure, in particular by:

a) limiting access to the Personal Data of the other Party only to their Personnel, that:
   - are required or authorized to access such Personal Data;
   - have committed themselves to confidentiality or are under a statutory obligation of confidentiality;
   - have received the appropriate Personal Data protection training.

b) taking into consideration, in terms of IT tools, product, applications, the principles of personal data protection by design and by default.

7. SECURITY

The Parties shall adopt appropriate technical and organisational security measures, giving due regard to the risks inherent in the Processing and to the nature, scope, context and purpose of the Processing, in order to ensure the following as appropriate:

a) the on-going confidentiality, integrity, availability and resilience of Processing systems and services;
b) measures to protect Personal Data from accidental, unlawful or unauthorized access, use, destruction, loss, modification or transfer.

8. DATA PROTECTION OFFICER/CONTACT POINT

For any Personal Data protection matters, the Parties shall involve their specific contact points identified in the Contract.

9. TRANSFER

The Party having received the other Party's Personal Data under the Contract shall Process (and have processed by its authorised subcontractors or sub-processors) such Personal Data only in the Agreed Territory of Processing. No transfer of Personal Data outside the Agreed Territory is allowed without prior written approval of the other Party.

10. SUB-CONTRACTORS

10.1 The Contractor is authorised to disclose Personal Data received from the Agency to its Sub-contractors provided that:

a) sub-contracting is specifically authorised by Contract and the Sub-contractors are indicated in the Contract;
b) all the general conditions set forth in this Annex are fulfilled; in particular the Processing of the Personal Data by the Sub-contractors is performed for the purpose described in Article 2.3 herein and the Personal Data are not transferred outside the Agreed Territory.

10.2 Disclosure of the Agency's Personal Data to other third Parties requires prior approval of the Agency.

11. PERSONAL DATA BREACHES

11.1 After becoming aware of a Personal Data Protection Breach falling in its area of responsibility, and affecting the Personal Data communicated by the other Party, the Party shall notify the other Party within 48 hours.

11.2 The Parties will provide each other reasonable assistance to facilitate the handling of the Personal Data Breach and accurate information about the breach, in particular (but not only) in case a complaint is, or likely to be, lodged by a Data Subject in relation to the Breach.

12. LAW – DISPUTE RESOLUTION

Concerning Personal Data protection matters, notwithstanding any other provisions on the governing law set forth elsewhere in the Contract, the provisions set forth in the Data Privacy Regulations, as defined herein, will apply as mentioned in Article 2 herein and will prevail in case of conflict. Without prejudice to the foregoing, disputes between the Parties on Personal Data protection matters shall be settled in accordance with Clause 35 of the Contract.

PRODEX Experiment Arrangement

Guidelines for the preparation of Appendix 1 (Work Description) and Appendix 2 (Financial Plan)

Part I – Appendix 1

1. Work Description

The Work Description shall identify the Project, i.e. the work in execution of which reimbursable cost will be incurred by the Institute during the term of the Arrangement.
Length: One page should be sufficient but in no way be regarded as a firm limit.

2. Distinctions as to 'who' and 'when'

The work to be carried out by the Institute and to be paid for by ESA under the PRODEX Experiment Arrangement (the Project) is to be clearly separated from the work to be carried out by other parties (if the latter is mentioned at all).
The work to be carried out during the term specified in the PRODEX Experiment Arrangement must be clearly separated from the work planned outside said term (if the latter is mentioned at all).

3. Compatibility with other Applicable Documents

Subject to sections 1) and 2) above, the Work Description must correspond to the work description submitted to the relevant national authority in support of the Financial Plan, and is covered by the Institute Agreement.

4. Conventions

- In this contract, the term "Contractor" means the Institute or University signatory of the present PRODEX Experiment Arrangement (PEA) or its Change Notices (CN)
- The present PRODEX Experiment Arrangement is here after designated as "the Contract"
- The term "Project" means the activity covered by the Contract.

Part II – Appendix 2

1. Content

The Financial Plan's minimum content will encompass:

a) Title of the Project and identification of the Institute
b) Cost categories such as:
   - Salaries [please specify employee(s) name(s)]
   - Travel
   - Miscellaneous
   - Overheads: Please note that for Belgium, overheads can only be charged for a **maximum of 5%.**
   - Equipment purchased directly by Institute/University
   - etc.
c) Amounts: all figures should be mentioned in Euro and should be exclusive of VAT in the Agency's Member States.
d) Project Term (Project time periods).

2. Procurement of VAT exempt equipment, services, or other items

This category should not be integrated into the Financial Plan, but should be listed separately, e.g. in table 2 of Appendix 2, clearly separated from the Financial Plan (i.e. Table 1 of Appendix 2 and its exhibits). The procurements listed in Table 2 of Appendix 2 can be established via the PRODEX Office by means of a Purchase Order placed by the Agency, or by equivalent means (for purchases above 5 000 Euro). This approach has the advantage of ensuring that the goods or services purchased for the purpose of the Project are exempt from VAT.

Appendix 1

Work Description

CZECH PARTICIPATION IN ENVISION MISSION - DERISKING OF VENSPEC-H DEVELOPMENT

VenSpec-H electronics (Phase B1)

1. PROJECT DESCRIPTION

1.1. General description – Objectives of the project

EnVision is a Venus orbiter mission that will determine the nature and current state of Venus' geological evolution and its relationship with the atmosphere to understand how and why Venus and Earth evolved so differently. EnVision will deliver new insights into geological history through complementary imagery, polarimetry, radiometry, and spectroscopy of the surface coupled with subsurface sounding and gravity mapping. The probe will search for thermal, morphological, and gaseous signs of volcanic and other geological activity; and it will trace the fate of key volatile species from their sources and sinks at the surface through the clouds up to the mesosphere.

Spectrometer suite, VenSpec, will obtain global maps of surface emissivity in six wavelength bands using five near-infrared spectral transparency windows in the nightside atmosphere to constrain surface mineralogy and inform evolutionary scenarios; and measure variations of gases in the mesosphere, to link these variations to tropospheric variations and volcanism. VenSpec-H stands for Venus Spectrometer with High resolution. VenSpec-H is one of three in a spectrometer suite, together with VenSpec-M (Germany) and VenSpec-U (France). VenSpec-H is dedicated to extremely high-resolution atmospheric measurements. The main objective is to quantify $SO2$, $H2O$ and HDO in the atmosphere, below and above the clouds, characterizing gas exchanges from the surface and within the atmosphere and searching for sources such as volcanic plumes. The detailed windows into the nightside atmosphere, and the corresponding trace gas species and the altitudes at which they can be measured, are as follows: (1) 1.16–1.19 μm (H2O, HDO at 0–15 km); (2) 1.72 to 1.75 μm (H2O, HCl at 15-25 km); (3) 2.29–2.48 μm (H2O, HDO, HF, CO, COS, SO2 at 30–40 km). The high spectral resolution (R ~ 8000) coupled to the high sensitivity of the VenSpec-H instrument will be sufficient to clearly identify the absorption features of the targeted species.

The research and development as well as technical role of the applicant is to provide development, coordination and testing of VenSpec-H electronic components within the phase B1. During its solution within the current project, Prodex project for further phases will be prepared.

The overall Czech technical development leading to successful construction of the EnVision probe will involve:

- **Full development** of the PROC electronic board,

- **Full development** of the FPGA electronic board,
- **Full development** of the MOD electronic board,
- **Full development** of the DEP electronic board,
- **Full development** of E-Box interconnecting harness plus E-Box to instrument harness.

No on-board software will be developed by the consortium - this will be developed by BIRA.

These responsibilities as stated above are related to the full development cycle.

The objective of the activity within the current project proposed under leadership of the Czech Academy of Sciences, J. Heyrovský Institute of Physical Chemistry (that we are proposing in this proposal) is to provide a bridging phase between Phase B1 and B2 to be able to derisk development of the technology and provide the technological feedback as well as development recommendations to the scientific team developing the VenSpec-H electronics.

The technical-science and development role of the Czech Republic will also involve composition of data sets for testing the electronic components during their development, mainly focusing on data quality, size and flow, and the preparation of these datasets by means of software tools. Recording of the experimental spectra and generating excessive simulated spectral libraries will enable rigorous testing (including calibration/validation) and further assessment of effectivity of the built electronic set up in corresponding spectral range and resolution for data processing of spectra recorded by VenSpec-H channels (Table 1). We will supply all these data to the consortium and provide feedback for electronic manufacturers. Our results will be used further as reference for the data acquired by the probe once operational on the Venusian orbit. The reference laboratory data and consequently generated simulated spectra of possible mixtures will be crucial in all applicable spectral ranges. The existence of this data is critical for a correct testing and validation of the electronic components in order to simulate real observation data since current databases are incomplete and, therefore, not directly applicable.

For further support needed from the Phase B2 onwards, the tasks in this bridging Phase were selected in order to prepare for Phase B2 and later phases as well as identify possible risks, time delays and technology gaps in the implementation of the instrument.

This bridging phase suggested in this project will specifically focus on:

- Requirements discussion and finalization
- Manufacturability and assembly methods discussion
- Test Philosophy
- Preliminary design, prototyping and testing of FPGA and PROC boards
- LLI EEE components procurement for all EM and EFM boards and harnesses

The activities will also involve national project management and activities coordination, representation of the Czech Republic within the consortium, outreaching the project among the Czech-speaking audience (scientific and industrial) as well as abroad, supervision of technical implementation of delivery, coordination of requirements and activities between us and the EnVision consortium, supervision of compatibility and functionality of equipment in the whole range of requirements, supervision of required hardware quality as well as coordination of working group meetings and overall providing contacts within the consortium and an interface between the domestic scientific community and the EnVision consortium.

1.2. Hardware Description

The aim of VenSpec-H is to perform night side mapping of the near surface atmosphere and day side mapping of the atmosphere above the cloud deck. It will perform its measurements by means of nadir observations. More specifically VenSpec-H will measure gases related to volcanism and surface changes on Venus. The functional block diagram of VenSpec-H is shown in Figure 1.

VenSpec-H is composed of:

- a warm section that contains the main base plate and the overall cover of the instrument.
- a cooled optical bench (also called "the cold section") mounted inside the warm section (warm and cold section form together the main instrument);
- an electronic box (separated from the main instrument).

The warm base plate interfaces to the S/C deck by means of 4 mounts. It carries the cold section. The warm section contains the instrument entrance (nadir aperture). In front of the cold section a first part of the band selector is mounted, a filter wheel with 6 filters and associated optics. At the exit of the cold section a detector-cooler assembly is mounted with its proximity electronics.

A shutter mechanism is foreseen to close off the instrument aperture and to protect the instrument during aerobraking.

The optical bench (cold section) contains a cooled spectrometer. The entrance of the cold section is a rectangular slit that is part of a filter-slit-assembly. The image of the slit is projected on the spectrometer. The filter on the filter-slit-assembly consists of an upper and a lower zone that is a part of the band selection of the instrument, together with the filters in the filter wheel (hence, the band selector is partly in the warm, partly in the cold section). Filters and slit are deposited together on a carrier substrate. The spectrometer consists further of a parabolic mirror (rendering the incoming light parallel), a free form corrector plate (correcting the aberrations of the parabolic mirror), an echelle grating (spectral diffraction of the light), a detector optics unit (collimating the diffracted light on the detector). The optical path contains a folding mirror to reduce the size of the spectrometer section.

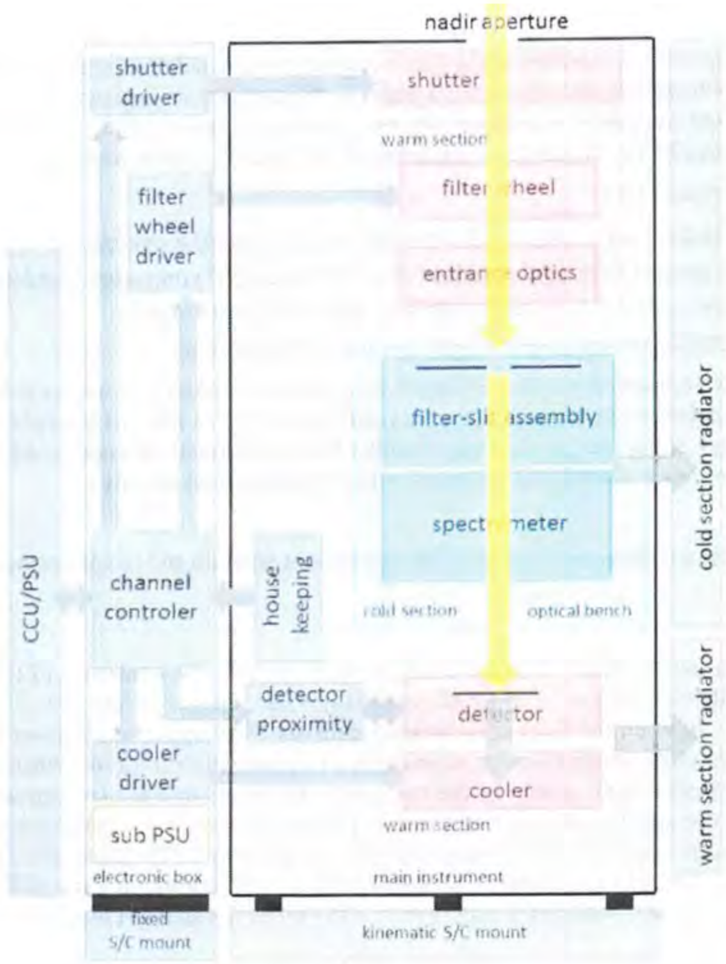

Figure 1. VenSpec-H Functional block diagram

The cold section is cooled down by means of a cold section radiator to -45 °C. The warm baseplate is kept at approximately 0 °C by means of a warm section radiator.

The detector is an Integrated Dewar Detector-Cooler Assembly (IDDCA). The dewar window sits in the exit aperture of the cold section. The Focal Plane Array (FPA) is located a bit further in the focal plane of the detector optics. The FPA is cooled by means of a cryocooler.

