esa

PRODEX OFFICE

Noordwijk, 30 January 2025

[redacted]
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: [redacted]
Email: [redacted]@jh-inst.cas.cz.

related to 4000147310 "Development of VenSpec-H Electronics". The ESA representative for all administrative and contractual matters is [redacted], and for all technical/scientific matters it is [redacted].

The total price of the present arrangement amounts to € 703,897. 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 period 1 November 2024 through 31 December 2029.

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,

[redacted]

Head of the PRODEX Office

Received, accepted and signed by Institute: [redacted] Place / date:

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

1. The Funds available for the present Arrangement amount to .... (see cover letter).
2. The above amount is stated to be a limit of liability in the sense defined in sections 4 and 5 of Annex II to the ESA "General Conditions", referred to in Article 4.

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:

[redacted],
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

Development of VenSpec-H Electronics

1. PROJECT DESCRIPTION

1.1. General description – Objectives of the project

The EnVision mission is designed as a Venus orbiter with a primary goal to elucidate the nature and current status of Venus's geological evolution and its interaction with the atmosphere. This mission aims to comprehend the divergent evolutionary paths of Venus and Earth. EnVision will shed light on Venus's geological history by employing a suite of complementary methodologies, including imagery, polarimetry, radiometry, and spectroscopy of the surface, alongside subsurface sounding and gravity mapping. This probe will investigate thermal, morphological, and gaseous indicators of volcanic and other geological activities. Furthermore, it will monitor the trajectory of key volatile species from their origins and deposits on the surface through the clouds to the mesosphere.

The VenSpec spectrometer suite, an integral part of this mission, consists of three independent spectrometers doing complementary science. VenSpec-H, which stands for High-Resolution Venus Spectrometer, is one of the three components of the spectrometer suite, alongside VenSpec-M (Germany) and VenSpec-U (France). VenSpec-M, led by DLR, Germany, will generate global maps of surface emissivity. VenSpec-H will measure gases in the troposphere by utilizing four near-infrared spectral transparency windows on the planet's nightside. The goal is to constrain surface mineralogy and support the development of evolutionary models. Additionally, on the dayside, VenSpec-H will track variations of gases in the mesosphere, together with VenSpec-U, to connect these changes to those in the troposphere and volcanic activities. Specifically, VenSpec-H will focus on highly detailed atmospheric measurements with the aim of quantifying the variation of CO, OCS, SO_2, H_2O, and HDO both below and above the clouds. It will characterize gas exchanges between the surface and the atmosphere and investigate potential sources such as volcanic plumes. The specific atmospheric windows targeted for nightside observation and the trace gases and their altitudinal measurement ranges are detailed as follows: (1) 1.16–1.19 μm for H2O and HDO at altitudes of 0–15 km; (2) 1.72–1.75 μm for H_2O and HCl at 15–25 km; and (3) 2.29–2.48 μm for H_2O, HDO, HF, CO, COS, and SO_2 at 30–40 km. The VenSpec-H instrument's high spectral resolution (R ~ 8000) combined with its sensitivity is expected to clearly delineate the absorption features of the targeted species. These specifications are summarized in Table 1 for further reference.

Table 1. Expected performances of VenSpec-H. The SNR values are given for an averaged value of the signal and considering that the cold section temperature is -45°C.

		Spectral range (nm)	SNR binned	Targeted molecules	Altitude range probed
DAYSIDE	Band#2a	2340-2420	175	H_2O, HDO, OCS, CO	65-80 km
	Band#2b	2450-2480	175	H_2O, HDO, OCS, SO_2, HF	65-80 km
	Band#4	1370-1390	175	H_2O, HDO	65-80 km
NIGHTSIDE	Band#1	1165-1180	84	H_2O, HDO	0-15 km
	Band#2a	2340-2420	220	H_2O, HDO, OCS, CO	30-45 km
	Band#2b	2450-2480	220	H_2O, HDO, OCS, SO_2, HF	30-45 km
	Band#3	1720-1750	122	H_2O, HCl	20-30 km

Proposed Developments

The Czech academic contribution to the VenSpec-H project represents a critical integration of experimental, theoretical, and computational expertise aimed at ensuring the instrument's success in Venusian atmospheric exploration. A primary responsibility is the creation and preparation of comprehensive datasets tailored for testing and validating the instrument's electronic components. This includes curating high-resolution experimental spectra and generating simulated data to replicate the conditions VenSpec-H will encounter. The datasets are designed to test the electronics' capability to process data accurately across the specified spectral range and resolution, ensuring robust performance in mission-critical operations.
Beyond their immediate utility for hardware testing, these datasets form a vital reference for interpreting Venusian atmospheric phenomena post-deployment. They address existing gaps in spectral databases, enhancing the mission's ability to analyze key gases and atmospheric interactions. By leveraging advanced laboratory capabilities, such as high-resolution Fourier transform spectrometers, and sophisticated modeling tools like ARGO and TauREx3, the Czech team ensures data quality and relevance. This multifaceted effort not only bolsters the instrument's calibration and validation processes but also establishes a foundational framework for the mission's scientific output, emphasizing the significance of academic input in the project's overall success

The Czech Republic's industrial contribution to the VenSpec-H instrument development during Phase B2/C/D includes the design finalization, construction, coordination, and testing of key electronics and harnesses. This entails the complete development of the PROC, FPGA, MOD, and DEP electronic boards, along with the E-Box interconnecting harnesses, harnessing inside the Optical Bench, and the harness between the E-Box and Optical Bench. These efforts build on Phase B1 risk assessments and aim to ensure the successful technical delivery of VenSpec-H.

1.2. Hardware Description

The industrial development of the electronic components will be subject of a contract for industrial partner selected in ESA´s tender action. Briefly, the VenSpec-H instrument is designed to explore Venus's atmosphere, focusing on gases indicative of volcanic activity and surface transformations. It maps the night side's near-surface atmosphere and the day side's atmosphere above the cloud deck through nadir observations. Its architecture includes a warm section, housing the main base plate and nadir observation entrance, a cooled optical bench (cold section) with core optical components like the spectrometer, and an electronic box (E-Box) containing control electronics. A band selector, integrated within the optical path, features a filter wheel with six filters for precise measurements.
The E-Box serves as the central hub for electronics, housing four primary circuit boards: the processor (PROC), field-programmable gate array (FPGA), motor drivers (MOD), and power supply unit (H-PSU). These are compactly arranged for optimal heat dissipation and electromagnetic compatibility. Additionally, a Detector Proximity (DEP) board is situated in the warm section to manage signals from the detector, ensuring high-fidelity data acquisition. The modular design allows for efficient maintenance and upgrades while ensuring robustness in space.
Temperature control is critical, with the cold section maintained at -45°C and the warm section at 0°C. A cryocooler integrated into the detector assembly ensures precise operation, contributing to the instrument's reliability in the harsh Venusian environment. This sophisticated hardware design underscores VenSpec-H's pivotal role in the EnVision mission's scientific objectives.

Data pack acquisition and testing

Data recording and preparation: Experimental spectra, crucial for data reconstruction and the testing of electronic components, are captured using the high-resolution Fourier transform Bruker IFS 125HR spectrometer. The spectra laboratory acquisition will especially focus on the operation range of EnVision VenSpec-H and SOIR. This instrument, equipped with a White cell offering an optical path length of up to 100 meters, is versatile in its detection capabilities, incorporating InSb, MCT, Si, and Bolometric detectors. It covers a spectral range from 2 cm^{-1} to 35,000 cm^{-1} with an exceptional resolution of 0.002 cm^{-1}. The configuration of the spectrometer, illustrated in Figure 1, facilitates measurements across a broad wavelength spectrum.

Analysis of these spectra is conducted using a comprehensive library, developed in Python/Fortran, that specializes in fitting high-resolution line absorption cross-sections to observed data. This enables the accurate calculation of number densities while accounting for variables such as temperature and pressure broadening and incorporating different apodization functions. In cases where line absorption cross-sections for specific species are unavailable, independent calibration with pure gases is employed to ensure accuracy.

To provide a clearer understanding, spectral features identified on Venus are outlined and presented in Figure 2, alongside a detailed summary of the operational ranges of VenSpec-H in Table 1. Additionally, examples of data already collected in our laboratory, showcasing the capability and precision of our current setup, are depicted in Figure 11. This systematic approach ensures that the electronic components under development are rigorously tested and calibrated, laying a solid foundation for their successful deployment in the VenSpec-H instrument.

Figure 1: Our Bruker IFS 125 HR spectrometer.

Simulation of the testing Data Packs

Our software tool is designed for efficient fitting of spectral samples using specified parameters. Leveraging a Python algorithm, widely accessible in open-source repositories, it streamlines the analysis process. This algorithm is capable of being incorporated into a straightforward bash script, facilitating the extraction of necessary metadata in a format that simplifies sorting and filtering tasks. This functionality is independent of the proprietary Bruker OPUS software or any other specialized software formats, offering a versatile and user-friendly alternative for data processing.

The software is currently fully operational, with spectral data being continually added to its database. This ongoing enhancement ensures that the tool remains up-to-date with the latest spectral information, thereby improving its accuracy and utility for various scientific and engineering applications. Through this integration, users can expect a seamless and efficient process for analyzing spectral data, significantly aiding in the exploration, and understanding of complex datasets.

