

Glossary

aberration | distortion in an image caused by departures from the small-angle approximation [OpenStax]

absorber | any object that absorbs radiation [OpenStax]

absorption spectrum | wavelengths of absorbed radiation by atoms and molecules [OpenStax]

acceptor impurity | atom substituted for another in a semiconductor that results in a free electron [OpenStax]

acceptor impurity | atom substituted for another in a semiconductor that results in a free electron [OpenStax]

accommodation | use of the ciliary muscles to adjust the shape of the eye lens for focusing on near or far objects [OpenStax]

activity | magnitude of the decay rate for radioactive nuclides [OpenStax]

alpha (α) rays | one of the types of rays emitted from the nucleus of an atom as alpha particles [OpenStax]

alpha decay | radioactive nuclear decay associated with the emission of an alpha particle [OpenStax]

amplifier | electrical device that amplifies an electric signal [OpenStax]

angular magnification | ratio of the angle subtended by an object observed with a magnifier to that observed by the naked eye [OpenStax]

angular momentum orbital quantum number (l) | quantum number associated with the orbital angular momentum of an electron in a hydrogen atom [OpenStax]

angular momentum projection quantum number (m) | quantum number associated with the z-component of the orbital angular momentum of an electron in a hydrogen atom [OpenStax]

anti-symmetric function | odd function [OpenStax]

antielectrons | another term for positrons [OpenStax]

antineutrino | antiparticle of an electron's neutrino in β^- decay [OpenStax]

antiparticle | subatomic particle with the same mass and lifetime as its associated particle, but opposite electric charge [OpenStax]

apparent depth | depth at which an object is perceived to be located with respect to an interface between two media [OpenStax]

atomic mass | total mass of the protons, neutrons, and electrons in a single atom [OpenStax]

atomic mass unit | unit used to express the mass of an individual nucleus, where $1u = 1.66054 \times 10^{-27}$ kg [OpenStax]

atomic nucleus | tightly packed group of nucleons at the center of an atom [OpenStax]

atomic number | number of protons in a nucleus [OpenStax]

atomic orbital | region in space that encloses a certain percentage (usually 90%) of the electron probability [OpenStax]

Balmer formula | describes the emission spectrum of a hydrogen atom in the visible-light range [OpenStax]

Balmer series | spectral lines corresponding to electron transitions to/from the $n=2$ state of the hydrogen atom, described by the Balmer formula [OpenStax]

baryon number | baryon number has the value $B=+1$ for baryons, -1 for antibaryons, and 0 for all other particles and is conserved in particle interactions [OpenStax]

baryons | group of three quarks [OpenStax]

base current | current drawn from the base n-type material in a transistor [OpenStax]

BCS theory | theory of superconductivity based on electron-lattice-electron interactions [OpenStax]

becquerel (Bq) | SI unit for the decay rate of a radioactive material, equal to 1 decay/second [OpenStax]

beta ($\beta\beta$) rays | one of the types of rays emitted from the nucleus of an atom as beta particles [OpenStax]

beta decay | radioactive nuclear decay associated with the emission of a beta particle [OpenStax]

Big Bang | rapid expansion of space that marked the beginning of the universe [OpenStax]

binding energy (BE) | energy needed to break a nucleus into its constituent protons and neutrons [OpenStax]

binding energy per nucleon (BEN) | energy need to remove a nucleon from a nucleus [OpenStax]

birefringent | refers to crystals that split an unpolarized beam of light into two beams [OpenStax]

blackbody | perfect absorber/emitter [OpenStax]

blackbody radiation | radiation emitted by a blackbody [OpenStax]

body-centered cubic (BCC) | crystal structure in which an ion is surrounded by eight nearest neighbors located at the corners of a unit cell [OpenStax]

Bohr magneton | magnetic moment of an electron, equal to 9.3×10^{-24} J/T or 5.8×10^{-5} eV/T [OpenStax]

Bohr radius of hydrogen | radius of the first Bohr's orbit [OpenStax]

Bohr's model of the hydrogen atom | first quantum model to explain emission spectra of hydrogen [OpenStax]

Born interpretation | states that the square of a wave function is the probability density [OpenStax]

boson | particle with integral spin that are symmetric on exchange [OpenStax]

Brackett series | spectral lines corresponding to electron transitions to/from the $n=4$ state [OpenStax]

Bragg planes | families of planes within crystals that can give rise to X-ray diffraction [OpenStax]

braking radiation | radiation produced by targeting metal with a high-energy electron beam (or radiation produced by the acceleration of any charged particle in a material) [OpenStax]

breakdown voltage | in a diode, the reverse bias voltage needed to cause an avalanche of current [OpenStax]

breeder reactor | reactor that is designed to make plutonium [OpenStax]

Brewster's angle | angle of incidence at which the reflected light is completely polarized [OpenStax]

Brewster's law | $\tan \theta_b = \frac{n_2}{n_1}$, where n_1 is the medium in which the incident and reflected light travel and n_2 is the index of refraction of the medium that forms the interface that reflects the light [OpenStax]

carbon-14 dating | method to determine the age of formerly living tissue using the ratio $^{14}\text{C}/^{12}\text{C}$ [OpenStax]