The VenSpec-H electronics (lodged in a dedicated E-Box unit and mounted separately to the S/C deck) consist of a channel control unit (PROC- and FPGA-board) and a motor driver unit (MOD) that drives the filter wheel driver, the cryocooler and the shutter. Close to the detector is located the proximity electronics (DEP-board). The VenSpec-H electronics interface with the Central Control Unit (CCU) and Power Supply Unit (PSU) of the VenSpec-suite. The E-Box contains a so-called sub-PSU that receives primary power from the central VenSpec-PSU and provides secondary power to the VenSpec-H instrument.

OVERVIEW OF THE VENSPEC-H ELECTRONICS

The main instrument (optical bench) contains one PCB. The DEtector Proximity board (DEP) board sits close to the detector in the warm section of the instrument.

The electronic box (E-box) of the VenSpec-H instrument contains the rest of the electronics boards: four individual PCB boxes (slices) stacked together. Inside each E-box slice a PCB will be mounted.

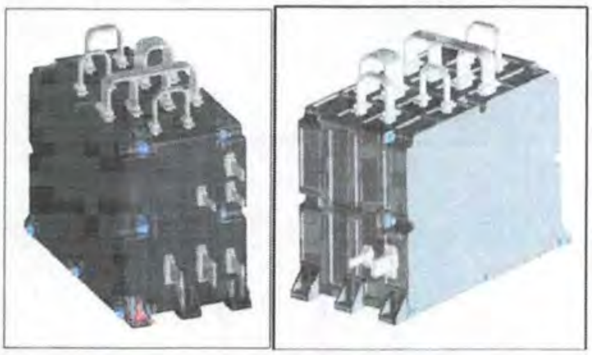

Figure 2: VenSpec-H E-box

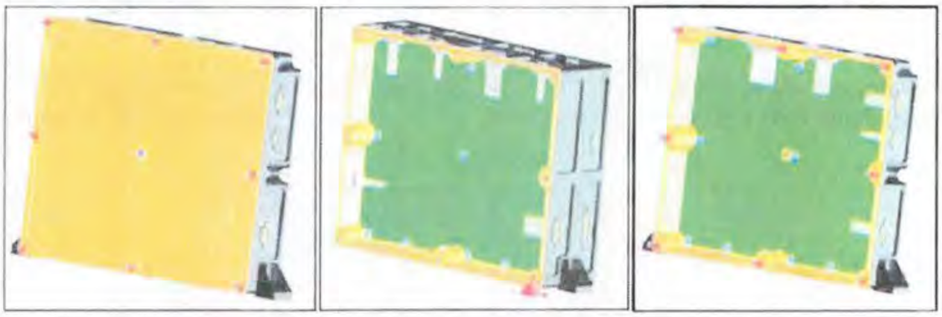

Figure 3: Individual PCB boxes (slices)

The two middle boards (PROC-board and FPGA-board) are placed back-to-back in one central double frame with two openings. The two other boards (MOD-board and sub-PSU-board) are placed in single frames. These frames are mounted face-to-face to the central frame (sub-PSU board facing PROC-board and MOD-board facing FPGA-board).

The MOD- and sub-PSU-boards have the highest power dissipation and therefore are placed at the outsides so that the bottom of their frames can drain heat radiatively.

For EMC reasons 2 shields are placed between the 3 frames, so that all 4 boards are completely enclosed.

esa

REQUIREMENTS OF THE ACTIVITY

Below please see basic requirements provided by BIRA. As part of the work is to tune out the requirements, discuss them with BIRA and ESA and help to establish a specification for the future phases, please see these as preliminary:

Parent	Requirement					Verification method
Number	Number	Topic	Text	Value	Unit	
FWM						
EL-FWM-300	VCD-ELEC-012	Filter wheel motor	The filter wheel shall be driven by a stepper motor.	/	/	R
EL-FWM-301	VCD-ELEC-013	Filter position	The filter wheel position shall be determined by means of an encoder	/	/	R
VCD-FWM-013	VCD-ELEC-014	Filter number	The wheel shall have 7 fixed positions	/	/	R
ROIC/cooler						
EL-DET-100	VCD-ELEC-015	ROIC/Detector	The selected detector shall be SWIR384-288 from AIM	/	/	R
EL-DET-101	VCD-ELEC-016	Cooler	The ROIC/detector shall be cooled down with a SF070 Stirling cryocooler	/	/	R

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EL-DET-102	VCD-ELEC-017	Nr analog outputs	The AIM SWIR384x288 has 8 parallel analog outputs	/	/	R
EL-DET-103	VCD-ELEC-018	Nr of pixels	The AIM SWIR384x288 has 384 pixels x 288 pixels	/	/	R
EL-DET-104	VCD-ELEC-019	Read-out frequency	Maximum value for reading out the detector analog signals	10	MHz	R + T
External						
EL-EXT-400	VCD-ELEC-020	External TC/TM interface	The interface to receive telecommands and forward telemetry is a spacewire interface towards the CCU	/	/	R
EL-EXT-401	VCD-ELEC-021	External Power interface	28V shall be provided to the VenSpec-H instrument from the CCU.	/	/	R + T
EL-EXT-402	VCD-ELEC-022	Sub-PSU voltages	The secondary voltages required from the sub-PSU are	+/-12, +3.3, +28	V	R + T
Read-out electronics						
EL-ROE-200	VCD-ELEC-023	AD resolution	Analog-to-Digital precision for the detector read-out	14	bits	R + T
EL-ROE-201	VCD-ELEC-024	Binning	Flexible on-board binning of detector rows	/	/	R

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EL-ROE-202	VCD-ELEC-025	Accumulation	On-board accumulation of detector row values	/	/	R
EL-ROE-203	VCD-ELEC-026	Background subtraction	On-board background subtraction	/	/	R
Operational heaters						
EL-OPH-700	VCD-ELEC-027	Operational heaters	Operational heaters required	/	/	R
EL-OPH-701	VCD-ELEC-028	Operational heater power	Maximum power for the operational heaters	TBD	W	R + T
EL-OPH-703	VCD-ELEC-029	Operational heaters regulation	regulation of operational heaters in closed loop with thermistors	/	/	R
EL-OPH-702	VCD-ELEC-030	Temperature sensors	The operational heaters driven in closed loop with multiple temperature sensors as feedback	/	/	R
Radiation						
EL-RAD-800	VCD-ELEC-031	TID	Total Ionization Dose for EEE parts	50	kRad	R + A
EL-RAD-801	VCD-ELEC-032	LET	LET requirement (EnVision mission)	60	MeV.cm^2/mg	R + A

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EL-RAD-802	VCD-ELEC-033	stuck bits / multiple bit upset	LET threshold below which extra analysis is required	< 60	MeV.cm^2/mg	R
Quality						
EL-OPS-900	VCD-ELEC-034	EEE parts grade	class 1 components	/	/	R + I
Electrical						
EL-OPS-901	VCD-ELEC-035	on-board SW/FW	fail safe approach for memory management of on-board SW/FW. Combine safety (protected zone) with flexibility (reprogrammable zone)	/	/	R
EL-OPS-902	VCD-ELEC-036	data rate to CCU	data rate shall allow the downlinking of maximum data volume (full frames) within minimum measurement time.	TBD	Mbits/s	R + T
EL-OPS-903	VCD-ELEC-037	science data read out	efficient detector read-out + transmission between Main Instrument and E-Box + AD conversion	TBD	Mbits/s	R + T
EL-OPS-904	VCD-ELEC-038	housekeeping rate	foresee sufficient housekeeping measurements to have consistent monitoring of the instrument status and behaviour	1	Hz	R + T
EL-OPS-905	VCD-ELEC-039	on-board storage	measurement taken, measurement downlinked to CCU, i.e. no on-board storage inside VenSpec-H	/	/	R
EL-OPS-906	VCD-ELEC-040	command parameters	high operational flexibility with parameters in command rather than in COP tables	/	/	R

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EMC						
EL-EMC-600	VCD-ELEC-041	EMC Emissions	Keep-out zone: 9 MHz +/-2.5 MHz	9 +/- 2.5	MHz	R + T
EL-EMC-601	VCD-ELEC-042	EMC provisions	limit radiated/conducted emissions from the instrument - foresee EMC protective measures	/	/	R
EL-EMC-602	VCD-ELEC-043	signal type separation	separation of signal types in connectors (use of separate connectors if possible)	/	/	R
EL-EMC-603	VCD-ELEC-044	connectors mechanically disconnected	mechanical disconnection between board mounted connector and PCB	/	/	R
EL-EMC-604	VCD-ELEC-045	grounding	single star point concept	/	/	R
/	VCD-ELEC-046	case	All electronics shall be housed in a non-magnetic and continuous conductive metallic case which shall form an all-enclosing electromagnetic shield.	/	/	R
Command parameters						
/	VCD-ELEC-100	Parameters update	Tunable parameters which are needed in orbit for performance optimization, instrument monitoring etc. shall be modifiable through the commanding interface, without the necessity for complete reprogramming	/	/	R

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/	VCD-ELEC-101	Data management margin	Design margin on RAM, EEPROM and PROM sizes, data busses and pcint to point communication link loads, CPU processing loads	25	%	R
/	VCD-ELEC-102	ESD	All electric circuits shall be protected against the effects of Electrostatic Discharges	ECSS-E-ST-20-06C	/	R

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Please see below a short discussion of selected requirements:

Parent	Requirement		
Number	Number	Topic	Discussion
ROIC/cooler			
EL-DET-101	VCD-ELEC-016	Cooler	The use of a Stirling cryocooler for cooling the ROIC/detector is a reliable and efficient method, but careful consideration should be given to the cooler's power consumption and potential mechanical vibration.
EL-DET-102	VCD-ELEC-017	Nr analog outputs	Eight parallel analog outputs provide flexibility for data acquisition, but consideration should also be given to the data rate and potential noise introduced by the parallel outputs.
EL-DET-104	VCD-ELEC-019	Read-out frequency	The maximum read-out frequency is essential for achieving the required data rate, but consideration should also be given to the read-out noise and potential interference with other subsystems. These should be defined as well.
Read-out electronics			
EL-ROE-200	VCD-ELEC-023	AD resolution	The AD converter's noise and linearity performance should be defined as well.
Operational heaters			
EL-OPH-700	VCD-ELEC-027	Operational heaters	The requirement for operational heaters ensures proper functioning in different thermal environments, but the maximal power consumption needs to be established as well as potential interference with other subsystems.
Electrical			

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EL-OPS-902	VCD-ELEC-036	data rate to CCU	While it is important to downlink the maximum data volume within the minimum measurement time, it is equally important to ensure that the data transmission is reliable and that the data is not lost during the downlink process. The data rate should be carefully chosen to balance these factors.
EL-OPS-904	VCD-ELEC-038	housekeeping rate	Monitoring the instrument status and behavior at a rate of 1 Hz is important, but consideration should be given to the amount of data generated by this monitoring and the impact it will have on the data rate and downlink capabilities.
EL-OPS-905	VCD-ELEC-039	on-board storage	While it is important to minimize the weight and power consumption of VenSpec-H, not having any on-board storage may limit the instrument's ability to take measurements during periods of poor communication or during unexpected events. At least it should be considered some FIFO buffer for a limited number of frames to cover short downlink issues.
EL-OPS-906	VCD-ELEC-040	command parameters	It is important to ensure that the command parameters are well-defined and that there is no ambiguity in their interpretation. Careful consideration should be given to the structure and format of the command parameters. There should also be considered potential data consistency issues. When the new command is coming there should be checked not only the validity of its data, but also the consistency with the current device status and configuration.
EMC			
EL-EMC-602	VCD-ELEC-043	signal type separation	Separating signal types in connectors and using separate connectors can ensure signal integrity and prevent interference, but it may increase the complexity and cost of the system. There should be a trade-off between these two factors.
EL-EMC-603	VCD-ELEC-044	connectors mechanically disconnected	The mechanical disconnection between board-mounted connectors and PCB is an effective way to minimize interference and ensure signal integrity, but it may also increase the risk of connection failure - thus again a trade-off should be introduced to justify this approach.
Command parameters			
/	VCD-ELEC-100	Parameters update	The ability to modify tunable parameters through the commanding interface provides operational flexibility, but it may also introduce additional complexity and potential risks for the system. A derisking approach keeping the required flexibility should be introduced. There should also be considered potential configuration data consistency issues.

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DESIGN OUTLINE AND POINTS OF FEASIBILITY FOR INDUSTRIAL WORK

The description of the board as presented by BIRA:

Processor Board (PROC)

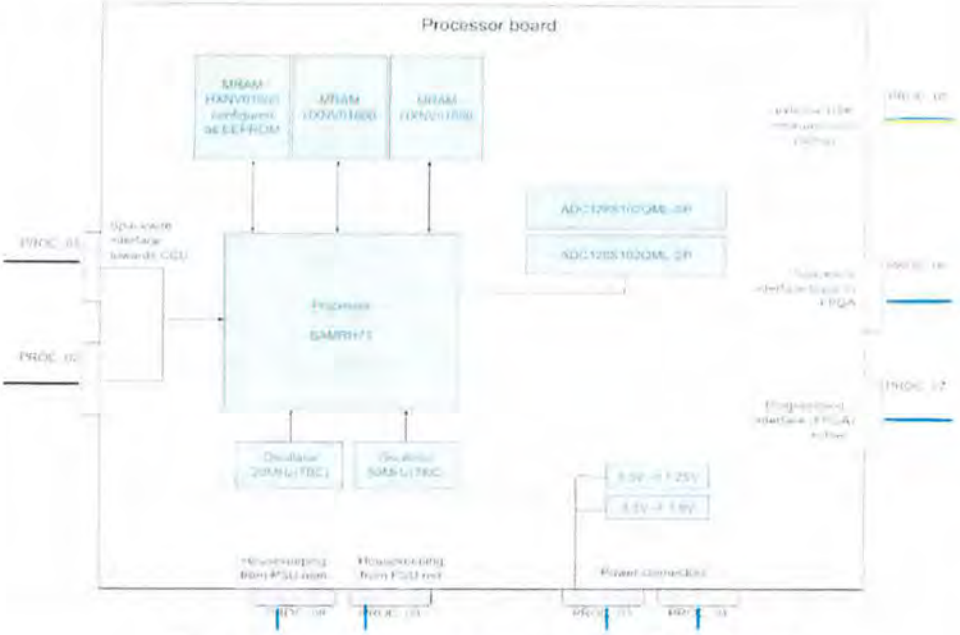


Figure 4: General schematic diagram of the PROC board

The PROC board contains the microcontroller (MicroChip Technologies SAMRH71) and its configuration memory containing the initial version of the microcontroller's program. Optionally the program code of the FPGA can be lodged also in this configuration memory on the PROC-board. The FPGA could be configured from the microcontroller over a QSPI interface. It is TBD if the configuration memory will be EPROM (ESA requirement) or MRAM (preferred). The microprocessor communicates with the VenSpec-CCU over a bi-directional SpaceWire link (receiving of command parameters and transmission of data packages). Also, the communications with the FPGA on the FPGA-board is done via SpaceWire. The PROC-board also contains several Analog-to-Digital convertors for the housekeeping data (Texas Instruments ADC128S102-SP).

