# Agile Information Acquisition and Management System for Magnetized Dusty Plasma Experiment Project

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## 1. INTRODUCTION

Plasma is a state of matter in which enough energy is obtained from an outside source for the electrons to become unbound from the nucleus of individual atoms. By definition a plasma is ionized gas which consists of electrons and positively charged ions. Due to the free electrons, plasma, unlike gas, is an excellent conductor of electricity.

Plasma is rarely found without some kind of dust particulate. When Lewi Tonks and Irving Langmuire conceived the term plasma in 1929, they reported seeing "globules" gas discharges that can be tracked with naked eyes [**?**]. A lose definition of dusty plasma is an ionized gas with micron-sized particulate components. In a plasma, the dust particles become electro-statically charged by surrounding plasma. The interaction of these charged macro-particles increase the complexity of the state of the plasma environment; therefore, dusty plasma is also called complex plasma.

We can more strictly define the property of a dusty plasma. Given the radius of the dust particulates, $r_d$, the average distance between dust grains, $a$, and the Debye radius of the plasma, $\lambda_D$

Dusty plasma is ubiquitous in space. The rings of Saturn is an example of plasma interacting with ice particulates. Based on the data sent back from the voyager 1 spacecraft, which is the first man-made object to reach the edge of our solar system, the interstellar medium, the matter that surrounds our solar system consists of ionized gas, dust and cosmic rays, which contains the ingredients of dusty plasma. Studies have found that over 99% of the matter is in the state of plasma with dust being an omnipresent ingredient.

IC, nuclear fusion??

The study of dust interactions in a plasma system has implication in formation of stars and formation of planetesimals in early formation of solar systems.

In addition to dust particulate, another ingredient in the soup of this plasma is magnetic field. In many settings, magnetic fields exist. Saturn generates a magnetic field, so it probably has influence to the pattern in the rings. Without magnetic field, the only forces acting on the the dust particulates and the plasma are the electrostatic forces between the particulates. A magnetic field has large influence on the interaction and behavior of the entire system.

The Magnetized Dusty Plasma Experiment (MDPX) is advanced research facility at Auburn University started in late Spring of 2014 to conduct research in magnetized dusty plasma. [This facility is awesome with state-of-the-art equipments!!!]



Plasma are often found with dust particulates. When the dust particulates become electrically charged, by the ions, and start interacting with nearby particulates, a dusty or complex plasma is formed. Dusty plasma can be found everywhere in the universe. One example is the ring system of Saturn where plasma interact with ice particulates. Dusty plasma is also found in industrial settings. Dusts are present in plasma during dry etching of integrated circuit (IC) manufacturing process.

Due to the

In Physics, plasma is the fourth state of matter, after the sates of solids, liquids, and gases, in which the electrons (negatively charged particles) of the atoms have enough energy that they escape the electromagnetic influence of the atomic nucleus and become free flowing. Due to the fact that the electrons are detached from the atoms, the particles in a plasma are ionized, where electrons have negative electric charge and ions have positive electric charge. Because of this, plasma are often called ionized gas [**?**].

Plasmas are ubiquitous in nature. One of the most obvious example in nature is the Sun, which is a plasma of mostly hydrogen and helium [**?**]. The tail of comets is also composed of plasma. Interstellar medium which surrounds our solar system is also composed of mostly plasma. The reason that plasma is cautious in our universe is because gases becomes easily ionized in space. Studies have found that 99% of the matter in the universe is the state of plasma [**?**].

However, it is rare to find isolated plasma. In most environments, dust particulates interact with plasma as seen in the Rings of Saturn. The pattern in the rings are formed from the interaction of dust, plasma, gravity of the planet, and magnetic field of the planet. Dust particulates are also present in plasma used in integrated circuit (IC) fabrication process on silicon wafer.