EXODOCS

Recruitment Process:

Guide for Applicants

Doctoral Networks (DN)
Marie Skłodowska-Curie Action
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History of Changes

Date	Version	Author(s)	Comments
13 oct 2025	1.0	UVA	First Version
10 Dec 2025	2.0	UVA	Second version, including inputs from all beneficiaries
03 Jan 2026	2.1	UVA	Updated version, including inputs from the UVa's European projects office
15 Apr 2026	3.0	UVA	Final version, including inputs from all beneficiaries

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1 Offer Description

We are pleased to announce the opening of 15 Doctoral Candidate (DC) positions within the EXODOCS project (ExoMars Rosalind Franklin Doctoral Network), funded by the European Commission under the Marie Skłodowska-Curie Actions (MSCA) Doctoral Networks programme within Horizon Europe (Grant Agreement No 101226728).

EXODOCS is an ambitious European training network designed to prepare a new generation of scientists to maximize the scientific return of the ExoMars Rosalind Franklin rover mission and to pave the way for future planetary exploration endeavors.

The overarching objective of EXODOCS is to create an interdisciplinary research and training environment where doctoral candidates will:

- Develop innovative analytical and interpretative methodologies for the scientific instruments on board the Rosalind Franklin rover;
- Advance instrument operation strategies and data processing pipelines to enhance mission efficiency and data quality;
- Foster integration and synergies among analytical instruments, promoting a more holistic approach to rover operations and data interpretation;
- Better leverage data from previous rover and orbiter missions, to increase the scientific outcome of the mission;
- Strengthen the link between laboratory analogue studies and in situ Martian data, ensuring robust and traceable scientific conclusions;

The EXODOCS consortium is composed of 10 beneficiaries and 18 associated partners, 52% of which are non-academic institutions and companies at the forefront of European space research. This strong industrial participation ensures that doctoral candidates gain direct exposure to real-world applications, thereby enhancing their employability and boosting the innovation potential of the European space market.

EXODOCS offers doctoral candidates the unique opportunity to work at the core of the ExoMars Rosalind Franklin rover mission. By joining one of the eight instrument teams (PanCam, Enfys, WISDOM, CLUPI, Ma_MISS, RLS, MicrOmega, or MOMA), the DCs will have the unique opportunity to analyse real Martian data, participate in official ESA ExoMars mission simulations, collaborate closely with world-leading experts in planetary research and astrobiology, and much more.

For general inquiries, please contact the EXODOCS Project Management Team at info@exodocs.eu. For any question about a particular position, e-mail the Main Supervisor of that position. Incomplete and late submissions shall not be considered.

2 Available DC Positions

The EXODOCS network offers 15 Doctoral Candidate (DC) positions across the following 10 beneficiary institutions:

1. Universidad de Valladolid (UVA), Spain [2 positions: DC6 and DC14]

2. Université Paris-Saclay (UPS), France [2 positions: DC9 and DC15]
3. Université Paris Cité (UPC), France [1 position: DC12]
4. University of Versailles Saint-Quentin-en-Yvelines (UVSQ), France [2 positions: DC5 and DC11]
5. Technische Universität Dresden (TUD), Germany [1 position: DC10]
6. La Sapienza University of Rome (LSU), Italy [2 positions: DC8 and DC13]
7. University College London (UCL), United Kingdom [2 positions: DC3 and DC7]
8. Open University (OU), United Kingdom [1 position: DC2]
9. German Aerospace Center (DLR), Germany [1 position: DC4]
10. Technical University of Munich (TUM), Germany [1 position: DC1]

Table 2.1 below provides a summary of the main information for each position, including the host institution, project title, supervisor, and contact details.

Table 2.1: List of DC positions

Position	Title	Recruiting institution	Supervisors
DC 1	Optimizing the Scientific Return of Close-Up Cameras for Mars Exploration	TUM	Detlef Koschny (detlef.koschny@tum.de) Frédéric Foucher (frederic.foucher@cnrs.fr)
DC 2	Automated Analysis of Martian Surface Clasts and Regolith Using Imaging Instruments	OU	Matthew Balme (matt.balme@open.ac.uk) Daniela Tirsch (daniela.tirsch@dlr.de)
DC 3	Optimizing Mineral Identification Using Shortwave Infrared (SWIR) spectrometry	UCL	Andrew Coates (a.coates@ucl.ac.uk) Claire Cousins (crc9@st-andrews.ac.uk)
DC 4	Multi-Scale Target Prediction for Mars Exploration Using AI Methods	DLR	Katharina Otto (Katharina.Otto@dlr.de) Helen Miles (hem23@aber.ac.uk)
DC 5	3D Mapping of the Surface and Subsurface Using WISDOM (GPR)	UVSQ*	Valerie Ciarletti (valerie.ciarletti@latmos.ipsl.fr) Alessandro Frigeri (alessandro.frigeri@inaf.it)
DC 6	Comparative Analysis and Optimization of Spectrometers for Mars Exploration	UVA	Marco Veneranda (marco.veneranda@uva.es) Olga Prieto Ballesteros (prietobo@cab.inta-csic.es)
DC 7	Monitoring the dehydration of drill tailings from Martian subsurface sampling	UCL	Louisa Preston (l.preston@ucl.ac.uk) Peter Grindrod (p.grindrod@nhm.ac.uk)
DC 8	Monitoring the alteration of drill cores from Martian subsurface sampling	LSU**	Francesca Altieri (Francesca.Altieri@inaf.it) Maria-Paz Zorzano Mier (maria-paz.zorzano.mier@ltu.se)