1.1 FPGA Board (FPGA)

The FPGA-board contains a NanoXplore NG-Medium NX1H35AS FPGA. The FPGA communicates with the microcontroller on the PROC-board over a bi-directional SpaceWire link (receiving of command parameters and transmission of data packages). The firmware used for this SpaceWire interface is SpaceWire Light, a VHDL core implementing a SpaceWire encoder-decoder that is synthesizable for FPGA targets.

Further the FPGA-board contains the so-called image SRAM memory (HXSR01632 or HXSR01208) where the accumulation of the spectra, coming from the detector, is performed. The accumulation is done in words of 20 bits. There is an 8 or 32-bit (TBC) wide data bus between FPGA and imaging memory, an address bus and three control lines.

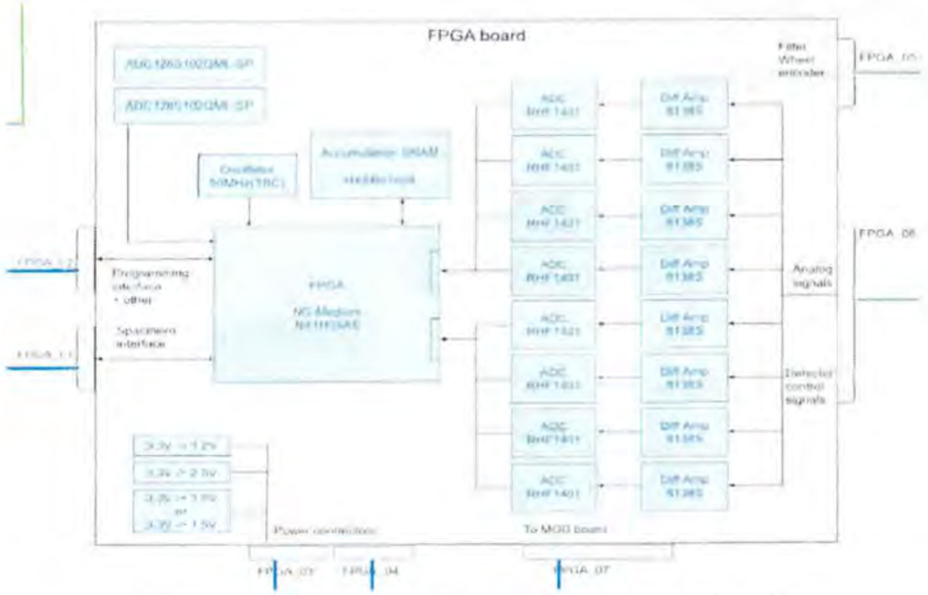


Figure 5: General schematic diagram of the FPGA board

The FPGA-board also contains several Analog-to-Digital convertors for the detector data (science data) (ST Microelectronics RFH1401 – 14bits) and the housekeeping data (Texas Instruments ADC128S102-SP – 12bits).

All control signals (in and out) of the detector are passed to the detector proximity board via an LVDS interface (Cobham AES UT54LVDS031 and UT54LVDS032). The analog data signals from the two detector channels are transported differentially to the ADCs in the CCC module. To scale the levels of the analog signals to the correct input levels of the acquisition ADCs, high speed OPAMPs (Renesas Electronics ISL70244SEH TBC) are used.

The signals coming from the 16 (TBC) housekeeping elements in the instrument are also adapted to the input of the housekeeping ADC's using the same OPAMPs (Renesas Electronics ISL70244SEH).

The interface to the MOD motor driver board is an LVDS interface. Following signals will pass over this link:

- towards FET driver bridges for cryocooler motor and FWM stepper motor;
- SPI-signals for the housekeeping;
- actuation signals for the operational heater and shutter.

1.2 Motor Driver Board (MOD)

The MOD- board has four functions:

- driving the filter wheel motor;

- driving the cryocooler compressor;
- driving the operational heaters;
- actuating the shutter mechanism.

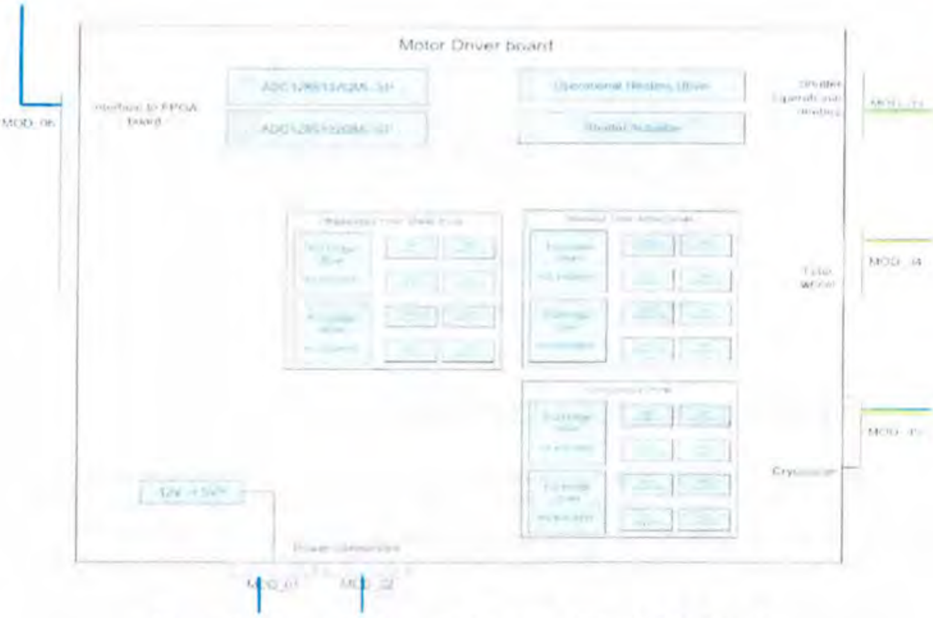


Figure 6: General schematic diagram of the MOD board

The MOD board contains a driver for the cryocooler motor. TBD

The MOD board also contains the electronics for firing the shutter. TBD

The MOD board also contains two full bridge drivers (Renesas Electronics HS-4080AEH), each of them driving four switching N-channel power MOSFETs (Infineon IRHNJ67130), are used to control the filter wheel motor. Each phase of the motor is fed by a Pulse Width Modulated (PWM) signal generated in the FPGA.

There will be two housekeeping ADCs (Texas Instruments ADC128S102) combined with scaling OPAMPs (TBD device) on the MOD board.

1.3 Detector Proximity board (DEP)

The analog-to-digital science data chain (top) works as follows:

- transformation of the 8 unipolar analog output signals of the detector to differential signals (including buffering and level adaptation) and transmission of the analog signals in a differential amplifier (8138S) (DEP-board).
- reception of the analog signals and preparation of the analog signals for the Analog-to-Digital conversion (including buffering and level adaptation) in a differential amplifier (8138S) (FPGA-board);
- Analog-to-Digital conversion (RHF1401) (FPGA-board).

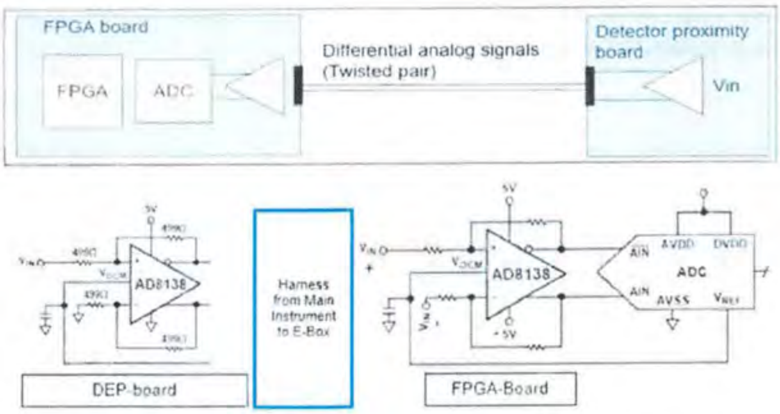


Figure 7: General schematic diagram of the DEP board

2 LABORATORY MEASUREMENTS

Experimental spectra used for data reconstruction and testing of electronic components will be recorded by the high resolution Fourier transform Bruker IFS 125HR spectrometer equipped with a White cell with an optical path of up to 100 m. The present configuration is equipped with a series of InSb, MCT, Si and Bolometric detectors and allows measurements in the region from 2 cm−1 to 35 000 cm−1 with a resolution of 0.002 cm−1. The spectrometer is shown in Figure 8. The spectra are analyzed with a library spectra, which is a python/Fortran library designed to fit high-resolution line absorption cross- sections to data and calculate the corresponding number densities. The library accounts for temperature and pressure broadening as well as various apodization functions. For species where line absorption cross-sections are not available, independent calibration using pure gases will be used. For better imagination, spectral features observed on Venus are summarized and depicted in Figure 9 together with a summary of VenSpec-H operation ranges in Table 1. Sample data so far recorded in our laboratory are depicted in Figure 10.

Figure 8: Our Bruker IFS 125 HR spectrometer.

Simulation of the testing Data Packs

Our software tool allows us to fit a sample of spectra quickly with a certain set of parameters. The Python algorithm that performs the necessary operations is used in open-source repositories. This code can be integrated into a simple bash-script that allows to get the necessary metadata in a convenient form for sorting and filtering, which can be produced independently of the Bruker OPUS software or other software formats. The software is fully operational and the spectral data are under continual implementation to the software database.

Vertical profiles of the atmospheric species

For the project, we will also use a wide range of data evaluation software packages. The vertical profiles of VenSpec-H target molecules can be predicted theoretically by simulation of Venus atmosphere chemistry. We are equipped with ARGO 1D Lagrangian photochemistry/thermochemistry atmospheric chemistry model, that takes a prescribed temperature, pressure, eddy diffusion coefficient, high resolution (1 Angstrom), UV radiation stellar spectrum, and a comprehensive chemical network, STAND, valid between 300 K and 6000 K incorporating H/C/N/O ion and neutral chemistry including hydrocarbons and amines, including the amino acid glycine. The numerical core is written in FORTRAN77, using the DLSODE solver for the chemistry, with a Python wrapper that keeps track of the timescales at which the parcel exists at a particular temperature and pressure, and then changes the temperature and pressure. Molecular diffusion is approximated using 'banking' reactions. This model can be applied to planetary atmospheres from hot Jupiter's and hot Super Earths, to Earth, Venus, and is reasonably accurate for Jupiter.

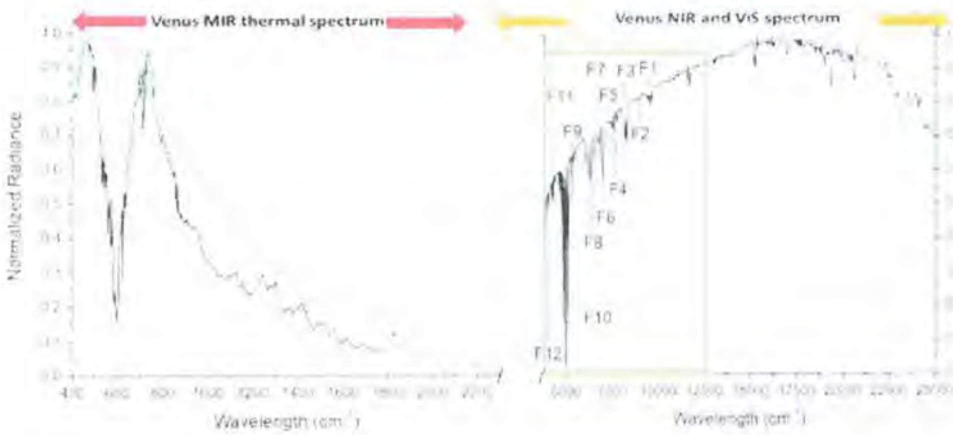


Figure 9: Low resolution Venus spectrum compiled by our team from the data recorded by probes Venera 15, 16, Akatsuki, and spectral simulations. The green rectangle stands for VenSpec spectral range, while F1 – F12 indicate the most apparent spectral features mainly assigned to CO2.

Software for Spectra Evaluation and Simulation.

Our software tool allows us to fit a sample of spectra quickly with a certain set of parameters. The Python algorithm that performs the necessary operations is used in open-source repositories. This code can be integrated into a simple bash-script that allows to get the necessary metadata in a convenient form for sorting and filtering, which can be produced independently of the Bruker OPUS software or other software formats. The software is fully operational and the spectral data are under continual implementation to the software database.

