## Instructions for the Applicant

## 

This template shall be used to fill in the project description by the *applicant under the call 09I03-03-V04 – Fellowships for excellent researchers R2-R4.* The structure of this form **must be maintained.** It is prepared to allow an efficient, transparent and fair evaluation of each application. Parts 1, 2 and 3 are identical to the evaluation criteria. Only complete applications, which address all the mandatory parts set out in this template and in the call, will be included in the evaluation process. If an application is approved, major changes in the content of the project will not be possible.

The description of the project shall not exceed 30 pages. All tables, numbers, references or other relevant information must be included in the project description and count towards the total page limit. The maximum limit must not be circumvented by inserting external hyperlinks. Content that exceeds the allowed page limit will not be taken into account and will not be subject to peer review, so it is recommended to comply with the maximum page limit.

Formal requirements for the description of the project:

The prescribed font to use in the description of the project is Times New Roman or Arial, minimum size 11. A font size of 10 is allowed in the tables; the applicant should not circumvent the page limit by artificially replacing the text with tables.

The size of the page is A4 with edges of at least 1.5 cm. Page numbering should be maintained.

Delete all instructions in this template highlighted in grey before the application is submitted.

Project description (template) for call 09I03-03-V04 Fellowships for excellent researchers R2-R4

Content[[1]](#footnote-2)

[Instructions for the Applicant 1](#_Toc137228923)

[1. Excellence 2](#_Toc137228924)

[1.1 PROJECT OBJECTIVES 2](#_Toc137228925)

[1.2 RELEVANCE, QUALITY AND NOVELTY OF THE PROJECT 2](#_Toc137228926)

[1.3 METHODOLOGY 2](#_Toc137228927)

[1.4 EXCELLENCE OF THE RESEARCHER 2](#_Toc137228928)

[1.5 EXCELLENCE OF THE APPLICANT/HOST ORGANISATION 2](#_Toc137228929)

[2. Impact 2](#_Toc137228930)

[2.1 THE WIDER IMPACT OF THE PROJECT 2](#_Toc137228931)

[2.2 MEASURES TO MAXIMISE IMPACT – DISEMINATION AND COMMUNICATION, EXPLOITATION OF RESULTS 2](#_Toc137228932)

[3. Implementation 2](#_Toc137228933)

[3.1 PROJECT PLAN AND DELIVERABLES 2](#_Toc137228934)

[3.2 IMPLEMENTATION RISKS AND PROPOSED MEASURES 2](#_Toc137228935)

[3.3 OPERATIONAL CAPACITY OF THE APPLICANT/HOST ORGANISATION 2](#_Toc137228936)

Title of the project:

Short title of the project/Acronym: *max. 50 characters*

Category of researcher: Select an item.

Researcher’s job type (full-time, part-time – in %):

Type of research[[2]](#footnote-3): independent, basic, industrial

Identification of the entity involved in the implementation of the project:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Official name of the entity | Abbreviated name of the entity  Please indicate the short name of the entity that you will use throughout the application, max. 15 characters | Role in the project |
| 1 | Mathematical Institute of the Slovak Academy of Sciences | MISAS | Applicant/host organisation |

## 1. Excellence

*Specific aspects that are relevant for this section*:

*The quality and adequacy of the proposed objectives of the project.*

*Relevance of the problems/needs the project is focused on.*

*How the project goes beyond the currently available solutions, procedures, etc. (“beyond the state of the art”).*

*Appropriateness, timeliness and relevance of the proposed methodology to the objectives of the project.*

*The quality and adequacy of the researcher’s professional experience, expertise, competences and skills.*

*The quality and adequacy of the host organisation in relation to the project and the researcher.*

*The quality and adequacy of the conditions that the host organisation will ensure and provide for the researcher (e.g., additional training, supervision/mentoring, possibilities to build its own research team, etc.).*

*The quality of two-way knowledge transfer between the researcher and the host organisation.*

### 1.1 PROJECT OBJECTIVES

Describe objectives of the project – they should be clearly defined, realistic, measurable and achievable in the implementation of the project. For each objective, please also indicate how it will be verified and evaluated.

