CALL FOR APPLICATIONS - March 2023

PhD Student Position

Donostia International Physics Center (DIPC) is currently accepting applications for PhD Student positions. This is a unique opportunity for highly motivated students, recently graduated from the university in Physics or related fields, to join one of DIPC's high-profile research teams. A description of each of the available openings, contact information and deadlines can be found on the following pages.

Although candidates are welcome to contact the project supervisors to know further details about the proposed research activity, please be aware that the application will be evaluated only if it is submitted directly to the email address listed as "application email".

Applications received by the deadline will be evaluated by a Committee designed by the DIPC board on the basis of the following criteria:

- CV of the candidate (60%)
- Adequacy of the candidate's scientific background to the project (20%)
- Reference letters (10%)
- Other: Diversity in gender, race, nationality, etc. (10%)

Evaluation results will be communicated to the candidates soon after. Positions will only be filled if qualified candidates are found.

The DIPC may revoke its decision if the candidate fails to join by the appointed time, in which case the position will be awarded to the candidate with the next highest score, provided it is above 50 (out of 100).

However, the selected candidate may keep the position if, in the opinion of the Selection Committee, the candidate duly justifies the reasons why he or she cannot join before the specified deadline, and as long as the project allows it.

Ref. 2023/40
Immobilisation of Fluorescent Biocolor Indicators

Supervisor(s):
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Duration: *1 year*

Application Deadline: *14/03/2023* ***Application Email:*** *jobs.research@dipc.org*

Searching for neutrinoless double-beta decays (ββ0v) is the only practical way to establish if the neutrinos are their antiparticles, a discovery of enormous importance for particle physics and cosmology. Due to the smallness of neutrino masses, the lifetime of ββ0v is expected to be much longer than the noise associated with the natural radioactive chains making the search very challenging. Identification of ββ0v decays requires finding a signal that radioactive backgrounds cannot mimic. In particular, the ββ0v decay of 136Xe could be established by detecting the doubly ionised daughter atom, Ba2+created, in the decay. Such detection could be achieved via a sensor made of a monolayer of molecular detectors. Ba2+ would be captured by one of the chemical entities that act as a fluorescent sensor, giving rise to a new fluorescent complex, which can be subsequently revealed by different technologies, such as using a laser system. The development of such new molecules is a challenge from the chemistry point of view that offers the possibility to contribute to one of the most relevant problems of science.

The chemical team has developed a new Fluorescent Bicolour Indicator (FBI) that binds strongly to Ba2+ in dry media and offers a shining difference with the unchelated state of >12000 by introducing a colour shift. This colour shift is due to a perpendicular arrangement between two aromatic units of the fluorophore upon Ba2+ chelation, thus disconnecting both polycyclic systems. The FBI concept is a milestone for the identification of Ba2+ in gaseous detectors and the development of the next generation of experiments. Also, obtaining these molecules, which our group have designed and synthesised, represents a significant milestone in supra-molecular chemistry in the solid-state and the study of the photophysics of fluorescent molecules in a dry environment.

Due to the strong requirements imposed by using a molecule in a real experiment, the capacity to optimise the molecule is of uttermost importance. Our highly modular FBI sensor design, with clearly identified synthon for each property, is perfectly suited for this purpose. Namely, the specificity and selectivity for barium sensing, the fluorescence characteristics, and the capability to create a monolayer on the desired surface can be independently addressed. Although the crown showed the best selectivity for Ba2+ in solution, it should be confirmed in the dry phase; otherwise, it can be substituted by another receptor. The fluorescence characteristics rely on the two aromatic systems of the fluorophore. Therefore, intensive exploration of the chemical space will be required in order to maximise the bicolour character of these molecules. Thus, maximising the $\Delta\lambda$ and ΔI parameters, resulting in a more efficient sensor.

Last but not least, the creation of a monolayer with these molecules presents several challenges. Due to the restrictions on the surface characteristics, the linker needs to be versatile enough to be adapted to the chosen substrate. In addition, the physical distance between the fluorophore and the conductive surface is relevant as the emission could be quenched. In this sense, anchoring groups of different chemical nature and length can be easily bonded at a different position on the aromatic group 1.

The candidate should have basic knowledge on organic synthesis. In addition, the student will benefit from the opportunity to work on state-of-the-art instruments for organic and organometallic synthesis. Some of them include detection and structural elucidation techniques, NMR, MS, FITR, etc.

Interested candidates should submit an updated CV and a brief statement of interest to the application email listed above. Reference letters are welcome but not indispensable. The reference of the specific opening to which the candidate is applying should also be stated in the subject line.