Simulation of the Venus Spectra Datapack

We intend to simulate the spectral data using the radiative transfer code TauREx3 (56). For the chemistry, we will use thermochemical equilibrium using ggchem or fastchem or the output from ARGO. We will consider the contributions from Collision Induced Absorption and Rayleigh Scattering. We will first estimate the transmission spectrum at the instrumental resolution and then convolve this with the VenSpec-H instrument response.

Artificial Neural Network Suite. We will also employ artificial neural networks for spectra and data flow simulation. Our software package utilizes a nonlinear regression method for determining physical parameters of the system such as plasma, electron number density in plasma, atomic and molecular abundances, where both matrix and analyte components of the specimen are taken into account at once. ANNs are used for their ability to simplify the phenomena by processing highly nonlinear correlated data. We apply ANN for functional prediction, modeling, and estimation of physical factors that are not well described from first principles or are highly complex, with incomplete knowledge regarding the whole system and imprecise input data. This might be especially interesting for Venus spectroscopy and simulation of Venus spectra under different conditions. Most of the data analysis are performed using MATLAB. Particularly, a neural network toolbox is utilized for ANN calculations. Spectral line selection, particle number density fitting, and spectra are automated by in-house programmed scripts covered by PYTHON modules NUMPY and SCIPY.

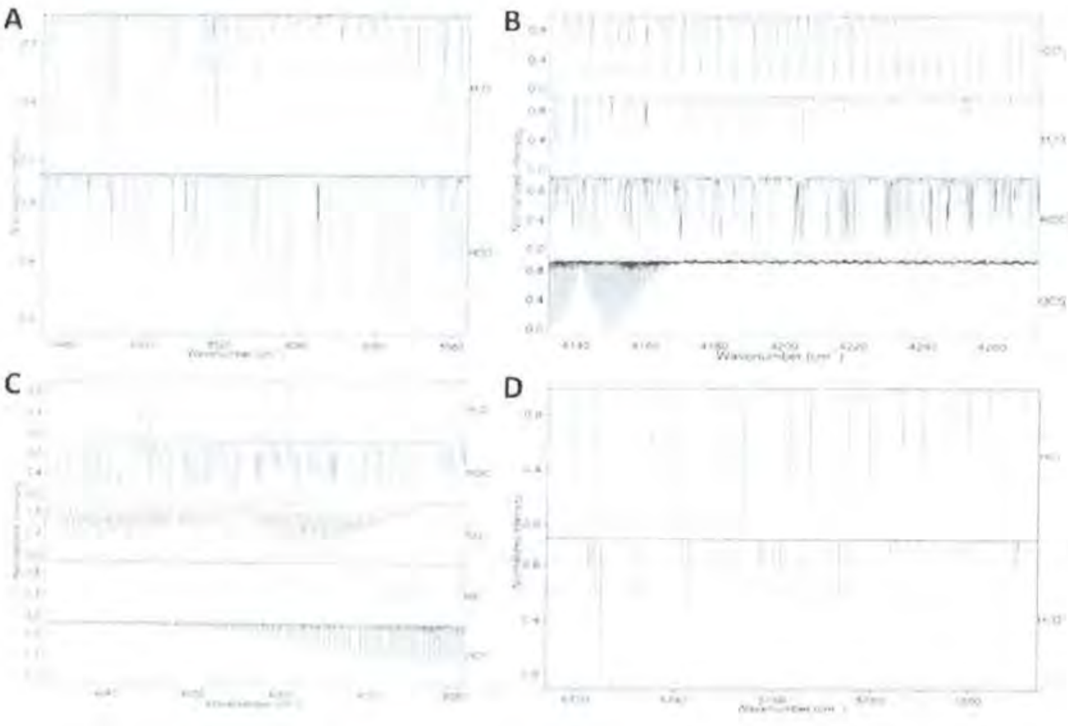


Figure 10: Selected spectra of VenSpec-H target molecules recorded in our laboratory in its operation spectral bands (see Table 1). Panel A shows the range of Band#1, Panel B the range of Band#2a, Panel C the range of Band#2b, and Panel D the range of Band#3.

HARDWARE (SOFTWARE) MATURITY

All the software and hardware is accessible in our laboratories and we are ready for the project solution on the level of laboratory usage of the all the technologies (TRL4). For the Venus DataPack simulation, the production of the relevant data has to reach the TRL6, which is only a question of the science segment collaboration with the industry and the development of theoretical know-how and computation in the direction of the data pack completion and validation. Therefore, our requests on material are limited. The composition of the gas phase will be monitored using our Fourier transform high resolution Bruker IFS 125HR spectrometer (Bruker Optics, Germany) equipped with a KBr beam splitter and a nitrogen cooled MCT, InSb detectors and Si Photodiode covering the spectral range 650 to 15 000 cm−1, including the range of EnVision operation. Spectra can be recorded with a resolution up to 0.002 cm−1 (measurements are typically made with 0.01 cm−1 resolution). To enhance the detection limit of the instrument, the a multipass cell with an optical beam length of up to 30 m is connected to the spectrometer. Concentrations will be determined using the Spectr library which is based around fitting spectral lines using HITRAN line intensities, and if necessary, also by an independent calibration using pure gases. Experimental data will be analyzed using a chemical kinetic numerical model implemented in the Python 2.6.4 programming language equipped with modules Numpy and Scipy. A set of ordinary differential equations constructed according to the postulated reaction scheme is numerically solved by the Scipy module using the ODEPACK library. Atmospheric models In order to explore theoretically chemistry of planetary atmospheres, we are equipped with ARGO Lagrangian photochemistry/cosmic-ray atmospheric chemistry model, that takes a prescribed temperature and high resolution (1˚Angstrom) UV field estimated for the 1 Gyr old sun, and a comprehensive chemical network, STAND, valid between 300K and 30000K incorporating H/C/N/O ion and neutral chemistry including complex hydrocarbons and amines, including the amino acid glycine. The numerical model is written in FORTRAN77, using the DLSODE solver for the chemistry, with a Python wrapper that keeps track of the time-scales at which the parcel exists at a particular temperature and pressure, and then changes the temperature and pressure. Molecular diffusion is approximated using 'banking' reactions. This model can be applied to planetary atmospheres from hot Jupiters and hot Super Earths, to Earth, and is even reasonably accurate for Jupiter. Thermo-chemical equilibrium models with the GGchem-code.72 written in modern FORTRAN-90, can be run on both desktop and high-performance super-computers. For a proper coupling, an implementation in the atmosphere and planet evolution codes can be considered, which has been done before, for example for the ARCiS software to compute and retrieve atmospheric structures for exoplanets. High level calculations will be performed by our group upon remote access to the cluster located at Czech Academy of Sciences, Biophysical Institute in Brno, equipped for a wide range of MD and QM applications: (i) 768 2.4 GHz E5-2630v3 Xeon cores (48 nodes) with 3.1 TB of DDR3 memory; (ii) 320 2.6 GHz E5- 2640v3 Xeon CPU cores (20 nodes), each with 64 GB of RAM; (iii) 25 clients having more than 160 000 GPU cores and 320 GB of DDR5 memory; (iv) Cluster for memory-demanding jobs with AMD opteron 6328 CPUs with 1TB of DDR3 memory (one node) and with 512 GB of DDR3 memory (one node); (v) 12 nodes each having 48 AMD Opteron 6238 2.6 GHz CPU cores; (vi) 72 nodes with different architectures with 960 Xeon cores and 3.5 TB of DDR3 memory; (vii) 250 TB disk arrays. All leading quantum chemical software (such as Gaussian, Turbomole, Molpro) are directly available.

Research and technical development and its work-logic

In the scope of this contract, these conceptual designs will be discussed and assessed in detail to provide feedback and possible changes to them and to prepare the project for future phases. This was in some kind already done with BIRA in terms of preparation of this proposal and should continue.

As can be seen in the WBS and WPD, the whole Bridging Phase contract is focused on derisking the future phases and preparing for them.

The preliminary design of FPGA and PROC boards is a crucial step in the development. The first step in the preliminary design of FPGA and PROC boards is to identify the key requirements for the system. This includes the performance criteria, such as the processing speed, memory, and power consumption. It also involves the identification of the interfaces, including the communication protocol and physical connections, required for interfacing with other components in the system. This will be done by discussing the requirements from BIRA, as already mentioned above and also all other input documentation that will be provided to the industrial team. Part of this process is also opponency of the decisions made, especially in the circumstances where a different solution may lead to derisking on schedule, complexity, budget or any other. The manufacturability assessment and testing philosophy will be suggested by the industrial team as well. Based on these three (requirements, manufacturability and test philosophy) and once again with derisking in mind, the preliminary design will be suggested.

The preliminary design of the FPGA and PROC boards will involve the development of a schematic diagram that includes all the components, interfaces, and connections required for the system. This will be followed by the development of a layout design that specifies the physical placement of the components and connections on the board. The layout design will take into account factors such as signal integrity, power distribution, and heat dissipation.

During the preliminary design phase, the design team will also need to ensure that the system meets the necessary safety and reliability requirements. This will involve the identification of potential failure modes and the development of appropriate mitigation strategies.

The full designing process will be done in constant communication with BIRA, reviewing and discussing the best way forward as well as staying aware of the paths that have been already rejected before our participation in the project. This should lead to combination of detailed knowledge of the instrument that BIRA has and years of experience in electrical engineering and electronics design held by our experts.

After the design will be consolidated, the next step is to purchase the commercial EEE components required for the FPGA and PROC board prototypes. This will involve identifying suitable suppliers, obtaining quotes, and selecting the components that meet the necessary specifications and quality standards. A preliminary Bill Of Materials (BOM) has been prepared already and it is used as a way to provide the pricing for this proposal. The BOM was prepared based on these assumptions:

- There were used preliminary design concept descriptions and block diagrams provided by BIRA (as presented above) to identify all critical EEE components they plan to use.
- As critical were assumed all integrated circuits (e.g. microcontroller, communication drivers) and active components (e.g. transistors, operational amplifiers, oscillators). Passive components (resistors, capacitors, etc.) were not present at the preliminary design concept and were not understood as critical components.
- For each component where it is possible there was found a commercial grade alternative. This is not possible/available for the FPGA, but we can use screening level Prototype.
- Based on the same design data there was estimated a quantity of each component necessary for the design of each type of board (FPGA and PROC).

- This quantity was multiplied by the expected number of prototypes to be assembled. We assumed 1x 1st run and 3x 2nd run of each type.
- No attrition rules were applied for these reasons:
  - In the case of faulty/destroyed component in the 1st run, there can be used a component procured for the 2nd run and there should be enough time to buy additional one;
  - In the case of faulty/destroyed component in the 2nd run we have additional 2 spare assembled boards.
  - There is planned to use a socket for the FPGA, so it can be re-used among the runs, boards and project phases.
- Prices and minimum ordering quantities for common components (e.g. FET) were found at well known distributors (Farnell, Digi-Key).
- Prices for the FPGA (NanoXplore NX1H35AS) were provided by the distributor EBV (for screening levels Prototype and Flight).

The next step is to assemble the FPGA and PROC board prototypes. This will involve the physical assembly of the components on the board and the testing of the board to ensure that it meets the necessary performance and interface requirements. We expect two iterations (1st run and 2nd run) to reach the required level of functionality.

Once the FPGA and PROC board prototypes have been assembled and tested, the design team will need to embed the FPGA and processor code in the prototype boards. The firmware is provided by BIRA in this case, and the design team will need to ensure that the code is correctly embedded in the board and interfaces with other components in the system.

The next step is to realize stand-alone testing of the FPGA and PROC board prototypes with embedded FPGA/processor code using BIRA EGSE. This will involve a thorough testing of the board to ensure that it meets the necessary performance and interface requirements and is safe and reliable.

The design team will assist with integrated testing of the FPGA and PROC board prototypes with DEP and MOD prototype boards from BIRA. This will involve the integration of the different components in the system and a comprehensive testing to ensure that the system meets the necessary performance and safety requirements.

As a final step of the bridging phase there will be procured LLI EEE components for all EM and EFM boards (FPGA, PROC, MOD, DEP).

The BOM was prepared based on these assumptions:

- There were used preliminary design concept descriptions and block diagrams provided by BIRA (as presented above) to identify all critical EEE components they plan to use.
- As critical were assumed all integrated circuits (e.g. microcontroller, communication drivers) and active components (e.g. transistors, operational amplifiers, oscillators). Passive components (resistors, capacitors, etc.) were not present at the preliminary design concept and were not understood as critical components.
- For each flight component where it is possible there was found an engineering grade alternative.
- Based on the same design data there was estimated a quantity of each component necessary for the design of each type of board (FPGA, PROC, MOD and DEP).

- This quantity was multiplied by the expected number of boards to be assembled. We assumed one complete set for EM and PROC+FPGA for EFM. It is possible that the FPGA board will not be necessary for the EFM.
- Overall attrition rules were not applied for these reasons:
  - To reduce the costs at this early phase of the project.
  - Potential reuse of FPGA from prototypes in case of socket usage.
  - Attrition rules may be applied only for selected LLI components which may have a big influence on the project schedule in case of a component failure/destruction during assembly or tests.
- Prices and minimum ordering quantities were provided by well known space components distributors (Alter, Avnet, Kamaka).
- Prices for the FPGA (NanoXplore NX1H35AS) were provided by the distributor EBV (for screening levels Prototype and Flight).