Cassegrain design | arrangement of an objective and eyepiece such that the light-gathering concave mirror has a hole in the middle, and light then is incident on an eyepiece lens [OpenStax]

charge-coupled device (CCD) | semiconductor chip that converts a light image into tiny pixels that can be converted into electronic signals of color and intensity [OpenStax]

chart of the nuclides | graph comprising stable and unstable nuclei [OpenStax]

chemical group | group of elements in the same column of the periodic table that possess similar chemical properties [OpenStax]

classical (Galilean) velocity addition | method of adding velocities when $v \ll c$; velocities add like regular numbers in one-dimensional motion: $u = v + u'$, where v is the velocity between two observers, u is the velocity of an object relative to one observer, and u' is the velocity relative to the other observer [OpenStax]

coherent light | light that consists of photons of the same frequency and phase [OpenStax]

coherent waves | waves are in phase or have a definite phase relationship [OpenStax]

collector current | current drawn from the collector p-type material [OpenStax]

color | property of particles and that plays the same role in strong nuclear interactions as electric charge does in electromagnetic interactions [OpenStax]

coma | similar to spherical aberration, but arises when the incoming rays are not parallel to the optical axis [OpenStax]

complex function | function containing both real and imaginary parts [OpenStax]

compound microscope | microscope constructed from two convex lenses, the first serving as the eyepiece and the second serving as the objective lens [OpenStax]

Compton effect | the change in wavelength when an X-ray is scattered by its interaction with some materials [OpenStax]

Compton shift | difference between the wavelengths of the incident X-ray and the scattered X-ray [OpenStax]

Compton wavelength | physical constant with the value $\lambda_c = 2.43 \text{ pm}$ [OpenStax]

concave mirror | spherical mirror with its reflecting surface on the inner side of the sphere; the mirror forms a "cave" [OpenStax]

conduction band | above the valence band, the next available band in the energy structure of a crystal [OpenStax]

converging (or convex) lens | lens in which light rays that enter it parallel converge into a single point on the opposite side [OpenStax]

convex mirror | spherical mirror with its reflecting surface on the outer side of the sphere [OpenStax]

Cooper pair | coupled electron pair in a superconductor [OpenStax]

Copenhagen interpretation | states that when an observer is not looking or when a measurement is not being made, the particle has many values of measurable quantities, such as position [OpenStax]

corner reflector | object consisting of two (or three) mutually perpendicular reflecting surfaces, so that the light that enters is reflected back exactly parallel to the direction from which it came [OpenStax]

correspondence principle | in the limit of large energies, the predictions of quantum mechanics agree with the predictions of classical mechanics [OpenStax]

cosmic microwave background radiation (CMBR) | thermal radiation produced by the Big Bang event [OpenStax]

cosmology | study of the origin, evolution, and ultimate fate of the universe [OpenStax]

covalent bond | chemical bond formed by the sharing of electrons between two atoms [OpenStax]

covalent bond | bond formed by the sharing of one or more electrons between atoms [OpenStax]

critical angle | incident angle that produces an angle of refraction of 90° [OpenStax]

critical magnetic field | maximum field required to produce superconductivity [OpenStax]

critical mass | minimum mass required of a given nuclide in order for self-sustained fission to occur [OpenStax]

critical temperature | maximum temperature to produce superconductivity [OpenStax]

criticality | condition in which a chain reaction easily becomes self-sustaining [OpenStax]

curie (Ci) | unit of decay rate, or the activity of 1 g of ^{226}Ra , equal to $3.70 \times 10^{10}\text{ Bq}$ [OpenStax]

curved mirror | mirror formed by a curved surface, such as spherical, elliptical, or parabolic [OpenStax]

cut-off frequency | frequency of incident light below which the photoelectric effect does not occur [OpenStax]

cut-off wavelength | wavelength of incident light that corresponds to cut-off frequency [OpenStax]

dark energy | form of energy believed to be responsible for the observed acceleration of the universe [OpenStax]

dark matter | matter in the universe that does not interact with other particles but that can be inferred by deflection of distance star light [OpenStax]

daughter nucleus | nucleus produced by the decay of a parent nucleus [OpenStax]

Davisson–Germer experiment | historically first electron-diffraction experiment that revealed electron waves [OpenStax]

de Broglie wave | matter wave associated with any object that has mass and momentum [OpenStax]

de Broglie's hypothesis of matter waves | particles of matter can behave like waves [OpenStax]

decay | process by which an individual atomic nucleus of an unstable atom loses mass and energy by emitting ionizing particles [OpenStax]

decay constant | quantity that is inversely proportional to the half-life and that is used in equation for number of nuclei as a function of time [OpenStax]

decay series | series of nuclear decays ending in a stable nucleus [OpenStax]

density of states | number of allowed quantum states per unit energy [OpenStax]

depletion layer | region near the p-n junction that produces an electric field [OpenStax]

destructive interference for a single slit | occurs when the width of the slit is comparable to the wavelength of light illuminating it [OpenStax]