Vertical profiles of the atmospheric species

For the project, we will leverage a comprehensive suite of data evaluation software packages to enhance our analysis capabilities. One of the key tools at our disposal is the ARGO 1D Lagrangian photochemistry/thermochemistry atmospheric chemistry model. This model is specifically designed to simulate the atmospheric chemistry of Venus, enabling the theoretical prediction of vertical profiles for molecules targeted by VenSpec-H. The ARGO model operates based on a set of prescribed atmospheric conditions, including temperature, pressure, and eddy diffusion coefficients. It utilizes a high-resolution (1 Angstrom) UV radiation stellar spectrum and a detailed chemical network, STAND, which is applicable across a wide temperature range (300 K to 6000 K). This network encompasses H/C/N/O ion and neutral chemistry, extending to hydrocarbons and amines, and notably includes the amino acid glycine. The numerical core of the ARGO model is developed in FORTRAN77 and employs the DLSODE solver to handle the chemical reactions. A Python wrapper enhances the model's functionality by monitoring the timescales at which an atmospheric parcel remains at specific temperature and pressure conditions before implementing changes to these parameters. Additionally, molecular diffusion within the model is approximated through 'banking' reactions, providing a more realistic representation of atmospheric behavior. This modeling tool is versatile enough to be applied to a broad spectrum of planetary atmospheres, from the hot Jupiters and Super Earths to planets within our solar system like Earth, Venus, and even Jupiter, where it achieves reasonable accuracy. By integrating the ARGO model into our project, we are equipped to conduct sophisticated simulations and analyses that contribute to our understanding of Venus's atmosphere and its chemical dynamics.

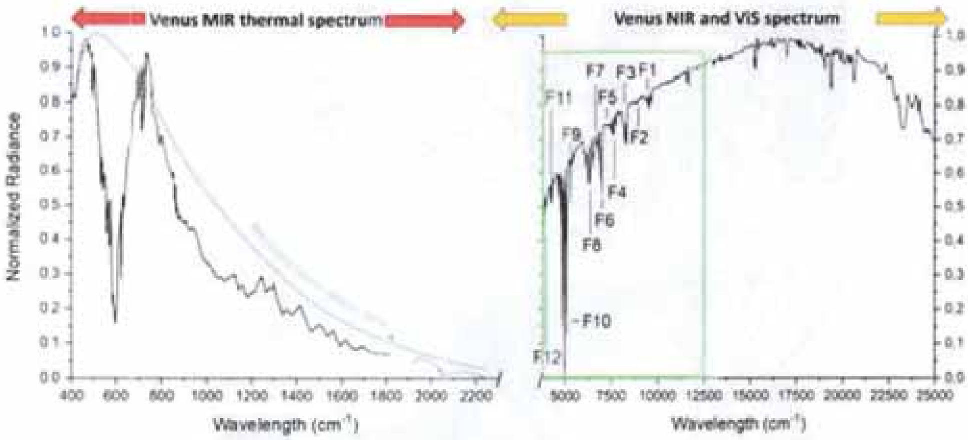

Figure 2: Low resolution Venus spectrum compiled by our team from the data recorded by probes Venera 15, 16, Akatsuki, and spectral simulations. The green rectangle stands for VenSpec spectral range, while F1 – F12 indicate the most apparent spectral features mainly assigned to CO_2.

Simulation of the Venus Spectra Datapack

To simulate spectral data, we plan to utilize the TauREx3 radiative transfer code, a sophisticated tool designed for such purposes. The chemical compositions involved in these simulations will be determined through thermochemical equilibrium, employing either GGchem, Fastchem, or outputs generated from the ARGO model. Our analysis will include factors such as Collision Induced Absorption and Rayleigh Scattering, crucial for accurate spectral modeling. Initially, we aim to calculate the transmission spectrum at the instrumental resolution, which will subsequently be convolved with the response of the VenSpec-H instrument to ensure precise compatibility.

In addition to these methods, our approach encompasses the use of artificial neural networks (ANNs) for the simulation of spectra and data flow. Our software package employs a nonlinear regression methodology for the elucidation of physical parameters within the system, including plasma characteristics, electron number density in plasma, and atomic and molecular abundances. This analysis uniquely considers both matrix and analyte components of the specimen simultaneously. ANNs are particularly favored for their proficiency in simplifying complex phenomena by processing highly nonlinear and correlated data.

We leverage ANNs for the functional prediction, modeling, and estimation of physical factors that may be challenging to derive from first principles or are characterized by high complexity. This application is notably beneficial in scenarios where the system is not fully understood, or the input data is imprecise. Such capabilities are of significant interest for the spectroscopy and simulation of Venusian spectra under varying conditions.

The majority of our data analysis tasks are conducted using MATLAB, with particular reliance on its neural network toolbox for ANN computations. The process of spectral line selection, particle number density fitting, and spectrum analysis is facilitated by custom scripts developed in-house, utilizing the PYTHON modules NUMPY and SCIPY for enhanced functionality. This comprehensive suite of tools and methodologies equips us with a robust framework for conducting detailed and accurate spectral simulations, particularly in the context of exploring Venus's atmospheric conditions.

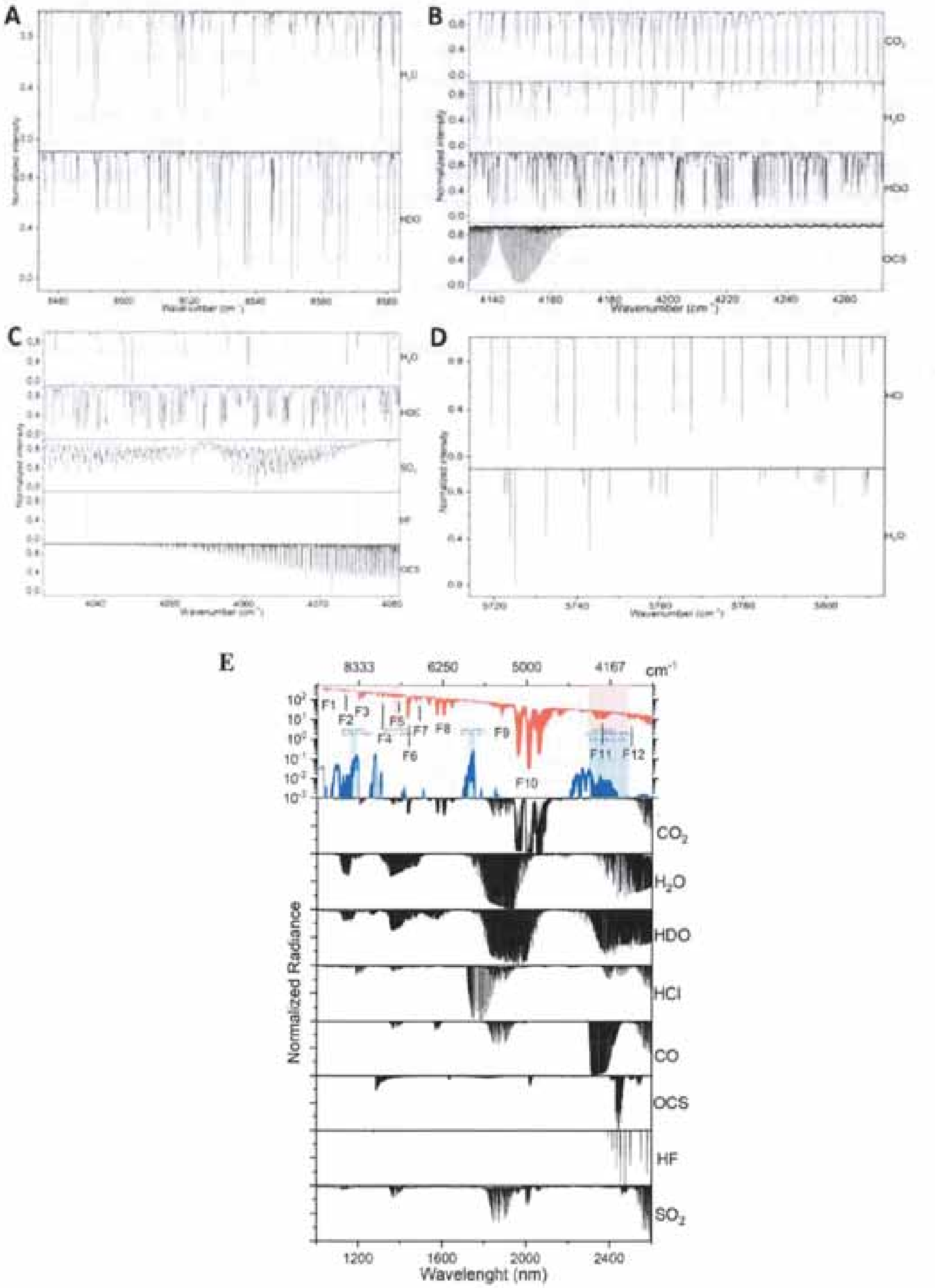

Figure 3: Selected spectra of VenSpec-H target molecules recorded in our laboratory in its operation spectral bands (see Table 1). Panel A shows the range of Band#1, Panel B the range of Band#2a, Panel C the range of Band#2b, and Panel D the range of Band#3. Panel E depicts the overview of all the molecules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

Hardware (software) maturity

Our team has access to advanced software and hardware within our laboratories, positioning us at Technology Readiness Level 4 (TRL4) for laboratory use of all technologies relevant to the project. To elevate the Venus DataPack simulation to TRL6, collaboration with the industrial sector and further development of theoretical knowledge and computational resources are required. This step is pivotal for the completion and validation of the data pack, yet our material needs remain modest due to the comprehensive facilities and tools already at our disposal.

For gas phase composition analysis, we utilize the high-resolution Bruker IFS 125HR Fourier transform spectrometer, equipped with a KBr beam splitter and detectors (MCT cooled by nitrogen, InSb, and Si Photodiode) covering the spectral range of 650 to 15,000 cm^{-1}. This range encompasses the operational spectrum of the VenSpec suite. The spectrometer can record spectra with resolutions as fine as 0.002 cm^{-1}, although measurements are typically conducted at 0.01 cm^{-1} resolution. To improve the detection limit, a multipass cell extending the optical beam path up to 30 meters is connected to the spectrometer. Concentration determinations are made using the Spectral library, which relies on fitting spectral lines with HITRAN line intensities and, if necessary, independent calibration with pure gases, as depicted in Figure 3.

