Position

1. Project Title/ Job Position title: Mathematical Physics
2. Area of Knowledge: Physical Sciences, Mathematics and Engineering
3. Group of disciplines: Theoretical and Applied Mathematics, Computer Sciences
4. Research project/ Research Group description (max. 2.000 characters)

The Mathematical Physics group at BCAM consists of the research lines in Quantum Mechanics, Statistical Physics and Singularity Theory & Algebraic Geometry.

Specific project thesis:

- **Singularities in Algebraic Geometry.** Advisor: Ilya Smirnov. We are offering projects on the algebraic side of the study of singularities: algebraic geometry and local algebra. The choice of a specific topic is up to the applicant’s preferences. Among potential options are multiplicity theory and various aspects of positive characteristic methods in commutative algebra and algebraic geometry. More information about advisor’s interests can be found at [https://people.kth.se/~ismirnov/](https://people.kth.se/~ismirnov/).

A background in algebraic geometry is not necessary for this project. However, an interest in geometry will be helpful since the applicant will be part of a diverse group of PhD students and postdocs that studies singularities using different, such as algebraic, topological, symplectic or Hodge-theoretical, methods.

- **Study of Many-Fermion Systems with Long Range Interactions.** Advisor: Jean-Bernard Bru. Description: The first goal is to use cluster expansions techniques and the structural stability of the catastrophes in catastrophe theory to show the stability of phase diagrams of many-fermion systems with long-range interactions. The second goal is to relax the mean-field limit used to study fermionic systems in [1] by taking the so-called "Kac limit". Such analysis requires further work, but it is a natural continuation of the first objective which allows to study mean-field fermionic models in details. Beside this plan, there is a possibility of proving a large deviation principle for the convergence of electric current densities in fermionic systems and in presence of interactions, with rate function given via current quantum fluctuations.

5. Job position description (max. 2,000 characters)

The candidate will be part of one of the research groups of the **Mathematical Physics** research area at BCAM.

- Quantum Mechanics, Group Leader: Jean-Bernard BRU
- Singularity Theory and Algebraic Geometry is a multidisciplinary group studying singularities from different viewpoints. Group Leader: Javier Fernández de Bobadilla

The BCAM research environment is international and open to national and international collaborations, the candidate must have willingness to team working and traveling.

Requirements:
- A master’s degree in mathematics.
- An excellent academic record.
- Solid knowledge of the topics related to the corresponding PhD project.

Skills:
- Good communication and interpersonal skills.
- Ability to effectively communicate and present research ideas to researchers with different background (e.g., mathematicians and engineers).
- Ability to clearly present information in spoken (talks) and written (papers) form.
- Good command of spoken and written English.

**BCAM** is a world-class research center located in Bilbao (Spain). It obtained the **Severo Ochoa Center of Excellence award in 2013 and 2018** given by the Spanish Ministry of Science, Innovation and Universities. BCAM is part of the **ERC** European Research Centers on Mathematics networks: [http://www.ercom.org](http://www.ercom.org). BCAM has endorsed the **Charter & Code** in 2008 and has been awarded the **HR Excellence in research Logo** in 2016.

The fellow will receive all the needed support from BCAM to be fully integrated in the group and in the center. In terms of **transferable & complementary skills**, BCAM is carrying out the **Action Plan** within Human Resources Strategy for Researchers (HRS4R) BCAM action plan [https://bit.ly/2MH1R9S](https://bit.ly/2MH1R9S). A successful applicant will benefit of the training program on topics such as: **Gender Balance, Leadership, Effective Communication/Teamwork, Ethics and Research, Citizenship Science**, etc.

**Group Leader**

1. Title: Prof.
2. Full name: Javier Fernandez de Bobadilla
3. Email: jbobadilla@bcamath.org
4. Research project/Research Group website (Url):
5. Website description: Website of the MP group.
Additional website (optional, max. 5 websites)

- Statistical Physics: http://www.bcamath.org/en/research/lines/SP
- Singularity Theory And Algebraic Geometry: http://www.bcamath.org/en/research/lines/STAG

INPhINIT Offer, eligibility requirements, evaluation and selection process

Incoming: https://fundacionlacaixa.org/es/becas-doctorado-inphinit-incoming

Retaining: https://fundacionlacaixa.org/es/becas-doctorado-inphinit-retaining

How to Apply:

1. Click in https://hosts.lacaixafellowships.org/finder, click in RESEARCH CENTRE and choose “Basque Center for Applied Mathematics - BCAM”
2. Click in “SEARCH” and the displayable will list the positions offered

3. Click in the selected PhD Offer and click in “START THE APPLICATION”
4. The system will open a new window with the application website [https://www.lacaixafellowships.org/index.aspx](https://www.lacaixafellowships.org/index.aspx). Click in “Please register” for new applicants.

5. After the registration, the system will send to you the confirmation email and the link to access into the system. Now you are in the position to access into the application system. Please choose INPhINIT: Doctorate in Spanish Research Centre of Excellence.
6. Now you are in the position to fill the application form, upload the required documents and choose the project thesis. To choose the project thesis, click in “Studies to be Pursued”, choose the centre and the position.