DC 9	Developing Quantification Methods for Mineral Analysis Using Raman and NIR Spectroscopies	UPS	Cedric Pilorget (cedric.pilorget@universite-paris-saclay.fr) Mathieu Vincendon (mathieu.vincendon@universite-paris-saclay.fr)
DC 10	Developing a Polarimetric Radargram Library for Subsurface Analysis with GPR	TUD	Dirk Plettemeier (dirk.plettemeier@tu-dresden.de) Valerie Ciarletti (valerie.ciarletti@latmos.ipsl.fr)
DC 11	Analytical Characterization and Optimization of GC-MS procedures for Organic Detection on Mars	UVSQ*	Cyril Szopa (Cyril.szopa@latmos.ipsl.fr) Caroline Freissinet (Caroline.freissinet@latmos.ipsl.fr)
DC 12	Novel solutions to Discriminate Biominerals from Abiotic Equivalents	UPC	Fabien Stalport (fabien.stalport@lisa.ipsl.fr) William B. Brinckerhoff (William.b.brinckerhoff@nasa.gov)
DC 13	Developing Spectral Analysis Tools for Trace Organic Detection and Biosignature recognition in Geological Mixtures	LSU**	M. Cristina De Sanctis (mariacristina.desanctis@inaf.it) Cedric Pilorget (cedric.pilorget@universite-paris-saclay.fr)
DC 14	Investigating Organic-Mineral Interactions for Biosignature Detection Using Spectroscopic Techniques	UVA	Jose Antonio Manrique (joseantonio.manrique@uva.es) Teresa Fornaro (teresa.fornaro@inaf.it)
DC 15	Enhancing Cooperative Spectroscopic Analysis for Biosignature Detection on Mars	UPS	Cedric Pilorget (cedric.pilorget@universite-paris-saclay.fr) Guillermo Lopez Reyes (Guillermo.Lopez@uva.es) Donia Baklouti (donia.baklouti@universite-paris-saclay.fr)

** The candidate will be hired by UVSQ, but the PhD degree will be awarded by UPS.*
*** The candidate will be hired by LSU, while INAF (Istituto Nazionale di Astrofisica, Rome) will act as the hosting institute*.

Further details of each DC position are provided in Annex 1 of this document.

3 Who can apply?

Candidates will be required to meet the Marie Skłodowska-Curie Early-Stage Researcher eligibility criteria (http://ec.europa.eu/research/mariecurieactions/).

3.1 Eligibility Criteria

Applicants must comply with the following eligibility criteria:

- To hold, at the time of the PhD starting date, an MSc degree (or equivalent) in Engineering, Mathematics, Physics, Astronomy, Astrophysics, Planetary Science, Geology or related fields. Applicants who are in the final stage of their MSc studies and expect to obtain the degree before the start of the PhD are also eligible to apply.

- To have not been awarded a doctoral degree.
- At the time of recruitment by the host organization, you must be in the first four years (full-time equivalent) of your research career, counted from the date of obtaining the MSc degree (or equivalent).
- You must comply with the European Commission's mobility rule, meaning at the time of recruitment by the host organization, you must not have resided or carried out your main activity (work, studies, etc.) in the country of the host organization for more than 12 months in the 3 years immediately before the starting employment contract date. Compulsory national service and/or short stays such as holidays are not taken into account.
- To be proficient in English language. The required level of English proficiency will be assessed in a position-specific manner, depending on the DC position (details are provided in each DC job vacancy post advertised on EURAXESS).

3.2 Mobility

Researchers are required to undertake trans-national mobility (i.e., move from one country to another) when taking up the appointment. At the time of selection by the host organisation, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organization for more than 12 months in the 3 years immediately prior to their recruitment. Short stays, such as holidays, are not taken into account.

For all recruitments, the eligibility of the researcher will be determined at the date of the recruitment in the action.

4 Work conditions

The MSCA DN programme offers a highly competitive and attractive salary and working conditions. The successful candidates will receive a salary in accordance with the MSCA regulations for DCs.

Selected candidates will have a fulltime employment contract for the duration of 3 years (36 months).

The DC will be contracted according to the national rules of the country with full social security benefits.

Selected candidates will receive a salary in accordance with the MSCA regulations for DCs, constituted by a generous living allowance, a mobility allowance and a family allowance (depending on family situation) as shown in Table 5.1 (note that the following figures are the funding received from EC but it also include taxes, social security, health insurance, etc., and that depends on country regulations. Therefore, check the gross salary provided in each DC job vacancy post advertised on EURAXESS):

- **Living Allowance**, fixed amount (gross) that depends on the country of the recruitment beneficiary. To be paid as salary in the currency of the host country to all DCs recruited.
- **Mobility allowance**, fixed amount of 710€/month to be paid to all DCs recruited.
- **Family allowance** of 660€/month, depending on family situation.

Table 4.1: Allowance per month for countries involved in EXODOCS

Country	Living allowance (per month)	Mobility Allowance (per month)	Family Allowance (per month)
United Kingdom	5682,2	710	660
Germany	4058,1	710	660
Spain	3833,6	710	660
France	4735,8	710	660
Italy	3821,5	710	660

5 Recruitment procedure

EXODOCS has established a coordinated recruitment process supervised by the Recruitment and Equal Opportunity Committee (REOC), which ensures that all selections are open, transparent, and consistent with the principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers.

The recruitment process will be jointly coordinated at the network level, while the employment contracts will be managed according to the internal procedures of each hiring institution.

All Doctoral Candidate (DC) positions will be jointly advertised through the EURAXESS Jobs Portal (https://euraxess.ec.europa.eu/jobs), social media (LinkedIn:@EXODOCS MSCA-DN) and the EXODOCS website (www.exodocs.eu/vacancies). Each beneficiary will also publish its particular positions in EURAXESS, as well as through its own institutional channels.

Applicants must follow the application procedure of each DC positions (described in each particular call).

Applicants may apply for up to five (5) DC positions within the EXODOCS network.

Each application must be written in English and named according to the following format: **EXODOCS_NameSurname_DCnumber**
(e.g. *EXODOCS_MarioRossi_DC5*).

Each application must be submitted via email to both the EXODOCS recruitment board (recruitment@exodocs.eu) and the supervisors of the selected PhD position (email addresses are provided on Table 2.1).