Data analysis is supported by a chemical kinetic numerical model, developed in Python 2.6.4 and enhanced with Numpy and Scipy modules. This model solves a set of ordinary differential equations based on the proposed reaction scheme, utilizing the ODEPACK library within the Scipy module for numerical solutions.

To theoretically explore the chemistry of planetary atmospheres, we employ the ARGO Lagrangian photochemistry/cosmic-ray atmospheric chemistry model. This model, which accounts for a prescribed temperature and a high-resolution (1 Angstrom) UV field reflective of the sun 1 billion years ago, uses the STAND chemical network. Valid for temperatures between 300 K and 30,000 K, STAND includes a wide array of H/C/N/O ion and neutral chemistries, even complex hydrocarbons and amines like glycine. Written in FORTRAN77 and utilizing the DLSODE solver, the model features a Python wrapper for dynamic temperature and pressure adjustments, simulating molecular diffusion through 'banking' reactions. This model is applicable to a wide range of planetary atmospheres, from hot Jupiters to Earth, demonstrating reasonable accuracy even for Jupiter.

For thermo-chemical equilibrium analyses, we use the GGchem code, developed in modern FORTRAN-90, suitable for both desktop and high-performance computing environments. Integration into atmospheric and planet evolution codes, such as the ARCiS software for exoplanet atmospheric structure computation and retrieval, is feasible.

High-level calculations are performed remotely at our institutional cluster. This cluster is equipped for various molecular dynamics (MD) and quantum mechanics (QM) applications, featuring an extensive range of computing resources and leading quantum chemical software, ensuring comprehensive support for our research activities.

Development approach

The Science segment's responsibilities extend to managing and coordinating activities as well as compiling testing data packs crucial for assessing the performance of the manufactured hardware. To facilitate this, a comprehensive data library will be constructed, drawing upon both existing instruments and software. The focus of these activities will be on the compilation and preparation of data packages that are essential for the rigorous testing phase.

The creation of data sets for evaluating the electronic components will involve capturing high-quality spectra. This process emphasizes data integrity, ensuring high-resolution data that is accurately fitted using our proprietary Spectr software. Additionally, data simulation will incorporate vertical profiles of target species generated by the ARGO model, complemented by spectral computations via the TauREx planetary spectra simulation software. Detailed descriptions of the relevant software and hardware setups are outlined in the proposal's corresponding sections.

This methodological approach enables a thorough assessment of the components' performance based on data packs characterized by specific qualities, such as data resolution, size, and flow. It allows for a comprehensive evaluation of the electronic setup's effectiveness across the applicable spectral ranges and resolutions pertinent to the VenSpec-H bands' data processing capabilities.

Upon completion of the testing, the gathered data will be disseminated -within the VenSpec-H consortium, providing invaluable feedback to the electronic manufacturers. This dataset plays a pivotal role in the accurate testing and validation of the electronic components, ensuring that there are no compromises in terms of data quality and integrity. Through this meticulous process, we aim to guarantee the reliability and effectiveness of the electronic components within the scope of the project's requirements.

Risks

The project team implements a multi-faceted approach to mitigate risks and reduce the likelihood or impact of potential setbacks. Effective communication between the scientific and engineering teams, along with regular technical design reviews and the evaluation of testing data pack preparation, are crucial elements in ensuring successful project management. A detailed project schedule, coupled with a robust technical segment backed by the Czech scientific board—experienced in space mission leadership (including the Czech CubeSat SLAVIA, space telescope Ariel, and the Czech Lunar mission LUGO)—and expertise in experimental and theoretical spectroscopy, radar data evaluation, planetary chemistry, evolution, and planetology, as well as kinetic and mechanistic computations, forms the foundation of our risk mitigation strategy. Each key researcher is supported by a competent deputy, ensuring continuity and resilience across all project facets, including management, coordination, data package preparation, and technological aspects.

Our team's proficiency extends to spectral calculations, neural network applications, data pack preparation, and other spectral and chemical calculations, with robust collaboration with our partners. Access to a dedicated computer cluster at our institute further enhances our computational capabilities, ensuring independence from external providers or data sources. Our established international collaborations with the EnVision team and a strong track record of publication activity reinforce our position.

The project's stability is bolstered by a well-established, knowledgeable team, mitigating risks associated with hiring new employees. Our technological know-how and the anticipated benefits of the project significantly outweigh potential risks, which we plan to address through regular coordination meetings, effective project management, and leveraging our team's expertise along with our access to top-class instrumentation and know-how.

WP1: Data Package Preparation

The primary risks associated with WP1 revolve around the quality and compatibility of the datasets required for testing and calibration. Potential challenges include delays in generating high-resolution experimental spectra or simulated datasets and ensuring their alignment with the specifications of VenSpec-H. To mitigate these risks, the team employs advanced spectroscopic tools and computational models, such as the ARGO and TauREx codes, to streamline data generation. Regular reviews and validations ensure that the datasets meet the mission's stringent quality requirements, reducing the likelihood of inconsistencies or delays.

WP2: Experimental Spectroscopy

For WP2, risks include equipment malfunctions or calibration errors during laboratory measurements, which could compromise the accuracy of reference spectra. The team mitigates these risks by maintaining rigorous equipment calibration schedules and leveraging redundancy through access to multiple spectroscopic instruments, such as the Bruker IFS 125HR. Additionally, clear protocols for handling data variability and independent validation processes are in place to ensure robust outputs.

WP3: Spectral Simulation and Modeling

The primary risks in WP3 involve inaccuracies in simulated spectral datasets due to limitations in chemical or radiative transfer models. Another concern is the potential underestimation of Venusian atmospheric complexities, such as variable pressure or temperature conditions. To address these issues, the team employs a combination of validated models (ARGO and GGchem) and experimental cross-verification with real spectra. The use of artificial neural networks (ANNs) adds robustness to the simulation pipeline, ensuring resilience against gaps in theoretical data or unexpected spectral features.

General Mitigation Strategies

To manage interdependencies among WP1, WP2, and WP3, regular interdisciplinary meetings are held to align efforts and address potential bottlenecks. Backup plans for hardware and software resources further minimize disruptions. These strategies collectively ensure that the academic segment fulfills its objectives with minimal risk to the mission timeline and deliverables.

2. PROJECT ORGANISATION AND INTERFACES

Work logic

The development within the scope of the PRODEX program ensures that the BIRA-IASB will serve as the pivotal interface between the contractor and the VenSpec-H consortium, with ongoing support from hardware and software designers throughout the contract duration.

Our goal is to leverage our laboratory's hardware and software capabilities extensively for all project objectives. These activities will encompass the measurement of EnVision's target molecules for data pack reconstruction through Venus spectral measurement simulation. Our spectrometric system will be instrumental in verifying the electronic design's quality in handling spectral data across VenSpec-H instrument's operational ranges.

Dr. Martin Ferus of the J. Heyrovský Institute of Physical Chemistry, serving as the co-ILS for VenSpec-H and the project's PI, will continue to lead the Czech team. He will oversee project management, liaise with the EnVision Consortium, and guide the Czech team. Dr. Petr Brož, the second co-PI, will handle scientific aspects and contribute to the consortium's spectral library. Dr. Veronika Strnadová will supervise technological and scientific controls, including calibration/validation processes. The development and manufacturing of the electronic boards will be contracted upon tender, a separate legal entity, with work packages managed by Dr. Kateřina Němečková and Dr. Strnadová.

Following Phase B1, which spans from January 2024 to October 2024, the academic segment will focus on the preparation of comprehensive datasets, experimental spectra, and simulated models to support testing and validation efforts for the VenSpec-H instrument. Phase B2, beginning in November 2024 and concluding in September/October 2025 with the iPDR, will emphasize refining these datasets to align with the instrument's preliminary designs and prototypes. This phase also includes close collaboration with hardware developers to ensure data compatibility with electronic components under prototyping.

In Phase C, starting in November 2025 and concluding in May/June 2027 with the iCDR, the academic team will play a critical role in validating the outputs of the manufactured EM and EFM boards through rigorous testing using the prepared data packages. This phase will also involve updating and expanding the spectral libraries and simulations to incorporate additional atmospheric conditions and trace species, ensuring that the datasets remain relevant and comprehensive for calibration needs.

Phase D, commencing in July 2027 and concluding in April 2029 with the FM Delivery Review Board/Acceptance Review (DRB/AR), will see the academic segment focused on supporting environmental testing and final calibrations. During this phase, the academic team will provide refined simulated data and validation benchmarks to confirm the instrument's readiness for operational conditions. Any non-compliances identified during this process will be addressed collaboratively, ensuring the academic deliverables are fully aligned with the mission's final objectives.

2.1. Contact information

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Head of Institute / Department endorsing the Project (name, function, e-mail): prof. Martin Hof, 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.
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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. (1983) 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-ILS of the Ariel space telescope mission. He published over 90 scientific papers and received 1426 citations, H–index (WOS): 24. 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. (1984) 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 and selected as Member of ESA Solar System Exploration Working Group (2024-2026). He published 19scientific papers (on 14 of them as a first author) and received 568 citations (June, 2024), his H–index is 12. 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 45 scientific papers and received over 700 citations, H–index (WOS): 18 . She will be responsible for technological and scientific control including calibration and validation and coordination of the work packages.

Mgr. Kateřina Němečková, PhD. (1994) is currently a postdoctoral researcher at the Department of Spectroscopy, J. Heyrovský Institute of Physical Chemistry. She received the Charles University Faculty of Science Dean's Award for the best dissertation thesis, titled "Detecting Biomarkers of Extremophiles in Martian Analogues." Her scientific work focuses on the detection of biomarkers, primarily using spectroscopic methods. She will conduct spectral laboratory measurements, prepare experimental data, perform data analysis, and publish scientific results.