diffraction | bending of a wave around the edges of an opening or an obstacle [OpenStax]

diffraction grating | large number of evenly spaced parallel slits [OpenStax]

diffraction limit | fundamental limit to resolution due to diffraction [OpenStax]

direction of polarization | direction parallel to the electric field for EM waves [OpenStax]

dispersion | spreading of light into its spectrum of wavelengths [OpenStax]

dissociation energy | amount of energy needed to break apart a molecule into atoms; also, total energy per ion pair to separate the crystal into isolated ions [OpenStax]

diverging (or concave) lens | lens that causes light rays to bend away from its optical axis [OpenStax]

donor impurity | atom substituted for another in a semiconductor that results in a free electron hole [OpenStax]

doping | alteration of a semiconductor by the substitution of one type of atom with another [OpenStax]

double-slit interference experiment | Young's double-slit experiment, which shows the interference of waves [OpenStax]

drift velocity | average velocity of a randomly moving particle [OpenStax]

electric dipole transition | transition between energy levels brought by the absorption or emission of radiation [OpenStax]

electron affinity | energy associated with an accepted (bound) electron [OpenStax]

electron configuration | representation of the state of electrons in an atom, such as $1s^2 2s^2 2p^6$ for lithium [OpenStax]

electron microscopy | microscopy that uses electron waves to "see" fine details of nano-size objects [OpenStax]

electron number density | number of electrons per unit volume [OpenStax]

electroweak force | unification of electromagnetic force and weak-nuclear force interactions [OpenStax]

emission spectrum | wavelengths of emitted radiation by atoms and molecules [OpenStax]

emitter | any object that emits radiation [OpenStax]

energy band | nearly continuous band of electronic energy levels in a solid [OpenStax]

energy gap | gap between energy bands in a solid [OpenStax]

energy levels | states of definite energy, often represented by horizontal lines in an energy "ladder" diagram [OpenStax]

energy of a photon | quantum of radiant energy, depends only on a photon's frequency [OpenStax]

energy quantum number | index that labels the allowed energy states [OpenStax]

energy spectrum of hydrogen | set of allowed discrete energies of an electron in a hydrogen atom [OpenStax]

energy-time uncertainty principle | energy-time relation for uncertainties in the simultaneous measurements of the energy of a quantum state and of its lifetime [OpenStax]

equilibrium separation distance | distance between atoms in a molecule [OpenStax]

even function | in one dimension, a function symmetric with the origin of the coordinate system [OpenStax]

event | occurrence in space and time specified by its position and time coordinates (x, y, z, t) measured relative to a frame of reference [OpenStax]

exchange symmetry | how a total wave function changes under the exchange of two electrons [OpenStax]

exchange symmetry | property of a system of indistinguishable particles that requires the exchange of any two particles to be unobservable [OpenStax]

excited energy states of the H atom | energy state other than the ground state [OpenStax]

expectation value | average value of the physical quantity assuming a large number of particles with the same wave function [OpenStax]

eyepiece | lens or combination of lenses in an optical instrument nearest to the eye of the observer [OpenStax]

face-centered cubic (FCC) | crystal structure in which an ion is surrounded by six nearest neighbors located at the faces at the faces of a unit cell [OpenStax]

far point | furthest point an eye can see in focus [OpenStax]

farsightedness (or hyperopia) | visual defect in which near objects appear blurred because their images are focused behind the retina rather than on the retina; a farsighted person can see far objects clearly but near objects appear blurred [OpenStax]

Fermi energy | largest energy filled by electrons in a metal at $T=0\text{ K}$ [OpenStax]

Fermi factor | number that expresses the probability that a state of given energy will be filled [OpenStax]

Fermi temperature | effective temperature of electrons with energies equal to the Fermi energy [OpenStax]

fermion | particle with half-integral spin that is antisymmetric on exchange [OpenStax]

Feynman diagram | space-time diagram that describes how particles move and interact [OpenStax]

field emission | electron emission from conductor surfaces when a strong external electric field is applied in normal direction to conductor's surface [OpenStax]

fine structure | detailed structure of atomic spectra produced by spin-orbit coupling [OpenStax]

first focus or object focus | object located at this point will result in an image created at infinity on the opposite side of a spherical interface between two media [OpenStax]

first postulate of special relativity | laws of physics are the same in all inertial frames of reference [OpenStax]

fission | splitting of a nucleus [OpenStax]

fluorescence | radiation produced by the excitation and subsequent, gradual de-excitation of an electron in an atom [OpenStax]

focal length | distance along the optical axis from the focal point to the optical element that focuses the light rays [OpenStax]

focal plane | plane that contains the focal point and is perpendicular to the optical axis [OpenStax]

focal point | for a converging lens or mirror, the point at which converging light rays cross; for a diverging lens or mirror, the point from which diverging light rays appear to originate [OpenStax]

forward bias configuration | diode configuration that results in high current [OpenStax]

