Physics 物理学

Physics is a part of natural philosophy and a natural science that involves the study of matter and its motion through space and time, 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.

物理学是自然哲学的一部分，也是一门自然科学，涉及研究物质及其在空间和时间中的运动，以及相关的概念，如能量和力。更广泛地说，它是对自然界的一般分析，是为了了解宇宙的行为方式而进行的。

Physics is one of the oldest **academic disciplines**, perhaps the oldest through its inclusion of astronomy. Over the last two millennia,physics was a part of natural philosophy along with chemistry, certain branches of mathematics, and biology, but during the Scientific Revolution in the 17th century, the natural sciences emerged as unique research programs **in their own right**. Physics **intersects** with many **interdisciplinary** areas of research,such as biophysics and **quantum** chemistry,and the boundaries of physics are not rigidly defined. New ideas in physics often explain the fundamental mechanisms of other sciences, while opening new avenues of research in areas such as mathematics and philosophy.

物理学是最古老的学科之一，也许是最古老的学科，因为它包含了天文学。在近两千年的时间里，物理学与化学、数学的某些分支学科、生物学一道成为自然哲学的一部分，但在17世纪的科学革命期间，自然科学作为其自身的独特研究项目出现了。物理学与许多跨学科的研究领域相交，如生物物理学和量子化学，物理学的边界并没有严格的界定。物理学的新思想往往能解释其他科学的基本机制，同时在数学和哲学等领域开辟新的研究途径。

Physics also makes significant contributions through advances in new technologies that arise from theoretical breakthroughs. For example, advances in the understanding of electromagnetism or nuclear physics led directly to the development of new products which have dramatically transformed modern-day society, such as television, computers, domestic appliances, and nuclear weapons; advances in thermodynamics led to the development of industrialization; and advances in mechanics inspired the development of calculus.

物理学还通过理论突破来对产生的新技术的进步作出重大贡献。例如，对电磁学或核物理认识的进步，直接导致了电视机、计算机、家用电器、核武器等急剧变革现代社会的新产品的开发；热力学的进步带动了工业化的发展；力学的进步激发了微积分的发展。

Classical mechanics 经典力学

In physics, classical mechanics is one of the two major sub-fields of mechanics, which is concerned with the set of physical laws describing the motion of bodies under the action of a system of forces. The study of the motion of bodies is an ancient one, making classical mechanics one of the oldest and largest subjects in science, engineering and technology.

在物理学中，经典力学是力学的两个主要分支领域之一，它涉及描述物体在力系作用下运动的一组物理规律。对物体运动的研究是一个古老的课题，这使得经典力学成为科学、工程和技术领域最古老、规模最大的学科之一。

Classical mechanics describes the motion of macroscopic objects, from projectiles to parts of machinery, as well as astronomical objects, such as spacecraft, planets, stars, and galaxies. Besides this, many specializations within the subject deal with gases, liquids, solids, and other specific sub-topics.

经典力学描述了宏观物体的运动，从弹丸到机械部件，以及天文对象，如航天器、行星、恒星和星系。除此之外，本学科的许多专业都涉及气体、液体、固体和其他特定的子课题。

Classical mechanics provides extremely accurate results as long as the domain of study is restricted to large objects and the speeds involved do not approach the speed of light. When the objects being dealt with become sufficiently small, it becomes necessary to introduce the other major sub-field of mechanics, quantum mechanics, which reconciles the macroscopic laws of physics with the atomic nature of matter and handles the wave–particle duality of atoms and molecules. In the case of high velocity objects approaching the speed of light, classical mechanics is enhanced by special relativity. General relativity unifies special relativity with Newton's law of universal gravitation, allowing physicists to handle gravitation at a deeper level.

只要研究领域局限于大型物体，并且所涉及的速度不接近光速，经典力学就能提供极其准确的结果。当被处理的物体变得足够小时，就需要引入力学的另一个主要子领域——量子力学，它将物理学的宏观规律与物质的原子性质相调和，并处理原子和分子的波粒二象性。在高速物体接近光速的情况下，狭义相对论对经典力学做了补充。广义相对论将狭义相对论与牛顿万有引力定律统一起来，允许物理学家在更深层次上处理引力问题。

The initial stage in the development of classical mechanics is often referred to as Newtonian mechanics, and is associated with the physical concepts employed by and the mathematical methods invented by Newton himself, in parallel with Leibniz【莱布尼兹】, and others.