Ing. Růžena Ferusová Živorová (1984) will provide the administrative management and economy of the project, control the industrial segment. 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.

3. PROJECT TERM COVERED BY THE PRODEX EXPERIMENT ARRANGEMENT

1st of November, 2024 – 31st of December, 2029

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-iss6rev0+AER-ProjectManagmentPlan-20230330	VenSpec-H Project Management Plan
[AD2]	ENVIS-VS-VEH-PL-0027-iss2rev0+AER-PA_QA_Safety_Dependability_Plan-20230330	VenSpec-H PA/QA, Safety and Dependability Plan
[AD3]	ENVIS-VS-VEH-PL-0010-iss3rev0+AER-CleanlinessContaminationPlan-20230320	VenSpec-H Cleanliness and Contamination Plan
[AD4]	ENVIS-VS-VEH-VC-0002-iss3rev4+AER-EID-A_compliance-20240411	EnVision EID-A
[AD5]	ENVIS-VS-VEH-IF-0006-iss5rev3+AER-MechanicalElectricalInterfacesPSU-20240412	VenSpec-H H-PSU Interface Requirements document
[AD6]	ENVIS-VS-VEH-IF-0014-iss1rev2+AER-MechanicalElectricalInterfacesCCU-20240216	VenSpec-H CCU Interface Requirements document
[AD7]	ENVIS-VS-VEH-VC-0001-iss17rev4+AER-VerificationControlDocument-20240415	Verification and Control Document + Requirements + CM

[AD8]	ENVIS-VS-VEH-VC-0003-iss0rev2+AER-CCU_requirements_compliance-20240409	CCU and suite level requirements
[AD9]	ENVIS-VS-VEH-DD-0007-iss3rev3+AER-HarnessDefinition-20240319	Harness definition

4.2. Reference Documents

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

[RD1]	ENVIS-VS-VEH-DD-0002-iss8rev1+AER-DesignDefinitionFile-20240202	VenSpec-H Design Definition File
[RD2]	ENVIS-VS-VEH-DD-0005-iss2rev0+AER-PhaseB_DesignJustificationFile-20231129_released ENVIS-VS-VEH-DD-0012-iss1rev0+AER-PhaseB_DesignJustificationFile_Part2-20230609 ENVIS-VS-VEH-DD-0014-iss0rev2+AER-PhaseB_DesignJustificationFile_Part3-20240131	VenSpec-H Design Justification File
[RD3]		PRODEX User Guide, European Space Agency, version 7, May 2011. http://sci.esa.int/prodex

5. WORK BREAKDOWN STRUCTURE (WBS)

This section outlines the Work Breakdown Structure (WBS) and detailed descriptions of the work packages assigned to the Czech Republic team within the framework of the VenSpec-H Consortium, led by the Principal Investigator institute (BIRA-IASB). It provides a comprehensive account of each work package, delineating the responsibilities allocated to the Czech team based on their expertise and the collective experience of the participating institutes.

Work Package Coordination:

The work packages described in this proposal are coordinated by the Czech management team, set in place for this project. BIRA-IASB, as Instrument lead institute, and the VenSpec-H instrument Prime will follow up the Czech work.

Authorization and Execution:

The contractor is obligated to carry out the work precisely as outlined and authorized within this document. Initiating any work not expressly approved by both the VenSpec-H ILS institute and the Agency is strictly prohibited. Following this introduction, the document enumerates the work packages by project phase (B2, C, and D), providing succinct descriptions of each task along with anticipated inputs and outputs.

Contributions and Expertise:

The J. Heyrovský Institute of Physical Chemistry of the Czech Academy of Sciences (hereinafter referred to as HIPC) will lead the activities, research, and technical development efforts, leveraging extensive experience in the development of space technologies. This includes contributions to the ARIEL space telescope, the CubeSat SLAVIA, the hyperspectral system FREYA, and the mass spectrometric device LILA, among others. Several candidate industrial suppliers capable of providing the necessary electronic and optical components for the project have been identified. However, the specific partner will be selected through an open tender organized in accordance with the established practices of Prodex projects.

Czech Consortium:

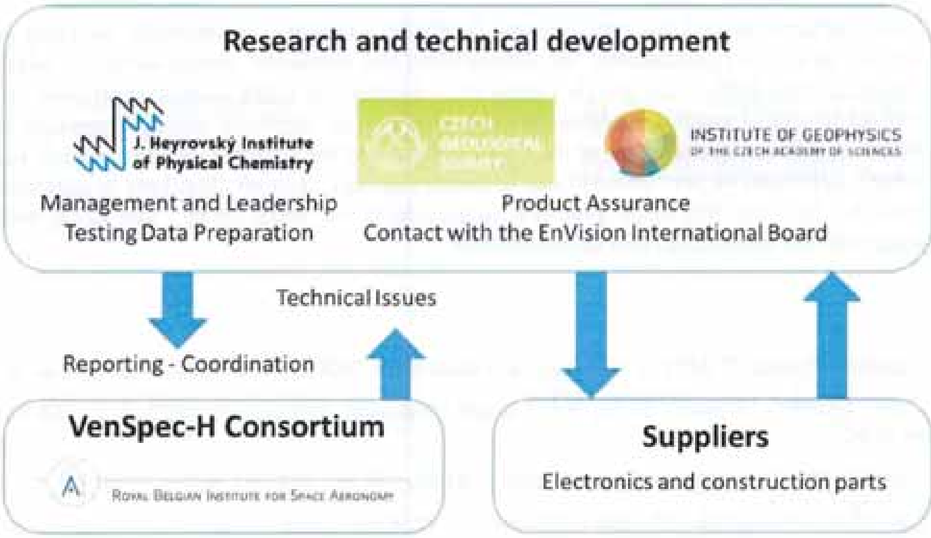
The Czech consortium consists of HIPC as the prime coordinator and contractor, the Institute of Geophysics of the Czech Academy of Sciences (hereinafter referred to as IG), and the Czech Geological Survey, s.p.o. (hereinafter referred to as CGS).

HIPC and IG are state organizational units that operate as public research institutions. Their central authority is the Czech Academy of Sciences, established by Act No. 283/1992 Coll., as amended, as the direct successor of the Czechoslovak Academy of Sciences, established by Act No. 52/1952 Coll., on the Czechoslovak Academy of Sciences.

The Czech Geological Survey (CGS) is a state-funded organization established by the Ministry of the Environment under Section 17 of Act No. 62/1988 Coll., on Geological Works, as amended.

This structured approach ensures that the Czech Republic team's contributions to the VenSpec-H Consortium are clearly defined, meticulously planned, and expertly executed, drawing on a network of experienced industrial suppliers and the team's proven track record in space technology development.

The consortium and the activity structure following also selection of the industrial partner upon a tender can be summarized as follows:



Department of Spectroscopy of the J. Heyrovsky Institute of Physical Chemistry, Czech Academy of Sciences:

The Department of Spectroscopy at the J. Heyrovsky Institute of Physical Chemistry, part of the Czech Academy of Sciences, stands as a beacon of advanced research in physical chemistry, spectroscopy, nanotechnology, electrochemistry, and chemical physics. Renowned for its cross-disciplinary research and international collaborations, the institute significantly contributes to both fundamental and applied sciences, particularly in catalysis, spectroscopy, electrochemistry, and space technologies.

Established in 1963, the Department of Spectroscopy has grown into the Czechia's leading center for spectroscopic research, bridging the gap between basic science and applied science towards industrial applications. It is at the forefront of developing cutting-edge spectral detectors, gas-phase sensors, and high-tech materials for next-generation light sources, contributing to the field with innovations in material characterization and analytical techniques. A significant part of its research is dedicated to astrochemistry and astrophysics, exploring chemical evolution in space, stellar spectroscopy, and the infrared spectroscopy of exoplanets, among other topics. The department's involvement as Czech Co-PIs in the Ariel telescope project, leading the CubeSat SLAVIA, and pioneering the hyperspectral camera FREYA and the combined LISB – mass spectrometric device LILA, underscores its pivotal role in space research.

Laboratory system for laser and hard radiation interaction experiments

- Vacuum chamber equipped with focusing optics, automatized motorized stages, context video camera and collimating optics (manufacturer Optixs, Czech Republic and Vacuum Praha, Czech Republic). All the experiments can be performed in presence of air or buffer gas (He, Ar, N_2, air) under pressure ranging from 0.02 mbar to 1 atm.
- Laser-induced breakdown spectroscopy (LIBS) is a modern, dynamically evolving analytical method of atomic emission spectroscopy for determining the elemental composition of solid, liquid, or gaseous samples. With little or no sample preparation needed, the LIBS method represents an ideal technique for remote in situ elemental analysis. We can conduct an extensive testing campaign to study the relation between different parameters of the LIBS system and the performance under high vacuum (down to 10^{-8} mbar). LIBS can be performed in our laboratory in high vacuum chambers in presence of air or buffer gas (He, Ar, N_2, CO_2, air) under pressure ranging from 10^{-8} mbar up to 1 atm using different laser sources, experimental conditions, and spectrometers.

