PHYSICAL RESEARCH LABORATORY
Navrangpura, Ahmedabad - 380009, India

Advt. No. – 02/2023

Position available for Junior Research Fellowship

Applications are invited from highly motivated and eligible candidates for the project entitled "A comprehensive study of the physical and chemical evolution of volatiles and formation of organics in the comets: From reprocessing of primordial ices in cometary nuclei to the formation of cometary atmosphere during perihelion passage" under the 'SERB-Core Research Grant' scheme, Government of India at Physical Research Laboratory, Ahmedabad.

Name of the Post	No. of Vacancy	Age as on last date of application	Qualifications/ Experience	Fellowship per month (Consolidated)
Junior Research Fellowship (JRF)- SERB-CRG-Project	1 (ONE)	Maximum 26 Years	1. M.Sc. in Physics 2. CSIR-UGC NET including lectureship or GATE **Desirable:** Good knowledge of programming languages and some experience on numerical simulations	Rs. 31,000/- + HRA for first two years and Rs 35,000 + HRA for 3rd year. HRA is as per prevailing rates for

Interested candidate may send a letter of motivation and latest Curriculum Vitae (should include educational qualifications from 10th onwards, date of birth, details on NET/GATE exams, research experience if any, internship details, programming skills etc.) along with scanned copies of all the relevant documents through e-mail (with subject "SERB-CRG-JRF") to the project investigator:

Dr Kinsuk Acharyya
Planetary sciences Division
Physical Research Laboratory
Navrangpura, Ahmedabad- 380 009.
E-mail:acharyya@prl.res.in

Last date of receipt of applications: 10th March **2023**

Terms & Conditions:

1. The above position is purely contractual and coterminus with the project.
2. Initial appointment is for one year, which is extendable up to three years upon successful annual evaluation of the candidate.
3. Only shortlisted candidates will be intimated for an online interview.
4. Participation in selection process is subject to possessing relevant original documents substantiating online application submitted by the candidates.

Project Summary:

Comets are made up of the leftover materials that formed our solar system and are the least altered objects surviving the protoplanetary disks. They are the building block for the cores of outer planets, transport water and organics throughout the planetary system and might have played a crucial in the habitability of terrestrial planets. Thus the study of comets is of paramount importance. Also, recent observation of interstellar comet

2I/Borisov with a unique CO-rich atmosphere broadened the horizon significantly by opening the doorway to study other planetary systems. So far, 72 cometary species are detected in the cometary atmosphere or coma, out of which 37 are complex organic molecules, and the list is expected to grow. How this large number of organics are formed is one of the unresolved questions. It is well-accepted that their formation in the cometary atmosphere is not efficient; only a small fraction of organics can be produced for highly active comets. Since the cometary atmosphere forms due to the sublimation of volatiles from the nucleus, it is pertinent to seek the answer by studying the processing of volatiles in the nucleus—a largely unexplored topic. In the interstellar medium (ISM), chemistry on the surface of a dust grain is used to explain the formation of organics. The same prescription with required modifications can be applied to study the formation of organics in the cometary nucleus, which can then be sublimated to form the cometary atmosphere. With a numerical model, we plan to study the cometary nucleus's ice chemistry and the cometary atmosphere's chemical and dynamical evolution to study the formation of organics in the comet. In analogy with ISM, we will consider thermal hopping and photodissociation processes due to UV radiation field and Galactic cosmic rays to reprocess the ice in the nucleus. Temperature is a critical parameter in determining the reaction rates; therefore, determining it correctly is essential. The temperature will be primarily constant when the comet is in the reservoir and will evolve according to the energy-balance equation when approaching the sun. When the comet is near the sun, volatiles in the nucleus will start sublimating and form the cometary atmosphere or coma. We will consider fluid approximations for the flow in the coma and use hydrodynamical models to determine velocity and the temperature of the flow, which will be coupled with a chemical model with suitable modifications to address the changes in the heliocentric distances. Such a combined approach will be employed for the first time. The outcome of the proposed project will provide a comprehensive understanding of the evolution of volatiles, particularly organics in the cometary nucleus and coma. It will help us understand the inter-connection between the nucleus and coma. Finally, it will aid to create a repository of volatiles, including trace species found in the cometary nucleus, for future in-situ studies of comets.