Table 1: Preliminary BOM table

[illegible]	[illegible]
FPGA	2 EM, for EFM TBC
PROC	2 EM + EFM
MOD	1 EM only
DEP	1 EM only

Type	Component	Vendor	Supplier	FPGA	PROC	MOD	DEP	Total	Attrition (No attrition)	MOQ	To buy	Price per piece EUR	Total price
Differential amplifier	RHF200	ST	Alter	0	0	0	2	2	2	5	5	488,00 €	2 440,00 €
LVDS driver	UT54LVDS031	CAES/Cobham	Alter	2	3	0	1	9	9	1	9	820,00 €	7 380,00 €
LVDS receiver	UT54LVDS032	CAES/Cobham	Alter	2	2	0	1	11	11	1	11	830,00 €	9 130,00 €
Full bridge driver	HS-4080AEH	Renesas/Intersil	Avnet	0	0	3	0	3	3	1	3	550,00 €	1 650,00 €
FET	[illegible]	Infineon/International rectifier	Kamaka	0	0	14	0	14	14	10	14	180,00 €	2 520,00 €
FPGA	NX1H35AS	NanoXplore	EBV	1	0	0	0	2	2	1	2	5 900,00 €	11 800,00 €
SRAM	HXSR01632	Honeywell	Alter	1	0	0	0	2	2	1	2	770,00 €	1 540,00 €
ADC	RHF1401	ST	Alter	8	0	0	0	16	16	5	16	2 400,00 €	38 400,00 €
ADC	ADC128S102_SP	Texas instruments	Alter	16	2	2	0	38	38	6	38	1 100,00 €	41 800,00 €
MCU	SAMRH71	Microchip	Alter	0	1	0	0	2	2	1	2	3 732,00 €	7 464,00 €
Opamp	[illegible]	Renesas	Alter	24	2	2	0	54	54	1	54	160,00 €	8 640,00 €
MRAM	UT8MR2M8-40	Cobham Colorado Springs	TBD	0	2	0	0	4	4	1	4	350,00 €	1 400,00 €
Oscillator 20MHz	[illegible]	Vectron	TBD	0	1	0	0	2	2	1	2	600,00 €	1 200,00 €
Oscillator 50MHz	TBD	Vectron	TBD	1	1	0	0	4	4	1	4	800,00 €	3 200,00 €
Reserve	Overall 6,5%			0	0	0	0	0	0	0	0		9 162,88 €
													150 000,00 €

DEVELOPMENT APPROACH

The activities of the Science segment involve management and coordination, but also preparation of the testing data packs. For this specific activity, we will create a data library for the testing of manufactured hardware performance. The instruments as well as software already exist. The activities therefore involve summary and preparation of the data packages. Composition of the data sets for testing the electronic components will be performed by measurement of high quality spectra with emphasis on data quality (high resolution data, fit using our Spectr software, data simulation using vertical profiles of target species calculated by ARGO model and spectra computation by TauREx planetary spectra simulation software). The software and hardware description is provided in the corresponding sections of the proposal. By this approach, we are able to rigorously test performance of the components on the data packs with specific data quality, size and flow, provide assessment of effectivity of the built electronic set up in corresponding spectral range and resolution for data processing of spectra recorded in all applicable spectral ranges by VenSpec-H channels. Based on the testing, we will supply all these data to the consortium and provide feedback for electronic manufacturers. The data set is critical for a correct testing and validation of the electronic components and we do not expect any trade-off.

RISKS

The project team adopts multiple active steps to reduce the probability or impact of negative risks. Communication between the scientific and engineering side, review of the technical design and results as well as results of testing data pack preparation is among the most important factors in successful project management. The major factor is the detailed project schedule and strong combination of the technical segment with the Czech scientific board focused skilled in space mission leadership (the Czech CubeSat SLAVIA, space telescope Ariel, Czech Lunar mission LUGO, etc.) experimental and theoretical spectroscopy, radar data evaluation, planetary chemistry, evolution and planetology, kinetic and mechanistic computations. Each key researcher has also a reasonable deputy within the existing team or in the group. This regards mainly the management and coordination part, however, also preparation of the data packages and technological part of the project. Spectral calculations can be provided by several team members as well as neural network utilization, data pack preparation and other spectral and chemical calculations in collaboration with our partners. The computer cluster for calculations is also accessible at our institute. We do not depend on external providers or external data. We have established very close international collaboration with the EnVision team as well as abroad documented by our publication activity. Risks related to hiring employees are also well mitigated, because the project is submitted by a stable, well established team and all the participants are known in advance. The expertise of each member can be substituted by the others. The technological know-how is already well established and the future gain of the project is very high. The risks will be also mitigated by regular coordination meetings, the project management, high expertise of the team and availability of the top-class instrumentation and know-how.

The main risks and their mitigation strategies regarding the specific technical development provided by our institute can be summarized as follows:

Risk: There is a risk that the requirements provided by BIRA may be incomplete, conflicting, or difficult to implement within the project's budget and schedule constraints. This could cause delays, cost overruns, or compromise the instrument's performance.

Mitigation: Thoroughly analyze and assess the requirements provided by BIRA to identify any potential issues or gaps in the information.

Engage in open and transparent communication with BIRA to discuss any concerns or issues with the requirements and work collaboratively to find solutions. Conduct a feasibility analysis to determine whether the requirements can be implemented within the project's budget and schedule constraints, and if not, identify alternative options or propose changes to the requirements.

Finalize the requirements for the following phases only after they have been thoroughly reviewed, analyzed, and agreed upon by all stakeholders to ensure they are complete, accurate, and feasible.

Risk: Risks associated with creating a test philosophy include: incorrect identification of necessary tests, lack of clarity on responsibilities, insufficient availability of test platforms or tools, and delays caused by incomplete test software or firmware.

Mitigation: To mitigate these risks, it is recommended to involve all stakeholders in the identification of necessary tests, clearly define roles and responsibilities, ensure availability of necessary test platforms and tools, and prioritize early delivery of required test software and firmware. Additionally, regular review and updating of the test philosophy throughout the project can help identify and address any emerging risks.

Risk: The preliminary design may not fully meet the necessary requirements and specifications, leading to delays and additional design iterations.

Mitigation: To mitigate this risk, the design team will carefully review and discuss the design with BIRA and seek input from other professionals in the field. It may also be beneficial to build in flexibility into the design to allow for future modifications and updates.

Risk: Potential failure modes may be overlooked or not adequately addressed during the preliminary design phase, leading to safety and reliability issues.

Mitigation: To mitigate this risk, the design team will review and analyze the system to identify potential failure modes and develop appropriate mitigation strategies. Seeking input from safety and reliability experts in the field can also be beneficial.

2. PROJECT ORGANISATION AND INTERFACES

WORK LOGIC

The present development is performed in the frame of the PRODEX programme. In accordance with the PRODEX rules, the Institute (IASB-BIRA) and its personnel will participate on the execution of the work within the Phase B1 including the acceptance process of the deliverables under the contract. Reference is made to the relevant provisions of the contract. IASB-BIRA will act as the interface point between the contractor and the VenSpec-H consortium. Support is available from the hardware and software designers throughout the contract.

Our aim is to employ our hardware and software laboratory facilities for all the activities indicated in the objectives of the project, mainly the development and testing of the electronic boards indicated hereby within the Phase B1. The activities will also consist of measurement of EnVision targeting molecules for data pack reconstruction by simulation of Venus spectral measurement. The spectrometric system in our laboratory will be used to control the quality of the electronic design for processing the spectral data in the operation ranges of the VenSpec-H instrument.

The Czech team will be led by Dr. Martin Ferus, head of the Department of Spectroscopy of the J. Heyrovský Institute of Physical Chemistry. Dr. Ferus is co-PI for the VenSpec-H instrument and will serve as the PI of the Czech project and as the main representative of the Czech team in the EnVision consortium. The main task of Dr. Ferus will be the management of the project, communication with the EnVision Consortium and leadership of the Czech team. The second co-PI from the Czech side is Dr. Petr Brož, who will be responsible for scientific issues and working on the spectral library for the consortium. The technological and scientific control including the calibration/validation processes will be carried out by Dr. Veronika Strnadová. The part of development and manufacturing of the electronic boards will be fulfilled by the engineering team of the Department of Spectroscopy of the J. Heyrovský Institute.

Phase B1 is currently ongoing. It started mid-June 2021 and will end with the Mission Adoption Review that will be conducted by ESA from Sep 2023 until February 2024. This phase will contain tasks related to the knowledge transfer of the design from BIRA to the Contractor for the 4 boards and for the harnessing.

Phase B2 shall commence in July 2024 with a Kick-off Meeting and shall end in Dec 2025 with the successful completion of the iPDR. During this phase the Contractor shall support the design and prototyping of the boards, building further on phase B1 preliminary design and prototypes.

Phase C will commence upon authorization to proceed from the Agency (Dec 2025) and shall end (Sep 2027) with the successful completion of the iCDR. During this phase the Contractor shall support the production of the boards for the EM and EFM models and the relevant harnesses. This phase will also contain tasks related to the transition of BIRA's preliminary design of the DEP and MOD boards into a (space qualified) detailed design and the final design of the overall instrument harnessing. Because of schedule constraints, the LLI procurement of components and PCBs for all QM/FM boards will be initiated in phase C.

Phase D will commence upon authorization to proceed from the Agency (December 2027). In this phase, all QM and FM boards and the flight harnesses shall be further manufactured, assembled, integrated and tested. Furthermore, the Contractor shall supervise and follow up the environmental tests. Phase D shall end with the successful completion of the FM Delivery Review Board /Acceptance Review (DRB/AR), completion of remedial actions with respect to any non-compliances, and the formal acceptance of the deliverables and the related documentation by the Agency (Feb 2031). Figure 11 gives an overview of the work logic of the following Phases.

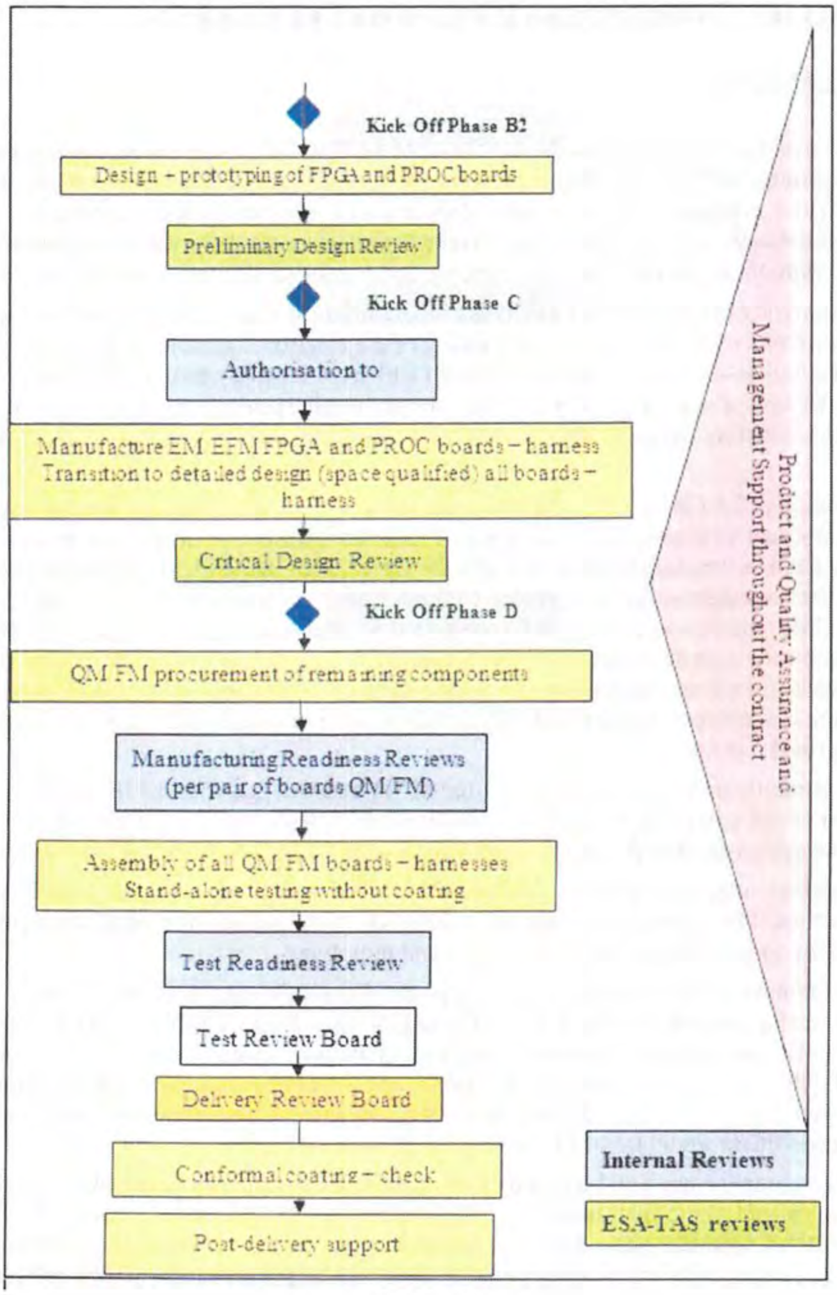


Figure 11: Work Logic

2.1. Contact information

Investigator title and full name: RNDr. Martin Ferus, Ph.D.

Institute/University: J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.

Department: Department of Spectroscopy.

Address: Dolejškova 2155/3, 182 23, Prague, Czech Republic.

Phone, e-mail : +420266053204, martin.ferus@jh-inst.cas.cz.

Head of Institute / Department endorsing the Project (name, function, e-mail): prof. Hof Martin Dr. rer. nat., DSc, director@jh-inst.cas.cz / Department of Spectroscopy, the applicant is head of the department

Co-investigator 1 title and full name: Mgr. Petr Brož, Ph.D.

Institute/University: Institute of Geophysics, Czech Academy of Sciences, v.v.i.

Department: Geodynamics

Address: Boční II/1401, Prague 4, Czech Republic.

Phone, e-mail : +420267103063, petr.broz@ig.cas.cz

Head of Institute / Department endorsing the Project (name, function, e-mail): RNDr. Aleš Špičák CSc., director of the institute, als@ig.cas.cz

Co-investigator 2 title and full name: Mgr. Veronika Strnadová, PhD.

Institute/University: Czech Geological Survey

Department: Department of Remote Sensing.

Address: Klarov 3, 118 21, Prague, Czech Republic.

Phone, e-mail : +420606547908, veronika.strnadova@geology.cz.

