SEMINAR NOTICE

Department of Physics and Engineering Physics
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SPEAKER: Dr. Lénaïc Couëdel
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(Candidate for Experimental Plasma Physics Faculty Position)

TOPIC: Experimental investigations of dusty plasmas: particle growth and two-dimensional complex plasma crystals

DATE: Tuesday, April 11th, 2017

TIME: 3:30-4:30pm.

PLACE: **Rm. 165**, Physics Building

ABSTRACT:

Complex or dusty plasmas are weakly ionised gases containing solid nano- or micro-particles (dust particles). Due to their interactions with the plasma electrons and ions, the dust particles acquire a net electric charge [1]. In that sense, dusty plasmas can be seen as three component plasmas. Dusty plasmas can be found in astrophysical environment [2], industrial plasmas [3], in fusion devices such as tokamaks [4] and in laboratory gas discharges [5, 6].

In laboratory plasmas, dust particles generally acquire a negative electric charge due to the high mobility of the electrons. They can be either grown directly or injected in the plasma. For example, nanoparticles are routinely grown in radio-frequency (RF) or direct-current (DC) discharges using chemically active plasmas such as silane-based plasmas, acetylene-based plasmas or by sputtering [5, 6, 7]. Nanoparticles grown directly in the plasma have some valuable applications such as the fabrication of polymorphous silicon used in solar cells [8].

In discharges in which a large amount of calibrated spherical micro-particles are injected, due to the electrostatic interactions between the negatively charged microspheres, it is possible to study strongly coupled systems [9]. In ground-based laboratory discharges, two-dimensional dust monolayers can be created by injecting calibrated microspheres in the plasma. The microparticles thus are all levitating at the same height in the sheath above the electrode where the electric force can balance the gravity force. By tuning the experimental conditions, it is possible to crystallise the monolayer and formed the so-called two-dimensional complex plasma crystal in which the dust particles formed a hexagonal lattice [10, 11]. As the microparticles can easily be imaged, it is possible to study phenomena such as wave propagation, dislocations and phase transition at the particle ("atom") level.

In this seminar, after a short introduction to the key aspects of the physics of dusty plasmas, two active research topics are presented: (i) nanoparticle growth and characterisation in DC and RF argon glow discharges and, (ii) instabilities in two-dimensional complex plasma crystals. In the first part, the influence of nanoparticle growth on discharge parameters is discussed and the dynamics of the cloud is investigated [5, 7]. Real-time in-situ diagnostics of the dust particle size and number concentration is presented [6]. In the second part, spectra of phonons with out-of-plane polarization is studied experimentally in 2D plasma crystals during dedicated experiments on crystal instability (especially the mode coupling instability) [10, 11]. The kinematics of dust particles during the early stage of mode-coupling induced melting is explored [12, 13, 14].

References

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Coffee and Cookies will be served in the Physics lounge at 3:00 pm. for those attending the seminar.