Fraunhofer lines | dark absorption lines in the continuum solar emission spectrum [OpenStax]

free electron model | model of a metal that views electrons as a gas [OpenStax]

fringes | bright and dark patterns of interference [OpenStax]

fundamental force | one of four forces that act between bodies of matter: the strong nuclear, electromagnetic, weak nuclear, and gravitational forces [OpenStax]

Galilean relativity | if an observer measures a velocity in one frame of reference, and that frame of reference is moving with a velocity past a second reference frame, an observer in the second frame measures the original velocity as the vector sum of these velocities [OpenStax]

Galilean transformation | relation between position and time coordinates of the same events as seen in different reference frames, according to classical mechanics [OpenStax]

gamma (γ) rays | one of the types of rays emitted from the nucleus of an atom as gamma particles [OpenStax]

gamma decay | radioactive nuclear decay associated with the emission of gamma radiation [OpenStax]

geometric optics | part of optics dealing with the ray aspect of light [OpenStax]

gluon | particle that carry the strong nuclear force between quarks within an atomic nucleus [OpenStax]

grand unified theory | theory of particle interactions that unifies the strong nuclear, electromagnetic, and weak nuclear forces [OpenStax]

ground state energy | lowest energy state in the energy spectrum [OpenStax]

ground state energy of the hydrogen atom | energy of an electron in the first Bohr orbit of the hydrogen atom [OpenStax]

group velocity | velocity of a wave, energy travels with the group velocity [OpenStax]

hadron | a meson or baryon [OpenStax]

half-life | time for half of the original nuclei to decay (or half of the original nuclei remain) [OpenStax]

Heisenberg uncertainty principle | sets the limits on precision in simultaneous measurements of momentum and position of a particle [OpenStax]

Heisenberg's uncertainty principle | places limits on what can be known from a simultaneous measurements of position and momentum; states that if the uncertainty on position is small then the uncertainty on momentum is large, and vice versa [OpenStax]

high dose | dose of radiation greater than 1 Sv (100 rem) [OpenStax]

hole | unoccupied states in an energy band [OpenStax]

hologram | three-dimensional image recorded on film by lasers; the word hologram means entire picture (from the Greek word holo, as in holistic) [OpenStax]

holography | process of producing holograms with the use of lasers [OpenStax]

horizontally polarized | oscillations are in a horizontal plane [OpenStax]

Hubble's constant | constant that relates speed and distance in Hubble's law [OpenStax]

Hubble's law | relationship between the speed and distance of stars and galaxies [OpenStax]

Humphreys series | spectral lines corresponding to electron transitions to/from the $n=6$ state [OpenStax]

Huygens's principle | every point on a wave front is a source of wavelets that spread out in the forward direction at the same speed as the wave itself; the new wave front is a plane tangent to all of the wavelets [OpenStax]

hybridization | change in the energy structure of an atom in which energetically favorable mixed states participate in bonding [OpenStax]

hydrogen-like atom | ionized atom with one electron remaining and nucleus with charge $+Ze$ [OpenStax]

hyperfine structure | detailed structure of atomic spectra produced by spin-orbit coupling [OpenStax]

image distance | distance of the image from the central axis of the optical element that produces the image [OpenStax]

impurity atom | acceptor or donor impurity atom [OpenStax]

impurity band | new energy band create by semiconductor doping [OpenStax]

incoherent | waves have random phase relationships [OpenStax]

index of refraction | for a material, the ratio of the speed of light in a vacuum to that in a material [OpenStax]

inelastic scattering | scattering effect where kinetic energy is not conserved but the total energy is conserved [OpenStax]

inertial frame of reference | reference frame in which a body at rest remains at rest and a body in motion moves at a constant speed in a straight line unless acted on by an outside force [OpenStax]

infinite square well | potential function that is zero in a fixed range and infinitely beyond this range [OpenStax]

interferometer | instrument that uses interference of waves to make measurements [OpenStax]

ionic bond | chemical bond formed by the electric attraction between two oppositely charged ions [OpenStax]

ionic bond | bond formed by the Coulomb attraction of a positive and negative ions [OpenStax]

ionization energy | energy needed to remove an electron from an atom [OpenStax]

ionization limit of the hydrogen atom | ionization energy needed to remove an electron from the first Bohr orbit [OpenStax]

isotopes | nuclei having the same number of protons but different numbers of neutrons [OpenStax]

junction transistor | electrical valve based on a p-n-p junction [OpenStax]

laser | coherent light produced by a cascade of electron de-excitations [OpenStax]

lativistic velocity addition | method of adding velocities of an object moving at a relativistic speeds [OpenStax]

lattice | regular array or arrangement of atoms into a crystal structure [OpenStax]

law of reflection | angle of reflection equals the angle of incidence [OpenStax]

law of refraction | when a light ray crosses from one medium to another, it changes direction by an amount that depends on the index of refraction of each medium and the sines of the angle of incidence and angle of refraction [OpenStax]

length contraction | decrease in observed length of an object from its proper length L_0 to length L when its length is observed in a reference frame where it is traveling at speed v [OpenStax]

lepton | a fermion that participates in the electroweak force [OpenStax]

lepton number | electron-lepton number L_e , the muon-lepton number L_μ , and the tau-lepton number L_τ are conserved separately in every particle interaction [OpenStax]

lifetime | average time that a nucleus exists before decaying [OpenStax]

linear magnification | ratio of image height to object height [OpenStax]

liquid drop model | model of nucleus (only to understand some of its features) in which nucleons in a nucleus act like atoms in a drop [OpenStax]