Lasers

- Lambda Physik COMPEX 102 XeCl excimer laser (308 nm, 20 Hz, 240 mJ, 20 ns pulse)
- 2 pcs Quantel Qsmart 450 Nd:YAG lasers (available frequencies 1064, 532, 366 nm, 10 Hz, 450 mJ, 6 ns pulse)
- Lambda Physik Compex 205 ArF laser (193 nm, 50 Hz, 400 mJ, pulse 15 ns)
- ExciStar S Industrial ArF laser (193 nm, 1 kHz, 8 mJ, pulse 10 ns)

Emission UV-ViS spectrometers

- **Aryelle 400 Butterfly Echelle spectrometer (LTB Lasertechnik Berlin)** equipped with an iStar DH334T ICCD camera, provides spectra within the UV/VIS. The optical-analyzer unit enables spatially and temporally resolved imaging of very low spectral intensities (better than ESA 400) in the range of 192 – 750 nm. The resolution is 13 – 31 pm in the UV range and less than 21 -37 pm in the optical region. The spectrometer operates in two spectral ranges: 192 – 433 nm and 425 – 750 nm. The optical signal is collected by a collimator. Prior to the very measurement, the calibration of the Butterfly spectrograph with Hg lamp is needed. During the experiments, the spectrograph will be set to trigger 1 μs after the laser pulse and keeping the gate open in μs range.
- **Ocean Optics HR4000** is small grating CCD spectrometer operating in range of 200 – 1100 nm. Optical resolution is 0.47 nm.

Multispectral table top and meteor observation cameras

- 2 pcs - Pointgrey Grasshoper3 GS3-U3-32S4M VS-Technology 6 mm, f/1.4 60°×40° (with high quantum efficiency (Q_E= 76%, 525 nm), dynamical range (71. 34 dB), with CMOS chip (Sony Pregius 2048×1536 px), and grating 1000 lines/mm allowing for a resolution of 0. 48 nm/px).
- 2 pcs - QHY 5II-LM Tamron MPX 3-8 mm, f/1.0 68°×51° (1280×960 px CMOS chip and Tamron objective (f/1,00; F/3-8 mm) equipped with a 1000 lines/mm grating, which allows a resolution up to 0.97 nm/px).

Mass spectrometer - gas chromatography

- GC-MS Spectrometer Trace 1310, Thermo Scientific Corp. with implemented MS-MS detection and an ion trap (ITQ 1100, Thermo Scientific). For the separation, the apparatus is equipped with a capillary column TR-1 (100 % dimethylpolysiloxane) for a routine analysis, and an SPB-20 (20% diphenyl/80% dimethyl siloxane) for the analysis of organic polar molecules, mainly using a derivatization agent.

High resolution FT spectrometers

- The experimental gas-phase composition can be monitored directly in the interaction hall with a Fourier-transform high-resolution **Bruker Vertex 80V** spectrometer, and post-analyzed with a **Bruker IFS 125 HR** spectrometer (Bruker Optics, Germany). Both spectrometers use KBr beam splitters and nitrogen-cooled MCT and InSb detectors over the 650 to 8000 cm^{-1} spectral range. Spectra are measured with resolution ranging from 0.06 cm^{-1} (in situ located Bruker Vertex 80V for continuous diagnostics of composition after each laser pulse) to 0.002 cm^{-1} (HR FTIR spectrometer Bruker IFS 125). Gas-phase concentrations are determined by independent calibration with pure gases. To enhance the detection limit of the Bruker IFS 125 HR instrument, the final analysis is performed in a White multi pass cell with 100 m optical path.

Time resolved FT spectrometer with continual scan

- Modified Bruker IFS 120 HR spectrometer is designed for the study of the dynamics of small radicals, excited atoms, molecular ions and unstable intermediate products. We have developed a high-resolution Fourier transform spectroscopic microsecond time–resolved technique operating with continuous scanning and a very high S/N ratio. The data acquisition process is time synchronized with a Field–Programmable Gate Array processor (FPGA) microcontroller. The principles of the method have been discussed in our previous papers. Briefly, a mixture of gases and precursor molecules in a buffer gas is directed into a positive-column discharge tube or laser ablation chamber. The emission signal is focused into the interferometer chamber and recorded with photomultipliers, Si semiconductor detectors or using MCT and InSb detectors (for the IR and MIR range and used for recording the NIR spectra of meteorite ablation).

- **Multispectral cameras:** 2 pcs - Pointgrey Grasshoper3 GS3-U3-32S4M VS-Technology 6 mm, f/1.4 60°×40° (with high quantum efficiency (Q_E= 76%, 525 nm), dynamical range (71.34 dB), with CMOS chip (Sony Pregius 2048×1536 px), and grating 1000 lines/mm allowing for a resolution of 0.48 nm/px). 2 pcs - QHY 5II-LM Tamron MPX 3-8 mm, f/1.0 68°×51° (1280×960 px CMOS chip and Tamron objective (f/1,00; F/3-8 mm) equipped with a 1000 lines/mm grating, which allows a resolution up to 0.97 nm/px).

3D Printers

- 3D printers ORIGINAL PRUSA I3 MK3S+ extruder printer
- Original Prusa SL1 3D MSLA-technology resin laser printer with Prusa Curing and Washing Machine BUNDLE

Laboratory and electronic equipment

Laboratories for spectroscopic measurements (absorption, LIBS, emission) and plasma diagnostics equipped with optical tables, mounts, stages, chemical laboratories for basic synthesis and laboratory operations, glass works and engineering works.

Theoretical, Computational and Methodological know-how:

Kinetics calculations - Experimental data can be analyzed using models of plasma chemistry and physics. In this way, every result will be supported by a theoretical model and the results of previous theoretical studies will also be verified. Our numerical model is implemented in the Python 2.6.4 programming language using 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.

Model of planetary atmospheric chemistry. In order to theoretically explore 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 Gy sun, and a comprehensive chemical network, STAND, valid between 300 K and 30000 K 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.

Fundamental spectroscopic analysis. This approach involves a detailed investigation of the energy levels and transition properties of the studied quantum system (atomic and/or molecular species). This procedure usually requires a very precise extraction of the measured spectral features and their assignment to the corresponding energy transitions. The theoretical interpretation requires extensive data sets obtained in literature or calculated using ab initio computational methods. On the other hand, this procedure provides very precise and detailed structural information about the species. These data are used in many areas of physics, chemistry, and astronomy. This method has been used in our group for many years.

Analysis based on the statistical modeling. Compared to the previous method (based mainly on the fundamental physical principles), the statistical modeling analysis provides a very different kind of information about the analyzed sample. The main goal here is not the extraction of the fundamental physical properties of the analyte but the overall characterization of the sample. The typical application is for instance classification of archeological artifacts. In our group, this approach was used for the classification of meteoritic samples. In modeling procedures, we use various algorithms of regression and clustering with support of reference experimental data measured in our laboratory. The main advantage of this methodology is the robustness and relatively high speed of the analysis as well as the ability to partially suppress the matrix effects.

Fitting radiation model parameters

This method focuses on the description of the spectrometrically studied plasma. It provides detailed information about the plasma temperature and electron density as well as the elemental composition. The calculations are performed by software developed at the J. Heyrovsky Institute. The main features of the program include:

1. multiple LTE plasma volumes with different temperatures and electron densities (simulation of the non-homogeneous plasma),
2. radiative transfer model (simulation of optically thick environments),
3. iterative calculation of the electron density and the ionization stages of the atomic species included directly in the simulation (no corrections for the ionization required).

The method is based on the optimization of plasma radiation model parameters. The synthetic spectrum of the plasma object is generated and compared to the measured spectrum at each step of the optimization process. The comparison will give new plasma parameters and this whole process is being repeated till an optimum is found. This optimization procedure is performed automatically by a robust global optimization algorithm based on Monte Carlo direct search methods. The main benefit of the chosen approach is the ability to overcome the local extremes on the objective function as well as the good performance when the number of the free parameters grows. The software is implemented in the Python programming language. This language enables rapid development and testing of new ideas but at the same time provides a reliable and stable development platform with great support from the scientific community. To increase the speed of the computation, the numerical modules Numpy and Scipy are used. This method of the experimental data analysis is especially suitable for plasma diagnostics including the laboratory LIDB experiments as well as the remote sensing measurements (e.g. bolide plasma spectra recorded with spectral cameras).

Artificial neural networks are utilized as a nonlinear regression method for determining plasma parameters such as plasma temperature, electron number density and atomic 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 processes that are not well described from first principles or are highly complex, with incomplete knowledge regarding the whole system and imprecise input data. Most of the data analysis is performed using MATLAB. Particularly, a neural network toolbox is utilized for ANN calculations. Spectral line selection, electron and heavy particle number density fitting, and for LTE calculation of emission spectra were automated by in-house programmed scripts covered by PYTHON modules NUMPY and SCIPY.

These briefly described methods enable the full characterization of the samples studied using the experimental methods based on the laboratory (laser and/or discharge) plasma generation as well as the remote plasma sources diagnostics.

Preparation and Coordination of Space Missions and Development and construction of space instrument:

- Manufacturing and testing of mirrors for the ARIEL satellite mission (PEA 4000129979, 2020 – 2026) PI: M. Ferus, M. Ferus and S. Civiš serve as CoPI in the Ariel telescope consortium. Industrial partner: Toptec.
- SLAVIA (ITT3 - Ambitious Projects - Mission Proposals - for the Czech Republic: Phase 0/A/B1 Study (Activity Type D) in the Project Arrangement for a Framework Project Implementing ESA's Support Of Space-Related Activities in the Czech Republic, 2021-2022. PI: Martin Ferus. Industrial partner: SAB Aerospace.
- Compact optical hyperspectral camera FREYA for CubeSat missions, No: T002000009/07

Development towards novel spectral techniques

- Advanced solutions of light sources (FW01010038, 2020-2024) Co-PI: M. Ferus, Industrial partner: Crytur.
- Center of Advanced Applied Sciences, program Chemistry (reg. no. CZ.02.1.01/0.0/0.0/16_019/0000778, 2019-2023) PI: M. Ferus, partner: Czech Technical University.