经典力学发展的初始阶段通常被称为牛顿力学，与牛顿本人以及莱布尼茨等人所使用的物理概念和发明的数学方法有关。

Later, more abstract and general methods were developed, leading to reformulations of classical mechanics known as Lagrangian mechanics and Hamiltonian mechanics. These advances were largely made in the 18th and 19th centuries, and they extend substantially beyond Newton's work, particularly through their use of analytical mechanics. Ultimately, the mathematics developed for these were central to the creation of quantum mechanics.

后来，更多的抽象和一般方法被开发出来，导致经典力学的被重新表述，被称为拉格朗日力学和哈密尔顿力学。这些进展主要是在18和19世纪取得的，而且它们大大超出了牛顿的工作范围，特别是通过对分析力学的使用。最终，为这些发展起来的数学成为是创造量子力学的核心。

Thermodynamics 热力学

Thermodynamics is a branch of natural science concerned with heat and its relation to energy and work. It defines macroscopic variables (such as temperature, internal energy, entropy, and pressure) that characterize materials and radiation, and explains how they are related and by what laws they change with time. Thermodynamics describes the average behavior of very large numbers of microscopic constituents, and its laws can be derived from statistical mechanics.

热力学是自然科学的一个分支，涉及热及其与能量和功的关系。它定义了表征材料和辐射的宏观变量(如温度、内能、熵、压力等)，并解释了它们之间的关系以及它们随时间变化的规律。热力学描述了非常大量微观组分的平均行为，其规律可以从统计力学中推导出来。

Thermodynamics applies to a wide variety of topics in science and engineering—such as engines, phase transitions, chemical reactions, transport phenomena, and even black holes. Results of thermodynamic calculations are essential for other fields of physics and for chemistry, chemical engineering, aerospace engineering, mechanical engineering, cell biology, biomedical engineering, and materials science—and useful in other fields such as economics.

热力学适用于科学和工程领域的多种课题——如发动机、相变、化学反应、输运现象，甚至黑洞。热力学计算的结果对于物理学的其他领域以及对于化学、化学工程、航空航天工程、机械工程、细胞生物学、生物医学工程、材料科学等都是必不可少的，而且在经济学等其他领域也很有用。

Much of the empirical content of thermodynamics is contained in the four laws.

热力学的大部分经验内容都包含在四大定律中。

The first law asserts the existence of a quantity called the internal energy of a system, which is distinguishable from the kinetic energy of bulk movement of the system and from its potential energy with respect to its surroundings. The first law distinguishes transfers of energy between closed systems as heat and as work.

第一条定律认为存在一个称为系统内能的量，这个量可与系统的大量运动的动能和相对于其周围环境的势能区分开来。第一定律将封闭系统之间的能量转移区分为热和功。

The second law concerns two quantities called temperature and entropy. Entropy expresses the limitations, arising from what is known as irreversibility, on the amount of thermodynamic work that can be delivered to an external system by a thermodynamic process. Temperature, whose properties are also partially described by the zeroth law of thermodynamics, quantifies the direction of energy flow as heat between two systems in thermal contact and quantifies the common-sense notions of "hot" and "cold".

第二定律涉及两个被称为温度和熵的量。熵表示由所谓的不可逆性引起的对热力学过程可以传递给外部系统的热力学功的限制。温度，其性质也被热力学零定律部分描述，量化了热接触的两个系统之间作为热量的能量流动方向，并定量描述了 "热 "和 "冷 "的常识性概念。

Initially, the thermodynamics of heat engines concerned mainly the thermal properties of their 'working materials', such as steam. This concern was then linked to the study of energy transfers in chemical processes, for example to the investigation, published in 1840, of the heats of chemical reactions by Germain Hess, which was not originally explicitly concerned with the relation between energy exchanges by heat and work. Chemical thermodynamics studies the role of entropy in chemical reactions. Also, statistical thermodynamics, or statistical mechanics, gave explanations of macroscopic thermodynamics by statistical predictions of the collective motion of particles based on the mechanics of their microscopic behavior.