Lorentz transformation | relation between position and time coordinates of the same events as seen in different reference frames, according to the special theory of relativity [OpenStax]

low dose | dose of radiation less than 100 mSv (10 rem) [OpenStax]

Lyman series | spectral lines corresponding to electron transitions to/from the ground state [OpenStax]

Madelung constant | constant that depends on the geometry of a crystal used to determine the total potential energy of an ion in a crystal [OpenStax]

magnetic orbital quantum number | another term for the angular momentum projection quantum number [OpenStax]

magnetogram | pictorial representation, or map, of the magnetic activity at the Sun's surface [OpenStax]

magnification | ratio of image size to object size [OpenStax]

majority carrier | free electrons (or holes) contributed by impurity atoms [OpenStax]

Malus's law | where I_0 is the intensity of the polarized wave before passing through the filter [OpenStax]

mass defect | difference between the mass of a nucleus and the total mass of its constituent nucleons [OpenStax]

mass number | number of nucleons in a nucleus [OpenStax]

mesons | a group of two quarks [OpenStax]

metastable state | state in which an electron "lingers" in an excited state [OpenStax]

Michelson-Morley experiment | investigation performed in 1887 that showed that the speed of light in a vacuum is the same in all frames of reference from which it is viewed [OpenStax]

minority carrier | free electrons (or holes) produced by thermal excitations across the energy gap [OpenStax]

missing order | interference maximum that is not seen because it coincides with a diffraction minimum [OpenStax]

moderate dose | dose of radiation from 0.1 Sv to 1 Sv (10 to 100 rem) [OpenStax]

momentum operator | operator that corresponds to the momentum of a particle [OpenStax]

monochromatic | light composed of one wavelength only [OpenStax]

monochromatic | light that consists of photons with the same frequency [OpenStax]

Moseley plot | plot of the atomic number versus the square root of X-ray frequency [OpenStax]

Moseley's law | relationship between the atomic number and X-ray photon frequency for X-ray production [OpenStax]

n-type semiconductor | doped semiconductor that conducts electrons [OpenStax]

nanotechnology | technology that is based on manipulation of nanostructures such as molecules or individual atoms to produce nano-devices such as integrated circuits [OpenStax]

near point | closest point an eye can see in focus [OpenStax]

nearsightedness (or myopia) | visual defect in which far objects appear blurred because their images are focused in front of the retina rather than on the retina; a nearsighted person can see near objects clearly but far objects appear blurred [OpenStax]

net magnification | (Mnet/Mnet) of the compound microscope is the product of the linear magnification of the objective and the angular magnification of the eyepiece [OpenStax]

neutrino | subatomic elementary particle which has no net electric charge [OpenStax]

neutron number | number of neutrons in a nucleus [OpenStax]

Newtonian design | arrangement of an objective and eyepiece such that the focused light from the concave mirror was reflected to one side of the tube into an eyepiece [OpenStax]

Newton's rings | circular interference pattern created by interference between the light reflected off two surfaces as a result of a slight gap between them [OpenStax]

normalization condition | requires that the probability density integrated over the entire physical space results in the number one [OpenStax]

nuclear fusion | process of combining lighter nuclei to make heavier nuclei [OpenStax]

nuclear fusion reactor | nuclear reactor that uses the fusion chain to produce energy [OpenStax]

nuclear model of the atom | heavy positively charged nucleus at the center is surrounded by electrons, proposed by Rutherford [OpenStax]

nucleons | protons and neutrons found inside the nucleus of an atom [OpenStax]

nucleosynthesis | process of fusion by which all elements on Earth are believed to have been created [OpenStax]

nucleosynthesis | creation of heavy elements, occurring during the Big Bang [OpenStax]

nucleide | nucleus [OpenStax]

object distance | distance of the object from the central axis of the optical element that produces its image [OpenStax]

objective | lens nearest to the object being examined. [OpenStax]

odd function | in one dimension, a function antisymmetric with the origin of the coordinate system [OpenStax]

optical axis | axis about which the mirror is rotationally symmetric; you can rotate the mirror about this axis without changing anything [OpenStax]

optical power | (P) inverse of the focal length of a lens, with the focal length expressed in meters. The optical power P of a lens is expressed in units of diopters D; that is, $\displaystyle 1D=1/m=1m^{-1}$ [OpenStax]

optically active | substances that rotate the plane of polarization of light passing through them [OpenStax]