This **application form** must be submitted together with the following supporting documents in PDF format:

1. Short **curriculum vitae** (CV) in Europass format (https://europass.europa.eu/en/create-europass-cv);
2. Bachelor's and, where applicable, Master's **degree diplomas;**
3. **Academic transcript(s) of records**;
4. **Supporting documentation for merits** listed in the CV (e.g. language certificates or others);
5. **Two Reference letters** (up to one page, each);

6. **Motivation letter** (up to two pages) outlining your motivation for applying to the selected EXODOCS DC position. IMPORTANT: If applying for more than one position, a separate motivation letter must be submitted for each DC position.

Only complete applications submitted before the specified deadline will be considered.

While the evaluation and selection of candidates will be coordinated at the EXODOCS network level, the final recruitment of each selected DC will be carried out by the recruiting beneficiary, in accordance with its national and institutional employment regulations.

Applicants may contact the main supervisor of each position for specific questions, or the EXODOCS Project Management Team (info@exodocs.eu) for administrative inquiries.

6 Selection and evaluation criteria

The recruitment process will be open, transparent, merit-based, efficient, supportive of equal opportunities (i.e. unbiased by gender), nationality, etc., internationally comparable, and in accordance with the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers. This guaranteed worldwide access and a fair and competitive selection of fellows by the host institutions in accordance to gender equality and minority rights. Thus, official acceptance e-mails/letters will be sent by the supervisors of each position to the selected candidates, on behalf of the whole Recruitment and Equal Opportunities Committee (REOC). In the same way, rejection e-mails will be sent personally to all ineligible and not selected candidates for each DC position.

6.1 Eligibility check

All applications will be checked according to the eligibility criteria shown in Section 3.

6.2 Selection procedure

The evaluation of the applications will be carried out by the REOC for the evaluated position. The recruitment committee (RC) will be named for each DC position which will be composed of three members: at least one member should be from the recruiting beneficiary institution and at least one member from a different beneficiary/partner organization that will host the DC candidate during secondment. Table 6.1 shows the composition of the recruitment committee for each DC position.

Table 6.1: Recruitment committees' composition

Position	Recruiting beneficiary	1st chair in RC	2nd chair in the RC	3rd chair in the RC
DC1	TUM	TUM	TUM	CNRS
DC2	OU	OU	OU	DLR
DC3	UCL	UCL	UCL	USA
DC4	DLR	DLR	DLR	ABU
DC5	UVSQ	UVSQ	UVSQ	USA
DC6	UVA	UVA	UVA	INTA
DC7	UCL	UCL	UCL	NHM
DC8	LSU	LSU	INAF	INAF

DC9	UPS	UPS	UPS	UVA
DC10	TUD	TUD	TUD	INAF
DC11	UVSQ	UVSQ	UVSQ	MPS
DC12	UPC	UPC	UPC	NASA
DC13	LSU	LSU	INAF	INAF
DC14	UVA	UVA	UVA	INAF
DC15	UPS	UPS	UPS	UVA

6.3 Evaluation procedure

The EXODOCS recruitment process is **open, transparent, merit-based, and international**, following the principles of the **European Charter for Researchers** and the **Code of Conduct for the Recruitment of Researchers**.

The evaluation is carried out in **two consecutive stages**:

- **Step 1 – Evaluation of the Application Form (50%)**

All complete and eligible applications will first be evaluated by the Recruitment Committee of the corresponding DC position, based on the submitted documents.

Each application will be scored according to the following criteria (maximum 50 points, see table 6.2 below):

Table 6.2: Evaluation criteria of the application form

Criteria	Points	Explanation
Academic formation	20	Evaluated from the Application form of the applicant and certificates/evidence of merits. The participation of the applicant in European mobility programs (e.g. ERASMUS+) will be positively considered. BCs degree final mark, MSc degree final mark (or average exams marks if the degree is not hold yet)
Professional and/or research experience	8	Evaluated from applicant CV, application form, and certificates/evidence of merits
Letter of motivation	8	Each applicant has to submit a letter of motivation showing the interest in the selected DC position(s).
References	14	Each applicant can indicate two references and submit a letter of support from them. Selection committees can contact the provided referees.
Total	50	

Only candidates obtaining a minimum score of **35/50** in this first stage will be taken into consideration for the next step.

The five highest-ranked candidates for each DC position will be invited to an online interview with the respective Recruitment Committee.

- **Step 2 – Online Interview (50%)**

Shortlisted candidates will be evaluated during an online interview, which will account for 50% of the final score.

The interview will assess:

- The candidate's scientific understanding and motivation for the specific project;
- Their ability to communicate and reason clearly in English; and
- Their potential to carry out independent research within an international environment.

- **Step 3 – Final selection**

The final evaluation will combine both steps, resulting in a score out of 100 points (Step 1: 50% + Step 2: 50%).

The candidate with the highest final grade will be proposed for recruitment.

If no candidate reaches a final score of at least 70/100, the position will not be awarded, and the corresponding call will be reopened at the earliest convenience.

Applicants who receive a positive evaluation but are not selected will be placed on a reserve list, which may be used to fill future positions in case of withdrawal or availability of new DC openings.

7 Recruitment Timeline

The recruitment process will follow the timeline outlined below:

- Opening of positions: 30 April 2026.
- Application period: Positions will remain open until 31 May 2026
- Eligibility check and evaluation: A period of up to 30 calendar days following the application deadline will be dedicated to the eligibility verification and evaluation of candidates based on the established criteria.
- Interviews: Shortlisted candidates will be invited to interviews, which will be conducted over a period of up to 15 calendar days.

Following the selection of the candidate, the hiring process will commence in accordance with the institution's internal recruitment procedures (for some hiring institutions this involves additional steps to assess and verify the candidate's final compatibility with institutional requirements).

In the event that one or more positions remain vacant, an additional recruitment call will be launched immediately after the announcement of the selected candidates.