最初，热机的热力学主要关注其“工作材料”的热特性，如蒸汽。这种关注后来与化学过程中能量转移的研究联系起来，例如, 热尔曼-赫斯于1840年发表的对化学反应热的研究，该研究最初并没有明确关注热与功的能量交换之间的关系。化学热力学研究的是化学反应中熵的作用。此外，统计热力学，或称统计力学，根据粒子的微观行为力学，通过对粒子集体运动的统计预测，对宏观热力学作出了解释。

Thermodynamic equilibrium is one of the most important concepts for thermodynamics. The temperature of a system in thermodynamic equilibrium is well defined, and is perhaps the most characteristic quantity of thermodynamics. As the systems and processes of interest are taken further from thermodynamic equilibrium, their exact thermodynamical study becomes more difficult. Relatively simple approximate calculations, however, using the variables of equilibrium thermodynamics, are of much practical value in engineering. In many important practical cases, such as heat engines or refrigerators, the systems consist of many subsystems at different temperatures and pressures. In practice, thermodynamic calculations deal effectively with these complicated dynamic systems provided the equilibrium thermodynamic variables are nearly enough well-defined.

热力学平衡是热力学最重要的概念之一。处于热力学平衡状态下的系统的温度有很好的定义，也许是热力学中最有特点的量。随着感兴趣的系统和过程进一步远离热力学平衡，对它们进行精确的热力学研究变得更加困难。然而，使用热力学平衡的变量进行相对简单的近似计算，在工程中具有很大的实用价值。在许多重要的实际案例中，如热机或冰箱，系统由许多处于不同温度和压力的子系统组成。在实践中，只要热力学平衡变量的定义几乎足够明确，热力学计算就能有效地处理这些复杂的动态系统。

Electromagnetism 电磁学

The electromagnetic force is one of the four fundamental interactions in nature, the other three being the strong interaction, the weak interaction, and gravitation. This force is described by electromagnetic fields, and has innumerable physical instances including the interaction of electrically charged particles and the interaction of uncharged magnetic force fields with electrical conductors.

电磁力是自然界的四种基本相互作用之一，另外三种是强相互作用、弱相互作用和引力。这种力用电磁场来描述，有无数物理实例包含带电粒子的相互作用和未带电磁场与电导体的相互作用。

The science of electromagnetic phenomena is defined in terms of the electromagnetic force, sometimes called the Lorentz force, which includes both electricity and magnetism as elements of one phenomenon.

电磁现象的科学是用电磁力来定义的，有时称为洛仑兹力，它利用电和磁的这两种元素来描述现象。

The electromagnetic force is the interaction responsible for almost all the phenomena encountered in daily life, with the exception of gravity. Ordinary matter takes its form as a result of intermolecular forces between individual molecules in matter. Electrons are bound by electromagnetic wave mechanics into orbitals around atomic nuclei to form atoms, which are the building blocks of molecules. This governs the processes involved in chemistry, which arise from interactions between the electrons of neighboring atoms, which are in turn determined by the interaction between electromagnetic force and the momentum of the electrons.

电磁力是负责日常生活中遇到的几乎所有现象的相互作用，但重力除外。普通物质的形态是由物质中各个分子之间的分子间相互作用力形成的。电子被电磁场力束缚在原子核周围的轨道上，形成原子，而原子是分子的构成单位。这支配着化学所涉及的过程，这些过程产生于相邻原子的电子之间的相互作用，而这又是由电磁力和电子的动量之间的相互作用决定的。

There are numerous mathematical descriptions of the electromagnetic field. In classical electrodynamics, electric fields are described as electric potential and electric current in Ohm's law, magnetic fields are associated with electromagnetic induction and magnetism, and Maxwell's equations describe how electric and magnetic fields are generated and altered by each other and by charges and currents.

对电磁场有许多数学上的描述。在经典电动力学中，电场按欧姆定律描述为电动势和电流，磁场与电磁感应和磁性有关，麦克斯韦方程描述了电场和磁场是如何互相以及在电荷电流的作用下产生和变化的。

The theoretical implications of electromagnetism, in particular the establishment of the speed of light based on properties of the "medium" of propagation (permeability and permittivity), led to the development of special relativity by Albert Einstein in 1905.

