

**AGREEMENT FOR THE CREATION OF AN
INTERNATIONAL RESEARCH LABORATORY**

“IRL France-Vietnam in Mathematics and its Applications”

FVMA

BETWEEN

The **Centre National de la Recherche Scientifique**, hereinafter referred to as the **CNRS**, a public scientific and technological establishment, having its registered office at 3, rue Michel Ange, Paris 75016, France, represented by its Chairman – Chief Executive Officer, **Prof Antoine Petit**, having delegated its signature for this Agreement to **Prof. Jean-Stephane Dhersin**, Scientific Deputy Director of the Institute of Mathematics of CNRS,

AND

The **Vietnam Academy of Science and Technology**, hereinafter referred to as **VAST**, a national research organization, whose registered address is 18 Hoang Quoc Viet, Cau Giay, Ha Noi, Vietnam represented by its President, Prof. Acad. **Chau Van Minh**,

AND

The **Vietnam Institute for Advanced Study in Mathematics**, hereinafter referred to as **VIASM**, a national research organization, whose registered address is 157 Lane, Chua Lang Street, Ha Noi, Vietnam represented by its Scientific director, Prof. Ngo Bao Chau ;

Hereinafter referred to jointly as the “Parties” or individually as the “Party”,

Preamble

The system of teaching and research in Vietnam has always maintained links with the French system, despite the vicissitudes. The country has a very good level of basic training in mathematics for several decades. In the 1980s, the major influence on mathematics in Vietnam was the one of the soviet school. In the 1990s the Vietnamese and French colleagues in France, under the banner of *Projet International de Coopération Scientifique (PICS)* "Formath Vietnam", began to unite dispersed collaborations that existed between the two countries. The word “Formath” was intended as an abbreviation of “formation en mathématiques” (in french).

This was done with the help of the CNRS, the *Agence Universitaire de la Francophonie (AUF)* and the Embassy of France in Vietnam. Activities undertaken by Formath Vietnam had intended in particular to help to attract to the basic science gifted students who might be tempted by the new economic opportunities, have developed scientific cooperation and have diversified the topics carried out in Vietnam.

The “Laboratoire International Associé Formath Vietnam” (**LIAFV**) was created in 2011 and renewed in 2015 as a continuation and an amplification of these works by a former PICS. Between 2011 and 2018, the scientific cooperation has been very intensive, and improvements have been realized in the following directions:

- (a) an important increase of the number of PhD thesis submitted in France by Vietnamese students,

- (b) a significant number of them have returned to Vietnam to work in the academic system (see below),
- (c) a substantial number of joint publications, many of them partially supported by the LIAFV,
- (d) various activities, including workshops and congresses.

The future “IRL France-Vietnam in Mathematics and its Applications” (as defined in Article 1) will continue to support research visits between France and Vietnam, Master’s programs and its focus on the supervision of theses. It will promote the development of conferences, summer schools and will also support *Centre International de Mathématiques Pures et Appliquées (CIMPA)* schools.

The following has been agreed upon:

Article 1 – Purpose of the Agreement

An international research laboratory is hereby created between the Parties, called: “IRL France-Vietnam in Mathematics and its Applications” or simply “IRL FVMA”, and hereinafter referred to as the “Laboratory”.

Details of the scientific Programme of the Laboratory, hereinafter referred to as the “Programme”, are provided in annex 1, which is attached to this Agreement.

The Laboratory is placed under the joint responsibility of the Parties which provide it with staff and resources. It is located at VIASM 157 Lane Chùa Láng street, Đống Đa and VAST, Institute of Mathematics 18 Hoang Quoc Viet Road, Cau Giay district, 10307. Both institutions are in Hà Nội, Viet Nam.

The CNRS code number of the Laboratory is: IRL 2018.

It is not the purpose nor effect of the Agreement, and nothing herein may be construed in this respect, to form, create, make effective or even acknowledge the creation of a joint venture, a mandate, a company, and interest group or any other commercial group or entity, or a de facto company between the Parties.

Article 2 – Term – Renewal – Termination

This Agreement is executed for a five (5) year term as from 1st January 2023. It may be renewed by amendments for subsequent five (5) year terms.

On exceptional and justified grounds, the Laboratory may be terminated prior to the end of a five (5) year contractual term with a year’s notice. In this case, the Parties shall endeavour to successfully complete the joint initiatives which have been started.

The renewal, or non-renewal, or termination decision is taken by the Parties following an opinion from the Parties’ relevant statutory bodies, the Laboratory Council and Steering Committee as defined hereinafter.

Notwithstanding the expiry or termination of this collaboration, the provisions of articles Publications, Results and Confidentiality shall survive.

Article 3 – Management of the Laboratory

The Director of the Laboratory, hereinafter referred to as the “Director”, is appointed jointly by the Parties for a five (5) year term, renewable on a maximum of one (1) occasion, following the opinion of the relevant statutory bodies. Should the term of office be interrupted, the Director’s replacement shall be appointed according to the same procedure.

On the signature date of this Agreement, the Director of the Laboratory is NGO Bao Chau. The Director is assisted by two Deputy Directors of the Laboratory, hereinafter referred as the “Deputy Directors”, who, on the signature date of this Agreement, are Marc PEIGNE and Minh Hà LÊ. The Deputy Directors are appointed by the Parties for the term of this Agreement.

