Department of Physics

About Department

The Physics Department is located in the physics building on the Hashemite University campus in Zarqa city. The Department of Physics offers basic studies in theoretical and experimental fields at the Bachelor and Master levels.

The mission of the physics department is to offer various academic courses, wide-ranging research areas, and to enhance students' educational standards in the basic foundation of physics and applied physics to help students.

Courses offered in the physics department are geared to prepare the student's with the best opportunities to be successful scientists in the ever changing scientific vistas and to provide them with the best training to compete in the competitive job market in our region and the world. Our outstanding bachelor's of science (B.Sc) program conferring requires passing 132 credit hours, including required several pre-requisite subjects such as Arabic, English, Mathematics and physical education

The department goal is to provide the local, regional, and international markets with well qualified graduates either for employment or for post graduate programs.

Objectives

The physics department is working hardly to achieve the following objectives.

1. Improve the methods of teaching by preparing modern laboratories and providing the physics classes with the best teaching tools.

2. Build the teaching and the research laboratories in which the faculties are interesting in.

3. Support the graduate program in the department and expand it to include a master program in medical and biological physics in addition to the current master program in applied physics.

4. Provide the tools that support the scientific research. This includes building the machine and the electronic shops and the liquid nitrogen machine which serve all the departments in the university.

5. Support the research and teaching laboratories with the qualified teams by training the technicians, teaching and research assistants, and the laboratory instructors with the training programs they need.

6. Provide a number of rooms for the research and teaching laboratories.

7. Following a comprehensive policy strategy that leads to a technical and academic stability in the department.

8. Enrich the library with the best and modern physics books and provide it with subscriptions with the online databases that contain the needed journals.

Research Areas

The department has a diverse pool of 20 faculty members who teach and carry out research in several areas of research including:

Theoretical Condensed Matter Physics

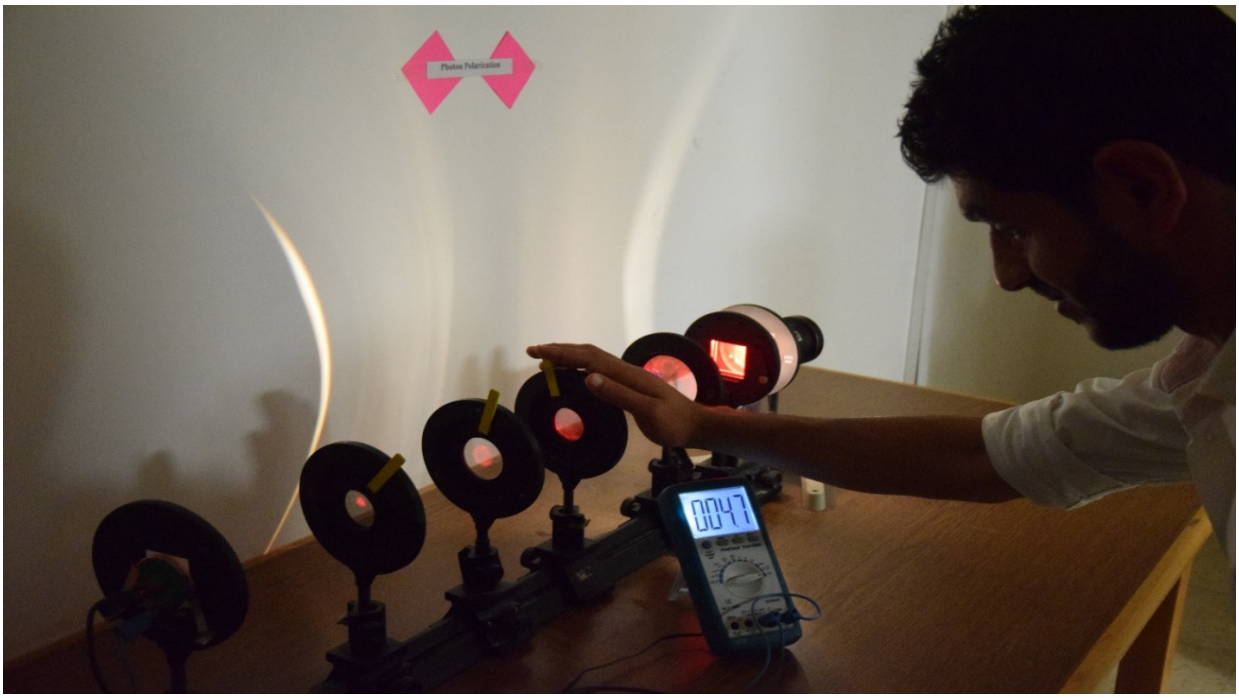
Condensed matter physics is a branch of physics that deals with the structural, magnetic, thermal, and optical properties of condensed phases of matter at the atomic level. Physicists in the area of research seek to understand the behavior of these systems using the laws of quantum, electromagnetic, thermal, and statistical mechanics. These laws are developed and coded over a long period of time in the form of numerical computation softwares. These numerical softwares are used to calculate properties of matter by solving the many-body wavefunction obtain meaningful predictions. The density functional theory (DFT) has been widely used as a prediction tool of electronic, optical, thermal, and magnetic properties of matter in the solid, liquid, and gas phases. Our faculty members at the department of physics use high performance computing (HPC) facilities in the united states to carry out these numerical simulations. Our group areas of expertise include computational studies of complex nanoscale systems such as atomic clusters and nanocrystals, nanotubes and nanowires. They employ a wide range of computational techniques with the emphasis on ab initio DFT and molecular dynamics methods. For more information about, please visit our faculties homepages at the physics department faculty list.