电磁学的理论意义，特别是根据传播 "介质 "的特性（磁导率和介电常数）确定光速，使得阿尔伯特-爱因斯坦在1905年提出了狭义相对论。

Optics 光学

Optics is the branch of physics which involves the behaviour and properties of light, including its interactions with matter and the construction of instruments that use or detect it. Optics usually describes the behaviour of visible, ultraviolet, and infrared light. Because light is an electromagnetic wave, other forms of electromagnetic radiation such as X-rays, microwaves, and radio waves exhibit similar properties.

光学是一个涉及光的行为和属性的物理学分支，包括它与物质的相互作用以及使用或检测它的仪器的构造。光学通常描述可见光、紫外线和红外线的行为。因为光是一种电磁波，其他形式的电磁辐射，如X射线、微波和无线电波，也表现出类似的特性。

Most optical phenomena can be accounted for using the classical electromagnetic description of light. Complete electromagnetic descriptions of light are, however, often difficult to apply in practice. Practical optics is usually done using simplified models. The most common of these, geometric optics, treats light as a collection of rays that travel in straight lines and bend when they pass through or reflect from surfaces. Physical optics is a more comprehensive model of light, which includes wave effects such as diffraction and interference that cannot be accounted for in geometric optics. Historically, the ray-based model of light was developed first, followed by the wave model of light. Progress in electromagnetic theory in the 19th century led to the discovery that light waves were in fact electromagnetic radiation.

大多数光学现象都可以用经典的光的电磁描述来解释。然而，完整的光的电磁描述在实践中往往难以应用。应用光学通常使用简化模型。其中最常见的是几何光学，它将光视为直线传播的光线的集合，当它们通过或从表面反射时，会发生转向。物理光学是一个更全面的光的模型，它包括波的效应，如衍射和干涉，这些效应在几何光学中是无法解释的。从历史上看，光的射线模型首先被开发出来，然后是光的波动模型。19世纪电磁理论的进步使人们发现光波实际上是电磁辐射。

Atomic physics 原子物理

Atomic physics is the field of physics that studies atoms as an isolated system of electrons and an atomic nucleus. It is primarily concerned with the arrangement of electrons around the nucleus and the processes by which these arrangements change. This includes ions as well as neutral atoms and, unless otherwise stated, for the purposes of this discussion it should be assumed that the term atom includes ions.

原子物理学是研究原子作为电子和原子核的孤立系统的物理学领域。它主要关注的是电子在原子核周围的排列以及这些排列的变化过程。这包括离子和中性原子，除非另有说明，在本讨论中，应假定原子一词包括离子。

The term atomic physics is often associated with nuclear power and nuclear bombs, due to the synonymous use of atomic and nuclear in standard English. However, physicists distinguish between atomic physics — which deals with the atom as a system consisting of a nucleus and electrons — and nuclear physics, which considers atomic nuclei alone.

由于在标准英语中原子和核的同义使用，原子物理学这个术语经常与核能和核弹联系在一起。然而，物理学家将原子物理学和核物理学区分开来--前者将原子作为一个由原子核和电子组成的系统来处理，后者则只考虑原子核。

Statistical mechanics 统计力学

Statistical mechanics or statistical thermodynamics is a branch of physics that applies probability theory, which contains mathematical tools for dealing with large populations, to the study of the thermodynamic behavior of systems composed of a large number of particles. Statistical mechanics provides a framework for relating the microscopic properties of individual atoms and molecules to the macroscopic bulk properties of materials that can be observed in everyday life, thereby explaining thermodynamics as a result of the classical- and quantummechanical descriptions of statistics and mechanics at the microscopic level.

统计力学或统计热力学是物理学的一个分支，它将包含处理大人群的数学工具的概率理论应用于研究由大量粒子组成的系统的热力学行为。统计力学提供了一个框架，将单个原子和分子的微观属性与日常生活中可以观察到的材料的宏观体积属性联系起来，从而将热力学解释为在微观层面下统计学和力学的经典和量子描述。

Statistical mechanics provides a molecular-level interpretation of macroscopic thermodynamic quantities such as work, heat, free energy, and entropy. It enables the thermodynamic properties of bulk materials to be related to the spectroscopic data of individual molecules. This ability to make macroscopic predictions based on microscopic properties is the main advantage of statistical mechanics over classical thermodynamics. Both theories are governed by the second law of thermodynamics through the medium of entropy. However, entropy in thermodynamics can only be known empirically, whereas in statistical mechanics, it is a function of the distribution of the system on its microstates.

