Seminar

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Institute for Plasma Research

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Title: Ferro and electrohydrodynamics of impacting droplets

Speaker: Dr. Nilamani Sahoo
IIT Ropar, Punjab

Date: 16th December 2022 (Friday)

Time: 03:30 PM

Venue: Join the online meeting:
https://meet.ipr.res.in/join/9978717499?be_auth=Mzg1ODgx
(Conference ID: 9978717499; Password: 385881)

Abstract

Hydrodynamics of droplet collision with solid surfaces is important towards understanding and improvement of various engineering applications like spray cooling of hot surfaces, annealing, quenching, spray coating, printing technology, rapid prototyping using polymer droplets, and pesticide deposition. Drop impact studies are also relevant to several natural processes like rain drop impact on ocean surfaces leading to upward jet and secondary drops, soil erosion kinetics, or rainwater distribution within dense canopies, or underwater noise during rains. In the present study, impact dynamics of drops on variant wettability surfaces is investigated in presence of magnetic and electric fields.

In the first study I will report the aspects of post-impact hydrodynamics of ferrofluid droplets on superhydrophobic (SH) surfaces in the presence of a horizontal magnetic field. The impact dynamics is observed by varying the impact Weber number (We), the magnetic field strength (manifested through the magnetic Bond number (Bom), and the Hartmann number (Ha). For a fixed We ~60, I observe that at moderately low Bom ~300, droplet rebound off the SH surface is suppressed. I also develop the analytical model to explain the ferrohydrodynamic mechanism leading to suppression of droplet rebound. In addition, the role of Bom on the shattering of liquid lamella after impact onto SH surface is investigated during retraction phase for fixed We ~60. A phase map encompassing all the post-impact ferrohydrodynamic phenomena on SH surfaces is presented for a wide range of We and Bom. Also, the droplet impact dynamics will be presented in presence of vertical magnetic field.

In the second study I investigate the experimental and semi-analytical findings to elucidate the electrohydrodynamics (EHD) of a dielectric liquid droplet impact on superhydrophobic (SH) and hydrophilic surfaces. A wide range of Weber numbers (We) and electro-capillary numbers (Cae) will be covered to explore the various regimes of droplet impact EHD. It is observed that for a fixed We~60, droplet rebound on SH surface is suppressed with increase of electric field intensity (increase of Cae). Subsequently I propose a semi-analytical model to explain the field induced rebound phenomenon on SH surfaces. It is also observed that rebound droplets exhibit somersault-like motion during rebound for certain values of We and Ohnesorge number (Oh). Further, the spreading EHD on both hydrophilic and SH surfaces will be discussed. Finally, a phase map is developed to explain the post impact droplet dynamics on SH surfaces for a wide range of We and Cae.