Orbital magnetic dipole moment | measure of the strength of the magnetic field produced by the orbital angular momentum of the electron [OpenStax]

order | integer m used in the equations for constructive and destructive interference for a double slit [OpenStax]

p-n junction | junction formed by joining p- and n-type semiconductors [OpenStax]

p-type semiconductor | doped semiconductor that conducts holes [OpenStax]

parent nucleus | original nucleus before decay [OpenStax]

particle accelerator | machine designed to accelerate charged particles; this acceleration is usually achieved with strong electric fields, magnetic fields, or both [OpenStax]

particle detector | detector designed to accurately measure the outcome of collisions created by a particle accelerator; particle detectors are hermetic and multipurpose [OpenStax]

Paschen series | spectral lines corresponding to electron transitions to/from the $\displaystyle n=3$ state [OpenStax]

Pauli's exclusion principle | no two electrons in an atom can have the same values for all four quantum numbers $\displaystyle (n,l,m,m_s)$ [OpenStax]

Pfund series | spectral lines corresponding to electron transitions to/from the $\displaystyle n=5$ state [OpenStax]

photocurrent | in a circuit, current that flows when a photoelectrode is illuminated [OpenStax]

photoelectric effect | emission of electrons from a metal surface exposed to electromagnetic radiation of the proper frequency [OpenStax]

photoelectrode | in a circuit, an electrode that emits photoelectrons [OpenStax]

photoelectron | electron emitted from a metal surface in the presence of incident radiation [OpenStax]

photon | particle of light [OpenStax]

Planck's hypothesis of energy quanta | energy exchanges between the radiation and the walls take place only in the form of discrete energy quanta [OpenStax]

plane mirror | plane (flat) reflecting surface [OpenStax]

polarization | attribute that wave oscillations have a definite direction relative to the direction of propagation of the wave [OpenStax]

polarized | refers to waves having the electric and magnetic field oscillations in a definite direction [OpenStax]

polyatomic molecule | molecule formed of more than one atom [OpenStax]

population inversion | condition in which a majority of atoms contain electrons in a metastable state [OpenStax]

position operator | operator that corresponds to the position of a particle [OpenStax]

positron | electron with positive charge [OpenStax]

positron | antielectron [OpenStax]

positron emission tomography (PET) | tomography technique that uses $\displaystyle \beta^+$ emitters and detects the two annihilation $\displaystyle \gamma$ rays, aiding in source localization [OpenStax]

postulates of Bohr's model | three assumptions that set a frame for Bohr's model [OpenStax]

potential barrier | potential function that rises and falls with increasing values of position [OpenStax]

power intensity | energy that passes through a unit surface per unit time [OpenStax]

principal maximum | brightest interference fringes seen with multiple slits [OpenStax]

principal quantum number | energy quantum number [OpenStax]

principal quantum number (n) | quantum number associated with the total energy of an electron in a hydrogen atom [OpenStax]

probability density | square of the particle's wave function [OpenStax]

propagation vector | vector with magnitude $\displaystyle 2\pi/\lambda$ that has the direction of the photon's linear momentum [OpenStax]

proper length | $\displaystyle L_0$; the distance between two points measured by an observer who is at rest relative to both of the points; for example, earthbound observers measure proper length when measuring the distance between two points that are stationary relative to Earth [OpenStax]

proper time | $\displaystyle \Delta t$ is the time interval measured by an observer who sees the beginning and end of the process that the time interval measures occur at the same location [OpenStax]

proton-proton chain | combined reactions that fuse hydrogen nuclei to produce He nuclei [OpenStax]

quantized energies | discrete energies; not continuous [OpenStax]

quantum chromodynamics (QCD) | theory that describes strong interactions between quarks [OpenStax]

quantum dot | small region of a semiconductor nanocrystal embedded in another semiconductor nanocrystal, acting as a potential well for electrons [OpenStax]

quantum electrodynamics (QED) | theory that describes the interaction of electrons with photons [OpenStax]

quantum number | index that enumerates energy levels [OpenStax]

quantum phenomenon | in interaction with matter, photon transfers either all its energy or nothing [OpenStax]

quantum state of a Planck's oscillator | any mode of vibration of Planck's oscillator, enumerated by quantum number [OpenStax]

quantum tunneling | phenomenon where particles penetrate through a potential energy barrier with a height greater than the total energy of the particles [OpenStax]

quark | a fermion that participates in the electroweak and strong nuclear force [OpenStax]

radial probability density function | function use to determine the probability of a electron to be found in a spatial interval in r [OpenStax]

radiation dose unit (rad) | ionizing energy deposited per kilogram of tissue [OpenStax]

radioactive dating | application of radioactive decay in which the age of a material is determined by the amount of radioactivity of a particular type that occurs [OpenStax]

radioactive decay law | describes the exponential decrease of parent nuclei in a radioactive sample [OpenStax]

radioactive tags | special drugs (radiopharmaceuticals) that allow doctors to track movement of other drugs in the body [OpenStax]

radioactivity | spontaneous emission of radiation from nuclei [OpenStax]

radiopharmaceutical | compound used for medical imaging [OpenStax]

radius of a nucleus | radius of a nucleus is defined as $\displaystyle r=r_0A^{1/3}$ [OpenStax]

ray | straight line that originates at some point [OpenStax]

ray tracing | technique that uses geometric constructions to find and characterize the image formed by an optical system [OpenStax]

