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Unified Phase Field Theory Based on the Interaction of Positive and Negative Magnetic Poles and Analysis of ATLAS, CMS Experiment at the LHC

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Abstract

This article assumes that the elementary particle is a magnetic pole field formed by the interaction of positive and negative magnetic poles and believes that gravity, electromagnetic forces, strong forces and weak forces are all produced by the interaction of positive and negative magnetic poles. The collision of the high-energy elementary particles appears as a strong force, the decay of the high-energy elementary particles appears as a weak force, the cohesive force of the high-energy elementary particle magnetic pole field (the gravitational field) to its magnetic pole is gravity, and the spin force of the high-energy elementary particle magnetic pole field in the external field (the gravitational field) is the electromagnetic force. This article discusses a high-energy proton-antiproton collision experiment based on the interaction of positive and negative magnetic poles and reveals the production mechanism of protonium, tauium, muonium, positronium, three generations of leptons and neutrinos, and the final state. This article explains the unification of the strong force, weak force, electromagnetic force and gravity with unified phase field theory and tests this theory by the ATLAS and CMS experimental data at the LHC. The data of the ATLAS and CMS experiments at the LHC are completely consistent with the calculated data of the phase field curvature tensor equation. Differential geometric variables are covariant with physical variables. The Lagrangian function of Einstein's mass-energy equation, the Lagrangian function of the Schrodinger particle differential motion wave function based on the theory of relativity, the Lagrangian density of the Young-Mills gauge field equation, and the high-energy elementary particle phase difference momentum-energy tensor of the curvature tensor equation are completely consistent in the high-energy proton-antiproton collision experiment. These results fully prove that the unified phase field theory is more in line with the physical reality of the high-energy proton-antiproton collision experiment.

Introduction

In 1963, Gellman and Zweig^{1,2,3,4} independently proposed that hadrons are composed of quarks. They believed that these hadrons are composed of different combinations of u quarks, d quarks, and s quarks, the "Eightfold Way" according to the theory of SU(3) group symmetry. In 1957, Schwinger⁵ predicted that the intermediate boson W_+ and W_- would act as a mediator such as photons and directly unify the weak interaction and electromagnetic interaction based on the Yang-Mills gauge field theory⁶ and the Higgs mechanism of spontaneous symmetry breaking^{7,8,9}. In 1967, Weinberg¹⁰ described the unity of weak interaction and electromagnetic interaction based on the idea of strict gauge symmetry but

spontaneously broken after further research by Glashaw, Weinberg, and Salam. In 1973, Gross et al.¹¹ discussed the non-Abelian gauge field theory of the strong interaction under SU(3) the chromatic gauge group. They believed that the interacting mediators were massless gluons and found that the value of the function was negative. They found that Hadron in this gauge field is asymptotically free; thus, quantum chromodynamics (QCD) based on SU(3) and the chromatic gauge symmetry group is established. Standard model theory for explaining the unity of electromagnetic interactions, strong interactions and weak interactions was established through the efforts of Glasow and others.

In 1973, Li Zhengdao¹² proposed that it is possible to realize the transformation from the hadron phase to the quark matter phase through relativistic heavy ion collision experiments. Thus, people began to produce quark gluon plasma (QGP) through heavy ion collision experiments and to search various particles predicted in the Standard Model^{13,14,15,16}. In 1973, the CERN^{17,18} proton-antiproton collider found tracks of neutral flow through heavy liquid bubble chambers. It is believed that the neutral intermediate boson Z propagates weak force in the scattering process of neutrinos and electrons and nucleons. In 1974, Ding Zhaozhong and Richter^{19,20} discovered charm quark C. In 1977, Lederman and his colleagues at Fermi National Laboratory²¹ discovered T particles (similar to J/Ψ particles, particles composed of bottom quarks). In 1979, high-energy electron-positron collisions at Betra Hamburg, Germany discovered the phenomenon of three jets²², showing the existence of gluons. In 1983, CERN²³ found the intermediate boson W and Z. In 1995, the CDF and D0 Collaboration of Fermi National Laboratory^{24,25} detected top quarks in high-energy proton-antiproton collisions. In 2000, Fermi National Laboratory discovered T neutrinos²⁶. On July 4, 2012, ATLAS and CMS collaboration on the LHC jointly announced the discovery of a new boson^{27,28}, and the results showed that it conformed to the characteristics of the Higgs boson. To date, people have found all the particles predicted by the standard model.