1.2 RELEVANCE, QUALITY AND NOVELTY OF THE PROJECT

*Please briefly describe the current state in the area the project will focus on. How will the planned activities of the project address problems and challenges in this area? Why is necessary/appropriate to deal with such a project?*

*How does the project go beyond the currently available solutions, procedures, etc.? What makes it original and innovative?*

*Describe the link between the project and its activities with the European Research Area.*

1.3 METHODOLOGY

*Describe how the project will be implemented. Describe the methods and procedures used in each activity and their appropriateness and interconnection. Describe the concepts, models, assumptions underlying the proposed project methodology.*

*Describe how the proposed methods and procedures will ensure the achievement of the project’s objectives.*

*Describe possible challenges in the implementation of the project in relation to the methodology and the proposed way to overcome them.*

*Describe the use and management of research data and other research outputs within the project. If the project collects data and/or other research outputs (except publications), how the data/outputs of the research will be managed. Describe how open science principles are integrated in the project.*

*Describe how the following aspects are taken into account in the project: multi- and interdisciplinary approach, principles of open science, FAIR access to research data, gender equality in research.*

1.4 EXCELLENCE OF THE RESEARCHER

Describe the quality and adequacy of the researcher’s professional experience and expertise in relation to the proposed project. Please support the description by the CV below.

Curriculum Vitae

**Personal information**

First and last name:

Identifier (*ORCID or Researcher ID or other – specify)*:

Date of birth:

Nationality:

Website (if relevant):

**Education**

MM/YYYY – PhD

Name of Faculty/ Department, Name of University/ Institution, Country

MM/YYYY – Master/Doctor

Name of Faculty/ Department, Name of University/ Institution, Country

**Current position/positions**

MM/YYYY – name/description of current position 1

Name of Faculty/ Department, Name of University/ Institution, Country

MM/YYYY – name/description of current position 2

Name of Faculty/ Department, Name of University/ Institution, Country

**Previous positions**

MM/YYYY – MM/YYYY – name/description of previous position 1

Name of Faculty/ Department, Name of University/ Institution, Country

Mm/YYYY – MM/YYYY – name/description of previous position 2

Name of Faculty/ Department, Name of University/ Institution, Country

**Scholarships and awards**

MM/YYYY – MM/YYYY – Scholarship 1 – Name of Faculty/ Department/ other, Name of University/ Institution, Country

YYYY – award – Organisation name, Country

MM/YYYY – MM/YYYY – Scholarship 2 – Name of Faculty/ Department/ other, Name of University/ Institution, Country

Student and post-docs supervision (if applicable)

YYYY – YYYY - Number of Postdocs/ PhD/ Master Students

Name of Faculty/ Department/ other, Name of University/ Institution, Country

**Teaching activities (if applicable)**

YYYY – teaching position 1 – Topic, Name of University/ Institution, Country

YYYY – YYYY – teaching position 2 – Topic, Name of University/ Institution, Country

**Organisation of scientific meetings (if applicable)**

YYYY – describe your role and name of the event, the number of participants, Country

**Institutional responsibilities (if applicable)**

YYYY – Faculty member, Name of University/ Institution, Country

YYYY – YYYY – Graduate Student Advisor, Name of University/ Institution, Country

YYYY – YYYY – Member of the Faculty Committee, Name of University/ Institution, Country

YYYY – YYYY – Organiser of the Internal Seminar, Name of University/ Institution, Country

YYYY – YYYY – Member of a Committee; role, Name of University/ Institution, Country

**Reviewing activities (if applicable)**

YYYY – Scientific Advisory Board, Name of University/ Institution/ Publisher, Country

YYYY – Review Board, Name of University/ Institution/ Publisher, Country

YYYY – Review Panel member, Name of University/ Institution/ Publisher, Country

YYYY – Editorial Board, Name of University/ Institution/ Publisher, Country

YYYY – Reviewer, Name of University/ Institution/ Publisher, Country

YYYY – Scientific Evaluation, Name of University/ Institution/ Publisher, Country

