

# Physics Study Guide Magnetic Fields

Space physics

*Closely related fields include plasma physics, which studies more fundamental physics and artificial plasmas; atmospheric physics, which investigates*

Space physics, also known as space plasma physics, is the study of naturally occurring plasmas within Earth's upper atmosphere and the rest of the Solar System. It includes the topics of aeronomy, aurorae, planetary ionospheres and magnetospheres, radiation belts, and space weather (collectively known as solar-terrestrial physics). It also encompasses the discipline of

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heliophysics, which studies the solar physics of the Sun, its solar wind, the coronal heating problem, solar energetic particles, and the heliosphere.

Space physics is both a pure science and an applied science, with applications in radio transmission, spacecraft operations (particularly communications and weather satellites), and in meteorology. Important physical processes in space physics include magnetic reconnection, synchrotron...

Electromagnetic field

*electromagnetic field. The first one views the electric and magnetic fields as three-dimensional vector fields. These vector fields each have a value*

An electromagnetic field (also EM field) is a physical field, varying in space and time, that represents the electric and magnetic influences generated by and acting upon electric charges. The field at any point in space and time can be regarded as a combination of an electric field and a magnetic field.

Because of the interrelationship between the fields, a disturbance in the

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electric field can create a disturbance in the magnetic field which in turn affects the electric field, leading to an oscillation that propagates through space, known as an electromagnetic wave.

The way in which charges and currents (i.e. streams of charges) interact with the electromagnetic field is described by Maxwell's equations and the Lorentz force law. Maxwell's equations detail how the electric field converges...

Nucleon magnetic moment

*magnetic moment was determined by measuring the deflection of a beam of molecular hydrogen by a magnetic field. Stern won the Nobel Prize in Physics in*

The nucleon magnetic moments are the intrinsic magnetic dipole moments of the proton and neutron, symbols  $\mu_p$  and  $\mu_n$ . The nucleus of an atom comprises protons and neutrons, both nucleons that behave as small magnets. Their magnetic strengths are measured by their magnetic moments. The nucleons interact with normal matter through either the nuclear force or their

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magnetic moments, with the charged proton also interacting by the Coulomb force.

The proton's magnetic moment was directly measured in 1933 by Otto Stern team in University of Hamburg. While the neutron was determined to have a magnetic moment by indirect methods in the mid-1930s, Luis Alvarez and Felix Bloch made the first accurate, direct measurement of the neutron's magnetic moment in 1940. The proton's magnetic moment is exploited...

Accelerator physics

*different aspects of accelerator physics. One must model the elements that create the electric and magnetic fields, and then one must model the charged*

Accelerator physics is a branch of applied physics, concerned with designing, building and operating particle accelerators. As such, it can be described as the study of motion, manipulation and observation of relativistic charged particle beams and their interaction with accelerator structures by electromagnetic fields.

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It is also related to other fields:

Microwave engineering (for acceleration/deflection structures in the radio frequency range).

Optics with an emphasis on geometrical optics (beam focusing and bending) and laser physics (laser-particle interaction).

Computer technology with an emphasis on digital signal processing; e.g., for automated manipulation of the particle beam.

Plasma physics, for the description of intense beams.

The experiments conducted with particle accelerators...

Outline of physics

*is provided as an overview of and topical guide to physics: Physics – natural science that involves the study of matter and its motion through spacetime*

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The following outline is provided as an overview of and topical guide to physics:

Physics - natural science that involves the study of matter and its motion through spacetime, along with related concepts such as energy and force. More broadly, it is the general analysis of nature, conducted in order to understand how the universe behaves.

Magnetic resonance imaging

*physiological processes inside the body. MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to form images of the organs in*

Magnetic resonance imaging (MRI) is a medical imaging technique used in radiology to generate pictures of the anatomy and the physiological processes inside the body. MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to form images of the organs in the body. MRI does not involve X-rays or the use of ionizing radiation, which distinguishes it

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from computed tomography (CT) and positron emission tomography (PET) scans. MRI is a medical application of nuclear magnetic resonance (NMR) which can also be used for imaging in other NMR applications, such as NMR spectroscopy.

MRI is widely used in hospitals and clinics for medical diagnosis, staging and follow-up of disease. Compared to CT, MRI provides better contrast in images of soft tissues, e.g. in the brain or...

### Computational physics

*Computational physics is the study and implementation of numerical analysis to solve problems in physics. Historically, computational physics was the first*

Computational physics is the study and implementation of numerical analysis to solve problems in physics. Historically, computational physics was the first application of modern computers in science, and is now a subset of computational science. It is sometimes regarded as a subdiscipline (or offshoot) of theoretical physics, but others consider it an intermediate branch

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between theoretical and experimental physics — an area of study which supplements both theory and experiment.

Medical physics

*(CT), gamma rays/radionuclides in nuclear medicine, magnetic fields and radio-frequencies in magnetic resonance imaging (MRI), ultrasound in ultrasound*

Medical physics deals with the application of the concepts and methods of physics to the prevention, diagnosis and treatment of human diseases with a specific goal of improving human health and well-being. Since 2008, medical physics has been included as a health profession according to International Standard Classification of Occupation of the International Labour Organization.

Although medical physics may sometimes also be referred to as biomedical physics, medical biophysics, applied physics in medicine, physics applications in medical science, radiological physics or hospital radio-physics, a "medical

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physicist" is specifically a health professional with specialist education and training in the concepts and techniques of applying physics in medicine and competent to practice independently...

Plasma (physics)

*was also conducted in the field of supersonic and hypersonic aerodynamics to study plasma interaction with magnetic fields to eventually achieve passive*

Plasma (from Ancient Greek πλάσμα (plásma) 'moldable substance') is a state of matter that results from a gaseous state having undergone some degree of ionisation. It thus consists of a significant portion of charged particles (ions and/or electrons). While rarely encountered on Earth, it is estimated that 99.9% of all ordinary matter in the universe is plasma. Stars are almost pure balls of plasma, and plasma dominates the rarefied intracluster medium and intergalactic medium.

Plasma can be artificially generated, for example, by heating a neutral gas or subjecting it to a strong electromagnetic field.

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The presence of charged particles makes plasma electrically conductive, with the dynamics of individual particles and macroscopic plasma motion governed by collective electromagnetic fields...

Nuclear magnetic resonance spectroscopy

*re-orientation of atomic nuclei with non-zero nuclear spins in an external magnetic field. This re-orientation occurs with absorption of electromagnetic radiation*

Nuclear magnetic resonance spectroscopy, most commonly known as NMR spectroscopy or magnetic resonance spectroscopy (MRS), is a spectroscopic technique based on re-orientation of atomic nuclei with non-zero nuclear spins in an external magnetic field. This re-orientation occurs with absorption of electromagnetic radiation in the radio frequency region from roughly 4 to 900 MHz, which depends on the isotopic nature of the nucleus and increases proportionally to the strength of the external magnetic field. Notably, the resonance frequency of each NMR-active nucleus depends on its chemical

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environment. As a result, NMR spectra provide information about individual functional groups present in the sample, as well as about connections between nearby nuclei in the same molecule.

As the NMR spectra...

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