The Director is responsible for managing all the resources provided to the Laboratory and approves any secondment of staff to the Laboratory and all the resources allocated to the Laboratory by third parties. The Director is responsible for choosing trainee researchers.

At mid-term of this Agreement, the Director drafts an activity report, which is sent to all Parties.

Article 4 – Steering Committee

The Laboratory has a Steering Committee, composed of

4 members representing the Parties, with entitlement to vote:

- Two representatives of CNRS named by the Director of the Institute of Mathematics of CNRS
- a representative of VAST (named by the Director of the Institute of Mathematics, VAST)
- a representative of VIASM

Members, chosen from outside the Parties, appointed by joint agreement between the Parties for their expertise. They sit in an advisory capacity.

The Director and the Deputy Directors assist the Steering Committee in an advisory capacity.

The chairman of the Steering Committee is appointed by the Parties amongst the Steering Committee members. The term of office of the Steering Committee members is five years.

The Steering Committee meets at least once a year at the initiative of the Director and as often the interests of the Laboratory need it at the request of the Director or at the initiative of the Steering Committee members. Should it be impossible to physically hold a Steering Committee meeting, decisions of the Steering Committee may be adopted by teleconferencing or by written or electronically consultation.

The decisions of the Steering Committee are adopted by unanimity with all of its members being present or represented.

The Steering Committee approves the provisional budget and the financial and scientific reports every year.

It makes suggestions concerning the scientific directions of the Laboratory and verifies implementation thereof. It shall:

- assess the Programme’s implementation as well as its status and progress;
- make recommendations as to the research programmes within the Laboratory and the requests for resources required to conduct them;

The Steering Committee may also examine all others matters relating to the Laboratory. In particular and if needed, the Steering Committee can draft rules of procedure for the Laboratory in consistency with the Parties applicable bylaws.

Article 5 – Laboratory Council

5.1. Composition

A General Assembly composed of the all staff is put in place as a Laboratory Council.

5.2. Missions and running

The Laboratory Council, chaired by the Director will be an advisory body. In particular, it will provide its opinion on any measure relating to resources, the organization and operations of the Laboratory and, more generally, on any matter that the Director considers appropriate to refer to it.

The Laboratory Council shall meet at least three times a year and such meetings shall be convened by its chairman, either at his/her initiative, or at the request of a third of its members. Following an invitation from the chairman, it may hear any person involved in the work performed within the Laboratory or called as an expert in respect of an item on the agenda.

As and when required, by-laws dictate the other operating rules.

Article 6 – Allocation of resources

During the term of this Agreement, the Parties shall provide the Laboratory with material research resources, which are not subject to any allocation or which are allocated for specific, jointly defined assignments.

During said term of the Agreement, the Parties shall endeavour to keep these resources at a real level, which is at least equivalent both in terms of staff and credits. Should a reduction in resources seem nevertheless necessary, such must be justified.

The Parties second staff to the Laboratory. A list of the staff allocated to the Laboratory is attached in annex 2 to this Agreement. The Director updates this list every year and forwards it to the Steering Committee.

The Parties shall keep each other mutually informed of staff movements: either Party may, within fifteen (15) days, provide the other with its justified refusal of the secondment of personnel.

In the event of a noticeable increase in the number of staff seconded to the Laboratory, a reassessment of the material resources required is carried out by the Parties together with the Director.

As regards its staff, each Party remains bound by all the responsibilities and obligations relating to its capacity as employer.

The staffs allocated to the Laboratory are subject to the disciplinary procedures in force in the Laboratory, without in any way altering their rights and duties under their respective statuses.

VIASM and VAST provides the Laboratory with premises located in Hanoi, a detailed description of which appears in annex 3 hereto, and ensure the maintenance for which the owner is responsible.

Infrastructure expenses are specified in the provisional budget of the Laboratory, once the Parties have agreed as to their nature and amount.

Article 7 - Publications

7.1. Reference to publications

Publications by the staff allocated to the Laboratory and within the framework of the IRL shall mention the connection with the institutional affiliations:

- Name of author(s)
- France-Vietnam in Mathematics and its Applications **CNRS - VAST - VIASM** International Research Laboratory

7.2. Communication

The Parties wish to improve the visibility of research work and equip themselves with tools enabling the amount of publications and scientific renown of their laboratories to be reliably gauged. To this end, the Parties undertake to implement a system for the filing of researchers' publications in electronic format, in particular, in an open archive system such as HAL.

Moreover, one Party shall be able to ask for a delay in publication or communication of a maximum period of 18 (eighteen) months as and from the demand, if some information contained in such publication or communication have to be protected under industrial property rights.

Article 8 – Laboratory notebooks

The use of laboratory notebooks is mandatory in the Laboratory when this use is not incompatible with the nature of the research activities carried out.

The laboratory notebooks are owned jointly by the Parties.

The Director is responsible for the notebooks' rules of use and in this respect, the Director shall ensure, in particular, that the notebooks are archived.

The Director can authorize copying for the personal use of the authors of the notebooks.