Searching for quarks, heavy bosons, gluons, and Higgs particles through high-energy particle collision experiments is actually looking for hadrons for quantum chromodynamics calculations. QDPs (quark and gluon plasma) were produced through a high-energy particle collision experiment, and the corresponding signals with "jet quenching", "J/ψ particle depression", and "strange particles relative yield increase" were found to be Hadrons. The corresponding particles were calculated through quantum chromodynamics.

Various high-energy particle collision experiments are scientific, and the experimental results and descriptions are credible, but they are very difficult to explain with the relevant theories of the standard model. This article assumes that the elementary particle is a magnetic pole field formed by the interaction of positive and negative magnetic poles and believes that gravity, electromagnetic force, strong force and weak force are all produced by the interaction of positive and negative magnetic poles. The collision of the high-energy elementary particles appears as a strong force, the decay of the high-energy elementary particles appears as a weak force, the cohesive force of the high-energy elementary particle magnetic pole field (the gravitational field) to its magnetic pole is gravity, and the spin force of the high-energy elementary particle magnetic pole field in the external field (the gravitational field) is the electromagnetic force. This article discusses a high-energy proton-antiproton collision experiment based on the interaction of positive and negative magnetic poles and reveals the production mechanism of protonium, tauium, muonium, positronium, three generations of leptons and neutrinos, and the final state. This article explains the unification of the strong force, weak force, electromagnetic force and gravity with unified phase field theory and tests the ATLAS and CMS experimental data at the LHC. The data of the ATLAS and CMS experiments at the LHC are

completely consistent with the calculated data of the phase field curvature tensor equation. Differential geometric variables are covariant with physical variables. The Lagrangian function of Einstein's mass-energy equation, the Lagrangian function of the Schrodinger particle differential motion wave function based on the theory of relativity, the Lagrangian density of the Young-Mills gauge field equation, and the high-energy elementary particle phase difference momentum-energy tensor of the curvature tensor equation are completely consistent in the high-energy proton-antiproton collision experiment. These results fully prove that the unified phase field theory is more in line with the physical reality of the high-energy proton-antiproton collision experiment.

Main

Data of ATLAS and CMS experiment

Data of ATLAS experiment ²⁷. The datasets used correspond to integrated luminosities of approximately 4.8 fb^{-1} collected at $\sqrt{s}=7 \text{ TeV}$ in 2011 and 5.8 fb^{-1} at $\sqrt{s}=8 \text{ TeV}$ in 2012.

Individual searches in the channels $H \rightarrow Z Z^{(*)} \rightarrow 4\ell$, $H \rightarrow \gamma\gamma$ and $H \rightarrow WW^{(*)} \rightarrow e\nu\mu\nu$ in the 8 TeV data are combined with previously published results of searches for $H \rightarrow Z Z^{(*)}$, $WW^{(*)}$, $b.b$ and $\tau^+\tau^-$ in the 7 TeV data and results from improved analyses of the $H \rightarrow Z Z^{(*)} \rightarrow 4\ell$ and $H \rightarrow \gamma\gamma$ channels in the 7 TeV data. Clear evidence for the production of a neutral boson with a measured mass of $126.0 \pm 0.4 \text{ (stat)} \pm 0.4 \text{ (sys) GeV}$ is presented. This observation, which has a significance of 5.9 standard deviations, corresponding to a background fluctuation probability of 1.7×10^{-9} , is compatible with the production and decay of the Standard Model Higgs boson.

Table 1 | Summary of the individual channels entering the combination. The transition points between separately optimized m_H regions are indicated where applicable. In channels sensitive to associated production of the Higgs boson, V indicates a W or Z boson. The symbols $\otimes$ and $\oplus$ represent direct products and sums over sets of selection requirements, respectively.