YYYY – Evaluator, Name of University/ Institution/ Publisher, Country

**Memberships of scientific societies (if applicable)**

YYYY – Member, Research Network “Name of the Research Network”

YYYY – Associated Member, Name of Faculty/ Department/Centre, Name of University/ Institution, Country

YYYY – Founding Member, Name of Faculty/ Department/Centre, Name of University/ Institution, Country

**Major collaborations (if applicable)**

Name of collaborators, Topic, Name of Faculty/ Department/Centre, Name of University/ Institution, Country

**Overview of the researcher’s most important projects in the last 5 years** (max. 5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Project name/identification** | **Source of funding** | **Budget (EUR)** | **Project period** | **The role of the researcher in the project** |
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**Overview of the researcher’s most important outputs** (max. 5)

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| --- | --- | --- | --- |
| **Output name/identification** | **Type of output** *(e.g., publication, dataset, software, patent, service, product, etc.)* | **Short description** | **The role of the researcher** |
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Briefly describe your most important research and/or innovation achievements.

1.5 EXCELLENCE OF THE APPLICANT/HOST ORGANISATION

Describe the applicant/host organisation and its excellence.

*What is the comparative advantage of implementing this project within the given host organisation, why is the applicant the ideal hosting organisation to implement the project?*

*Describe the conditions that the applicant/host organisation will create and provide for the researcher for the implementation of the project. In the case of supervision/mentoring, describe the person of the supervisor/mentor, his/her quality and adequacy in relation to the researcher and the project.*

*Describe the conditions the researcher will be provided with to build his/her own team (particularly relevant for R3 and R4 researchers’ categories).*

*Describe the quality and how two-way knowledge transfer between the applicant/host organisation and the researcher will be ensured.*

Mathematical Institute of the Slovak Academy of Sciences is a scientific institute focused mainly on basic research in mathematics and theoretical informatics. The Institute has a long tradition in several important branches of pure and applied mathematics and participated in a number of successful projects in both basic and applied research, including projects of Frame Projects of EU, Structural projects of EU, and projects of domestic agencies APVV and VEGA. The researchers of the Institute belong to the top in their research, in a world-wide context, and are engaged in multiple collaborations with experts from internationally renowned institutions. In collaboration with the Commenius University, the Institute organises a PhD study program and many young scientists and students use the Slovak fellowship program SAIA for short term study stays at the institute.

MI SAS has a strong tradition in mathematical foundations of quantum theory and is one of the world-wide most important centers of research in Quantum Structures. Of the current researchers, Anatolij Dvurečenskij and Silvia Pulmannová are leading experts in this field. They are both former presidents of the International Quantum Structures Association (IQSA), they co-authored a fundamental monograph in this field (New Trends in Quantum Structures) and contributed hundreds of papers in top journals with thousands of citations. Furthermore, Anna Jenčová is an internationally renowned expert in quantum foundations and quantum information theory, both in finite dimensional setting and in von Neumann algebras, with emphasis on various generalizations of relative quasi-entropies and their connection to properties of quantum states and channels, which is very close to the research topics of the project. She authored and co-authored more than 50 papers, many of which were published in top mathematical physics and quantum information theory journals. She was awarded the Birkhoff-von Neumann prize of the IQSA in 2014.

The institute is well equipped with all the standard hardware and software needed for mathematics research, including quality equipment for online presentation and communication. The library of Mathematical Institute SAS belongs to the best mathematical libraries in Slovakia, with access to the most important scientific databases. Furthermore, the Slovak Academy of Sciences provides access to a supercomputer.

The researchers of the institute are well connected with world-wide experts in their respective branches. In the field of Quantum structures and quantum information theory, the Institute has a close connection to neighbouring institutions such as the Slovak Technical University in Bratislava and Palacký University in Olomouc. In particular, extensive collaboration with the group of Mario Ziman and Michal Sedlák from the Research Center for Quantum Information at the Institute of Physics of SAS has brought several successful joint projects. The institute organizes long-term established seminars, such as the seminar on Quantum structures, with invited talks by distinguished scientists. Recently, a less formal seminar on Category theory and applications in quantum mechanics is organized on weekly basis, including participants from Slovak Technical University and Palacký University, which is ideal for exchanging ideas and discussions. These seminars establish an excellent opportunity for communication and knowledge transfer between researchers from and outside of MISAS.