Article 9 – Partnership agreements

The partnership agreements which the Laboratory wishes to conclude with third parties shall be signed by all Parties, unless otherwise agreed upon by the Parties in a written separate mandate.

They will be negotiated then managed by one Party, as designated by the Director.

During the negotiation, a final draft of these agreements shall be communicated to the other Parties who shall be given thirty (30) days to confirm their approval on this version. After this thirty (30) days period, the opinion is deemed to be favourable.

Partnership agreements may be concluded with French or European agencies (e.g. the French National Research Agency (ANR), the European Commission (EC)). In these cases, such agreements and, if any, their affiliated contracts (non-disclosure agreement, consortium agreement, etc.) with French

agencies or European agencies shall be negotiated, signed and managed by the CNRS. Contracts with Vietnamese agencies shall be negotiated, signed and managed by VAST or VIASM.

Article 10: Notifications

Each Party shall identify a designated contact to develop and coordinate the specific activities agreed upon. The designated contacts for the purposes of this Agreement shall be:

- For the CNRS: dr16.SPV@cnrs.fr (CNRS Delegation Paris Michel-Ange Partnership and Research Promotion Office)
- For the VIASM: info@viasm.edu.vn
- For the VAST: vientoan@math.ac.vn

Article 11 - Results

11.1. Ownership of Results

The results, whether patentable or not, which are obtained pursuant to the Agreement, hereinafter referred to as the “Results”, are the joint property of the Parties according to the following principles:

- A fixed share (30%) is allocated equally among the Parties ;
- The remainder (70%) is allocated equally among the inventors’ employers.

Each Party retains ownership of the knowledge acquired by it outside this Agreement.

Each Party is entitled to use, free-of-charge, the Results for the sole purposes of its research and for research collaboration with third parties, to the exclusion of any other direct and/or indirect use for commercial purposes.

Any and all Results consisting of a new patent, software or other knowledge protected by an intellectual property right, shall be subject to rules of co-ownership, that shall be drawn-up in writing between the Parties as soon as necessary and, in all cases, prior to any and all industrial and/or commercial use or exploitation.

Any transfer of ownership of the Results shall require the prior written consent of the Parties.

11.2. Appointment of an Administrator Institution for the protection and exploitation of the Results

For each Result, the Parties designate an Administrator Institution (hereinafter referred as to “Administrator Institution”) to be in charge of the protection and the exploitation of the Results by taking into account the expertise, the relevance of the intellectual property portfolio already owned by each Party.

11.3. Protection of the Results by patent

Patent applications are filed in the joint name of the Parties; the name of the inventor(s) shall be mentioned.

The Administrator Institution has an express mandate from the other Parties to manage the filing of patent applications and for obtaining and maintaining the resulting patents.

The Administrator Institution assumes responsibility for steering and monitoring the priority filing procedure and keeps the other Parties informed of the progress of the application and provides the list of foreign countries in which extensions shall be filed.

Should one of the Parties waive entitlement to file or maintain a patent and/or part of the extensions effective, it shall inform the Administrator Institution thereof within a reasonable timeframe.

In addition, the waiving Party undertakes to sign or get signed any and all documents enabling the other Parties to become sole owners of the said patent(s) in question. The other Parties which continue with the procedure in their own names and shall be the sole beneficiaries of any income generated by use of the patent in the countries for which the other Party waived entitlement to continue with the procedure.

The Administrator Institution shall bear all charges relating to the filing, issue procedure and continuance in force of the jointly owned patents, together with those incurred for any extension abroad.

11.4. Exploitation of the Results

The Administrator Institution receives an express mandate from the other Parties to carry out all exploitation-related work. In particular, it negotiates contracts on behalf of the Parties with all companies wishing to exploit the Results.

The Administrator Institution shall keep the other Parties, regularly informed of the results of the canvassing or its negotiations. Any licensing agreement shall be signed by Administrator Institution, on behalf of the other Parties.

The Administrator Institution shall repay to the other Parties, a proportion of the Net royalties resulting from the exploitation of the Result(s). The repayment proportion is based on the distribution of the joint ownership provided for in Article 11.1. The Net royalties are defined as the royalties resulting from the exploitation of the Result(s) after reimbursement of the proceeding costs paid by the Administrator Institution and less a compensation for the exploitation efforts of the Administrator Institution representing twenty per cent (20%) of the balance after deduction of the proceeding costs.

When the cumulative income of an invention exceeds 500 k€, the Parties may decide to renegotiate between themselves the distribution of income shares, taking into account in particular the costs of accommodation, use of equipment, etc. If no agreement is reached within a maximum period of two months, the distribution provided for in Article 11.1 continue to apply.

11.5. Software

Derived Software without substantial modification

Software created on the basis of prior software owned by one of the Parties (hereinafter “the Existing Software”) in the context of this Agreement (hereinafter referred as to “Derived Software”) are the property of the Party owning the Existing Software concerned, irrespective of who the author is, only if the modifications are considered not substantial. When the Party that has made such modifications to an Existing Software is not the owner of said Existing Software, it undertakes to assign exclusively the economic rights over the Derived Software to the Party owning the Existing Software for no financial consideration for all countries and for the legal duration of the intellectual property rights.

