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A Brief Note on Atomic Physics and Nuclear Physics

Celeste Castilo*

Executive Manager, Journal of Physics and Astronomy, UK.

***Corresponding author**: Celeste Castilo, Executive Manager, Journal of Physics and Astronomy, UK., E-mail: physastronomy@journalres.com

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Introduction

Nuclear physics investigates the components (protons and neutrons) and interactions of atomic nuclei while atomic physics examines atoms as a standalone system of electrons and an atomic nucleus. Molecule physics and characteristics are also covered in atomic physics. What matters most is how the electrons are arranged around the nucleus and how these arrangements vary, including the role of ions and neutral atoms. There are many uses for nuclear physics, including radioactive dating in geology, palaeontology, archaeology, and the arts, as well as ion implantation in materials engineering and medical diagnosis (PET, MRI). Other uses include nuclear power generation and national security (nuclear weapons stockpile).

Atomic physics

Atomic physics examines atoms by focusing on their isolated electron system and atomic nucleus. This relates to the characteristics of atoms, which are mostly determined by the arrangement of their electrons. Most of the focus of atomic physics is on the electrons that surround an atom's nucleus. It has produced significant advancements in communications, lasers, medicine, and other fields while serving as a testing ground for quantum theory, quantum electrodynamics, and its offshoots.

Nuclear physics

Atomic nuclei, their components, and interactions are the subject of nuclear physics, a branch of physics. On the other hand, nuclear physics is concerned with the particles known as nucleons that make up the nucleus. Nuclear power, nuclear weapons, nuclear medicine, and nuclear magnetic resonance imaging are just a few of the applications that have resulted from this field's research. The "heavy" elements are created using atomic numbers greater than five through nuclear fusion, nuclear fission, nuclear decay, and nuclear decay.

Nuclear quantum physics

A branch of physics called quantum physics, also referred to as quantum mechanics and including the quantum field theory, describes the nature of subatomic particles and atoms at the lowest scales of their energy levels. All forms of matter are made up of subatomic particles, and quantum physics can reveal their individual performances. One treats a heavy nucleus, which has hundreds of nucleons, as a quantum-mechanical one.

Quantum mechanics

The fundamental physics theory of quantum mechanics (QM), which includes quantum field theory, describes nature at the tiniest scales of energy levels of atoms and subatomic particles. Electronics, cryptography, quantum computing, macroscale quantum effects, and quantum theory are a few examples of how quantum mechanics is applied.

Atomic spectroscopy

Atomic spectroscopy investigates the electromagnetic radiation that atoms absorb and release. The electromagnetic spectrum or mass spectrum, which can be spread depending on the type of spectroscopy being utilised or the atomization source, is used to determine the elemental compositions. Three methods—atomic absorption, atomic emission, and atomic fluorescence—were developed using atomic spectroscopy technology for systematic usage. The transitions involve the relaxation and excitation of the

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outer or bonding shell electrons of metal ions and atoms, and the associated photons have energy that fall within the visible and ultraviolet spectra. The dark absorption lines in the solar spectrum serve as a good illustration of this.

Laser atomic physics

Atomic Laser Physics Light Amplification by Stimulated Emission of Radiation, or laser. The main distinction between an optical and an atom laser is that atoms interact with one another, cannot be converted into photons, and retain mass, whereas photons do not. The physics of an atom laser are similar to those of an optical laser. Atom holography and atom interferometry are two of the atom laser's primary uses.

Plasma physics

The study of a charged particle-filled state of matter is known as plasma physics. In order to make plasmas, heat a gas until the electrons separate from their parent atom or molecule. High-power lasers or microwaves can likewise be used to produce this alleged ionisation. Stars and space both naturally contain plasma.

At the surface of the Earth, plasma can be seen in the form of lightning. 30,000 amps at up to 100 million volts are typically discharged by lightning, which also produces light, radio waves, X-rays, and even gamma rays. Electron densities can exceed 1024 m3 and plasma temperatures can approach 28,000 K (28,000 °C; 50,000 °F) in lightning.

Nuclear reactor physics

The study and use of chain reactions to produce a regulated rate of fission in a nuclear reactor for the generation of energy is the subject of nuclear reactor physics. This chain reaction is used by many nuclear reactors to control the rate of nuclear fission in fissile material, which releases free neutrons and energy. Nuclear fuel makes up the reactor, which is typically encircled by a neutron moderator like regular water, heavy water, graphite, or zirconium hydride.

Conclusion

Atomic physics focuses on atoms, which separate the electron and atomic nucleus systems. Understanding the physics of molecules and describing their physical properties both benefit from an understanding of atomic physics. Due to the extensive usage of atomic and nuclear physics, this discipline is linked to nuclear reactors and weapons.

Nuclear physics is the study of atomic nuclei and the interactions between them. Numerous applications, including nuclear energy, nuclear weapons, nuclear medicine, magnetic resonance imaging, industrial and agricultural isotopes, and ion implantation in materials engineering, have been made possible by this field.