## Impact

*Specific aspects that shall be taken into account in this section:*

*The credibility of the proposed procedures, the likelihood that the project will achieve the expected results and will have the expected impact.*

*The assumption of a positive impact on the further career of the researcher, the assumption of a positive impact on the applicant/host organisation.*

*The significance of the expected impact – on the given area of knowledge and the scientific community, on the economy, on society, on the environment.*

*Adequacy of expected results and impact of the project – qualitative and quantitative.*

*The appropriateness and quality of the proposed measures to maximise the results and impact of the project.*

*The quality of the proposed intellectual property rights management strategy for project results (if applicable).*

### 2.1 THE WIDER IMPACT OF THE PROJECT

Describe the expected impact of the project in the short, medium and long term. What impact will the implementation of the project have beyond its direct scope and after completion of its implementation?

Describe the impact of project implementation on the researcher’s further career and the development of his/her skills.

Describe the impact of the project implementation on the applicant/host organisation.

Identify the individual target groups that will benefit from the activities and achievement of the project objectives, describe the impact of the project on these groups.

Describe the direct and relevant scientific, economic, environmental, societal impact of the project (or other, if relevant).

Identify and describe the potential negative impact of the project and what the proposed measures to eliminate/mitigate it are.

Describe the specific expected results and impacts of the project activities (qualitative and quantitative), which will bring significant and direct benefits measurable within the monitored data.

Monitored data may include, for example:

* + number of excellent students, PhD candidates and researchers implementing the project;
  + number of patent applications;
  + number of publications;
  + number of collaborations (international, with private sector, application sphere),
  + Others.

When designing project results and impact as part of the monitored data, describe the basis on which the estimate, benchmarks, statistical data, etc. were made.

* Potential obstacles to the planned impact of the project

Describe potential barriers, conditions (e.g., legislative, competition or others that go beyond the scope and duration of the project) that may affect the desired results and impact. Identify whether these factors can evolve over time and the ways you address them.

(This does not include the implementation risks of the project, which will be described below)

### 2.2 MEASURES TO MAXIMISE IMPACT – DISEMINATION AND COMMUNICATION, EXPLOITATION OF RESULTS

*What tools and measures do you choose to maximise the impact of project results and deliverables? Describe what communication and sharing tools you will use, list the planned communication activities and target audience that will be targeted both during and after the project.*

*(In the planned communication activities, take into consideration the target groups and how to reach them through different tools)*

*How will possible technology transfer, commercialisation of project outputs, etc. be ensured?*

Describe the measures to exploit the results of the project even after its completion. Describe the measures for the use of research data and other research outputs after the completion of the project implementation.

*If relevant, describe the strategy for managing intellectual property rights in relation to the results of the project. How will their protection and the possibility of commercial use be ensured? Please briefly describe what requirements will need to be met in order for the results of the project to be exploited by intellectual property and how you intend to meet these conditions.*

## Implementation

*Specific aspects that shall be taken into account in this section*:

Quality and efficiency of the project plan, feasibility of planned activities.

The coherence and logical framework of the work packages and the adequacy of the resources allocated to them, the adequacy of the proposed milestones and deliverables.

Estimation of implementation risks, quality of proposed measures.

Capacities (personnel, professional, technical, infrastructure, other) of the applicant/host organisation.

3.1 PROJECT PLAN AND DELIVERABLES

Describe the overall structure of the project plan, which consists of individual work packages, their interconnection, logical and chronological relation.

Describe the timeline of the project – specify project duration and the time frame for the implementation of each work package (e.g., Gantt diagram).

Describe the planned work packages (template of the table below) and add a separate table for each work package. The number of work packages should reflect the scale and complexity of the project.