统计力学为宏观热力学量提供了分子层面的解释，如功、热、自由能和熵。它使批量材料的热力学特性与单个分子的光谱数据相关联。这种根据微观特性进行宏观预测的能力是统计力学相对于经典热力学的主要优势。这两种理论都是通过熵的媒介受热力学第二定律的制约。然而，热力学中的熵只能凭经验知道，而在统计力学中，它是系统微观状态的分布函数。

The essential problem in statistical thermodynamics is to calculate the distribution of a given amount of energy E over N identical systems. The goal of statistical thermodynamics is to understand and to interpret the measurable macroscopic properties of materials in terms of the properties of their constituent particles and the interactions between them. This is done by connecting thermodynamic functions to quantum-mechanical equations. Two central quantities in statistical thermodynamics are the Boltzmann factor and the partition function.

统计热力学的基本问题是计算给定数量的能量E在N个相同系统上的分布。统计热力学的目标是根据材料的组成粒子的性质以及它们之间的相互作用来理解和解释可测量的宏观性质。这是通过将热力学函数与量子力学方程联系起来实现的。统计热力学中的两个中心量是玻尔兹曼因子和配分函数。

Quantum mechanics 量子力学

Quantum mechanics (QM – also known as quantum physics, or quantum theory) is a branch of physics which deals with physical phenomena at microscopic scales, where the action is on the order of the Planck constant. Quantum mechanics departs from classical mechanics primarily at the quantum realm of atomic and subatomic length scales. Quantum mechanics provides a mathematical description of much of the dual particle-like and wave-like behavior and interactions of energy and matter. Quantum mechanics is the non-relativistic limit of Quantum Field Theory (QFT), a theory that was developed later that combined Quantum Mechanics with Relativity Theory.

量子力学（QM--也被称为量子物理，或量子理论）是物理学的一个分支，它处理微观尺度的物理现象，其中的作用是普朗克常数量级的。量子力学在原子和亚原子长度尺度的量子领域上与经典力学从根本上背离。量子力学对能量和物质的许多类似粒子和类似波的双重行为和相互作用进行了数学描述。量子力学是量子场论（QFT）的在非相对论极限下的近似，QFT是后来提出的将量子力学与相对论相结合的理论。

The name quantum mechanics derives from the observation that some physical quantities can change only in discrete amounts (Latin quanta), and not in a continuous way. For example, the angular momentum of an electron bound to an atom or molecule is quantized. In the context of quantum mechanics, the wave–particle duality of energy and matter and the uncertainty principle provide a unified view of the behavior of photons, electrons, and other atomic-scale objects.

量子力学的名称源于这样的观察：一些物理量只能以离散的数量（拉丁语量子）变化，而不是以连续的方式变化。例如，束缚在原子或分子上的电子的角动量是量子化的。在量子力学的背景下，能量和物质的波粒二象性和不确定性原理为光子、电子和其他原子尺度物体的行为提供了一个统一的观点。

The mathematical formulations of quantum mechanics are abstract. A mathematical function known as the wavefunction provides information about the probability amplitude of position, momentum, and other physical properties of a particle. Mathematical manipulations of the wavefunction usually involve the bra-ket notation, which requires an understanding of complex numbers and linear functions. The wavefunction treats the object as a quantum harmonic oscillator, and the mathematics is akin to that describing acoustic resonance. Many of the results of quantum mechanics are not easily visualized in terms of classical mechanics—for instance, the ground state in a quantum mechanical model is a non-zero energy state that is the lowest permitted energy state of a system, as opposed to a more "traditional" system that is thought of as simply being at rest, with zero kinetic energy.