The exact dates may be subject to minor adjustments for operational reasons. All applicants will be informed accordingly through the official recruitment channels.

8 Additional Information

8.1 Data Protection and Consent Notice

By applying for these positions, applicants give their consent to circulate their application materials and personal data within authorized EXODOCS members involved in the recruitment process.

All data provided by the applicants will be processed in accordance with the General Data Protection Regulation (GDPR, EU 2016/679) and will be used solely for the purpose of selecting the doctoral candidates.

8.2 Acknowledgments

This project has received funding from the European Union under Grant Agreement No 101226728

ANNEX 1: Additional information on DC positions

This Annex provides position-specific information for each Doctoral Candidate (DC) position offered within the project. For each DC position, the Annex details the scientific focus, host institution, supervision arrangements, specific eligibility or skill requirements, and any additional conditions relevant to the position.

Please note that certain requirements (e.g. English proficiency) may vary depending on the DC position and the host country. Where applicable, such position-specific requirements are clearly indicated in the corresponding DC description.

Applicants are therefore encouraged to carefully review the information provided for each DC position before submitting their application, to ensure full compliance with both the general eligibility criteria and the additional requirements outlined in this Annex.

DC1: Optimizing the Scientific Return of Close-Up Cameras for Mars Exploration (WP3)

Context:

Close-up imaging plays a crucial role in Mars exploration by providing detailed data on Martian rock, soil, and regolith. These high-resolution images allow scientists to analyse the structure, texture, mineralogy, and elemental or organic composition of the Martian surface, which is essential for understanding its geological and potential biological history.

Scientific challenges:

Close-up images from past and current rover missions have been subjected to technical limitations, including distortion, stray light, and colour response issues, which have hindered their scientific return. These problems reduce the accuracy of critical scientific measurements, affecting the interpretation of geological features and potential biosignatures.

Research objectives:

- Develop novel optical calibration techniques that allow automatic detection and correction of technical issues in close-up images. These should go beyond the scope of the standard calibration that will be performed by the project, with a focus on lighting conditions (e.g., reflections, straylight).
- Perform extended calibration using reference samples (lab-based). Develop data analysis methods for improved characterisation of sample properties (e.g., mineral composition, etc.). Verify the calibration methods and their robustness (uncertainty analysis, sensitivity analysis) based on the reference sample data.
- Develop methodologies for cross-interpreting images collected by ExoMars survey instruments (CLUPI, PanCam and Enfys) jointly with other DC's.
- Ensure proper integration of the newly developed analysis methods into the existing processing pipelines.

Impact:

- Deliver novel calibration data for close-up cameras (Enhance the scientific return of CLUPI and other imaging tools);
- Apply calibration pipeline to multiple missions (Improve close-up imaging data quality for past and future missions);
- Develop methods for cooperative science (Facilitate integration among survey instruments to maximize mission scientific outcomes.

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: Technical University of Munich (Germany)

ExoMars instrument team: CLUPI

Supervisor: Detlef Koschny (detlef.koschny@tum.de)

Co-supervisor: Frédéric Foucher (frederic.foucher@cnrs.fr)

DC2: Automated Analysis of Martian Surface Clasts and Regolith Using Imaging Instruments

Context:
Panoramic imaging of Martian clasts and regolith is key to understanding Mars' geology and environment. The size, shape, and distribution of clasts reveal rock lithology, while erosion and transport features indicate environmental processes. Regolith properties (e.g., grain size, color) help reconstruct Mars' geological and climatic history. Regular, high-resolution panoramic imaging is critical for tracking how these features vary across different terrains.

Scientific challenges:
Procedures for the automated identification and analysis of clasts and regolith remain underdeveloped. Additionally, panoramic images are rarely integrated with data from other survey instruments (e.g., close-up cameras, NIR imagers), limiting cross-instrumental insights.

Research objectives:

- Develop tools for automated detection and classification of clasts, boulders, and regolith in Mars panoramic images;
- Test protocols for cooperative analysis using ERF survey instruments (PanCam, CLUPI, Enfys);
- Benchmark this cooperative approach against previous missions' panoramic camera outputs.

Impact:

- Implement AI methods for panoramic image analysis (Automate the detection and classification of Martian clasts and regolith for enhanced geological insights);
- Promote cooperative science among ERF instruments (Integrate PanCam data with CLUPI and Enfys, maximizing cross-instrumental analysis and understanding);
- Optimize decision-making for rover missions (Refine tactical and strategic planning processes, improving mission efficiency and scientific outcomes).

English requirements: Applicants must have a good command of the English language. If English is not the applicant's first language, they must demonstrate proficiency in all four components (reading, writing, listening, and speaking). The host institution requires a minimum IELTS overall score of 6.5, with no less than 6.0 in any individual component, or an approved equivalent qualification. Overseas applicants must provide evidence of English language proficiency certified by a provider approved by UK Visas and Immigration (UKVI) and submit the corresponding certificate and grades as part of their application.

Hiring institution: The Open University (United Kingdom)

ExoMars instrument team: PANCAM

Supervisor: Matthew Balme (matt.balme@open.ac.uk)

Co-supervisor: Daniela Tirsch (daniela.tirsch@dlr.de)

DC3: Optimizing Mineral Identification Using Shortwave Infrared (SWIR) spectrometry

Context:

Previous Mars missions, such as Curiosity and Perseverance, have successfully utilized infrared (IR) imaging to capture data on the Martian surface, providing critical insights into its mineralogy and geochemistry. The Enfys instrument onboard RF will identify features of interest (FOIs) across varied terrains, to be approached for closer, more detailed analysis. By focusing on IR imaging at multiple spatial scales, Enfys aims to streamline the selection of key FOIs, a crucial step for maximizing mission efficiency and scientific yield.