R&D and collaboration with industrial segment:

- Collided high-power wide-spectrum source. Authors: M. Ferus, J. Kubát, Type of result: Gfunk+ RIV/25296558:_____/19:N0000013 (2019). Industrial partner: Crytur.

- Composite luminophore from two monocrystalline luminophores generating radiation at a different wavelength. Authors: Fídler, Kubát, Civiš, Nikl. M. Ferus a member of the project team. Type of result: G RIV/25296558:_____/17:N000000003 (2017). Industrial partner: Crytur.
- Monocrystalline radiation concentrator. Authors: J. Kubát; M. Ferus a member of the project team, Type of result: Gfunk RIV/25296558:______/19:N0000014 (2019). In collaboration with Crytur.
- Monocrystalline RGB luminophor. Authors: Kubát, Civiš, Nikl. M. Ferus a member of the project team. Industrial partner: G, RIV/25296558:______/17:N0000009 (2017). In collaboration with Crytur.
- Analyzer of gases with photoacoustic detection with automatic calibration - SUCHÁNEK, Jan, ZELINGER, Z., DOSTÁL, M., KUBÁT, P. Utility model, Prague: Industrial Property Office. Submitted 2022.
- Analyzer of gases based on the principle of laser spectroscopy in combination with Helmholtz resonator with variable length of connection of microphone and absorption space. ČECH Martin, ZELINGER, Z., SUCHÁNEK J. Utility model, Prague: Industrial Property Office. Submitted 2022.
- Set for continuous measurement of extinguishing concentrations by the QEPAS method. VÁLEK, Václav, ZELINGER, Z., SUCHÁNEK J., et al. Utility model, Prague: Industrial Property Office. Submitted 2022.

Scheme: The expertise of J. Heyrovský Institute in the role of project leader reaches from fundamental science with specific focus on high energy chemistry of planetary atmospheres simulated by lasers to close connection with observation astronomy and radioastronomy, as well as technical development, construction and applied research focusing towards devices for CubeSats (Hyperspectral cameras) and even space telescopes such as Ariel.

6. WORK PACKAGES

6.1. Work Package 1

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

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
Project phases:	runs over phase B2, C and D
Work Package Start and End dates:	1.11.2024-31.12.2029
Number of Full-Time Equivalent (FTE) for the Work Package:	1.3
Objectives: Czech Team Management and Leadership	

Inputs:
This PEA, applicable documents, and other relevant project documentation.

Description of Work:

- **Document and Requirement Analysis:**
  - Analyze this Statement of Work (SoW) in the context of academic contributions.
  - Review applicable documents in the SoW and other project documentation related to data preparation, validation methodologies, and scientific deliverables.
- **Project Scheduling and Reporting:**
  - Compile a schedule focusing on academic deliverables, ensuring compatibility with project milestones, especially related to testing datasets, spectral libraries, and model simulations.
  - Perform technical and programmatic reporting specific to academic tasks throughout the contract.
- **Support for Key Meetings:**
  - Provide scientific input and participate in MRR, TRR, TRB, PDR, CDR, and other ESA-imposed key meetings. Contributions will center on data validation strategies, test results, and refinement of academic deliverables.
- **Data and Document Management:**
  - Contribute to instrument-level document deliveries such as DCL, DPL, DML, DMPL, and DDVP, focusing on data validation, simulation, and testing outcomes.
  - Provide scientific insights into risk registers, validation reports, and data sheets for academic outputs.
- **Non-Conformance Handling:**
  - Notify the Agency of any non-conformances (NCRs) related to academic outputs, such as errors in datasets or simulation models, within 48 hours of discovery.

- Collaborate with BIRA-IASB and ESA to resolve issues, ensuring that academic contributions meet the required specifications.
- Participate in Non-Conformance Review Boards (NRBs) for academic-related issues, providing scientific justification and resolutions.

- **Post-Delivery Activities:**
  - Support instrument-level testing with academic deliverables, such as reference datasets and calibration models, ensuring compatibility with operational requirements.
- **Project Outreach:**
  - Contribute to dissemination and outreach efforts, emphasizing the academic achievements in spectroscopy, modeling, and data preparation for the VenSpec-H instrument.

Deliverables:

- Progress Reports
- Publications
- Coordination meetings
- Documentation updates as necessary
- Scheduling
- NCRs, RFDs, RFWs
- Miscellaneous inputs to documents

Work Package number:	WP2
Work Package Title:	Overseeing and Participation on Product Assurance for Czech activities
Responsible entity:	J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, v.v.i.
Local Managers:	Martin Ferus
Project phases:	runs over phase B2, C and D
Work Package Start and End dates:	1.11.2024-31.12.2029
Number of Full-Time Equivalent (FTE) for the Work Package:	1.1

Objectives: Assurance of technical activities, risk analysis and manufacturing documentation.

Inputs:
Relevant project documentation, applicable requirements, and guidance from the VenSpec-H consortium and Payload engineering team.

Description of Work:

- Academic Assurance and Compliance:
  - Provide assurance for academic contributions, such as data preparation, validation, and modeling, ensuring alignment with established scientific procedures and project guidelines.
  - Ensure that Czech academic and Industrial tasks are performed according to correct procedures and comply with relevant project requirements.
- Risk Analysis and Documentation:
  - Develop and maintain risk analyses focused on outputs, such as dataset preparation and validation methods, and deliver these analyses to the Payload engineering team and steering board.
  - Provide oversight and input into risk mitigation strategies, particularly in areas related to spectral data quality and modeling accuracy.
- Analysis and Review:
  - Participate in the analysis of applicable academic requirements, existing project documentation, and planetary data specifications.
  - Contribute to reviews of preliminary data and models, ensuring compatibility with instrument design and operational needs.
- Testing and Validation Support:
  - Assist in defining test methodologies for validating datasets, ensuring alignment with instrument capabilities and mission objectives.
  - Support calibration efforts using experimental and simulated datasets to validate instrument performance under simulated Venusian conditions.
- Document Preparation:
  - Provide input to instrument-level document deliveries relevant to academic outputs.
- Post-Delivery Coordination:
  - Support post-delivery activities by ensuring academic datasets and reference models are available and validated for instrument-level testing and operational use.

Deliverables:

- Reports

• Coordination meetings • Documentation updates as necessary

Phase C Tasks

Work Package number:	WP3
Work Package Title:	Electronics testing and 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 B2, C and D
Work Package Start and End dates:	1.11.2024-31.12.2029
Number of Full-Time Equivalent (FTE) for the Work Package:	0.6
Objectives: Testing the electronics performance and fulfillment of the mission and science criteria	
Inputs: **Description of work:** • Oversee and assist on determination whether some specific project requirements (e.g. planetary protection) may lead to significant changes in the usual manufacturing. • 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: atmospheric species profiles and observation regimes, simulation of synthetic mixtures of spectral libraries. • Connecting the production of datasets with the test philosophy of the components provided by the industrial partner (synergy with industrial part). • Overseeing part on testing design + manufacturing (industrial part). • Overseeing part on PA/QA Analysis (industrial part). • Assist testing of all EM and EFM boards (Windustrial part). • Post delivery support	
Deliverables: • Data pack (spectral library and test spectra) and software (atmospheric model) • Reports • Publications • Documentation updates as necessary	

The manpower distribution is schematically summarized as follows: Work Packages 1-3 (WP1-3) will be coordinated by the Project Principal Investigator (PI), Dr. Martin Ferus, from the HIPC, who will collaborate with the Co-Principal Investigators (Co-PIs), Dr. Veronika Strnadová from the CGS, and Dr. Petr Brož from the IG CAS, assuming responsibility. Ing. Růžena Ferusová Živorová, from the HIPC's project department, will serve as the main administrative coordinator. Additionally, in WP2, science and technical specialists, Kateřina Němečková (HIPC) and a student from the CGS, will be responsible. Work Package 3 (WP3) is essential for acquiring the testing dataset and evaluating the alignment between the scientific and mission criteria and the manufactured components. This task will be overseen by Project ILS Dr. Ferus (HIPC) and carried out by the science and technical specialists, Lukáš Petera (HIPC), and a CGS student. We note that the only exception from this is planned during the beginning of the project in 2024, where the collision with other projects caused different allocation of FTEs (total sum of 0.18 FTE allocated only on HIPC).

Manpower - Academia segment				Total allocation per WP
WP:	UFCH	IG CAS	CGS	
WP1	0.8	0.1	0.2	1.1
WP2	0.7	0.1	0.3	1.1
WP3	0.4	0.1	0.1	0.6
Total allocation per institute	1.9	0.3	0.6	Total manpower: **2.8 FTE**

STANDARD MANAGEMENT REQUIREMENTS

Table 2: Deliverable Documentation

	Milestone (delivery event/date)
Management Documentation	
Annual progress report	31.1.2025
Annual progress report	31.1.2026
Annual progress report	31.1.2027
Annual progress report	31.1.2028
Annual progress report	31.1.2029

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:

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 year (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 year (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

Progress Meetings shall be held month, 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

The documentation listed hereafter is a deliverable of the present Contract. The provisions of section 7.3 "Management requirements" apply. We note that the obligation to submit monthly reports has been temporarily suspended by the BIRA Institute.

Table 1: Deliverable Documentation

	Milestone (delivery event/date)				
Management Documentation					
Annual Progress report	31.1.2025	31.1.2026	31.1.2027	31.1.2028	31.1.2029
Schedule					
Action Items List					
Deliverable Items List					
Summary report					

8.2.2. Hardware

N/A

8.2.3. Computer Programs and Models

The Computer Programs and Models listed hereafter are a deliverable of the present Contract. The provisions of section 7.3 "Management requirements" apply.

SW-1: Atmospheric model for testing: 31. 12. 2026

SW-2: Datapack for testing: 31. 12. 2028

....

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 project starts on 1st November, 2024 and will end on 31st December, 2029.