量子力学的数学计算公式是抽象的。一种被称为波函数的数学函数提供了关于一个粒子的位置、动量和其他物理特性的概率振幅的信息。对波函数的数学操作通常涉及左矢-右矢符号，这需要对复数和线性函数的理解。波函数将物体视为一个量子谐振子，其数学原理类似于描述声学共振。量子力学的许多结果不容易用经典力学的术语来描述--例如，量子力学模型中的基态是一种非零能量状态，是一个系统的最低允许能量状态，而不是一个被认为是简单静止的、具有零动能的更'传统'的系统。

The earliest versions of quantum mechanics were formulated in the first decade of the 20th century. At around the same time, the atomic theory and the corpuscular theory of light first came to be widely accepted as scientific fact; these latter theories can be viewed as quantum theories of matter and electromagnetic radiation, respectively. Early quantum theory was significantly reformulated in the mid-1920s by Heisenberg, Born and Jordan, who created matrix mechanics; de Broglie and Schrödinger (Wave Mechanics); and Pauli and Bose (statistics of subatomic particles). And the Copenhagen interpretation of Niels Bohr became widely accepted. By 1930, quantum mechanics had been further unified and formalized by the work of Hilbert, Dirac and John von Neumann, with a greater emphasis placed on measurement in quantum mechanics, the statistical nature of our knowledge of reality, and philosophical speculation about the role of the observer. Quantum mechanics has since branched out into almost every aspect of 20th century physics and other disciplines, such as quantum chemistry, quantum electronics, quantum optics, and quantum information science. Much 19th century physics has been re-evaluated as the "classical limit" of quantum mechanics, and its more advanced developments in terms of quantum field theory, string theory, and speculative quantum gravity theories.

量子力学的最早版本是在20世纪的第一个十年里提出的。大约在同一时期，原子理论和光的微粒说首次称为被广泛接受的科学事实；后一种理论可以分别被视为物质和电磁辐射的量子理论。早期的量子理论在1920年代中期由海森堡、波恩和乔丹进行了重大的重改造，他们创立了矩阵力学；德布罗意和薛定谔（波动力学）；以及泡利和玻色（亚原子粒子的统计学）。而尼尔斯-玻尔的哥本哈根解释也被广泛接受。到1930年，量子力学已经被希尔伯特、狄拉克和约翰-冯-诺伊曼的工作进一步统一和正规化，更加强调量子力学的测量、我们对现实认识的统计性质以及对观察者角色的哲学思辨。从此，量子力学几乎渗透到20世纪物理学和其他学科的各个方面，如量子化学、量子电子学、量子光

学、量子信息科学等。19世纪的物理学被重新评价为量子力学的"经典极限"，并在量子场论、弦论和推测中的量子引力理论等方面得到了更进一步的发展。

Quantum mechanics is essential to understanding the behavior of systems at atomic length scales and smaller. In addition, if classical mechanics truly governed the workings of an atom, electrons would really 'orbit' the nucleus. Since bodies in circular motion accelerate, they must emit radiation and collide with the nucleus in the process. This clearly contradicts the existence of stable atoms.

量子力学对于理解原子长度尺度和更小的系统的行为必不可少。此外，如果经典力学真正支配着原子的运作，电子将真正 "围绕 "原子核运行。由于圆周运动的物体会加速，它们必须发出辐射，并在这个过程中与原子核发生碰撞。这显然与稳定原子的存在相矛盾。

Quantum mechanics was initially developed to provide a better explanation and description of the atom, especially the differences in the spectra of light emitted by different isotopes of the same element, as well as subatomic particles. In short, the quantum-mechanical atomic model has succeeded spectacularly in the realm where classical mechanics and electromagnetism falter.

量子力学最初是为了更好地解释和描述原子，特别是同一元素的不同同位素所发出的光的光谱的差异，以及亚原子粒子间的差异。简而言之，量子力学原子模型在经典力学和电磁学踉踉跄跄的领域取得了惊人的成功。

Broadly speaking, quantum mechanics incorporates four classes of phenomena for which classical physics cannot account: The quantization of certain physical properties; Wave–particle duality; The Uncertainty principle; Quantum entanglement

概括地说，量子力学包含了四类经典物理学无法解释的现象。某些物理量的量子化；波粒二象性；不确定性原理；量子纠缠。

Special relativity 狭义相对论

In physics, special relativity is a fundamental theory concerning space and time, developed by Albert Einstein in 1905 as a modification of Galilean relativity. The theory was able to explain some pressing theoretical and experimental issues in the physics of the time involving light and electrodynamics.