Higgs boson decay	Subsequent decay	Sub-channels	m_H range [GeV]	$\int L dt [\text{fb}^{-1}]$
$2011\sqrt{s}=7\text{TeV}$ $H \rightarrow ZZ^{(*)}$	4ℓ	$\{4e, 2e2\mu, 2\mu2e, 4\mu\}$	110-600	4.8
	$\ell\ell\nu\bar{\nu}$	$\{ee, \mu\mu\} \otimes \{\text{low, high pile-up}\}$	200-280-600	4.7
	$\ell\ell q\bar{q}$	$\{\text{b-tagged, untagged}\}$	200-300-600	4.7
$H \rightarrow \gamma\gamma$	-	10 categories $\{p_{T_i} \otimes \eta_{\gamma} \otimes \text{conversion}\} \oplus \{2\text{-jet}\}$	110-150	4.8
$H \rightarrow WW^{(*)}$	$\ell\nu\ell\nu$	$\{ee, e\mu/\mu e, \mu\mu\} \otimes \{0\text{-jet}, 2\text{-jet}\} \otimes \{\text{low, high pile-up}\}$	110-200-300-600	4.7
	$\ell\nu qq'$	$\{e, \mu\} \otimes \{0\text{-jet}, 1\text{-jet}, 2\text{-jet}\}$	300-600	4.7
$H \rightarrow \tau\tau$	$\tau_{lep}\tau_{lep}$	$\{e, \mu\} \otimes \{0\text{-jet}\} \oplus \{\ell\ell\} \otimes \{1\text{-jet}, 2\text{-jet}, V H\}$	110-150	4.7
	$\tau_{lep}\tau_{had}$	$\{e, \mu\} \otimes \{0\text{-jet}\} \otimes \{E_T^{miss} < 20\text{GeV}, E_T^{miss} > 20\text{GeV}\}$	110-150	4.7
$VH \rightarrow Vbb$	$\tau_{had}\tau_{had}$	$\oplus \{e, \mu\} \otimes \{1\text{-jet}\} \oplus \{\ell\} \otimes \{2\text{-jet}\}$	110-150	4.7
	$Z \rightarrow \nu\nu$	$E_T^{miss} \in \{120-160, 160-200, \geq 200 \text{ GeV}\}$	110-130	4.6
	$W \rightarrow \ell\nu$	$p_T^W \in \{< 50, 50-100, 100-200, \geq 200 \text{ GeV}\}$	110-130	4.7

2012 $\sqrt{s} = 8TeV$	$Z \rightarrow \ell\ell$	$p_T^Z \in \{< 50, 50-100, 100-200, \geq 200 GeV\}$	110-130	4.7
$H \rightarrow ZZ^{(*)}$	4ℓ	$\{4e, 2e2\mu, 2\mu2e, 4\mu\}$	110-600	5.8
$H \rightarrow \gamma\gamma$	-	10 categories $\{p_{T_i} \otimes \eta_\gamma \otimes \text{conversion}\} \oplus \{2\text{-jet}\}$	110-150	5.9
$H \rightarrow WW^{(*)}$	$e\nu\mu\nu$	$\{e\mu, \mu e\} \otimes \{0\text{-jet}, 1\text{-jet}, 2\text{-jet}\}$	110-200	5.8

Data of CMS experiment ²⁸. The results are presented from searches for the standard model Higgs boson in proton–proton collisions at $\sqrt{s} = 7$ and 8 TeV in the compact muon solenoid experiment at the LHC using data samples corresponding to integrated luminosities of up to 5.1 fb⁻¹ at 7 TeV and 5.3 fb⁻¹ at 8 TeV. The search is performed in five decay modes: $\gamma\gamma$, ZZ , W^+W^- , $\tau^+\tau^-$, and $b\bar{b}$. An excess of events is observed above the expected background, with a local significance of 5.0 standard deviations, at a mass near 125 GeV, signalling the production of a new particle. The expected significance for a standard model Higgs boson of that mass is 5.8 standard deviations. The excess is most significant in the two decay modes with the best mass resolution, $\gamma\gamma$ and ZZ ; a fit to these signals gives a mass of $125.3 \pm 0.4(\text{stat.}) \pm 0.5(\text{syst.})$ GeV. The decay to two photons indicates that the new particle is a boson with a spin different from one.