Head of Institute / Department endorsing the Project (name, function, e-mail): Mgr. Zdenek Venera, PhD., Head of the institute, zdenek.venera@geology.cz

2.2. Team members role in the Project

RNDr. Martin Ferus, Ph.D. graduated from Charles University in Prague in the field of physical chemistry in 2012. His research is focused mainly on applied high resolution molecular and atomic spectroscopy in high energy chemistry, physics and astrochemistry. His work in this field was awarded by Otto Wichterle Award (2016), Josef Hlávka Foundation Award (2015), Award of the Czech Learned Society (2016), Czech Science Foundation President's Award (2020) and Werner von Siemens Award (2021). Martin Ferus was also nominated by the Czech National Committee as a Czech delegate in the International Astronomical Union. He is the Czech Co-PI of the Ariel space telescope mission. He published over 80 scientific papers and received 1426 citations, H–index (WOS): 21. MF will coordinate the management part of the project as the main representative of the Czech consortium in EnVision, he will also coordinate electronic testing and the data package preparation.

Mgr. Petr Brož, PhD. graduated at the Faculty of Science of the Charles University in Prague in the field of martian small-scale volcanism in 2015. His research focuses on kilometer-sized volcanoes formed by explosive and effusive activity caused by magma degassing and water/magma interactions on the surface of Mars or by sedimentary volcanism. His research is based on the analysis of the remote sensing data from the morphological and morphometrical point of view as well as on analogue and numerical modelling. Brož was awarded for his work by the Josef Hlávka Foundation Award (2017), and by the Otto Wichterle Award (2018). Brož was also nominated by the Czech National Committee as a Czech delegate in the International Astronomical Union. He published 16 scientific papers (on 12 of them as a first author) and received 434 citations (March, 2023). Brož will be responsible for scientific issues and working on spectral libraries for the consortium.

Mgr. Veronika Strnadová PhD. has obtained her Bc., MSc. and PhD. degrees at the Charles University in Prague. In 2013 she received the Dean's award for the best dissertation. In 2015 and 2016, she was a visiting scientist at the Helmholtz Zentrum (GFZ), Potsdam. In 2018 she was appointed as an Earth Observation mentor for the ESA/NASA summer program - FDL Europe 2018. From 2016 to 2020 she was representing the EuroGeoSurveys (EGS) for Earth Observation and GEO activities. Although optical remote sensing is her main expertise, she is also familiar with remote sensing using thermal region and active remote sensing systems (e.g. Radar technologies). During her career she has been developing new geoscience multi-sensor applications combining optical, thermal and radar data sets. She published over 40 scientific papers and received over 600 citations, H–index (WOS): 17. She will be responsible for technological and scientific control including calibration and validation and coordination of the work packages.

Ing. Růžena Ferusová Živorová will provide the administrative management and economy of the project, control the fulfilment of contract. She will also provide administrative interface for the Czech Republic towards the Consortium and will oversee the correct handling with available resources including proper recording and invoicing.

Ing. Jaroslav Weiter is electronic hardware designer for industrial, medical and railroad applications. He studied VUT Brno, Faculty of electrical engineering and communication technology and started his career with development of a radio for air traffic control. Later on, he was involved in electronic design for safety related applications, design of the SIL and related applications, electronic design for Medical applications (Neurostimulation device, light therapy device) and he was responsible for for EMC and environmental testing and quality management. He was involved in top level design of Satellite sequencer for Arianne launcher. He will be responsible for construction works.

Ing. Lukáš Seget is an experienced space electronics engineer who worked e.g. on development of Ariane electronic boards. He studied University of Defense in Brno – specialization Automated systems for command and control forces Embedded software for safety related applications and later on experienced top level design of safety related application, he was esponsible for documentation and communication with certification authorities for safety related application (TUV, DIBt) and space applications. He will be responsible for project management of space related applications.

Ing. Michael Sidó is an experienced space electronics engineer who worked on Laser Demonstrator for TRL Space as well as on TROLL mission for the same company. Before that, Tomas worked as FPGA developer for ERA Aero and Tescan Brno. Tomas has more than 6 year of experience in PCB Design, circutry architecture and development of electronics systems. Tomas has experience with testing, analysis, and implementation of new technologies into the existing systems as well as analysis of substitute components for electronics design. He will be responsible for manufacturing of electronic components and PA/QA.

3. PROJECT TERM COVERED BY THE PRODEX EXPERIMENT ARRANGEMENT

The project starts on 2nd Januray, 2024 and will end on 31st October, 2024 (total duration of 10 months). The project will then continue with new application towards phase B.

4. APPLICABLE (AD) AND REFERENCE (RD) DOCUMENTS

4.1. Applicable Documents

The following documents are applicable to the Contract.

[AD1]	ENVIS-VS-VEH-PL-0006	VenSpec-H Project Management Plan (latest version)
[AD2]	ENVIS-VS-VEH-PL-0011	VenSpec-H Product Assurance Plan (latest version)
[AD3]	ENVIS-VS-VEH-PL-0010	VenSpec-H Cleanliness and Contamination Plan (latest version)
[AD4]	ENVIS-VS-VEH-IF-0001	VenSpec-H EID-B (latest version)
[AD5]	ENVIS-VS-VEH-IF-0006	VenSpec-H sub-PSU EICD (latest version)
[AD6]	to be issued by DLR	VenSpec-H Central CCU EICD (latest version)

4.2. Reference Documents

The following documents can be used as a reference to the Contract.

[RD1]	ENVIS-VS-VEH-DD-0002	VenSpec-H Design Definition File (latest version)
[RD2]	ENVIS-VS-VEH-DD-0005	VenSpec-H Design Justification File (latest version)
[RD3]		PRODEX User Guide, European Space Agency, version 7, May 2011. http://sci.esa.int/prodex

5. WORK BREAKDOWN STRUCTURE (WBS)

This section details the Work Breakdown Structure and work package descriptions assigned to the Czech Republic team by the VenSpec-H Consortium Principal Investigator institute (IASB-BIRA). Detailed description of the work is shown in each work package. The work structure (including schedule) is correct at the time of release. Future evolutions of the consortium, such as new partners, delays in other countries or transfer of responsibilities are not applicable to this version of the document and are subject to update when applicable. The responsibility of each partner in the VenSpec-H consortium was distributed according to the skills and experience of the participating institutes.

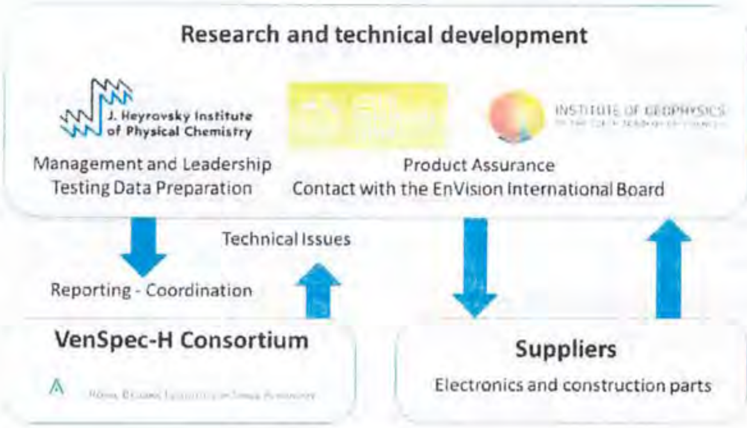
The VenSpec-H consortium PI institute (IASB-BIRA) specifies the overall name and purpose of each work package. The Czech team specifies the exact content and schedule of each work package in agreement with the consortium PI institute. The detailed description of each work package, including roles, is specified in the following section. The proposed work package content is presented to the EnVision Payload Management team so that all work is made in accordance with the overall restrictions, requirements, and schedule of the VenSpec-H instrument, and the EnVision project and mission.

The Contractor shall execute the work as defined and authorized in the present document. No work should be started that is not clearly authorized by the VenSpec-H PI institute and the Agency. The next section lists the work packages by project phase (B1, B2, C and D) and gives a concise description of the work, together with expected inputs and outputs.

The activities, research and technical development will be provided by our institute. Based on our experience with technical development of space technologies (mainly within ARIEL space telescope, CubeSat SLAVIA, hyperspectral system FREYA, mass spectrometric device LILA, etc.) we have identified several industrial suppliers for the electronic and optical parts:

- ESC Aerospace specialized in electronic development and design
- TOPTEC specialized in development of optics
- SAWtronics, specializing in electronics design
- G. L. Electronics, responsible for manufacturing of electronics
- Brno University of Technology, creating testing EGSE
- BrnoLogic as FPGA consultant (cluster membership of this company is under discussion right now)

The consortium and activity structure can be summarized as follows:



6. WORK PACKAGES

The following task descriptions provide a basis for the requested program of work.

The VenSpec-H project's phase B1 has already started mid-2021. The work of this contract shall be kicked off as soon as possible during the running phase B1. The phase B1 work shall end with the successful completion of the MAR (Mission Adoption Review).

The work packages are described below together with the time plan of the specific activities provided in the "Schedule" section.

The major task reflected by the WP below can be summarized as follows:

1. National management of the project, coordination of Co-PI activities including also representing the Czech side in the consortium and popularization of the mission on the national level. These activities are reflected in WP1.
2. Contact with the consortium, meeting arrangements, interface of the EnVision consortium with the manufacturer. These activities are reflected in WP1 and WP2.
3. Supervision and evaluation of the technical quality of the manufactured hardware and software involved in WP2.
4. Supervision over technical performance of manufactured compoments, coordination of scientific criteria fulfilment, the component compatibility and functionality within the whole range of parameters defined by the consortium as well as assessed on the national level. These activities are reflected in WP3.
5. Development and manufacturing of part of the VenSpec-H electronics
   - Prototype EGSE Design
   - Components for FPGA and PROC Boards
   - LLI EEE components for EM and EFM
   - Manufacturing of FPGA and PROC prototypes
   - Services for FPGA and GLE consultancy a development
6. Delivering of hardware:
   - PROC prototype board and associated harness
   - FPGA prototype board and associated harness
   - LLI EEE parts for all EM and EFM boards

Work Package number:	WP1
Work Package Title:	Czech Team Management and Leadership
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Martin Ferus, Veronika Kopáčková, Petr Brož
Project phases:	runs over phase B1, B2, C and D
Work Package Start and End dates:	2023-2024
Number of Full-Time Equivalent (FTE) for the Work Package:	1.0

Objectives: Czech Team Management and Leadership

Inputs:

Description of work:

- Provide management leadership for the Czech team including technical management and product assurance
- Provide management and communication interface for the subcontractors and the industrial team
- Increase the visibility of the project to scientific community and public
- Primary interface to the EnVision Consortium Steering committee
- Management of the Czech team
- Overseeing and taking part on system engineering and communication of technical topics to BIRA

Deliverables:

- Reports
- Publications
- Coordination meetings
- Documentation updates as necessary

Work Package number:	WP2
Work Package Title:	Product Assurance for Czech activities
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Veronika Kopáčková
Project phases:	runs over phase B1, B2, C and D
Work Package Start and End dates:	2023-2024
Number of Full-Time Equivalent (FTE) for the Work Package:	1.4
Objectives: Assurance of technical activities, risk analysis and manufacturing documentation.	
Inputs: **Description of work:** • Provide assurance for equipment manufactured in the Czech Republic. Ensure Czech tasks are performed according to the correct procedures • Assure correct handling of the manufactured components • Properly document the manufacturing, testing and sample handling procedure and maintain the documents for further use by the consortium.	
Deliverables: • Reports • Coordination meetings • Documentation updates as necessary	

Work Package number:	WP3
Work Package Title:	Preliminary dataset preparation
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Martin Ferus
Project phases:	runs over phase B1, B2, C and D
Work Package Start and End dates:	2023-2024
Number of Full-Time Equivalent (FTE) for the Work Package:	0.6
Objectives: Testing the electronics performance and fulfilment of the mission and science criteria	
Inputs: **Description of work:** • Initial preparation of all the necessary physical parameters using spectral library assembled as starting data pack for the simulations. • Spectral dataset for electronics testing and conditions: different observation geometries, atmospheric species profiles and observation regimes, simulation of synthetic mixtures of spectral libraries.	
Deliverables: • Preliminary data pack (spectral library and test spectra). • Reports • Publications • Documentation updates as necessary	

Work Package number:	WP4
Work Package Title:	Requirements discussion and finalization
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Antonín Knížek
Project phases:	B1 Bridging Phase
Work Package Start and End dates:	01/01/2024 30/04/2024
Number of Full-Time Equivalent (FTE) for the Work Package:	1 FTE (in the duration of 4 months)
Objectives: Discuss the requirements provided by BIRA and finalize them	
Inputs: • BIRA Project documentation **Description of work:** • Perform analysis and assessment of the requirements provided by BIRA • Discuss requirements that may be cause risk on budget, schedule, or other • Finalize requirements for following phases **Excluded tasks:** • none	
Deliverables: • D0 - Requirements table **Non-deliverables:** • none	

Work Package number:	WP5
Work Package Title:	Manufacturability and assembly methods
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Petr Kubelík
Project phases:	B1 Bridging Phase
Work Package Start and End dates:	01/01/2024 31/03/2024
Number of Full-Time Equivalent (FTE) for the Work Package:	1 FTE (in the duration of 3 months)

Objectives: Asses manufacturability and assembly methods

Inputs:

- BIRA Project documentation

Description of work:

- Perform manufacturability analysis and manufacturing risk assessment
- Determine whether some specific project requirements (e.g. planetary protection) may lead to significant changes in the usual manufacturing
- Oversee the analysis of the adequacy between the model philosophy (e.g. need for a void board, breadboard, harness, ...) and the specific manufacturing/mechanical constraints of the instrument;
- Oversee the approach for programming of components (memories).