3.1.1 Work packages

Template of the table for the work package (1 work package = 1 table):

|  |  |
| --- | --- |
| Work package number |  |
| Title of the work package | Provide the name of the work package, which will have a maximum of 20 characters. This name should be stated same throughout the application and its annexes. |
| **Start of implementation of the work package (Mx Month[[3]](#footnote-4))** |  |
| End of implementation of the work package (Mx month) |  |
| **Involvement (expressed in Person Months)[[4]](#footnote-5)** |  |
| **Personnel costs (in EUR)[[5]](#footnote-6)** |  |
| Other eligible costs, excluding personnel costs (in EUR excluding VAT) |  |
| Objectives | |
|  | |
| Description of the work package | |
| Where appropriate, please also provide a breakdown per task level. | |
| Deliverables | |
| Identify deliverables in numbered list and describe each deliverable in more detail | |

3.1.2 List of work packages (template):

|  |  |  |  |
| --- | --- | --- | --- |
| Work package number | Title of the work package | **Start of activities** *(specify month of project implementation)* | **End of activities** *(specify month of project implementation)* |
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3.1.3 List of deliverables (template):

Mandatory deliverables shall be at least:

* Interim report on the implementation and achievements of the project submitted at mid-term of project implementation
* Final report on the achievements of the project presented at the end of the project implementation
* Researcher’s publications in scientific and/or professional journals
* Outputs in the conference proceedings with the active participation of the researcher
* Submission/award of a research project(s)/grant(s) with the involvement of the researcher

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Deliverable number | Deliverable | Work package number | Type | Access and dissemination | Method of verification | Delivery (project implementation month) |
|  |  |  | Report, publication, prototype, software, patent, other (please specify) ... | P= public  N= non-public, limited only to team/host organisation, grant provider for reporting purpose |  |  |
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The applicant shall define the number of planned mandatory deliverables and define other deliverables relevant to its project.

3.1.4 List of milestones (template):

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| --- | --- | --- | --- | --- |
| Milestone number | Milestone | Work package number | Method of verification | Expected time to reach the milestone (project month) |
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3.2 IMPLEMENTATION RISKS AND PROPOSED MEASURES

Describe the approach to risk management in the implementation of the project.

3.2.1 Risks of implementation (template):

|  |  |  |
| --- | --- | --- |
| **Description of the risk of implementation[[6]](#footnote-7)** | **Work package** *(one or more)* | Proposed measures for risk mitigation or elimination |
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3.3 OPERATIONAL CAPACITY OF THE APPLICANT/HOST ORGANISATION

Describe the capacities (staff, professional, technical, infrastructure and others) of the applicant/host organisation that are necessary for the successful implementation of the project. Describe their relevance to the project and how they will be made available to the researcher or how the access to them will be ensured during the implementation of the project.

3.3.1 Description of the research/innovation infrastructure of the applicant/host organisation that is necessary for the implementation of the project (template):

|  |  |
| --- | --- |
| Name of infrastructure or equipment | Short description |
| Office equipment | A desk and a desktop computer, printer, quality hardware for video conferencing |
| DEVANA Supercomputer | The Slovak Academy of Sciences provides access to supercomputer DEVANA with available total performance about 800 Tflop/s (from 1.1. 2024) |
| Library services | Access to the mathematical library of MISAS and library services |
| Access to databases | The Slovak Academy of Sciences provides access to scientific databases such as the Web of Science, Scopus (from 1.1. 2024), Springerlink, ScienceDirect, Mathematical Reviews etc. |
|  |  |

3.3.2 List of the five most important projects of the applicant/host organisation and their relevance to the proposed project (in the last 5 years) (template):