Table 2 | The number of selected events compared to the expected background yields and expected number of signal events ($m_H = 125 GeV$) for each final state in the $H \rightarrow ZZ$ analysis. The estimates of the $Z + X$ background are based on data. These results are given for the mass range from 110 to 160 GeV.

channel	$4e$	4μ	$2e2\mu$	4ℓ
ZZ background	2.7 ± 0.3	5.7 ± 0.6	7.2 ± 0.8	15.6 ± 1.4
Z+X	$1.2^{+1.1}_{-0.8}$	$0.9^{+0.7}_{-0.6}$	$2.3^{+1.8}_{-1.4}$	$4.4^{+2.2}_{-1.7}$
All background ($110 < m_{4\ell} < 160 GeV$)	4.0 ± 1.0	6.6 ± 0.9	9.7 ± 1.8	20 ± 3
Observed ($110 < m_{4\ell} < 160 GeV$)	6	6	9	21
Signal ($m_H = 125 GeV$)	1.36 ± 0.22	2.74 ± 0.32	3.44 ± 0.44	7.54 ± 0.78
All background (signal region)	0.7 ± 0.2	1.3 ± 0.1	1.9 ± 0.3	3.8 ± 0.5
Observed (signal region)	1	3	5	9

The ATLAS and CMS experimental data show that m_H is equivalent to the sum of the relativistic masses of the corresponding scattered particle produced from the energy field of high-energy proton–antiproton collisions, such as determining the mass of the four leptons, $m_H = 125 GeV$. The participation of bosons such as W and Z is not required in high-energy proton–antiproton collisions based on the interaction of positive and negative magnetic poles. The relativistic masses of the scattering particles are not given by the Higgs boson but are inherited from the previous generation particles. The Higgs particle invariant mass spectrum used in the ATLAS and CMS experiments should be interpreted as the invariant mass spectrum of scattered particles produced from the high-energy particle collision point. This is more in line with physical reality.

High-energy proton–antiproton collision data based on the interaction of positive and negative

magnetic poles

How scattering particles are produced cannot be clearly explained by quantum chromodynamics. High-energy particles based on the interaction of positive and negative magnetic poles have multilevel collision and decay mechanisms. The high-energy proton-antiproton collisions at the collision point produce secondary particles, and the secondary particles collide in the high-energy field of the collision to produce scattered particles (or jets). The scattered particles enter the detector and collide with the atomic nucleus or outer electrons to produce the final state. This is used to explain ATLAS and CMS experimental data, which is more in line with physical reality.

Table 3 | Correspondence between scattered particles in the energy field of 7TeV proton collisions and decay particles in the energy field of the detector

In the collisions point		The scattered particle Energy range	In the detector	
Collision mode	Decay particles		Collision mode	decay particles
$p^+ \Leftrightarrow p^-$	p_{pp}^+, p_{pp}^-	$2228\text{GeV} > p_{pp}^{+-} > 354.6\text{GeV}$		
$p^+ \Leftrightarrow p^-$	$\tau^+ \nu_\tau^-, \tau^- \nu_\tau^+$	$948.18\text{GeV} > \tau > 150.91\text{GeV}$		
$p_{pp}^+ \Leftrightarrow p_{pp}^-$	p^+, p^-	$177.312077\text{GeV} > p > \dots$	$p^+, p^- \Leftrightarrow N$	$0\text{--jet}, 1\text{--jet}, \text{Baryon}$
$p_{pp}^{+-} \Leftrightarrow p^{-,+}$	$\tau_{\tau\tau}^+, \tau_{\tau\tau}^-$	$301.814326\text{GeV} > \tau_{\tau\tau}^{+-} > \dots$	$\tau_{\tau\tau}^+, \tau_{\tau\tau}^- \Leftrightarrow N$	$\text{Meson}, 1\text{--jet}, 2\text{--jet}, \mu^+ \nu_\mu^-, \mu^- \nu_\mu^+$
$\tau^+ \Leftrightarrow \tau^-$	$\mu^+ \nu_\mu^-, \mu^- \nu_\mu^+$	$141.041527\text{GeV} > \mu > \dots$	$\mu^+, \mu^- \Leftrightarrow e$	$e^+ \nu_e^-, e^- \nu_e^+, 0\text{--jet}, 1\text{--jet}$
$\tau^{+-} \Leftrightarrow p^{-,+}$	$e^+ \nu_e^-, e^- \nu_e^+$	$22.3997427\text{GeV} > e > \dots$	$e^+, e^- \Leftrightarrow e$	$0\text{--jet}, 1\text{--jet}, e_{ee}^+, e_{ee}^-, e^+, e^-$
$\mu^+ \Leftrightarrow \mu^-$	$\mu_{\mu\mu}^+, \mu_{\mu\mu}^-$	$44.894912\text{GeV} > \mu_{\mu\mu}^{+-} > \dots$	$\mu_{\mu\mu}^+, \mu_{\mu\mu}^- \Leftrightarrow e$	$\mu^+, \mu^-, 1\text{--jet}, 2\text{--jet}, e^+ \nu^-, e^- \nu^+$