The involved institutions will build on the first phase of the project, during which the production of engineering models was solely managed by academic institutions. In the next phase, we will oversee the manufacturing processes, industrial activities, and associated know-how, integrating them into the further development and production efforts led by industrial partners selected in accordance with ESA's rules. The participation of the academic sphere is not only beneficial but also essential for the successful manufacturing of the required electronics. Additionally, we will provide testing datasets and support all efforts necessary to ensure the successful delivery of components for the mission.

All activities undertaken by the Czech scientific segment will continue throughout the project's duration. Under Work Package 1 (WP1), we will immediately proceed with management and leadership tasks for the Czech EnVision consortium. This includes maintaining communication with subcontractors and increasing the visibility of the project through public outreach. Planned deliverables include the creation of EnVision web pages in Czech and a series of outreach articles highlighting the mission and Czech involvement. We will also maintain regular interfaces with EnVision committees and oversee interactions with subcontractors. Coordination meetings will be organized, and reports on Czech activities will be prepared and delivered.

Under Work Package 2 (WP2), which focuses on the coordination and support of technical activities, we will provide assurance for products developed in the Czech segment and monitor task performance. In collaboration with the industrial sector, we will contribute to risk analysis and ensure the manufacturing of mission-critical components. We will also define parameters and verify compliance with mission criteria. The manufacturing and testing processes will be documented for the consortium. We will assist and oversee preliminary design, prototyping, testing, and validation to meet mission and scientific performance requirements, including component procurement. WP2 will be conducted continuously throughout the project, with each step aligned with the activities and schedules set by the industrial partners.

Work Package 3 (WP3) will commence immediately after PRODEX authorization in 2024 to prepare testing datasets. These datasets are critical for the testing and verification of the scientific performance of manufactured components and for assessing their compliance with the mission's scientific objectives and criteria.

Regular meetings will ensure progress and effective communication. In addition to the Kick-Off, Requirements, and Final Review meetings, monthly progress meetings will provide updates, while weekly technical-level meetings will facilitate communication with representatives from ESA and BIRA-IASB.

Detailed: WP1 – WP3
Scientific Segment

WP:	2024	2025	2026	2027	2028	2029
WP1	SoW Analysis		Overseeing of R and D		Delivery and post delivery activities and testing	
			Project management and outreach, scheduling, overseeing of the activities			
			Meeting support			
			Input for the instrument documents			
			Non-conformances handling			
WP2			Manufacturing assurance			Post delivery assurance
			Overseeing and participation on technical WGs			
WP3	Req. Determination	First datapack review	Data production			Post delivery datapack usage and review
			Overseeing the technical WGs			

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
Annual progress report	31.1.2025	Annual progress report will contain reporting of all the steps regarding solution of the project and the projects results as well as the original outputs or their documentation such as publications, databases, etc.
Annual progress report	31.1.2026	Annual progress report will contain reporting of all the steps regarding solution of the project and the projects results as well as the original outputs or their documentation such as publications, databases, etc.
Annual progress report	31.1.2027	Annual progress report will contain reporting of all the steps regarding solution of the project and the projects results as well as the original outputs or their documentation such as publications, databases, etc.
Annual progress report	31.1.2028	Annual progress report will contain reporting of all the steps regarding solution of the project and the projects results as well as the original outputs or their documentation such as publications, databases, etc.

Annual progress report	31.1.2029	Annual progress report will contain reporting of all the steps regarding solution of the project and the projects results as well as the original outputs or their documentation such as publications, databases, etc.
Monthly progress report	Upon ESA's request	Monthly reports will contain summary of all the steps regarding solution of the project and the projects results as well as the original outputs or their documentation such as publications, databases, etc.

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

FINANCIAL PLAN

Project Name: Development of VenSpec-H Electronics

Institute: J. Heyrovský Institute of Physical Chemistry (HIPC), Czech Academy of Sciences,
Investigator (Co-ILS of the VenSpec Instrument): Martin Ferus

Starting date: 01/11/2024 Ending date: 31/12/2029

The total budget allocated to the Czech Academic Consortium amounts to €747,115 out of a total of €3,377,115. The overall declared financial plan amounts to €703,897. Accordingly, €43,218 is allocated to the reserve and will be subject to further changes via a Change Notice.

Table 1: Institute Costs in Euro

Table 1 below: (1): FTE = Full Time Equivalent allocation per year (1 full year of work is 1 FTE).

INSTITUTE COSTS	2024		2025		2026		TOTAL
	FTE(1)	Costs	FTE	Costs	FTE	Costs	(Costs)
Martin Ferus, senior	0	0	0.1	6768	0.1	6768	**13 536**
Kateřina Němečková	0.17	5640	1	33838	1	33838	**73 316**
Růžena Ferusová Živorová, local manager	0.01	440	0.8	42230	0.8	42230	**84 900**
...							-
							-
							-
							-
							-
Total Manpower	**0.18**	**6 080**	**1.90**	**82 836**	**1.90**	**82 836**	**171 752**
Travel cost (* Exhibit A to Table 1)		-		3 000		3 000	**6 000**
Cost of items purchased by Institute, funded from PEA (** Exhibit B to Table 1)							-
Miscellaneous costs (*** Exhibit C to Table 1)		-		6 726		2 000	**8 726**
Overheads (state % and costs they apply to):	Rate:	Overhads	Rate:	Overhads	Rate:	Overhads	
	10%	**606**	**10%**	**9 256**	**10%**	**8 783**	18 645.00
Grand Total		**6 686**		**101 818**		**96 619**	**205 123**

Exhibits: See next pages - PSS forms can be appended after Table 2.

INSTITUTE COSTS	2027		2028		2029		TOTAL
	FTE[1]	Costs	FTE	Costs	FTE	Costs	(Costs)
Martin Ferus, senior	0.1	6768	0.1	6768	0.1	6768	**20 304**
Kateřina Němečková	1	33838	1	33838	1	33838	**101 514**
Růžena Ferusová Živorová, local manager	0.8	42230	0.8	42230	0.8	42230	**126 690**
...							-
							-
							-
							-
							-
Total Manpower	**1.90**	**82 836**	**1.90**	**82 836**	**1.90**	**82 836**	**248 508**
Travel cost (* Exhibit A to Table 1)		3 000		2 000		-	**5 000**
Cost of items purchased by Institute, funded from PEA (** Exhibit B to Table 1)							-
Miscellaneous costs (*** Exhibit C to Table 1)		2 000		2 000		2 000	**6 000**
Overheads (state % and costs they apply to):	Rate:	Overhads	Rate:	Overhads	Rate:	Overhads	
	10%	**8 783**	**10%**	**8 683**	**10%**	**8 482**	25 948.00
Grand Total		**96 619**		**95 519**		**93 318**	**285 456**

Institute: Institute of Geophysics (IG), Czech Academy of Sciences,
Investigator (deputy of Co-ILS of the VenSpec Instrument): Petr Brož

Starting date: 01/11/2024 Ending date: 31/12/2029

Table 1: Institute Costs in Euro

Table 1 below: (1): FTE = Full Time Equivalent allocation per year (1 full year of work is 1 FTE).

INSTITUTE COSTS	2024		2025		2026		TOTAL
	FTE(1)	Costs	FTE	Costs	FTE	Costs	(Costs)
Petr Brož, senior researcher			0.3	10282	0.3	10282	**20 564**
							-
							-
...							-
							-
							-
							-
							-
Total Manpower	-	-	**0.30**	**10 282**	**0.30**	**10 282**	**20 564**
Travel cost (* Exhibit A to Table 1)		-		2 714		1 000	**3 714**
Cost of items purchased by Institute, funded from PEA (** Exhibit B to Table 1)							-
Miscellaneous costs (*** Exhibit C to Table 1)		-		-		-	-
Overheads (state % and costs they apply to):	Rate:	Overhads	Rate:	Overhads	Rate:	Overhads	
	10%	-	**10%**	**1 298**	**10%**	**1 128**	2 426.00
Grand Total		-		**14 294**		**12 410**	**26 704**

INSTITUTE COSTS	2027		2028		2029		TOTAL
	FTE(1)	Costs	FTE	Costs	FTE	Costs	(Costs)
Petr Brož, senior researcher	0.3	10282	0.3	10282	0.3	10282	**30 846**
							-
							-
...							-
							-
							-
							-
							-
Total Manpower	**0.30**	**10 282**	**0.30**	**10 282**	**0.30**	**10 282**	**30 846**
Travel cost (* Exhibit A to Table 1)		1 000		1 000		-	**2 000**
Cost of items purchased by Institute, funded from PEA (** Exhibit B to Table 1)							-
Miscellaneous costs (*** Exhibit C to Table 1)		-		-		-	-
Overheads (state % and costs they apply to):	Rate:	Overhads	Rate:	Overhads	Rate:	Overhads	
	10%	**1 128**	**10%**	**1 128**	**10%**	**1 028**	3 284.00
Grand Total		**12 410**		**12 410**		**11 310**	**36 130**

Institute: Czech Geological Survey (CGS),
Investigator (deputy of Co-ILS of the VenSpec Instrument): Veronika Strnadová

Starting date: 01/11/2024 Ending date: 31/12/2029

Table 1: Institute Costs in Euro

Table 1 below: (1): FTE = Full Time Equivalent allocation per year (1 full year of work is 1 FTE).