|  |  |  |
| --- | --- | --- |
| Project name/identification | Programme/scheme/grant provider | Short description |
| Mathematical support of quantum technologies/ NFP313011T683 | EU Operational Programme Research and Innovation/ ITMS-2014+ | The main goal of the project is the stabilisation of a quality research team and to realize independent research in the area of quantum technologies. The goals are reached by research of mathematical structures and functions relevant to quantum mechanics. |
| Probabilistic, Algebraic and Quantum Mechanical Methods of Uncertainty Determination/ APVV-20-0069 | Slovak Research and Development Agency (APVV) | Investigation of uncertainty in quantum  structures and elsewhere, by combination of methods of algebra, probability theory, functional analysis, category theory and fuzzy mathematics. Joint with STU.  The aim is the study of mathematical foundation so quantum mechanics and uncertainty using the most up to date methods of quantum structures.  Specific aspects of such structures will be studied using methods of category theory. Uncertainty contained in quantum measurements  will be analysed with focus on applications in quantum information theory. Joint with STU. |
| Mathematical models of non-classical events and uncertainty/ VEGA 2/0142/20 | Scientific Grant Agency of the Ministry of Education of the Slovak Republic and SAS (VEGA) | Mathematical models for quantum structures, quantum information theory and uncertainty. Joint with STU. |
| Designing quantum higher order structures/ APVV-22-0570 | Slovak Research and Development Agency (APVV) | Theoretical study and design of higher order maps – quantum networks. Joint with Institute of Physics, SAS. |
| Probabilistic, Algebraic and Quantum-Mechanical Aspects of Uncertainty/ APVV-16-0073 | Slovak Research and Development Agency (APVV) | The aim of the project is to obtain original research results concerning description of uncertainty related to quantum structures. We focus on the study of total and partial algebraic structures derived from mathematical foundations of quantum mechanics, as well as on the description of quantum states, channels and more general processes and their estimation and discrimination procedures. |

3.3.3 List of maximum five most important outputs of the applicant/host organisation relevant to the submitted project (Template):

|  |  |  |
| --- | --- | --- |
| Output name/identification | **Type of output** *(e.g., publication, dataset, software, patent, service, product, etc.)* | Short description |
| A. Jenčová, Rényi relative entropies and noncommutative Lp-spaces II, Ann. Henri Poincaré 22, 3235–3254 (2021**),**  <https://doi.org/10.1007/s00023-021-01074-9> | Publication (article) | In the setting of von Neumann algebras, sandwiched Rényi relative entropies for ½ ≤ α < 1 are defined and their properties are studied using noncommutative Lp-spaces. |
| A. Jenčová, Rényi Relative Entropies and Noncommutative Lp-Spaces, Annales Henri Poincaré 19, 2513-2542 (2018), <https://doi.org/10.1007/s00023-018-0683-5> | Publication (article) | In the setting of von Neumann algebras, sandwiched Rényi relative entropies for α > 1 are defined and their properties are studied using noncommutative Lp-spaces. |
| A. Jenčová, Reversibility conditions for quantum operations, Reviews in Mathematical Physics, 24(07), 1250016, 2012. <https://doi.org/10.1142/S0129055X1250016X> | Publication (article) | Sufficient (reversible) channels are characterized by preservation of various quantities, such as quasi-entropies, quantum Fisher information and the L1-distance. |
| A. Jenčová, Dénes Petz; Sufficiency in quantum statistical inference; Commun. Math. Phys. 263(2006), 259-276, <https://doi.org/10.1007/s00220-005-1510-7> | Publication (article) | A paper studying sufficient (reversible) channels and their characterizations in the setting of von Neumann algebras. |
| Dvurecenskij, Pulmannová - *New Trends in Quantum Structures, Dordrecht : Kluwer Academic Publishers; Bratislava : Ister Science, 2000. 541+xvi pp. https://doi.org/10.1007/978-94-017-2422-7. ISBN 0-7923-6471-6* | Publication (book) | A fundamental and widely cited monograph describing structures arising in the mathematical description of quantum theory and related areas. |

1. After completion of the document, update the content. [↑](#footnote-ref-2)
2. Choose one type of research. [↑](#footnote-ref-3)
3. The months are indicated ascending from the start of the project, i.e., the month in which the project started is M1. [↑](#footnote-ref-4)
4. In case of involvement of the research team in the project implementation, it is necessary to identify the individual positions, identify the category of researcher R1-R4 for researchers and determine the level of involvement for all members of the research team. [↑](#footnote-ref-5)
5. Where the research team is involved in the project implementation, the personnel costs will include personnel costs of the researcher and the members of the research team. [↑](#footnote-ref-6)
6. Indicate the probability of risk occurrence (low, medium, high) and the severity of the risk (low, medium, high) [↑](#footnote-ref-7)