Materials Nanoscience

Our materials science and engineering research group interested in the discovery, characterization, and design of new materials at the nano-,micro-, and macro-scale, with an emphasis on the condensed phase of metter. Our researchers use physical and engineering principles to understand the structural, chemical, physical, and engineering properties of materials. Our researchers at the physics department study both crystalline and non-crystalline nanomaterials, metals, semiconductors, and polymers. Our researchers use the state of art lab equipment's to design and

characterize these materials. Sample of these labs are the magnetic and electrical characterization laboratories described below.

1- Magnetic characterization laboratory



The Quantum Design Physical Property Measurement System (PPMS) EverCool-II is a cryogen-free which enables a cool-down procedure with only a standard helium gas cylinder. the PPMS is designed to run 24 hours a day, 7 days a week. Many physical properties may be measured by easily changing the heat capacity, Raman & Luminescence Spectroscopy Systemn (RLSS), DC resistivity and magnetometry. The running option in our lab so far is the Vibrating sample magnetometer (VSM), which operates on Faraday's Law of Induction in which changing the magnetic flux will induce a voltage (emf) in a pickup coil. These measurements are performed by oscillating the sample near detection coil while detecting the induced voltage. The precise position and amplitude of oscillation is controlled from the VSM motor module using an optical linear encoder signal readback from the VSM linear motor transport. By performing relatively large oscillation amplitude (1-3 mm peak) and a frequency of 40 Hz, the system may resolve magnetization of less than 10^{-6} emu. These measurements may be performed under very low temperatures of the order of 4 K and high magnetic

fields up to nine Teslas. Magnetization changes with Magnetic field, temperature and time may be performed as well.

2- Impedance Spectroscopy Laboratory

AC-voltage impedance spectroscopy analyzer with a frequency range from1 MHz down to 10^{-3} Hz is applied to solid and liquid materialsto characterize the dielectric properties of these materials. A holder connection unit allows the 4-point-probe of dielectric sample characterization. A high temperature sample holder in combination with furnace offers the possibility to incorporate the temperature effect on these properties in a temperature range between 20 and 500 °C. In this setup, our researchers can measure a wide range of physical properties of these polymeric materials; such as, ionic conductivities, activation energies, and diffusion coefficients. Electrical properties of biological materials were the main interest to our research group in collaboration with Chemistry and biology departments at the Hashemite university.