INSTITUTE COSTS	2024		2025		2026		TOTAL
	FTE[(1)]	Costs	FTE	Costs	FTE	Costs	(Costs)
Veronika Strnadova, senior researcher, PI			0.1	5141	0.1	5141	**10,282**
Student/TBD, junior researcher			0.5	20563	0.5	20563	**41,126**
							-
…							-
							-
							-
							-
							-
Total Manpower	**-**	**-**	**0.60**	**25,704**	**0.60**	**25,704**	**51,408**
Travel cost (* Exhibit A to Table 1)		-		3,143		3,143	**6,286**
Cost of items purchased by Institute, funded from PEA (** Exhibit B to Table 1)							-
Miscellaneous costs (*** Exhibit C to Table 1)		-		-		-	-
Overheads (state % and costs they apply to):	Rate:	Overhads	Rate:	Overhads	Rate:	Overhads	
	10%	-	**10%**	**2,884**	**10%**	**2,884**	5,768.00
Grand Total		-		**31,731**		**31,731**	**63,462**

INSTITUTE COSTS	2027		2028		2029		TOTAL
	FTE[1]	Costs	FTE	Costs	FTE	Costs	(Costs)
Veronika Strnadova, senior researcher, PI	0.1	5141	0.1	5141	0.1	5141	**15,423**
Student/TBD, junior researcher	0.5	20563	0.5	20563	0.5	20563	**61,689**
							-
...							-
							-
							-
							-
							-
Total Manpower	**0.60**	**25,704**	**0.60**	**25,704**	**0.60**	**25,704**	**77,112**
Travel cost (* Exhibit A to Table 1)		1,000		1,000		-	**2,000**
Cost of items purchased by Institute, funded from PEA (** Exhibit B to Table 1)							-
Miscellaneous costs (*** Exhibit C to Table 1)		-		-		-	-
Overheads (state % and costs they apply to):	Rate:	Overhads	Rate:	Overhads	Rate:	Overhads	
	10%	**2,670**	**10%**	**2,670**	**10%**	**2,570**	7,910.00

Table 1b: Manpower costs

(1): FTE = Full Time Equivalent allocation per year (1 full year of work is 1 FTE).

HIPC

INSTITUTE COSTS	2024		2025		2026		TOTAL
	FTE(1)	Costs	FTE	Costs	FTE	Costs	Costs
Martin Ferus, senior researcher, PI	0	0	0.1	6768	0.1	6768	**13 536**
Kateřina Němečková	0.17	5640	1	33838	1	33838	**73 316**
Růžena Ferusová Živorová, local manager	0.01	440	0.8	42230	0.8	42230	**84 900**
…							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
Total Manpower	**0.18**	**6 080**	**1.90**	**82 836**	**1.90**	**82 836**	**171 752**

INSTITUTE COSTS	2027		2028		2029		TOTAL
	FTE[1]	Costs	FTE	Costs	FTE	Costs	Costs
Martin Ferus, senior researcher, PI	0.1	6768	0.1	6768	0.1	6768	**20 304**
Kateřina Němečková	1	33838	1	33838	1	33838	**101 514**
Růžena Ferusová Živorová, local manager	0.8	42230	0.8	42230	0.8	42230	**126 690**
...							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
Total Manpower	**1.90**	**82 836**	**1.90**	**82 836**	**1.90**	**82 836**	**248 508**

IG

INSTITUTE COSTS	2024		2025		2026		TOTAL
	FTE(1)	Costs	FTE	Costs	FTE	Costs	Costs
Petr Brož, senior researcher			0.3	10282	0.3	10282	**20 564**
							-
							-
...							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
Total Manpower	**-**	**-**	**0.30**	**10 282**	**0.30**	**10 282**	**20 564**

INSTITUTE COSTS	2027		2028		2029		TOTAL
	FTE[1]	Costs	FTE	Costs	FTE	Costs	Costs
Petr Brož, senior researcher	0.3	10282	0.3	10282	0.3	10282	**30 846**
							-
							-
...							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
Total Manpower	**0.301**	**10 282**	**0.301**	**10 282**	**0.301**	**10 282**	**30 846**

CGS

INSTITUTE COSTS	2024		2025		2026		TOTAL
	FTE[(1)]	Costs	FTE	Costs	FTE	Costs	Costs
Veronika Strnadova, senior researcher, PI			0.1	5141	0.1	5141	**10 282**
Student/TBD, junior researcher			0.5	20563	0.5	20563	**41 126**
							-
...							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
Total Manpower	**-**	**-**	**0.60**	**25 704**	**0.60**	**25 704**	**51 408**

INSTITUTE COSTS	2027		2028		2029		TOTAL
	FTE[(1)]	Costs	FTE	Costs	FTE	Costs	Costs
Veronika Strnadova, senior researcher, PI	0.1	5141	0.1	5141	0.1	5141	**15 423**
Student/TBD, junior researcher	0.5	20563	0.5	20563	0.5	20563	**61 689**
							-
...							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
							-
Total Manpower	**0.60**	**25 704**	**0.60**	**25 704**	**0.60**	**25 704**	**77 112**

CZ Consortium	2024 FTE	2024 Costs	2025 FTE	2025 Costs	2026 FTE	2026 Costs	2027 FTE	2027 Costs	2028 FTE	2028 Costs	2029 FTE	2029 Costs	TOTAL (Cost)
Salaries. For each personnel paid from this													
R&D Workers	0.17	5640	2.00	76592	2.00	76592	2.00	76592	2.00	76592	2.00	76592	**388600**
Management	0.01	440	0.80	42230	0.80	42230	0.80	42230	0.80	42230	0.80	42230	**211590**
Total Manpower	**0.18**	**6080**	**2.8**	**118822**	**2.8**	**118822**	**2.8**	**118822**	**2.8**	**118822**	**2.8**	**118822**	**600190**
Travel cost (* *Exhibit A to Table 1*)	0		8857		7143		5000		4000		0		25000
Cost of items directly purchased by the Institute, funded from the PEA (** *Exhibit B to Table 1*)	0		0		0		0		0		0		0
Miscellaneous costs (*** *Exhibit C to Table 1*)	0		6726		2000		2000		2000		2000		14726
Overheads (when applicable – state which categories they apply to)	Rate: 10%	Overheads: **606**	Rate: 10%	Overheads: **13438**	Rate: 10%	Overheads: **12795**	Rate: 10%	Overheads: **12581**	Rate: 10%	Overheads: **12481**	Rate: 10%	Overheads: **12080**	**63981**
Grand Total													**703897**

Exhibit A to Table 1: Travel plan for the Czech Consortium

Year	*Destination and purpose*	*Number of trips*	*Number of persons per trip*	*Number of days per trip*	*Travel costs per person/trip*	*Total cost for all travelers per trip (EURO)*	*Total cost for all trips (EURO)*
2025	BIRA, coordination	3	1	7	1 000	**1 000**	**3 000**
	Consortium Conference	3	1	7	1 000	**1 000**	**3 000**
	TBD External Collaborati	2	1	7	1 357	**1 357**	**2 714**
	Domestic Trips	1	1	1	143	**143**	**143**
Total 2025						**3 500**	**8 857**
2026	BIRA, coordination	3	1	7	1 000	**1 000**	**3 000**
	Consortium Conference	3	1	7	1 000	**1 000**	**3 000**
	TBD External Collaborati	1	1	7	1 000	**1 000**	**1 000**
		1	1	1	143	**143**	**143**
Total 2026						**3 143**	**7 143**
2027	BIRA, coordination	2	1	7	1 000	**1 000**	**2 000**
	Consortium Conference	2	1	7	1 000	**1 000**	**2 000**
	TBD External Collaborati	1	1	7	1 000	**1 000**	**1 000**
						-	-
Total 2027						**3 000**	**5 000**
Grand Total							**21 000**

Travel plan

Year	*Destination and purpose*	*Number of trips*	*Number of persons per trip*	*Number of days per trip*	*Travel costs per person/trip*	*Total cost for all travelers per trip (EURO)*	*Total cost for all trips (EURO)*
2028	BIRA, coordination	2	1	7	1 000	**1 000**	**2 000**
	Consortium Conference	2	1	7	1 000	**1 000**	**2 000**
						-	-
						-	-
Total 2028						**2 000**	**4 000**
						-	-
						-	-
						-	-
						-	-
Total						-	-
						-	-
						-	-
						-	-
						-	-

Exhibit C to Table 1 – Miscellaneous costs.

Table 1C - Miscellaneous costs of HIPC, years 2025 and 2026

Year	*Miscellaneous cost, designation*	*Total Price (EURO)*
2025	Gas cylinder consumables	2 000
2025	Maintenance of the spectroscopic system	200
2025	Optical material	300
2025	Chemicals for operation and cleaning	200
2025	Electronic and mechanical material	4 026
otal 2025		**6 726**
2026	Gas cylinder consumables	1 000
2026	Maintenance of the spectroscopic system	200
2026	Optical material	300
2026	Chemicals for operation and cleaning	200
2026	Electronic and mechanical material	300
2025		
otal 2026		**2 000**
Total		-
Grand Total		**8 726**

Table 1C - Miscellaneous costs of HIPC, years 2027 - 2029

Year	*Miscellaneous cost, designation*	*Total Price (EURO)*
2027	Gas cylinder consumables	1 000
2027	Maintenance of the spectroscopic system	200
2027	Optical material	300
2027	Chemicals for operation and cleaning	200
2027	Electronic and mechanical material	300
Total 2027		2 000
2028	Gas cylinder consumables	1 000
2028	Maintenance of the spectroscopic system	200
2028	Optical material	300
2028	Chemicals for operation and cleaning	200
2028	Electronic and mechanical material	300
Total 2028		2 000
2029	Gas cylinder consumables	1 000
2029	Maintenance of the spectroscopic system	200
2029	Optical material	300
2029	Chemicals for operation and cleaning	200
2029	Electronic and mechanical material	300
Total 2029		2 000
Grand Total		6 000

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

esa **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): prof. Martin Hof Digitally signed by prof. Martin Hof Date: 2025.03.06 13:38:10 +01'00'	Date
ESA	
PRODEX Office representative(s):	Date

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