Scientific challenges:

Despite the utility of IR data in previous missions, fully automated systems for mineral identification from panoramic IR images, particularly across different spatial scales, are not yet developed. Furthermore, integrating panoramic IR data with outputs from other proximity-based instruments has been limited. This gap in cross-instrumental data analysis hinders the ability to identify FOIs promptly and accurately, reducing the mission's overall scientific return. To overcome these challenges, this project aims to address specific.

Research objectives:

- Develop tools for automated FOI identification at stand-off distances;
- Compare Enfys mineral identification capabilities with similar instruments on previous missions;
- Integrate Enfys data with outputs from ERF's complementary spectrometers

Impact:

- Develop automated tools for Enfys for mineral identification across scales (improve precision and efficiency in mineral analysis);
- Integrate IR images with spectroscopic data for comprehensive mineral analysis (enhance data consistency and depth in mineral detection);
- Provide a comparative analysis of IR imager outputs from Mars rovers, generating validated methodologies for future missions (optimize imaging techniques and support more accurate Mars exploration).

English requirements: Applicants must have a good command of the English language. If English is not the applicant's first language, they must demonstrate proficiency in all four components (reading, writing, listening, and speaking). The host institution requires a minimum IELTS overall score of 6.5, with no less than 6.0 in any individual component, or an approved equivalent qualification. Overseas applicants must provide evidence of English language proficiency certified by a provider approved by UK Visas and Immigration (UKVI) and submit the corresponding certificate and grades as part of their application.

Hiring institution: Mullard Space Science Lab., University College London (United Kingdom)

ExoMars instrument team: ENFYS

Supervisor: Andrew Coates (a.coates@ucl.ac.uk)

Co-supervisor: Claire Cousins (crc9@st-andrews.ac.uk)

DC4: Multi-Scale Target Prediction for Mars Exploration Using AI Methods

Context:

Efficient exploration of the Martian surface requires accurate target prediction across multiple spatial scales. By integrating orbital and ground-based observations, scientists can optimize rover paths and increase scientific yield. Instruments like the High-Resolution Stereo Camera (HRSC) on MEX and CaSSIS on TGO capture large-scale maps, while HiRISE provides higher-resolution images.

Scientific challenges:

Current target identification relies on manual interpretation, which is slow and limited in dynamically predicting targets across scales. Integration of orbital and ground data has been minimal, limiting multi-scale target prediction's effectiveness. AI-based, multi-scale prediction could greatly enhance target identification and improve rover mission planning. This project aims to develop an AI-driven multi-scale target prediction system integrating orbital and ground-based data.

Research objectives:

- Develop AI models to identify potential targets using orbital data and refine predictions with high resolution images;
- Create a workflow that integrates multi-scale data to prioritize targets;
- Validate prediction models through case studies applicable to current and future missions.

Impact:

- Develop a multi-scale target prediction system integrating orbital and ground-based data (improve targeting accuracy and optimize rover navigation strategies);
- Facilitate integration of ground-based data with orbital observations to refine global mineralogical maps of Mars (lead to a more accurate understanding of Mars' surface composition and geological history).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: German Aerospace Center (Germany)

ExoMars instrument team: ENFYS

Supervisor: Katharina Otto (Katharina.Otto@dlr.de)

Co-supervisor: Helen Miles (hem23@aber.ac.uk)

DC5: 3D Mapping of the Surface and Subsurface Using WISDOM (GPR)

Context:

Ground-penetrating radars (GPRs) such as RIMFAX (Mars 2020) and RoPeR (Tianwen-1) have demonstrated strong capabilities for subsurface characterization on Mars. The ERF mission's GPR, WISDOM, introduces several unique advantages:
• A larger antenna–ground gap, enabling improved acquisition of surface-related signals such as roughness and scattering.
• A dual-polarimetric, rotated antenna configuration, allowing accurate quantification of surface roughness and enhanced detection of localized scattering features.
These features position WISDOM as a significant advancement for studying Martian near-surface processes.

Scientific challenges:

Despite these instrumental strengths, advanced models and methods are still required to fully exploit WISDOM's scientific potential. In particular, improved surface/roughness characterization and enhanced subsurface parameter retrieval must be developed.

Research objectives:

- 3D characterization of surface roughness to refine permittivity estimates derived from ground reflections, leveraging WISDOM's polarimetric capabilities.
- Synergistic integration with CLUPI and PanCam stereo imagery to complement and validate surface roughness assessments, particularly during grid operations.
- Comparison with previous Martian radar instruments, applying the roughness characterization approach to datasets from the high-frequency, polarimetric channel of RoPeR onboard Zhurong.
- Evaluation of cluttergram generation using digital elevation models derived from PanCam data acquired near the antennas.
- Incorporation of subsurface loss tangent estimation into the data processing workflow (e.g., centroid frequency shift or alternative methods), to constrain electrical properties and link absorption features with material composition observed by Ma_MISS/Enfys. These methods will be tested on RIMFAX, RoPeR, and WISDOM field datasets.
- Adaptation of seismology processing tools for GPR data interpretation, exploring methodological cross-fertilization.

Impact:

- Creation of a database of surface roughness parameters, permittivity measurements, and electrical loss values across temporal and spatial scales → improving understanding of Martian near-surface electrical properties.
- Cross-correlation of permittivity measurements with other surface datasets → enhancing multi-instrument data integration and interpretation.
  Delivery of a comparative analysis of WISDOM with previous Martian radar instruments → identifying strengths, limitations, and implications for future Mars mission designs.

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: The candidate will be hired by University of Versailles Saint-Quentin-en-Yvelines (UVSQ, France) but the PhD degree will be awarded by the University Paris-Saclay (UPS).