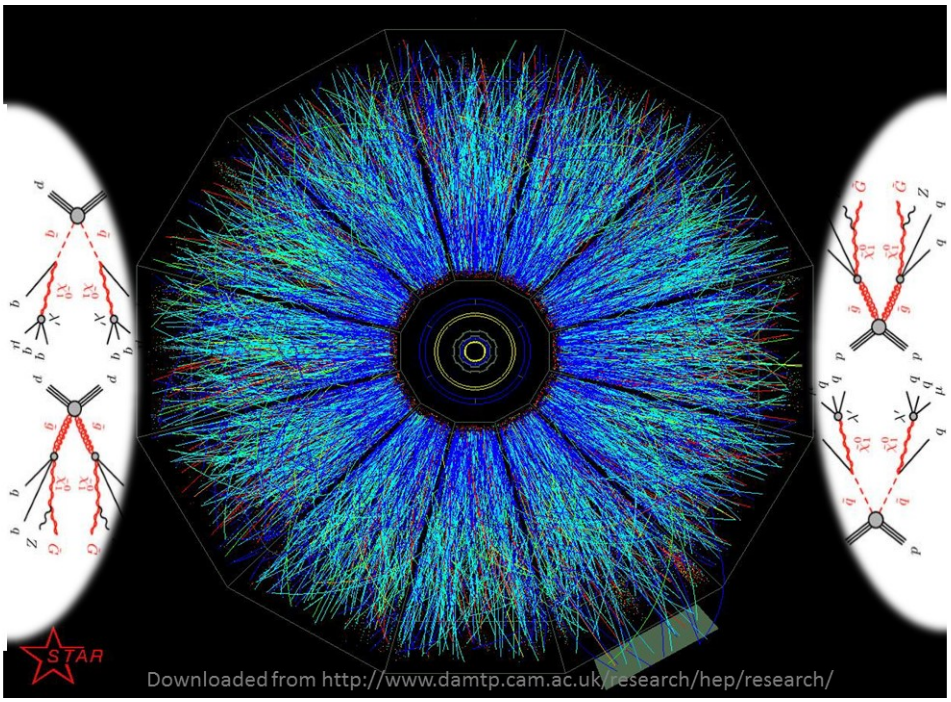
Atomic, Molecular, and Optical Physics (AMO)

Our researchers at the physics department incorporate classical and quantum theory to study light-matter interaction at the atomic level. Generation of lasers and

masers, absorption, scattering, and emission of light from atoms and molecules can be studies in the department of physics at the Hashemite University.

In our atomic and molecular physics lab, a high resolution imaging technique for electron-atomic and electron-molecular collisions has been built and operated. This technique is known as COLTRIMS which stands for COLd Target Recoil Ion Momentum Spectroscopy. We used our COLTRIMS imaging technique to measure the complete fragmentation of a few body systems. All charged fragments produced from atomic or molecular collisions are projected by a combination of electric and magnetic fields onto large area position sensitive detectors. Using the time-of-flight and the position of these fragments; the three dimensional momentum vector of these particles can be obtained. Cooling the target atoms before the fragmentation by supersonic expansion; allows a momentum resolution for the ion momenta of the order of 0.05 a.u. Multi hit capable position channel plate detectors with the delay-line readout can be used for the detection purposes of several electrons and ions per detector.

Theoretical High Energy Nuclear Physics



Our researchers at the physics department studies the behavior of nuclear matter in extremely high energy regimes. Our group study the direct nuclear reactions at stellar energies using the Asymptotic Normalization coefficients and kinetics modeling of heavy ions. The primary focus of our researchers is the study of heavy-ion collisions. At high collision energy, these collisions can be studied theoretically in the form of plasma. Due to small luminosities of leptons and mesons; the high energy study of these elementary particles are essential at the theoretical level.

In addition to these research facilities, the department of physics at the Hashemite University has a very well equipped teaching laboratories for physics and none-physics students. The purpose of these laboratories is to help our graduate and undergraduate students bridge physical concepts to real life experiment.