Rayleigh criterion | two images are just-resolvable when the center of the diffraction pattern of one is directly over the first minimum of the diffraction pattern of the other [OpenStax]

real image | image that can be projected onto a screen because the rays physically go through the image [OpenStax]

redshift | lengthening of the wavelength of light (or reddening) due to cosmological expansion [OpenStax]

reduced Planck's constant | Planck's constant divided by $\displaystyle 2\pi$ [OpenStax]

refraction | changing of a light ray's direction when it passes through variations in matter [OpenStax]

relative biological effectiveness (RBE) | number that expresses the relative amount of damage that a fixed amount of ionizing radiation of a given type can inflict on biological tissues [OpenStax]

relativistic kinetic energy | kinetic energy of an object moving at relativistic speeds [OpenStax]

relativistic momentum | $\displaystyle \vec{p}$, the momentum of an object moving at relativistic velocity; $\displaystyle \vec{p}=\gamma m\vec{u}$ [OpenStax]

repulsion constant | experimental parameter associated with a repulsive force between ions brought so close together that the exclusion principle is important [OpenStax]

resolution | ability, or limit thereof, to distinguish small details in images [OpenStax]

resonant tunneling | tunneling of electrons through a finite-height potential well that occurs only when electron energies match an energy level in the well, occurs in quantum dots [OpenStax]

resonant-tunneling diode | quantum dot with an applied voltage bias across it [OpenStax]

rest energy | energy stored in an object at rest: $\displaystyle E_0=mc^2$ [OpenStax]

rest frame | frame of reference in which the observer is at rest [OpenStax]

rest mass | mass of an object as measured by an observer at rest relative to the object [OpenStax]

reverse bias configuration | diode configuration that results in low current [OpenStax]

roentgen equivalent man (rem) | dose unit more closely related to effects in biological tissue [OpenStax]

rotational energy level | energy level associated with the rotational energy of a molecule [OpenStax]

Rutherford's gold foil experiment | first experiment to demonstrate the existence of the atomic nucleus [OpenStax]

Rydberg constant for hydrogen | physical constant in the Balmer formula [OpenStax]

Rydberg formula | experimentally found positions of spectral lines of hydrogen atom [OpenStax]

scanning tunneling microscope (STM) | device that utilizes quantum-tunneling phenomenon at metallic surfaces to obtain images of nanoscale structures [OpenStax]

scattering angle | angle between the direction of the scattered beam and the direction of the incident beam [OpenStax]

Schrödinger's time-dependent equation | equation in space and time that allows us to determine wave functions of a quantum particle [OpenStax]

Schrödinger's time-independent equation | equation in space that allows us to determine wave functions of a quantum particle; this wave function must be multiplied by a time-modulation factor to obtain the time-dependent wave function [OpenStax]

second focus or image focus | for a converging interface, the point where a bundle of parallel rays refracting at a spherical interface; for a diverging interface, the point at which the backward continuation of the refracted rays will converge between two media will focus [OpenStax]

second postulate of special relativity | light travels in a vacuum with the same speed c in any direction in all inertial frames [OpenStax]

secondary maximum | bright interference fringes of intensity lower than the principal maxima [OpenStax]

selection rule | rule that limits the possible transitions from one quantum state to another [OpenStax]

selection rules | rules that determine whether atomic transitions are allowed or forbidden (rare) [OpenStax]

semiconductor | solid with a relatively small energy gap between the lowest completely filled band and the next available unfilled band [OpenStax]

sievert (Sv) | SI equivalent of the rem [OpenStax]

simple cubic | basic crystal structure in which each ion is located at the nodes of a three-dimensional grid [OpenStax]

simple magnifier (or magnifying glass) | converging lens that produces a virtual image of an object that is within the focal length of the lens [OpenStax]

single-photon-emission computed tomography (SPECT) | tomography performed with $\displaystyle \gamma$ -emitting radiopharmaceuticals [OpenStax]

small-angle approximation | approximation that is valid when the size of a spherical mirror is significantly smaller than the mirror's radius; in this approximation, spherical aberration is negligible and the mirror has a well-defined focal point [OpenStax]

special theory of relativity | theory that Albert Einstein proposed in 1905 that assumes all the laws of physics have the same form in every inertial frame of reference, and that the speed of light is the same within all inertial frames [OpenStax]

speed of light | ultimate speed limit for any particle having mass [OpenStax]

spherical aberration | distortion in the image formed by a spherical mirror when rays are not all focused at the same point [OpenStax]

spin projection quantum number ($\displaystyle m_s$) | quantum number associated with the z-component of the spin angular momentum of an electron [OpenStax]

spin quantum number (s) | quantum number associated with the spin angular momentum of an electron [OpenStax]

spin-flip transitions | atomic transitions between states of an electron-proton system in which the magnetic moments are aligned and not aligned [OpenStax]

spin-orbit coupling | interaction between the electron magnetic moment and the magnetic field produced by the orbital angular momentum of the electron [OpenStax]