Derived Software with a substantial modification

A Derived Software with a substantial modification of an Existing Software is constituted by a different executable code that is independent and which can be executed in a separate address space; the Derived Software and the Existing Software calling each other while being executed.

All the new software and Derived Software other than “Derived Software without substantial modifications” are jointly owned by the Parties in accordance with the article 11.1. Their conditions of protection and exploitation are the same as the patents.

11.6 Databases

In case of new important investments (intellectual, material or financial) made by a Party to the databases owned by another Party, the Parties will discuss the sui generis rights.

All new Database is jointly owned by the Parties in accordance with the article 11.1 and the same conditions of protection and exploitation as for the patent, are applicable.

11.7. Results infringement actions

In the event of an action for infringement by a third party against the Results, a declaration of invalidity, the Parties shall act together to jointly agree on the strategy to adopt.

The Parties shall supply each other with all the evidence in their possession, permitting an evaluation of the nature and extent thereof.

In the event of it not being possible to obtain a consensus, each of the Parties may on its own and at its own expenses take the actions which appear to it appropriate. In this event, any compensation resulting from such actions ordered by the court shall wholly and irrevocably be the property of the Party acting.

The Parties, undertaking or not legal action, shall provide all the documents, proxies or information necessary to the other Parties undertaking legal action for the matters referred to above.

Article 12 – Confidentiality

The Parties undertake to ensure that the information exchanged pursuant to the Agreement and identified as confidential, hereinafter referred to as the “Confidential Information”:

- a) is kept strictly confidential and is protected to the same extent as their own Confidential Information;
- b) is only provided to their members of staff requiring knowledge thereof and is only used in application of this Agreement,

Any and all other communication or use of the Confidential Information is subject to the prior and written authorisation of the communicating Party. Each Party undertakes to ensure that its staff referred to in section b) hereinabove comply with the provisions of this Agreement.

These provisions shall remain in force for a period of five years after the termination of the Agreement.

Notwithstanding the foregoing provisions, each Party may provide Confidential Information for which it is able to prove:

- that it was in the public domain prior to its communication or subsequent thereto, but without any breach being attributable to it;

- that it was received legally from a third party;
- that it was already in its possession prior to the execution of the Agreement;
- that it was developed independently and in good faith by its members of staff who did not have access to said Confidential Information.

Moreover, these provisions may not preclude:

- either the obligation binding on all personnel involved in the research programmes performed within the Laboratory to provide an activity report to the establishment to which they report, provided such communication does not represent disclosure within the meaning of industrial property legislation;
- or the thesis defense related to the Programme of this Agreement, with such defense being organized whenever necessary so as to guarantee the confidentiality of the Results.

Article 13 – Liability

Each Party remains liable, without a right of action against the other Parties, with the exception of cases of gross or intentional negligence, for repairing damage to its own property owing to during the performance of this Agreement.

According to the rules of ordinary law, each Party is liable for damage / loss of any nature caused to third parties during the performance of this Agreement.

Article 14 – Settlement of disputes

The Agreement is governed by the legislation of the country where the Laboratory has its location.

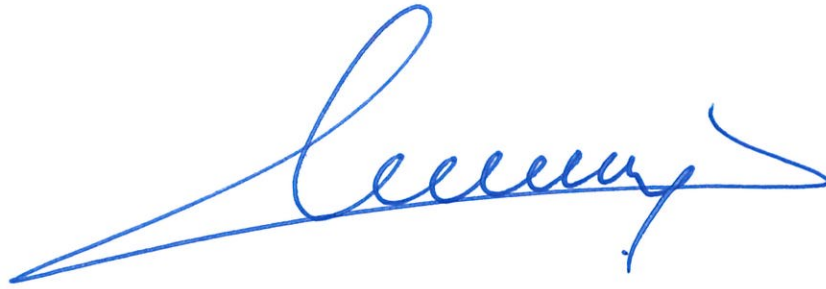
The Parties shall endeavour to settle their differences out of court in an amicable way.

Should they fail to do so, any disputes may be settled in accordance with the rules of conciliation and the arbitration of the International Chamber of Commerce, under the aegis of one or more arbitrators appointed pursuant to these rules.

The Agreement is drafted in three (3) originals.

In Hanoi, on 26 August 2022

For the Centre National de la Recherche Scientifique

A handwritten signature in blue ink, appearing to be 'Antoine Petit', written in a cursive style.

Prof. Antoine Petit
Chairman – Chief executive officer

And by delegation of signature
Prof. Jean-Stéphane Dhersin
Scientific Deputy Director of the Institute of Mathematics of CNRS

In Hanoi, on 26 August 2022

For the Vietnam Academy of Science and Technology



Prof. **Chau Van Minh**
President

And by delegation of signature
Prof.DrSc. Phung Ho Hai
Director of Institute of Mathematics, VAST

In Hanoi, on 26 August 2022

For the Vietnam Institute for Advanced Study in Mathematics

Prof.DrSc. Ngo Bao Chau
Scientific Director

And by delegation of signature
Prof.Dr. Le Minh Ha
CEO of VIASM

A handwritten signature in blue ink, consisting of a stylized, overlapping 'M' and 'H' followed by a long horizontal stroke.