在物理学中，狭义相对论是关于时空的基本理论，由爱因斯坦在1905年提出，是对伽利略相对论的修改。该理论能够解释当时物理学中涉及光和电动力学的一些紧迫的理论和实验问题。

Einstein postulated that the speed of light in free space is the same for all observers, regardless of their motion relative to the light source. This postulate stemmed from the assumption that Maxwell's equations of electromagnetism, which predict a specific speed of light in a vacuum, hold in any inertial frame of reference. This prediction contradicted the laws of classical mechanics, which had been accepted for centuries, by arguing that time and space are not fixed and in fact change to maintain a constant speed of light regardless of the relative motions of sources and observers. Einstein's approach was based on thought experiments, calculations, and the principle of relativity, which is the notion that all physical laws should appear the same to all inertial observers.

爱因斯坦认为，无论观察者相对于光源的运动如何，自由空间中的光速对所有观察者来说都是一样的。这一假设源于麦克斯韦的电磁学方程，它预测真空中的光速不变，在任何惯性参考系中都成立。这一预测与几个世纪以来被接受的经典力学定律相矛盾，认为无论光源和观察者的相对运动，时间和空间都不是固定的，实际上是变化的，以保证光速恒定。爱因斯坦的方法是基于思想实验、计算和相对性原则，即所有物理规律对所有惯性观察者来说都应该是一样的。

The predictions of special relativity are almost identical to those of Galilean relativity for most everyday phenomena, in which speeds are much lower than the speed of light, but it makes different, non-obvious predictions for objects moving at very high speeds. These predictions have been experimentally tested on numerous occasions since the theory's inception. The major predictions of special relativity are:

对于大多数日常现象，狭义相对论的预测与伽利略相对论的预测几乎完全相同，在这些现象中，速度远低于光速，但它对以极高速度运动的物体做出了不同的、不显然的预测。自该理论诞生以来，这些预言已在许多场合得到了实验检验。狭义相对论的主要预言是。

Relativity of simultaneity: Observers who are in motion with respect to each other may disagree on whether two events occurred at the same time or one occurred before the other.

同时性的相对性：对于两个事件是同时发生的，还是一个事件先于另一个事件发生的，对彼此处于运动状态的观察者可能会有不同意见。

Time dilation (An observer watching two identical clocks, one moving and one at rest, will measure the moving clock to tick more slowly)

时间膨胀(一个观察者看着两个相同的时钟 ,一个在移动 ,一个在休息 ,去测量移动的时钟更慢地滴答)

Length contraction (Along the direction of motion, a rod moving with respect to an observer will be measured to be shorter than an identical rod at rest), and

长度收缩(沿运动方向 ,一个相对于观察者运动的杆在静止时被测得比同一杆短)，以及

The equivalence of mass and energy (written as $E = mc^2$).

质能等式（写作$E = mc^2$）

Special relativity predicts a non-linear velocity addition formula which prevents speeds greater than that of light from being observed. In 1908, Hermann Minkowski reformulated the theory based on different postulates of a more geometrical nature. This approach considers space and time as being different components of a single entity, the spacetime. Likewise, energy and momentum are the components of the four-momentum, and the electric and magnetic field are the components of the electromagnetic tensor.

狭义相对论预测了一个非线性的速度加法公式，这使得大于光速的速度无法被观测到。1908年，赫尔曼 · 闵可夫斯基根据更具几何性质的不同假设重新表述了该理论。这种理论认为空间和时间是单个实体的不同组成部分，即时空。同样，能量和动量是四维动量的分量，电场和磁场是电磁张量的分量。

As Galilean relativity is now considered an approximation of special relativity valid for low speeds, special relativity is considered an approximation of the theory of general relativity valid for weak gravitational fields. General relativity postulates that physical laws should appear the same to all observers (an accelerating frame of reference being equivalent to one in which a gravitational field acts), and that gravitation is the effect of the curvature of spacetime caused by energy (including mass).

由于伽利略相对论现在被认为是对低速有效的狭义相对论的近似，狭义相对论被认为是对弱引力场有效的广义相对论的近似。广义相对论假定物理定律对所有的观察者都应该是一样的(一个加速参照系相当于一个引力场作用的参照系)，引力是由能量(包括质量)引起的时空曲率的影响。