ExoMars instrument team: WISDOM

Supervisor: Valerie Ciarletti (valerie.ciarletti@latmos.ipsl.fr)

Co-supervisor: Alessandro Frigeri (alessandro.frigeri@inaf.it)

DC6: Comparative Analysis and Optimization of Spectrometers for Mars Exploration

Context:

Raman spectroscopy is essential for detecting and characterizing minerals and their hydration states, making it a key tool for planetary missions targeting Martian (sub)surface exploration. Its ability to link mineralogy with biosignature preservation has led to its inclusion in Mars 2020 (SuperCam and SHERLOC) and ExoMars (RLS) missions, as well as the development of prototypes for future missions like PANGAEA (INTA) and DISCO (IMS). These instruments are often used in cooperation with complementary techniques, such as LIBS (SuperCam), X-ray fluorescence (XRF, PIXL), and NIR (MicrOmega), to provide a comprehensive view of Martian mineralogy at the micrometer scale.

Scientific challenges:

Despite the varying configurations of Raman instruments significantly influencing their analytical capabilities, a comprehensive comparison of their outcomes and cooperative use with complementary techniques remains unexplored.

Research objectives:

- Compare Raman spectrometers and prototypes from past, present, and future missions using terrestrial analogues;
- Evaluate the benefits of cooperative analyses with complementary techniques on current and future missions;
- Develop and validate protocols integrating RLS with complementary ERF spectrometers for enhanced qualitative analysis of complex mineral mixtures.

Impact:

- Comprehensive comparison of Raman spectrometers from past, present, and future missions (Optimizes instrument configurations for planetary exploration);
- Validated protocols for integrating RLS with complementary techniques (Enhances mineralogical analysis for ExoMars and future missions);
- Demonstrated benefits of cooperative analyses (Refines workflows for robust mineral characterization and biosignature detection).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: Universidad de Valladolid (Spain)

ExoMars instrument team: RLS

Supervisor: Marco Veneranda (marco.veneranda@uva.es)

Co-supervisor: Olga Prieto Ballesteros (prietobo@cab.inta-csic.es)

DC7: Monitoring the dehydration of drill tailings from Martian subsurface sampling

Context:

Detecting hydrated minerals is key to astrobiology, as these minerals indicate past water activity and potential habitability on Mars. Previous missions using multispectral cameras (e.g., MastCam and MastCam-Z) have successfully identified hydrated minerals in surface rocks. The ERF's survey instruments will enable monitoring of drill tailings, providing a unique chance to observe dehydration and hydration reactions in subsurface materials exposed to Martian surface conditions.

Scientific challenges:

Although potential alteration processes could compromise the optimal mineralogical interpretation of drill tailings, very little is known about the capability of PanCam and Enfys to detect the kinetics of mineral reactions under Martian conditions.

Research objectives:

- Simulate mineral alteration kinetics under Mars-like conditions in a laboratory setting;
- Use grain-size monitoring as a proxy for hydration reactions, correlating particle size changes with hydration/dehydration progress; and
- Explore synergies between PanCam and Enfys and other ERF survey instruments to improve hydration signal monitoring.

Impact:

- Develop a framework for monitoring (de)hydration reactions in Martian drill tailings using VNIR spectroscopy (improve analysis of subsurface mineral reactions on Mars);
- Provide insights into the behavior of Martian minerals (deepen understanding of Mars environmental evolution);
- Implement protocols during the RF mission, establishing best practices for integrating survey instruments (enhance scientific return from drilling and set standards for future missions).

English requirements: Applicants must have a good command of the English language. If English is not the applicant's first language, they must demonstrate proficiency in all four components (reading, writing, listening, and speaking). The host institution requires a minimum IELTS overall score of 6.5, with no less than 6.0 in any individual component, or an approved equivalent qualification. Overseas applicants must provide evidence of English language proficiency certified by a provider approved by UK Visas and Immigration (UKVI) and submit the corresponding certificate and grades as part of their application.

Hiring institution: Mullard Space Science Lab., University College London (United Kingdom)

ExoMars instrument team: PANCAM

Supervisor: Louisa Preston (l.preston@ucl.ac.uk)

Co-supervisor: Peter Grindrod (p.grindrod@nhm.ac.uk)

DC8: Monitoring the alteration of drill cores from Martian subsurface sampling

Context:

Accurately determining the composition of Martian subsurface materials is essential for evaluating Mars' geological history and habitability potential. Although the ExoMars Rosalind Franklin rover's drill cores are protected from direct environmental exposure, they may still experience alteration due to frictional heating during drilling and subsequent crushing processes, potentially affecting scientific analysis.

Scientific challenges:

By comparing spectroscopic data from Ma_Miss (at the drill tip) with those collected on crushed samples by MicrOmega and RLS, researchers can assess alteration effects from sample handling and develop strategies to reduce impact. However, these collaborative practices have yet to be systematically tested.

Research objectives:

- Identify potential mineral dehydration, alteration and structural changes during drilling and crushing of the sampled core;
- Develop a protocol for detecting dehydration and sample alteration;
- Integrate datasets from ERF spectrometers to improve subsurface geological interpretations.

Impact:

- Develop advanced methodologies for estimating mineral abundance via NIR spectroscopy
- Develop automated protocols for cross-comparison of complementary color data and spectroscopic data (improve accuracy in detecting sample alterations);
- Enhance the scientific return of the ExoMars mission, serving as a reference for future drilling missions (maximize insights gained from in-situ analysis);
- Provide a holistic understanding of stability and alteration dynamics of Martian subsurface materials (deepen knowledge of Martian subsurface conditions and processes).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution The candidate will be hired by the Sapienza University of Rome (LSU, Italy), while the Istituto Nazionale di Astrofisica (INAF-Rome) will act as the hosting institute.

ExoMars instrument team: Ma_Miss

Supervisor: Francesca Altieri (Francesca.Altieri@inaf.it)

Co-supervisor: Maria-Paz Zorzano Mier (maria-paz.zorzano.mier@ltu.se)

DC9: Developing Quantification Methods for Mineral Analysis Using Raman and NIR Spectroscopies

Context:

Spectroscopic techniques like Raman and NIR have been instrumental in recent Mars missions for mineralogy, with instruments such as SuperCam and SHERLOC on Mars 2020 advancing our understanding by identifying diverse minerals and potential biosignatures. The ERF mission will enhance this approach by enabling cooperative analysis between RLS and MicrOmega. Unlike previous instruments, RLS and MicrOmega are designed to generate extensive datasets that may allow mineral abundance estimation.