ANNEX 1: SCIENTIFIC PROGRAMME

1. History of cooperation and recent developments

The system of teaching and research in Vietnam has always maintained links with the French system, despite the vicissitudes. The country has a very good level of basic training in mathematics for several decades. In the 1980's the major influence on mathematics in Vietnam was the one of the soviet school. In the 1990's the Vietnamese and French colleagues in France began to unite under the banner of PICS "Formath Vietnam" dispersed cooperations that existed between the two countries. This was done with the help of the CNRS, the AUF and the Embassy of France in Vietnam. Activities of Formath Vietnam had intended in particular to help to attract to the basic science gifted students who might be tempted by the new economic opportunities, have developed scientific cooperation and have diversified the topics carried out in Vietnam.

The first French coordinators of the PICS Formath Vietnam have been Nguyen Thanh Van (Toulouse) and Frederic Pham (Nice), then Jean-Pierre Ramis (Toulouse), and later Lionel Schwartz (Paris). The Vietnamese partners were diverse, but three institutions played a major role. The Institute of Mathematics Vietnam (Vien Toan Hoc, section of the VAST), located in Ha Noi, Ha Noi University of Pedagogy (Trường Đại học Sư phạm Hà Nội, or "Ha Noi ENS") and the University of Natural Sciences of National University of Vietnam at Ha Noi and later in Ho Chi Minh City. The mathematicians who work there play an important role in the training of colleagues working in smaller universities (Vinh, Thai Nguyen, Hue, Quy Nhon, Dalat, etc.). Scientific collaborations have been developed in partial differential equations, complex analysis, algebraic topology, singularity theory, commutative algebra, discrete mathematics, probability theory.

Activities have included international conferences and intensive schools (level M/D) held in Vietnam with significant involvement from French mathematicians, co-advised PhD, travel support and student internships in France.

These activities are especially active in Ha Noi with the Ha Noi Institute of Mathematics (VAST) and Universities. Different partners in Ha Noi are fully involved in this program and the Vietnam Institute of Advanced Studies in Mathematics (VIASM) plays a major role in this cooperation. Other universities from centre and South Vietnam (with the help of ICISE, but not exclusively) are also involved in this program, via workshops and conferences in Ha Noi. Nevertheless, in these parts of Vietnam, there were less interaction with French colleagues and the influence of International Research Project (IRP) and the variety of developed topics is less important. The Northern Vietnam is traditionally more interested both in pure and applied mathematics and the south is focused mainly on applied mathematics. A few mathematicians in Ho Chi Minh City have been trained in France but most of them in the United States or the Soviet Union. It was following the pioneering work of Alain Pham that cooperation with the South took a real boom since the 2000s with the work of Michel Zinsmeister and Duong Minh Duc.

Since 2006 and 2008 respectively, two International Masters in Mathematics work in Vietnam, one in Ho Chi Minh City, one in Ha Noi. These courses send about thirty students each year to various universities and "Grandes Ecoles" in France. They form a significant part of the next generation of Vietnamese university teachers and researchers in mathematics.

The "Laboratoire International Associé" Formath Vietnam (LIAFV) was created in 2011 as a continuation and an amplification of these works by the former PICS. In the next appendices results of the cooperation between 2011 and 2014 is shown. It shows:

- an important increase in the number of PhD theses submitted in France by Vietnamese students;
- a significant number of them have returned to Vietnam to work in the academic system (see below);
- a substantial number of joint publications, many of them partially supported by the LIAFV
- various activities, including workshops and congresses.

The LIAFV has supported activities at the Vietnamese Institute of Advanced Studies in mathematics (VIASM) in Ha Noi and Tuan Chau. An agreement has been signed between VIASM and LIAFV about this. This is described in more details below. It is worth to note the implication of new colleagues on both sides, and that a new generation is there.

2. Subjects, future developments

The IRL **France-Vietnam in Mathematics and its Applications (FVMA)** continues and expands this cooperation. We will describe below the main collaborations by bringing together scientific topics.

The IRL FVMA provides active support to high-level scientific collaborations. To avoid dispersion and to facilitate coordination, these collaborations have been grouped under four main topics. The IRL FVMA attaches a major importance to the development of cooperation in applied mathematics, this will be a priority for the next few years. Main objectives are to develop modelling, probability and statistics. The Master's in Ho Chi Minh City has a special role to play in this context, in order to develop direct interactions between mathematics and the "real" world.

These four main topics (fields) are:

- AGT-DM: Algebra, Geometry, Topology, and Discrete Mathematics.
- Analysis and applications, scientific computing.
- Optimization and control.
- Probability, Statistics, Finance.

Each topic involves potential applications.

2.1 AGT-DM (Algebra, Geometry, Topology, Discrete Mathematics)

There are essentially five active topics in this team described below :

Singularity theory, algebraic geometry

- Local singularities: index of vector field, differential forms on singular varieties, local Euler obstruction.
- Global singularities and characteristic classes of singular varieties, properties and topological applications of multivariate polynomial real or complex, global monodromy, singularity at infinity.
- Relationship between intersection homology and cyclic homology.
- Newton trees, Jacobian conjecture.