Excluded tasks:

- none

Deliverables:

- D1 - Technical note: Manufacturability
- D2 - Technical note: Risk mitigation recommendations

Non-deliverables:

- none

Work Package number:	WP6
Work Package Title:	Test Philosophy
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Antonín Knížek
Project phases:	B1 Bridging Phase
Work Package Start and End dates:	01/01/2024 28/02/2024
Number of Full-Time Equivalent (FTE) for the Work Package:	3 FTE (in the duration of 2 months)
Objectives: Create test philosophy for boards and harnesses	

Inputs:

- BIRA Project documentation

Description of work:

- Create the test philosophy describing for each board and each harness:
  - which tests have to be performed;
  - who will perform these tests;
  - where these tests will be performed;
  - on which platform these tests will be performed;
  - what test tools have to be manufactured (e.g. harness);
  - what test tools have to be procured (e.g. non standard oscilloscope);
  - what test software/firmware needs to be embedded (to be delivered by BIRA).

Excluded tasks:

- none

Deliverables:

- D3 - Test philosophy

Non-deliverables: none

Work Package number:	WP7
Work Package Title:	Preliminary design, prototyping and testing of FPGA and PROC boards
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	David Černý
Project phases:	B1 Bridging Phase
Work Package Start and End dates:	01/03/2024 31/10/2024
Number of Full-Time Equivalent (FTE) for the Work Package:	1,5 FTE (in the duration of 8 months)

Objectives: Prepare preliminary design of PROC and FPGA boards

Inputs:

- FPGA and PROC boards functional description including interfaces with CCU, sub-PSU, DEP and MOD units (BIRA)

Description of work:

- Provide a design feasibility analysis from technical and also time schedule points of view. If applicable, recommend organizational change for risk mitigation;
- Perform preliminary design of FPGA and PROC boards;
- Consolidate of FPGA and PROC boards preliminary design with BIRA;
- Purchase commercial EEE components for FPGA and PROC board prototypes;
- Assemble FPGA and PROC board prototypes;
- Provide embedding of FPGA and processor code (firmware is CFI from BIRA) in prototype FPGA and PROC boards;
- Realize stand-alone testing of FPGA and PROC board prototypes with embedded FPGA/processor code (using BIRA EGSE);
- Assist with integrated testing of FPGA and PROC board prototypes with DEP and MOD prototype boards from BIRA.

Excluded tasks:

- none

Deliverables:

- D2 - Technical note: Risk mitigation recommendations
- D4 - Technical note: Preliminary design of FPGA board
- D5 - Technical note: Preliminary design of PROC board
- D6 - Component list: EEE components for PROC and FPGA board
- HW: PROC prototype board and associated harness
- HW: FPGA prototype board and associated harness

Non-deliverables:

- none

Work Package number:	WP8
Work Package Title:	LLI EEE components procurement for all EM and EFM boards
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Antonín Knížek
Project phases:	B1 Bridging Phase
Work Package Start and End dates:	01/6/2024 30/06/2024
Number of Full-Time Equivalent (FTE) for the Work Package:	1 FTE (in the duration of 5 months)

Objectives: Procure LLI EEE components

Inputs:

- preliminary design of FPGA and PROC boards and harnesses (Contractor)
- preliminary design of DEP and MOD boards (BIRA)
- EEE components list for FPGA and PROC boards (Contractor) and for DEP and MOD boards (BIRA)

Description of work:

- Provide availability analysis of the LLI EEE components and replacement identification and proposal to BIRA;
- Purchase long lead item EEE parts (commercial EM grade) for the EM and EFM boards (including attrition);

Excluded tasks:

- none

Deliverables:

- HW: LLI EEE parts for all EM and EFM boards

Non-deliverables:

- none

3 DELIVERABLES:

3.1 Documents to be delivered:

D0 - Requirements table: This document will contain a detailed table of all the requirements for the boards, including the performance criteria, interfaces, and other key specifications. It will serve as the primary reference for the industrial team during the design and development process.

D1 - Technical note: Manufacturability: This document will provide a technical analysis of the manufacturing process for the boards, including an assessment of any potential manufacturing challenges and recommendations for improving the manufacturability of the boards.

D2 - Technical note: Risk mitigation recommendations: This document will provide an analysis of the potential risks associated with the design and development of the boards, along with recommendations for mitigating these risks. It will serve as a guide for the industrial team to ensure that potential risks are identified and addressed during the development process.

D3 - Test philosophy: This document will outline the testing philosophy for the boards, including the types of tests that will be conducted, the testing equipment and methodologies that will be used, and the testing schedule. It will serve as a guide for the industrial team to ensure that the boards are thoroughly tested and meet all performance requirements.

D4 - Technical note: Preliminary design of FPGA board: This document will provide a detailed technical description of the preliminary design for the FPGA board, including the board architecture, component selection, and circuit schematics. It will serve as the primary reference for the industrial team during the design and development process.

D5 - Technical note: Preliminary design of PROC board: This document will provide a detailed technical description of the preliminary design for the PROC board, including the board architecture, component selection, and circuit schematics. It will serve as the primary reference for the industrial team during the design and development process.

D6 - Component list: EEE components for all EM and EFM boards: This document will provide a comprehensive list of all the electrical, electronic, and electromechanical (EEE) components required for the FPGA and PROC boards, including part numbers, suppliers, and quantities. It will serve as the primary reference for the industrial team during the procurement process.

3.2 Hardware to be delivered:

PROC prototype board and associated harness

FPGA prototype board and associated harness

LLI EEE parts for all EM and EFM boards

7. STANDARD MANAGEMENT REQUIREMENTS

7.1. Conditions for Employment

All personnel allocated to the Project shall be employed by the Contractor (Institute/University signatory of the Contract).

7.2. Communications

All communications to the Agency shall be addressed to the Agency's representatives identified in the Cover Letter.

Communications on technical and programmatic matters shall in addition be addressed to the entities identified here after:

N/A

7.3. Management requirements

The management requirements listed here after are the ESA "Standard requirements for management, reporting, meetings and deliverables", Annex 3 to ESA contracts, rev. 5: 2018-10. They are tailored to the present contract and retain the same numbering as in the original text.

The parameters of section 7.3 that are specific to the present contract (item 2.6: Frequency of progress reports, item 3 lit. b: Frequency of progress meetings, item 4: Deliverables) are defined in section 8.

1. MANAGEMENT

1.1. General

The Contractor shall implement effective and economical management for the Project. Its nominated Project Manager shall be responsible for the management and execution of the work to be performed and, when applicable, for the coordination and control of the team's work.

Decisions reached during the present contract having technical baseline, cost or planning consequences, shall require formal Agency approval before implementation.

1.2. Access

a) During the course of the Contract the Agency shall be afforded free access to any plan, procedure, specification or other documentation relevant to the programme of work. Areas and equipment used during the development/testing activities associated with the Contract shall also be available for inspection and audit.

b) The Contractor shall notify the Agency at least three (3) weeks before the start of any test programme, or as mutually agreed, in order to enable the Agency to select those tests that it wishes to witness. The Agency shall notify the Contractor of its visit at least one (1) week in advance.

2. REPORTING

2.1. Minutes of meeting

a) The Contractor is responsible for the preparation and distribution of minutes of meetings (see ECSS-M-ST-10C Rev. 1 section 5.2.2 for more details) held in connection with the Contract. Electronic version shall be issued and distributed to all participants, not later than ten (10) days after the meeting concerned.

b) The minutes shall clearly identify all agreements made and actions accepted at the meeting together with an update of the Action Item List (AIL) and the Document List. The minutes shall be signed.

Note: This clause may be restricted to progress meetings if specifically expressed.

2.2. Documents List

The Contractor shall create and maintain a Document List, recording all the documents produced during the work, including reports, specifications, plans and minutes. The list shall indicate the document reference (with unique identifier), type of document, date of issue, status (draft or approved by the Agency), confidentiality level and distribution. This list shall be maintained under configuration control.

2.3. Action Item List (AIL)

The Contractor shall maintain an Action Item List (AIL, see ECSS-M-ST-10C rev. 1, section 5.2.2.1 for more details), recording all actions agreed with the Agency. Each item shall be uniquely identified with reference to the minutes of the meeting at which the action was agreed and will record generation date, due date, originator and the person instructed to take action. The AIL shall be reviewed at each progress meeting.

2.4. Bar-Chart Schedule

a) The Contractor shall be responsible for maintaining the bar-chart for work carried out under the Contract, as agreed with the Agency.
b) The Contractor shall present an up-to-date chart for review at all consequent meetings, indicating the current status of the Contract activity (WP's completed, documents delivered, etc.).
c) Modifications of the schedule shall be contractually binding only if approved in writing by the Agency's representative for contractual and administrative matters.

2.5. Risk Register

a) The Contractor shall be responsible for maintaining a risk register, agreed at the kick-off meeting. This register shall identify potential risks, their likelihood and severity, and propose meaningful mitigation measures (one can refer to ECSS-M-ST-80C for more details).
b) The Contractor shall present an up-to-date risk register in its progress reports for review at progress meetings.

2.6. Progress Reports

Every 5 moths (see section 8.2.1 - Documentation), the Contractor shall provide a Progress Report to the Agency's representatives, covering the activities carried out under the Contract (on can refer to ECSS-M-ST-10C Rev.1 section 5.2.2.2 for more details). This report shall refer to the current activities shown on the latest issued bar-chart and shall include the following topics:

.1 action items completed during the reporting period

.2 a status report on all long lead or critical delivery items

.3 a description of the progress of the work: actual progress vs. planned schedule, milestones and events accomplished

.4 reasons for slippages and/or problem areas, if any, and corrective actions planned and/or taken, with revised completion date per task

.5 events anticipated during the next reporting period (e.g. milestones reached)

.6 expected date for major schedule items

.7 milestone payment status

.8 status of the risks.

2.7. Fixed assets N/A

2.8. Problem Notification

The Contractor shall notify the Agency's representatives (Technical Officer and Contracts Officer) of any problem likely to have a major effect on the time schedule of the work or to significantly impact the scope of the work to be performed (due to e.g. procurement problems, unavailability of facilities or resources, etc.).

2.9. Technical Documentation

a) As they become available and not later than the dates in the delivery plan, the Contractor shall submit, for the Agency's approval, technical notes, engineering drawings, manufacturing plans, test plans, test procedures, specifications and Task/WP reports.
b) Technical documentation to be discussed at a meeting with the Agency shall be submitted two (2) weeks prior to the meeting.
c) Technical documents from Subcontractors shall be submitted to the Agency only after review and acceptance by the Contractor and shall be passed to the Agency via the Contractor's formal interface to the Agency.
d) Tests carried out under the Contract shall be performed according to test plans and test procedures approved by the Agency's Technical Officer (see ECSS-E—ST-10-02C and ECSS-Q-20C Rev.1 for more details).

3. MEETINGS

a) N/A
b) Progress Meetings shall be held every … (see section 8.1 - Frequency of Progress meetings), either by teleconference or in person if deemed necessary by the Agency.
c) N/A
d) Additional meetings may be requested either by the Agency or by the Contractor.
e) The Contractor shall give to the Agency prior notice of any meetings with Third Party(ies) to be held in connection with the Contract. The Agency reserves the right of participation in such meetings.
f) With due notice to the Contractor, the Agency reserves the right to invite Third Parties to meetings, in order to facilitate information exchange.
g) For all meetings with the Agency, the Contractor shall ensure that proper notice is given at least two (2) weeks in advance. For all other meetings, the Contractor shall inform the Agency, which reserves the right to participate. The Contractor is responsible for ensuring the participation of its personnel and those of the Subcontractor(s), as needed.

h) For each meeting, the Contractor shall propose an agenda in electronic form and shall compile and distribute hand-outs of any presentation given at the meeting.

4. DELIVERABLES

4.1. Documentation

The Contractor shall submit to the Agency the documentation listed here below, for Agency review and, where required, approval. Documentation shall be submitted as per the milestones listed here below.

Documentation deliverables are listed in section 8.2.1 - Documentation. The following provisions apply:

a) All documentation deliverables (including all their constituent parts) shall also be delivered in electronic form in a format agreed by the Agency (searchable PDF format and the native format, and in other exchange formats, to be agreed with the Agency, where relevant, e.g. in case of CAD, drawings, models, databases).
b) All the documentation shall be delivered on computer readable media, as agreed with the Agency.
c) The draft version of the documentation shall be sent to the Technical Officer in electronic format not later than two (2) weeks before the documentation is to be presented. The final version shall be provided in a number of copies specified in the Statement of Work.
d) All documents shall bear the appropriate copyright notice. In all cases, this shall include the title, ESA Contract number, deliverable number, date, status (draft), version and/or revision number. This information shall be repeated consistently in the header or footer of every page.

4.1.1. N/A

4.1.2. Technical Data package:

The Technical Data Package consists of the final versions of all approved technical documents, delivered during the execution of the Project (See section 4.1).

4.1.3. Summary Report

For each (design and development) Contract, one Summary Report shall be produced. It shall summarise the findings of the Contract concisely and, informatively. The Summary Report shall be approximately twenty (20) pages or six thousand (6000) words and shall be self-standing, i.e. it shall not rely on references to other documents to be understood. This document shall not contain confidential information as it is releasable to the public.

4.1.4. to 4.1.8. N/A

4.2. Hardware

Hardware (including test equipment and control electronics) built or purchased under the Contract, together with an Operation Manual, shall be a deliverable item after completion of the associated activities at the Contractor's premises, unless otherwise agreed in writing by the Agency.
The Contractor will deliver the following hardware listed here after as part of the Project:
The hardware elements to be delivered as part of the present project are listed under section 8.2.2 - Hardware

4.3. Computer Programs and Models

Computer programmes, mathematical models of any type (e.g. closed-form, worksheets, XML, CAD/CAE) and HDL models developed or procured under the Contract shall be a deliverable, unless the Agency agrees otherwise in writing. Re-used or proprietary software embedded in the deliverable product and required for its correct functioning shall also be deliverable.

The Contractor will deliver the following Computer Programs or Models as part of the Project.
The computer programmes, mathematical models, or other software elements to be delivered as part of the present project are listed under section 8.2.3 - Computer Programs and Models.