Scientific challenges:

Although the quantification capability of RLS has been partly assessed, the potential for MicrOmega to provide quantitative data remains largely untested.

Research objectives:

- Develop quantification methods for estimating mineral abundances from NIR images collected by MicrOmega;
- Evaluate the complementarity of NIR-derived estimates with RLS and MOMA results;
- Determine how semi-quantitative analysis enhances the scientific value of spectroscopic data over traditional qualitative methods.

Impact:

- Develop advanced methodologies for estimating mineral abundance via NIR spectroscopy (improve precision in identifying key Martian minerals);
- Enhance MicrOmega- RLS- MOMA coordinated science capabilities (increase data quality and reliability in ERF mission results);
- Establish benchmarks demonstrating the advantages of semi-quantitative over qualitative spectroscopic analysis (set new standards for mineralogical studies in future Mars missions).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: Université Paris-Saclay (France)

ExoMars instrument team: MicrOmega

Supervisor: Cedric Pilorget (cedric.pilorget@universite-paris-saclay.fr)

Co-supervisor: Mathieu Vincendon (mathieu.vincendon@universite-paris-saclay.fr)

DC10: Developing a Polarimetric Radargram Library for Subsurface Analysis with GPR

Context:

Selecting optimal drilling sites on Mars relies on GPR data, which provides crucial insights into geological context and possible water or ice presence. Compared to past GPR instruments like RIMFAX (Perseverance) and RoPer (Zhurong), Wisdom offers the highest-resolution imaging of the shallow subsurface (up to 3 meters). Its dual polarimetric mode further enables it to characterize subsurface features (e.g., boulders, voids, layers) by providing additional data on shape, orientation, and dielectric properties.

Scientific challenges:

Despite the importance of GPR data, interpreting Wisdom's polarimetric data requires a systematic approach that has yet to be fully developed.

Research objectives:

- Create and evaluate GPR simulations for targets of varying shapes, orientations, sizes, and permittivity to establish a radargram signature library;
- Validate simulations through lab and Mars-analog field tests;
- Compare Wisdom's scientific output with previous mission GPRs;
- Integrate GPR data with complementary analytical instruments.

Impact:

- Create a comprehensive polarimetric radargram library (improve subsurface feature interpretation by Wisdom);
- Optimize drilling location selection to enhance the scientific return of the ERF rover (maximize mission efficiency and insights);
- Develop data analysis workflows for GPR (standardize and elevate GPR practices in planetary exploration).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: Technische Universität Dresden (Germany)

ExoMars instrument team: WISDOM

Supervisor: Dirk Plettemeier (dirk.plettemeier@tu-dresden.de)

Co-supervisor: Valerie Ciarletti (valerie.ciarletti@latmos.ipsl.fr)

DC11: Characterization, optimization and interpretation of GC-MS analyses for Organic Detection on Mars

Context:

GC-MS has been essential in Mars astrobiology missions, such as Viking and Mars Science Laboratory, for detecting organic molecules. While highly effective, past missions analyzed only top surface materials, where harsh Martian environmental conditions likely degrade organic biosignatures. The MOMA instrument on the RF rover is the first to access subsurface samples, where organic molecules may be better preserved, improving detection prospects.

Scientific challenges:

MOMA allows flexible extraction of organics from Martian samples, but a detailed assessment of how different preparation methods, performed on a variety of samples (composed of different inorganic phases), affect GC-MS results remains partially unaddressed.

Research objectives:

- Develop a database of organic compounds and their pyrolysis behavior under MOMA-like conditions;
- Evaluate how different sample preparations (pyrolysis, chemical derivatization) applied to a viariety of Mars analogue samples, impact the detection and identification of organics; and
- Refine GC-MS parameters to optimize sensitivity and accuracy.
- Compare MOMA's scientific output with previous Mars GC-MS instruments.

Impact:

- Build a comprehensive GC-MS reference signal library (this will improve identification of organic molecules on the RF mission);
- Enhance RF rover capability to detect organics in Martian subsurface samples (enhance life detection capability of the RF mission);
- Provide novel insights on GC-MS for past (Viking, Mars Science Laboratory) and future astrobiology missions (advance organic detection techniques in planetary exploration. as the DraMS instrument onboard the Dragonfly mission to Titan).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: The candidate will be hired by University of Versailles Saint-Quentin-en-Yvelines (UVSQ, France) but the PhD degree will be awarded by the University Paris-Saclay UPS.

ExoMars instrument team: MOMA

Supervisor: Cyril Szopa (Cyril.szopa@latmos.ipsl.fr)

Co-supervisor: Caroline Freissinet (Caroline.freissinet@latmos.ipsl.fr)

DC12: Novel solutions to Discriminate Biominerals from Abiotic Equivalents

Context:

Pyrolysis has been crucial in astrobiology missions like Viking and Curiosity, heating samples to release organics for analysis. Recent studies suggest it can also help differentiate biominerals (formed by biological processes) from abiotic minerals due to unique physic-chemical properties that can induce distinct thermal decomposition behavior during pyrolysis.

Scientific challenges:

Although this method could be vital for detecting biosignatures, detailed pyrolytic characterization of biominerals has never been attempted by pyrolytic units for astrobiology purposes.

Research objectives:

- Analyze biotic and abiotic minerals using pyrolysis techniques, including DTA-GC-MS and RE-GC-MS;
- Examine organic matter entrapment and release from mineral structures;
- Develop a statistical approach to optimize biomineral discrimination; and
- Evaluate the role of complementary spectroscopic techniques in identifying abiotic minerals.