Commutative algebra

- Problems on local algebra cohomology and local finiteness of local cohomology modules, finiteness of the first set of ideals associated Macaulayfication.
- Rings Rees monomials ideals, toric rings parameterized by monomials and their interaction with combinatorics.
- Castelnuovo-Mumford Regularity, structure of projective curves, Groebner basis, cocommutative (regular) algebra. Several studies are underway in the fields above.

Algebraic Topology

- Stable homotopy of spheres and Singer's transfer.
- Modular Representations of symmetric groups and linear groups, properties of Lannes' T-functor.
- Injective resolutions of unstable modules, applications to computations of homotopy groups.

- Cohomology of functors (Mac Lane cohomology)

Discrete mathematics

- Graph Theory: Studying the structures of graphs to model networks of distributed systems, bio-informatics, ecology, social networks, Tutte polynomial and recurrent configurations, rotor router model.
- Discrete dynamical systems: the ordered structures and algebraic structures of dynamical systems as models of sand piles, the ChipFiring Games.
- Editing graphs.

Cryptography

- Mathematics of public key cryptography, post-quantum cryptography, lattice-based/code-based cryptography, secure multiparty computation, fully homomorphic encryption, lightweight cryptography, hash functions, block ciphers and authenticated encryption schemes.
- Constructions, algorithmic issues, and new applications of block codes,
- Quantum error-correcting codes, space-time codes, locally decodable codes, non-malleable codes.

2.2. Analysis and Applications, Scientific Computing

Complex analysis

- Theory of infinite dimensional holomorphy and analysis of properties of topological vector spaces.
- The Kobayashi (pseudo)-metric, extensions of functions or maps and holomorphic invariants of the boundary of domains in C^n . Lempert function and Nevanlinna-Pick type problems of interpolation.
- Polynomial approximation in the complex case. Pluri-potential theory and plurisubharmonic functions. Singularities.
- Theoretical nonlinear PDE / inverse problems
- Applications of mathematics to physics and biology (theory of potential in areas with irregular edges, as porous material or polymer solutions., geometry of DNA molecules, etc)

Dynamical systems

- Holomorphic dynamics in several variables
- Algebraic differential equations (from theory to their numerical solutions)

High performance computing

It is a subject that emerges only in Vietnam, in particular with a course on the subject taught in the Master's in Ho Chi Minh City.

2.3 Optimization and Control

- Optimal mass transport
- Numerical Optimization
- Variational inequalities and problems associated;
- Non-Regular Dynamical Systems and Applications;
- Multi-criteria-optimization, global optimization (theory and algorithms);
- Optimal control of non-smooth systems;
- Convex analysis, non-smooth analysis and applications (Metric regularity, Newton's methods for generalized equations).

2.4 Probability, Statistics, Finance

We present this area into four sub-domains, “Ergodic Theory and probability theory”, “Statistics”, “Stochastic processes/Financial Mathematics” and “Mathematics for biology”:

Ergodic Theory and probability theory

- Ergodic theorems, cocycles and fluctuations;
- Random walks in fixed and random environment;
- Iterated functions systems;
- Galton-Watson processes in fixed and random environment.

Statistics

- Statistics in Medicine;
- Statistical Physics;
- Renewable Energy;
- Applied statistics (nonparametric statistics).

Stochastic processes and Financial Mathematics

- Stochastic processes, numerical methods and related topic;
- Probability theory, with applications in insurance and finance.

Mathematics for biology

- Mathematical Modelling Techniques for Biological Systems and population dynamics
- Mathematical population genetics
- Branching Processes

3. Activities of the IRL FVMA

3.1. Scientific collaborations

The IRL FVMA provides support to active scientific collaborations of high quality. To do this it supports research visits to France, Vietnam and Singapore, Master’s and it focuses on the supervision of theses. It promotes the development of conferences, summer schools and provides support to CIMPA schools.

3.2. Conferences and schools

Thematic workshops and summer schools are organized regularly, possibly as part CIMPA or Do Son schools. Support to SEAMS school will be prided. As well, and as it is said above support will be given to the special periods in VIASM.

3.3 Masters and student exchanges

The *Ha Noi Masters (MIM)*. Students take the one year of M1 with some of the courses provided by French visitors in Ha Noi. A Franco-Vietnamese jury determines whether students will be allowed to go to France to follow the M2 (scholarships are presently provided by various LabEx, Vietnamese grants are to come). The Masters of Ha Noi is operated by the Institute of Mathematics (VAST) and the Pedagogical University. Students may continue their M2 in a dozen partner universities in France (Paris 6, Paris 11, Paris 13, Orléans-Tours, Toulouse, Rennes, Strasbourg, Nice; universities of Toulouse and Paris represent half of the flow).

The *Master of Applied Mathematics in Ho Chi Minh City*. Initiated in 2007 by the French University Centre (PUF), it takes place at the University of Natural Sciences of Ho Chi Minh City (HCMC). This Master’s is delivered by several partners in France (Universities of Orléans and Tours, Paris 13, Rennes and Lorraine) and there is partnership with the *Ecole Polytechnique*. French teachers give five lectures during the first semester; two other courses are taught given by the Vietnamese part. The best students come to France during the second

semester to carry out their internship. In 2018, it is the 12th class (about 20 students each year); about one hundred PHD thesis have been defended during the decade. It should be noted that more and more students in the sector "Honours" (highest class) in HCMC, which have traditionally turned to the U.S. follow now this Master's, assuring them of recruitment at the highest level. In addition, this Master's has now established a lasting relationship between several universities/ institutes in Ha Noi and the University of Paris 13. The University of Nantes is presently developing a cooperation with the VNU Ha Noi. The University of Marseille is developing a Master's in probability with Quy Nonh.