Standard Model | model of particle interactions that contains the electroweak theory and quantum chromodynamics (QCD) [OpenStax]

standing wave state | stationary state for which the real and imaginary parts of $\Psi(x,t)\Psi(x,t)$ oscillate up and down like a standing wave (often modeled with sine and cosine functions) [OpenStax]

state reduction | hypothetical process in which an observed or detected particle "jumps into" a definite state, often described in terms of the collapse of the particle's wave function [OpenStax]

stationary state | state for which the probability density function, $\displaystyle |\Psi(x,t)|^2$, does not vary in time [OpenStax]

Stefan-Boltzmann constant | physical constant in Stefan's law [OpenStax]

stimulated emission | when a photon of energy triggers an electron in a metastable state to drop in energy emitting an additional photon [OpenStax]

stopping potential | in a circuit, potential difference that stops photocurrent [OpenStax]

strangeness | particle property associated with the presence of a strange quark [OpenStax]

strong nuclear force | force that binds nucleons together in the nucleus [OpenStax]

strong nuclear force | relatively strong attractive force that acts over short distances (about $\displaystyle 10^{-15}$ m) responsible for binding protons and neutrons together in atomic nuclei [OpenStax]

synchrotron | circular accelerator that uses alternating voltage and increasing magnetic field strengths to accelerate particles to higher and higher energies [OpenStax]

synchrotron radiation | high-energy radiation produced in a synchrotron accelerator by the circular motion of a charged beam [OpenStax]

theory of everything | a theory of particle interactions that unifies all four fundamental forces [OpenStax]

thin-lens approximation | assumption that the lens is very thin compared to the first image distance [OpenStax]

time dilation | lengthening of the time interval between two events when seen in a moving inertial frame rather than the rest frame of the events (in which the events occur at the same location) [OpenStax]

time-modulation factor | factor $e^{i\omega t}$ that multiplies the time-independent wave function when the potential energy of the particle is time independent [OpenStax]

total energy | sum of all energies for a particle, including rest energy and kinetic energy, given for a particle of mass m and speed u by $E = \gamma mc^2$, where $\gamma = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}$ [OpenStax]

total internal reflection | phenomenon at the boundary between two media such that all the light is reflected and no refraction occurs [OpenStax]

transition metal | element that is located in the gap between the first two columns and the last six columns of the table of elements that contains electrons that fill the d subshell [OpenStax]

transmission probability | also called tunneling probability, the probability that a particle will tunnel through a potential barrier [OpenStax]

transuranic element | element that lies beyond uranium in the periodic table [OpenStax]

tunnel diode | electron tunneling-junction between two different semiconductors [OpenStax]

tunneling probability | also called transmission probability, the probability that a particle will tunnel through a potential barrier [OpenStax]

two-slit diffraction pattern | diffraction pattern of two slits of width a that are separated by a distance d is the interference pattern of two point sources separated by d multiplied by the diffraction pattern of a slit of width a [OpenStax]

type I superconductor | superconducting element, such as aluminum or mercury [OpenStax]

type II superconductor | superconducting compound or alloy, such as a transition metal or an actinide series element [OpenStax]

unpolarized | refers to waves that are randomly polarized [OpenStax]

valence band | highest energy band that is filled in the energy structure of a crystal [OpenStax]

valence electron | electron in the outer shell of an atom that participates in chemical bonding [OpenStax]

van der Waals bond | bond formed by the attraction of two electrically polarized molecules [OpenStax]

vertex | point where the mirror's surface intersects with the optical axis [OpenStax]

vertically polarized | oscillations are in a vertical plane [OpenStax]

vibrational energy level | energy level associated with the vibrational energy of a molecule [OpenStax]

virtual image | image that cannot be projected on a screen because the rays do not physically go through the image, they only appear to originate from the image [OpenStax]

virtual particle | particle that exists for too short of time to be observable [OpenStax]

W and Z boson | particle with a relatively large mass that carries the weak nuclear force between leptons and quarks [OpenStax]

wave function | function that represents the quantum state of a particle (quantum system) [OpenStax]

wave function collapse | equivalent to state reduction [OpenStax]

wave number | magnitude of the propagation vector [OpenStax]

wave optics | part of optics dealing with the wave aspect of light [OpenStax]

wave packet | superposition of many plane matter waves that can be used to represent a localized particle [OpenStax]

wave quantum mechanics | theory that explains the physics of atoms and subatomic particles [OpenStax]

wave-particle duality | particles can behave as waves and radiation can behave as particles [OpenStax]

weak nuclear force | relative weak force (about 10^{-6} the strength of the strong nuclear force) responsible for decays of elementary particles and neutrino interactions [OpenStax]

width of the central peak | angle between the minimum for $m=1$ and $m=-1$ [OpenStax]

work function | energy needed to detach photoelectron from the metal surface [OpenStax]

world line | path through space-time [OpenStax]

Zeeman effect | splitting of energy levels by an external magnetic field [OpenStax]

α -particle | doubly ionized helium atom [OpenStax]

α -ray | beam of α -particles (alpha-particles) [OpenStax]

β -ray | beam of electrons [OpenStax]

γ -ray | beam of highly energetic photons [OpenStax]