Impact:

- Create a database of thermal degradation and organic release for biominerals and abiotic organo-minerals (provide new routes to distinguish biosignatures on Mars);
- Enhance MOMA's capabilities for life detection and coordinated operations with RLS and MicrOmega (improve decision-making and efficiency during RF operations);
- Provide methodologies to advance pyrolytic instruments in future astrobiology missions (strengthen scientific outcomes in future planetary exploration missions).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: Université Paris Cité (France)

ExoMars instrument team: MOMA

Supervisor: Fabien Stalport (fabien.stalport@lisa.ipsl.fr)

Co-supervisor: William B. Brinckerhoff (William.b.brinckerhoff@nasa.gov)

DC13: Developing Spectral Analysis Tools for Trace Organic Detection and Biosignature recognition in Geological Mixtures

Context:

The detection of organic biosignatures on Mars is closely tied to the mineral composition of samples, with phyllosilicates being key due to their ability to adsorb and protect organics from UV radiation. Formed through prolonged water-rock interactions, phyllosilicates suggest past habitable conditions, making these regions priority targets for astrobiology missions.

Scientific challenges:

Despite heavy reliance on spectroscopic instruments, few studies have assessed their capacity to detect trace organics within complex Martian-like mineral mixtures. Additionally, the impact of UV-induced alteration on organic signatures and differentiation between biosignatures and abiotic molecules remains poorly understood.

Research objectives:

- Define spectrometer detection limits for trace organics in complex mineral matrices;
- Examine phyllosilicates' role in preserving organics under harsh conditions; and
- Develop cooperative-science protocols to reliably differentiate altered biosignatures from abiotic signals.

Impact:

- Develop advanced methodologies for estimating mineral and organic abundance via NIR spectroscopy (improve precision in identifying key Martian minerals);
- Develop advanced spectral analysis tools for detecting trace organics in Martian mixtures (improve biosignature identification accuracy);
- Establish protocols for distinguishing organic biosignatures from abiotic compounds (enhance reliability in biosignature detection).
- Strengthen Ma_Miss, RLS, and MicrOmega (synergy with DC15) capabilities and provide insights from comparisons with instrument used in previous missions (optimize combined strategies for future missions).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: The candidate will be hired by the Sapienza University of Rome (LSU, Italy), while the Istituto Nazionale di Astrofisica (INAF-Rome) will act as the hosting institute.

ExoMars instrument team: Ma_Miss

Supervisor: Maria Cristina De Sanctis (Mariacristina.desanctis@inaf.it)

Co-supervisor: Cedric Pilorget (cedric.pilorget@universite-paris-saclay.fr)

DC14: Investigating Organic-Mineral Interactions for Biosignature Detection Using Spectroscopic Techniques

Context:

Studies have shown that organic molecules can bind to mineral surfaces, causing measurable changes in the vibrational modes of phyllosilicates, which affect Raman and NIR spectra. These spectral shifts can potentially signal organics, even at low concentrations, making them valuable in astrobiological detection.

Scientific challenges:

Despite these findings, comprehensive assessments of rover instruments' capabilities to detect these spectroscopic indicators under Martian conditions are lacking.

Research objectives:

- Explore how phyllosilicates protect adsorbed organics from degradation;
- Analyze perturbations in Raman and NIR spectra from organic-mineral interactions;
- Assess Mars-relevant spectrometers' sensitivity to these indicators; and
- Develop integrated analysis procedures between RLS and MicrOmega to enhance detection on Mars missions.

Impact:

- Deepen understanding of phyllosilicates' role in preserving organic biosignatures under Martian conditions (improve biosignature detection accuracy);
- Advance knowledge of spectroscopic perturbations from organic-mineral interactions and develop inter-instrumental detection strategies; (enhance life-detection capabilities of current and future missions to Mars);
- Provide a comparison of biosignature detection capabilities across spectroscopic techniques and their combinations (optimize instrument strategies for biosignature detection).

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: Universidad de Valladolid (Spain)

ExoMars instrument team: RLS

Supervisor: Jose Antonio Manrique (joseantonio.manrique@uva.es)

Co-supervisor: Teresa Fornaro (teresa.fornaro@inaf.it)

DC15: Enhancing Cooperative Spectroscopic Analysis for Biosignature Detection on Mars

Context:

Spectroscopic instruments are critical for astrobiology on Mars. The Perseverance rover uses SuperCam for remote Raman-VISIR and LIBS analysis, while SHERLOC and PIXL perform close-range Raman and XRF analyses. The ERF's RLS and MicrOmega offer a cooperative approach: MicrOmega maps powdered samples and identifies regions of interest (ROIs) like phyllosilicates, which the RLS can then target for detailed analysis.

Scientific challenges:

While RLS and MicrOmega have been studied individually, their combined potential remains largely unexplored, limiting their effectiveness in biosignature detection.

Research objectives:

- Simulate RLS, MicrOmega and MOMA cooperative science;
- Develop procedures to enhance ROI detection and characterization; and
- Evaluate this integrated method against previous mission techniques.

Impact:

- Upgrade MicrOmega methods to improve ROI detection (enhance targeting precision for potential biosignatures);
- Develop validated co-aligned procedures for RLS-MicrOmega-MOMA (boost cooperative detection capabilities and RF mission scientific output);
- Optimize protocols for future spectroscopic instruments in astrobiology missions (improve scientific outcomes in upcoming exploration efforts)

English requirements: Applicants must have a good command of the English language. English proficiency will be assessed during the interview stage for shortlisted candidates. No formal language certificate is required to apply to this DC position.

Hiring institution: Université Paris-Saclay (France)

ExoMars instrument team: MicrOmega

Supervisor: Cedric Pilorget (cedric.pilorget@universite-paris-saclay.fr)

Co-supervisor: Guillermo Lopez Reyes (guillermo.lopez@uva.es)

Donia Baklouti (donia.baklouti@universite-paris-saclay.fr