3.4 Role of the IRL FVMA in training Master level

The IRL FVMA is intended to assist the development of both existing Master's (the Master International Ha Noi and the HCMC Master of Applied Mathematics) with a coordination for the selection of French teachers and the management of the French side of these Master's. With its nationwide coverage, the IRL FVMA will allow the cooperation of new centres with these Masters. It will play a role in guiding students towards M2 France for international Master's, and in their choice of training place for students of Master's in HCMC. IRL FVMA helps the Vietnamese colleagues to develop thematic coordination between the North and the South. It should be recalled here that the development of applied mathematics is a priority of the IRL FVMA.

3.5 PhD students

The flow of PhD students coming to France is high, due to

- the Master's mentioned above,
- the demand of Vietnamese mathematicians to develop new areas, and
- the existence of lasting research relations in various fields.

The research for doctoral students. The IRL FVMA will not have its own scholarships nevertheless, it will help students in their search for such scholarships and will follow the "flow of doctoral students" (about 25-30 per year). It will:

- ensure as much as possible the coordination between the Parties,
- guide students in their choice,
- show them ways to find scholarships,
- follow them during and after their thesis,
- try to seek support from companies including scholarships.

ANNEX 2: HUMAN AND FINANCIAL RESOURCES

Table 2.1 Provisional budget summary for the first year

Country	Institution	In-cash funding		Amount (€) <i>(include detailed budget allocation if known)</i>	In-kind input <i>(if applicable)</i>	Type of staff	Full-time equivalent	
France	CNRS	<input type="checkbox"/> Operations	<input type="checkbox"/> Other (specify)	21 000 €	1 FTE	<input checked="" type="checkbox"/> Researcher	1	
		<input type="checkbox"/> Equipment				<input type="checkbox"/> Postdoc		
		<input checked="" type="checkbox"/> Mobility				<input type="checkbox"/> PhD students		
Vietnam	VAST	<input type="checkbox"/> Operations	<input type="checkbox"/> Other (specify)	10 000 €	(not applicable)	<input type="checkbox"/> Researcher		
		<input type="checkbox"/> Equipment				<input type="checkbox"/> Postdoc		
		<input checked="" type="checkbox"/> Mobility				<input type="checkbox"/> PhD students		
	VIASM		<input type="checkbox"/> Operations	<input type="checkbox"/> Other (specify)	10 000 €	(not applicable)	<input type="checkbox"/> Researcher	
			<input type="checkbox"/> Equipment				<input type="checkbox"/> Postdoc	
			<input checked="" type="checkbox"/> Mobility				<input type="checkbox"/> PhD students	
						<input type="checkbox"/> Support		

Table 2.2. Researchers involved in the IRL FVMA

Seconded Staff:

Researcher	Institution
French staff	
Marc Peigné	U. Tours/CNRS
Vietnamese staff	
Ngo Bao Chau	VIASM
Le Minh Ha	VIASM

IRL FVMA Collaborators:

The Collaborators are:

Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Tien Zung Nguyen
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Pascal Thomas
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Christine Thomas
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Stéphane Villeneuve
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Jean-Marc Azais
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Jean-Marc Bouclet
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Jean-Paul Calvi
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Jean-Yves Dauxois

(CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Fabrice Gamboa
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Vincent Guedj
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Radu Ignat
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Jean-Baptiste Lasserre
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Dan Popovici
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Jasmin Raissy
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Ahmed Zeriah
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Monique Pontier
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Benoît Truong Van
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Thierry Klein
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Agnès Lagnoux
Institut de mathématiques de Toulouse (CNRS/UTC1/ UTJJ/INSA Toulouse/UTPS)	Xavier Gendre
Institut Denis Poisson – (CNRS/Université d’Orléans/Université de Tours)	Romain Abraham
Institut Denis Poisson – (CNRS/Université d’Orléans/Université de Tours)	Michel Zinsmeister
Institut Denis Poisson – (CNRS/Université d’Orléans/Université de Tours)	François James
Institut Denis Poisson – (CNRS/Université d’Orléans/Université de Tours)	Pierre Debs
Institut Denis Poisson – (CNRS/Université d’Orléans/Université de Tours)	Stéphane Cordier
Institut Denis Poisson – (CNRS/Université d’Orléans/Université de Tours)	Marguerite Zani
Institut Denis Poisson – (CNRS/Université d’Orléans/Université de Tours)	Pierre Andreoletti

d'Orléans/Université de Tours)	
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Julien Barré
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Niels Berglund
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Laurent Delssol
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Sandrine Grellier
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Luc Hillairet
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Simona Mancini
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Magali Ribot
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Guy Barles
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Florent Malrieu
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Emmanuel Chasseigne
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Boris Andreianov
Institut Denis Poisson – (CNRS/Université d'Orléans/Université de Tours)	Olivier Durieu
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Jean-Stéphane Dhersein
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Lionel Schwartz
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Pascal Omnes
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Marc Bonino
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Bérengère Delourme
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Linda El Alaoui
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Grégory Ginot

