

Key Terms

W^+ boson positive carrier particle of the weak nuclear force

W^- boson negative carrier particle of the weak nuclear force

Z^0 boson neutral carrier particle of the weak nuclear force

annihilation the process of destruction that occurs when a particle and antiparticle interact

antimatter matter constructed of antiparticles; antimatter shares most of the same properties of regular matter, with charge being the only difference between many particles and their antiparticle analogues

baryon hadrons that always decay to another baryon

Big Bang a gigantic explosion that threw out matter a few billion years ago

bottom quark a quark flavor

carrier particle a virtual particle exchanged in the transmission of a fundamental force

charmed quark a quark flavor, which is the counterpart of the strange quark

colliding beam head-on collisions between particles moving in opposite directions

color a property of quarks that relates to their interactions through the strong force

cyclotron accelerator that uses fixed-frequency alternating electric fields and fixed magnets to accelerate particles in a circular spiral path

down quark the second lightest of all quarks

Electroweak Epoch the stage before 10^{-11} back to 10^{-34} seconds after the Big Bang

electroweak theory theory showing connections between EM and weak forces

Feynman diagram a graph of time versus position that describes the exchange of virtual particles between subatomic particles

flavor quark type

gluons exchange particles of the nuclear strong force

Grand Unification Epoch the time period from 10^{-43} to 10^{-34} seconds after the Big Bang, when Grand Unification Theory, in which all forces except gravity are identical, governed the universe

Grand Unified Theory theory that shows unification of the strong and electroweak forces

graviton hypothesized particle exchanged between two particles of mass, transmitting the gravitational force between them

hadron particles composed of quarks that feel the strong and weak nuclear force

Higgs boson a massive particle that provides mass to the weak bosons and provides validity to the theory that carrier particles are identical under certain circumstances

Higgs field the field through which all fundamental particles travel that provides them varying mass through the transport of the Higgs boson

Inflationary Epoch the rapid expansion of the universe by an incredible factor of 10^{-50} for the brief time from 10^{-35} to about 10^{-32} seconds

lepton fundamental particles that do not feel the nuclear strong force

meson hadrons that can decay to leptons and leave no hadrons

pair production the creation of a particle and antiparticle, commonly an electron and positron, due to the annihilation of a photon

particle physics the study of and the quest for those truly fundamental particles having no substructure

pion particle exchanged between nucleons, transmitting the strong nuclear force between them

Planck Epoch the earliest era of the universe, before 10^{-43} seconds after the Big Bang

positron a particle of antimatter that has the properties of a positively charged electron

quantum chromodynamics the theory of color interaction between quarks that leads to understanding of the nuclear strong force

quantum electrodynamics the theory of electromagnetism on the particle scale

quark an elementary particle and fundamental constituent of matter that is a substructure of hadrons

Quark Era the time period from 10^{-11} to 10^{-6} seconds at which all four fundamental forces are separated and quarks begin to exit

Standard Model an organization of fundamental particles and forces that is a result of quantum chromodynamics and electroweak theory

strange quark the third lightest of all quarks

superforce the unification of all four fundamental forces into one force

synchrotron a version of a cyclotron in which the frequency of the alternating voltage and the magnetic field strength are increased as the beam particles are accelerated

Theory of Everything the theory that shows unification of all four fundamental forces

top quark a quark flavor

up quark the lightest of all quarks

weak nuclear force fundamental force responsible for particle decay