Proposal Code : PDF – BasicPlasma -0001	
Title	Simulation and experimental study of Coulomb Cluster both in RF and DC discharges
Abstract	Coulomb clusters—finite systems of charged microparticles interacting through electrostatic forces—is a research topic of growing interest, that is employed to understand strongly coupled plasma behavior. Proposed work will address a comprehensive investigation combining experimental observations and numerical simulations of Coulomb clusters formed in both radio-frequency (RF) and direct-current (DC) plasma discharges. In RF plasmas, clusters exhibit dynamic behavior due to alternating sheath fields, while DC discharges offer a more static confinement environment, enabling clearer observation of equilibrium structures. Experiments will be conducted under controlled conditions in low-pressure argon discharges, where micron-sized dust particles will be levitated in the sheath region and their configurations tracked using high-resolution imaging. Complementary molecular dynamics simulations incorporating Yukawa-type interactions and external confinement potentials will be used to model cluster formation, stability, structural transitions, etc. The results will surely reveal distinct features in cluster morphology, symmetry, and oscillatory modes depending on the discharge type. The synergy between experiments and simulations offers insights into the fundamental physics of strongly coupled systems and helps refine models of dust-plasma interactions under varying confinement regimes.
Research Focus Areas	The proposed research work is highly significant to the ongoing activities in complex or dusty plasma research at the Institute for Plasma Research (IPR). Coulomb clusters are fundamental to understanding the physics of strongly coupled dusty plasmas, a key focus area at IPR. Experimental study of complex or dusty plasma with molecular dynamics simulations will enable rigorous validation and refinement of theoretical models supported by dusty plasma diagnostics and control. This focused approach will help in bridging the gaps

	between theory and experiment, improving predictive capabilities relevant to plasma processing and fusion devices where dust contamination poses operational challenges. The study would also support IPR's broader aim to explore fundamental plasma phenomena under varied discharge conditions, thereby enhancing the understanding of particle charging, transport, and cluster dynamics in dusty plasma environments. Overall, this work advances both basic and applied dusty plasma research at IPR, reinforcing its position as a leading center in complex plasma science.
Qualifications	PhD in Physics (preferably in plasma physics)
Desired Experience	Experience of MD simulation or/and experimental knowledge of dusty plasmas is desirable
Other remarks	Experiments are ongoing. IDL or Python based particle tracking code is available for analysing the experimental data.