(CNRS/UP8/UP13)	
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Laurence Halpern
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Jérôme Le Rousseau
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Alain Rousseau
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Philippe Souplet
Laboratoire Analyse Géométrie applications (CNRS/UP8/UP13)	Hatem Zaag
Institut Fourier, Université Grenoble Alpes	Michel Brion
Institut de Mathématiques de Jussieu-Paris Rive Gauche IMJ-PRG, (CNRS, UP 6)	Joao Pedro Dos Santos
Institut de Mathématiques de Jussieu-Paris Rive Gauche IMJ-PRG, (CNRS, UP 6)	Pierre-Henri Chaudouard
Institut de Mathématiques de Jussieu-Paris Rive Gauche IMJ-PRG, (CNRS, UP 6)	To Tat Dat
Laboratoire Jacques-Louis Lions (JLL) (CNRS, Sorbonne Université UPMC)	Nguyen Hoai Minh
Télécom Paris	Phan Duong Hieu
Laboratoire de Mathématiques Nicolas Oresme (LMNO), (CNRS, Université de Caen)	Ngo Dac Tuan
Laboratoire de Mathématiques Paul Painlevé (CNRS, Université de Lille)	Nguyen Viet Anh
Laboratoire IBISC (Informatique, BioInformatique, Systèmes Complexes) (CNRS, Université d'Evry, Université Paris-Saclay)	Nguyen Kim Thang
VAST	Phung Ho Hai
VAST	Ta Thi Hoai An
VAST	Phan Thi Hà Dương
VAST	The Luc ass.
VAST	Ngo Viet Trung
VAST	Le Tuan Hoa
VAST	Phan Ha Duong

VAST	Pham Hoang Hiep
VAST	Nguyen Dong Yen
VAST	Vu Ngoc Phat
VAST	Nguyen Tu Cuong
VAST	Don Thai Son
VAST	Nguyen Duy Tan
VAST	Nguyen Minh Tri
VIASM	Nguyen Viet Dung
VIASM	Nguyen Huu Du
VIASM	Ngo Long Hoang
VIASM	Dinh Si Tiep
VIASM	Le Hai Yen
VIASM	Dinh The Luc
VIASM	Nguyen Huu Viet Hung
VIASM	Le Quy Thuong
VIASM	Le Vy
VIASM	Nguyen The Cuong
VIASM	Phan Van Tuan
VIASM	Si Duc Quang
VIASM	Tran Van Tan
VIASM	Do Duc Thai
VIASM	Luong Dang Ky
VIASM	Huynh Van Ngai
VIASM	Nguyen Thi Phuong Chi
VIASM	Nguyen Dang Ho Hai
VIASM	Tran Quang Hoa
VIASM	Pham Ngoc Anh
VIASM	Pham Tien Son
VIASM	Nguyen Le Chi Quyet

VIASM	Ha Huy Vui
VIASM	Nguyen Duy Tan
VIASM	Nguyen Tu Cuong
VIASM	Can Van Hao
VIASM	Pham Viet Hung
VIASM	Ha Minh Lam
VIASM	Do Hoang Son
VIASM	Nguyen Hoang Thach
VIASM	Nguyen Tat Thang
VIASM	Nguyen Minh Tri
VIASM	Pham Van Trung
VIASM	Nguyen Chu Gia Vuong
VIASM	Le Dinh Dinh
VIASM	Nguyen Trong Hieu
VIASM	Vu Hoang Linh
VIASM	Vo Thi Nhu Quynh
VIASM	Triet Minh Le
VIASM	Dinh Dung
VIASM	Nguyen Hung Chinh
VIASM	Nguyen Quang Dieu
VIASM	Le Giang
VIASM	Pham Hoang Ha
VIASM	Le Mau Hai
VIASM	Phung Van Manh
VIASM	Luu Ba Thang
VIASM	Luu Ba Thang
VIASM	Phạm Nguyễn Thu Trang
VIASM	Nguyen Van Trao
VIASM	Duong Anh Tuan

VIASM	Phan Thanh Nam
VIASM	Truong Thi Thanh Phuong
VIASM	Nguyen Sum
VIASM	Nguyen Huu Tron
VIASM	Bui Van Chien
VIASM	Nguyen Ngoc Doanh
VIASM	Bui Xuan Hai
VIASM	Duong Minh Duc
VIASM	Dang Duc Trong
VIASM	Nguyen Dinh ass.
VIASM	Phan Quoc Khanh
VIASM	Mai Duc Thanh
VIASM	Phan Hoang Chon
VIASM	Nguyen Van Quang
VIASM	Le Van Thanh
VIASM	Le Dung Muu
VIASM	Le Thanh Nhan
VIASM	Nguyen Thi Dung

The Parties shall conclude hosting agreements to allow the presence in the IRL of the staff not allocated into the IRL. Such agreements shall preview notably as follows:

- Requirements of safety, liability and discipline ;
- Requirements of mentions in publications, confidentiality and intellectual property in compliance with this Agreement

ANNEX 3: PREMISES

The Laboratory is located at:

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