Ownership of Hardware and Software deliverables:

As a rule, the Agency, acting on behalf of the participating States, shall be the owner of the hardware and software identified under the Contract and its CN, and accepted by the Agency, for a period of 5 years following their respective delivery.

4.4 Project Web Page: N/A

5. Commercial evaluation: N/A

End of "Standard requirements for management, reporting, meetings and deliverables". Sequential Numbering resumed.

8. PARAMETERS OF SECTION 7.3 "MANAGEMENT REQUIREMENTS"

8.1. Frequency of Progress meetings

Refers to section 7.3, point 3 lit. b): Progress Meetings shall be held every months, either by teleconference or in person if deemed necessary by the Agency.

The provisions of section 7.3 "Management requirements" apply.

8.2. Deliverables

8.2.1. Documentation

Refers to section 7.3, point 2.6 (Progress reports) and point 4.1 (Documentation): The documentation listed hereafter is a deliverable of the present Contract. The provisions of section 7.3 "Management requirements" apply.

Table 2: Deliverable Documentation

	Milestone (delivery event/date)	
Management Documentation		
Progress report	1.6.2024	31.10.2024

8.2.2. Hardware

Section 7.3, point 4.2 (Hardware): The Hardware elements listed hereafter are a deliverable of the present Contract. The provisions of section 7.3 "Management requirements" apply.

HW-1: PROC prototype board and associated harness, 31.10.2024
HW-2: FPGA prototype board and associated harness, 31.10.2024
HW-3: LLI EEE parts for all EM and EFM boards, 31.10.2024

8.2.3. Computer Programs and Models

8.2.4. Operational Software and Open Source Code Software

8.2.4.1. Operational Software

- There is no production of Operational Software on the sense of GCC Clauses 39 and 42 hence 39.2 a) c) d) & 42 are Not Applicable to the present activity.

8.2.4.2. Open Source Code Software

- There is no production of Open Source Code Software on the sense of GCC Clauses 39 and 42 hence 39.2 a) c) d) & 42 are Not Applicable to the present activity.

9. INTERFACES

The Contractor acknowledges that changes to the ICDs (IRDs) or more generally to any document listed under the "Applicable Documents" section may be proposed upon the initiative of each Interface Responsible (i.e. the party responsible of each side of the interface). Interface changes shall be processed and change requests raised when necessary, as per the Product Assurance requirements applicable to the Project.

Approval of changes to the Applicable Documents (including changes to IRDs or ICDs):

Although PRODEX approves the contractual documentation, PRODEX will request a visa from the higher-level Interface Responsible(s) before approving any Change Requests to the ICDs or to other Applicable Documents to the Contract.

10. AVAILABILITY OF DOCUMENTATION FOR FUTURE PHASES

The Contractor acknowledges that documentation not labelled "confidential", deliverable to the Agency in the frame of the Project, may be used by the Agency for instance in preparation of future Invitation To Tenders or for any other Agency activity.

11. SCHEDULE

The WP1 will start immediately in 2023 and we will continue in management and leadership activities of the Czech EnVision consortium. We have to keep communication with the subcontractors and continue in extending visibility of the project. On of the planned results are EnVision web pages in Czech and popularisation article about the mission (the team has already released one article in Czech, see https://vesmir.cz/cz/casopis/archiv-casopisu/2021/cislo-11/sklenikove-peklo-venusi-sance-zivot.html). We will continuously provide interface with the EnVision committees and control interface with the subcontractors. Also, we will coordinate and manage the whole Czech team activities. We will also organize coordination meetings and provide reports on Czech activities. The WP2 focused on coordination and assistance on technical activities will also be performed immediately after the initiation of the project. We will provide risk analysis and assurance of manufacturing of parts for the mission. We will also take part in determining parameters and fulfil the mission criteria. The manufacturing and testing will be documented for the consortium. WP3 will be initiated immediately in 2023 in order to start preparation of the testing datasets. This is crucial input for the testing and verification of the science performance of the manufactured components and the assessment, if they fulfil the scientific and mission criteria and objectives. As can be seen from the Gantt Chart below, the proposed schedule is consisting of two major parts - pre and post Requierements Review. This it to be able to freeze the requirements and use them for further development of the preliminary design of the FPGA and PROC boards. As for the meetings, next to the Kick-Off meeting, Requirements and Final Review, a monthly progress meeting will be held to update on the progress. Weekly meetings will be held on technical level to communicate with BIRA. The WP4 will be focused on requirement definition and will start immediately and will be finished during end of April. WP5 and WP6 will involve finding solutions for manufacturing and assembly methods and tailoring the test philosophy respectively. They have to start at the beginning of the project and will be finished during end of April and March. The following-up phases will lead to delivery of hardware: FPGA and PROC boards within WP7 and LLI EEE components within WP8.

WP:	2024									
	1	2	3	4	5	6	7	8	9	10
WP1	Czech Team Management and Leadership				Czech Team Management and Leadership					Report PROC prototype FPGA prototype board LLI EEE parts
			Web Pages	Pupularization paper and lecture		Project progress report	Pupularization paper	Coordination Meeting		
					Coordination Meeting					
WP2	Product Assurance for Czech activities									
WP3	Testing data set preparation									
								Preliminary data pack		
WP4	Requirements discussion and finalization									
WP5	Manufacturability and assembly methods									
WP6	Test Philosophy									
WP7			Preliminary design, prototyping and testing of FPGA and PROC boards							
WP8					LLI EEE components procurement for all EM and EFM boards					

12. INVOICING

The Contractor will be asked to submit invoices when the corresponding costs are accrued and the following conditions are met.

- The last invoice of the year will be paid only when the deliverables planned for that year - as defined in section 8.2 here above, or in a Change Notice (CN) signed by both parties (Contractor and ESA) - have been accepted by ESA.
- The final invoice will be paid upon acceptance by ESA of all the deliverables of the activity - as defined in section 8.2 here above, or in a Change Notice (CN) signed by both parties (Contractor and ESA) - have been accepted by ESA.

13. PROJECT CHECK POINTS

Project progress and deliverables will be checked according to Table 3.

Table 2: Check points for deliverables readiness.

Check-Point number	Planned date	Description
1	1.6.2024	Project progress checkpoint.
2	31.10.2024	Project final checkpoint

14. EXPORT CONTROL

N/A.

15. BACKGROUND INTELLECTUAL PROPERTY RIGHTS

N/A

16. CUSTOMER FURNISHED ITEMS (CFIS)

N/A

17. ITEMS MADE AVAILABLE BY THE AGENCY

N/A

Appendix 2

FINANCIAL PLAN

Project Name: EnVision VenSpec-H Electronics

Institute/University and Investigator: J. Heyrovký Institute of Physical Chemistry CAS

Starting date: 02/01/2024 Ending date: 31/10/2024

Table 1: Institute Costs in Euro (J. Heyrovký Institute of Physical Chemistry CAS)

CZ Consortium	2024		
	FTE	Costs	TOTAL (Cost)
Salaries. For each personnel paid from this			
R&D Workers	4	174363	**174363**
Technicians	1	53577	**53577**
Management	1	43989	**43989**
Total Manpower	**6**	**271929**	**271929**
Travel cost *(* Exhibit A to Table 1)*	3022		3022
Cost of items directly purchased by the Institute, funded from the PEA *(** Exhibit B to Table 1)*	0		0
Miscellaneous costs *(*** Exhibit C to Table 1)*	206032		206032
Overheads (when applicable – state which categories they apply to)	Rate: 5%	Overheads: **24049**	**24049**
Grand Total	**505032**		**505032**

Note: The financial tables include the institute costs of three institutes: [1] J. Heyrovký Institute of Physical Chemistry CAS, [2] Institute of Geophysics CAS, v.v.i., and [3] Czech geological Survey, p.o.

The institute costs of each institute are given in the tables hereafter for information. Invoicing will be performed by the J. Heyrovský Institute and the J. Heyrovský Institute will reimburse the Institute of Geophysics CAS, v.v.i. and Czech geological Survey, p.o.

Table 1a: Institute Costs (J. HEYROVKÝ INSTITUTE OF PHYSICAL CHEMISTRY CAS, V.V.I.) in Euro

HIPC CAS	2024		
	FTE	Costs	TOTAL (Cost)
INSTITUTE COSTS			
Salaries. For each personnel paid from this Prodex Experiment Arrangement, state			
Martin Ferus, senior researcher, PI	0.1	3384	**3384**
Antonin Knížek, researcher	1	28198	**28198**
Tomáš Svoboda technician	1	53577	**53577**
Petr Kubelik R&D researcher	1	56396	**56396**
Anna Křivková R&D researcher	1	56396	**56396**
R?žena Ferusová Živorová, local manager	1	43989	**43989**
Total Manpower	**5.1**	**241941**	**241941**
Travel cost(* *Exhibit A to Table 1*)	2022		2022
Cost of items directly purchased by the Institute, funded from the PEA (*** Exhibit B to Table 1*)	0		0
Miscellaneous costs (**** Exhibit C to Table 1)*	206032		206032
Overheads (when applicable – state which categories they apply to)	Rate: 5%	Overheads: **22500**	**22500**
Grand Total	**472495**		**472495**

Table 1b: Institute Costs (Institute of Geophysics CAS, v.v.i.) in Euro

IG CAS	2024		
	FTE	Costs	**TOTAL (Cost)**
INSTITUTE COSTS			
Salaries. For each personnel paid from this			
Petr Brož, senior researcher	0.3	8568	**8568**
Total Manpower	**0.3**	**8568**	**8568**
Travel cost *(* Exhibit A to Table 1)*	0		0
Cost of items directly purchased by the Institute, funded from the PEA *(** Exhibit B to Table 1)*	0		0
Miscellaneous costs *(*** Exhibit C to Table 1)*	0		0
Overheads (when applicable – state which categories they apply to)	Rate: 5%	Overheads: **428**	**428**
Grand Total	**8996**		**8996**

*Table 1c: Institute Costs (*Czech geological Survey, p.o.*) in Euro*

CGS	2024		
	FTE	Costs	TOTAL (Cost)
INSTITUTE COSTS			
Salaries. For each personnel paid from this			
Veronika Strnadova, senior researcher, PI	0.1	4284	**4284**
Student/TBD, junior researcher	0.5	17136	**17136**
			0
Total Manpower	**0.6**	**21420**	**21420**
Travel cost *(* Exhibit A to Table 1)*	1000		1000
Cost of items directly purchased by the Institute, funded from the PEA *(** Exhibit B to Table 1)*	0		0
Miscellaneous costs *(*** Exhibit C to Table 1)*	0		0
Overheads (when applicable – state which categories they apply to)	Rate: 5%	Overheads: **1121**	**1121**
Grand Total	**23541**		**23541**

Exhibit A to Table 4: Travel plan

Summary for all the trips proposed by the team. One traveller from J. Heyrovský Institute of Physical Chemistry CAS (PI, Martin Ferus) and one from the Institute of Geophysics CAS (Co-PI Dr. Petr Brož).

We plan in 2024 three travels to BIRA and allocate 3022 EUR for that.

Exhibit B to Table 1 - Items purchased by the Institute.

N/A

Exhibit C to Table 4 – Miscellaneous costs.

Summary for the J. Heyrovský Institute of Physical Chemistry CAS (PI, Martin Ferus).

Year	Miscellaneous Costs	Total Price (EUR)
2024	Prototype EGSE electronic components	17000
	Electronic components for FPGA and PROC Boards	24000
	LLI EEE electronic components for EM and EFM	150000
	Connection and machinery material	10000
	Chemicals for cleaning	1000
	Optical material	3000
	Small administrative equipment, data media, IT	1032
	Total	206032

Table 5: Items to be purchased via ESA on behalf of the institute (above 5 000 Euro)

N/A

GUIDELINES for the preparation of Appendix 3 (CHANGE PROCEDURE)

A PRODEX Experiment Arrangement Change Procedure shall apply at least to any modifications of the Agency's financial commitment (Articles 2 of the Arrangement) and of the Term (Article 3 of the Arrangement).

1. Introduction of a Change

For all changes, whether requested by the Agency or initiated by the Institute, the latter shall submit a proposal for a PRODEX Experiment Arrangement Change Notice (CN) on the form (Appendix 3) attached hereto. The CN shall be filled in completely, and boxes or lines which are not applicable shall be so designated by use of the letters "N/A". The form shall be signed by the Institute's authorised representative(s) and be submitted to the Agency's representative for contractual and administrative matters.

The Institute shall ensure that each change proposal is fully co-ordinated with Appendices 1 and 2 to the arrangement and that all reasonably foreseeable implications of the change have been considered. If the space on the form is not sufficient to describe the change and its consequences, the additional information shall be annexed to the form. The Institute shall, on request of the Agency, provide additional documentary evidence.

2. Approval or Rejection of the Arrangement Change Notice

Upon receipt of a CN signed by the Institute, the Agency shall consider it as regards its acceptability. Should the CN be approved, it will be signed by the ESA PRODEX Office's authorised representative and a copy be returned to the Institute. Should a CN be rejected for any reason, the Institute shall be informed accordingly, together with the reasons for the rejection.

3. Implementation and Status of Approved Arrangement Change Notices

Upon signature of a CN by both parties, the CN has immediate effect and constitutes a binding contractual agreement for which the contractual clauses of the main contract which are not modified by the approved CN, remain applicable.

Appendix 3

PRODEX EXPERIMENT ARRANGEMENT CHANGE NOTICE	
PEA: Institute: Project:	CN No:
Title of area affected	Article(s) of the Arrangement: Initiator of change:
Description of change:	
Reason for change	
Funds *in addition to / in deduction of / in replacement of* those stipulated in Article 2.1 (write "Cost Neutral" if cost neutral CN): EURO: See updated Financial Plan in annex. Total amount LoL including present CN:	
Effect on other Arrangement provisions: N/A	Commencement of Term: End of Term:
Institute	
Institute's representative(s):	Date
ESA	
PRODEX Office representative(s):	Date

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