In the table, " $\Leftrightarrow$ " represents the inelastic collision of high-energy particles, and p_{pp}^+, p_{pp}^- represents protonium and anti-protonium. For example, protonium is composed of protons and antiprotons colliding and merging (Fig. b, c). p_{pp}^{+-} represents protonium or anti-protonium; $\tau_{\tau\tau}^+, \tau_{\tau\tau}^-$ represents tauium, anti-tauium; $\mu_{\mu\mu}^+, \mu_{\mu\mu}^-$ represents muonium, anti-muonium; e_{ee}^+, e_{ee}^- represents positronium, anti-positronium; $p^{-,+}$ represents incident proton or antiproton; τ^{+-} represents tau or anti-tau; N represents atomic nucleus. Relativistic energy (or mass) of decay particles

$$E_d = E_c/2\pi, \quad (1)$$

Where E_c is the energy of the collide particle.

Table 4 | Data of energy and radius of particles scattered in the energy field of 7TeV and 8TeV proton collision

Collision mode	Decay particles	7TeV Collision point	8TeV Collision point	The detector (7TeV)		The detector (8TeV)	
				Energy (GeV)	Radius (m)	Energy (GeV)	Radius (m)
$p^+ \Leftrightarrow p^-$	p_{pp}^+, p_{pp}^-	2228.17GeV	2546.479GeV	---		---	
$p_{pp}^+ \Leftrightarrow p_{pp}^-$	p^+, p^-	177.312GeV	202.6424GeV	175.548	$5.51367 \times 10^{-15} \text{m}$	200.878	$5.27143 \times 10^{-15} \text{m}$
$p_{pp}^{+-} \Leftrightarrow p^{-,+}$	τ^+, τ^-	948.1777GeV	1107.333GeV	---		---	
$p^+ \Leftrightarrow p^-$	ν_τ^+, ν_τ^-	165.907GeV	165.907GeV	165.907	$1.51407 \times 10^{-16} \text{m}$	165.907	$1.51407 \times 10^{-16} \text{m}$

$\tau^+ \Leftrightarrow \tau^-$	$\tau_{\tau}^+, \tau_{\tau}^-$	301.814GeV	352.4749GeV	295.24	$4.66364 \times 10^{-15} m$	345.9	$4.39801 \times 10^{-15} m$
$\tau^+ \Leftrightarrow \tau^-$	μ^+, μ^-	141.0415GeV	166.3718GeV	140.619	$5.93688 \times 10^{-15} m$	165.949	$5.618 \times 10^{-15} m$
$\tau^{+-} \Leftrightarrow p^{-+}$	ν_{μ}^+, ν_{μ}^-	9.86564GeV	9.86564GeV	9.86564	$3.87905 \times 10^{-16} m$	9.86564	$3.87905 \times 10^{-16} m$
$\mu^+ \Leftrightarrow \mu^-$	$\mu_{\mu\mu}^+, \mu_{\mu\mu}^-$	44.89491GeV	52.9578GeV	44.6095	$8.70491 \times 10^{-15} m$	52.6728	$8.2359 \times 10^{-15} m$
$\mu^+ \Leftrightarrow \mu^-$	e^+, e^-	22.39974GeV	26.431186GeV	22.399	$1.09521 \times 10^{-14} m$	26.4305	$1.03643 \times 10^{-14} m$
$\mu^+ \Leftrightarrow \mu^-$	ν_e^+, ν_e^-	47.7135MeV	47.7135MeV	0.04771	$2.29379 \times 10^{-15} m$	0.04771	$2.29379 \times 10^{-15} m$

The scattered particles are incident in the detector and collide with the nucleus or outer electrons, taking different paths in the 3.8 T magnetic field and release the corresponding energy (magnetic poles). The scattering angle of the scattering particles is different, and the path length is different. Take the CMS detector as an example. Set up that the path length of the electrons and the muonium incident in the electromagnetic calorimeter to collide with the outer electrons is 1.5m and 1.35m, the path length of the proton and the tauium incident in the hadron calorimeter to collide with the nucleus is 1.88m and 1.85m, and the path length of the muon incident in the muon detector to collide with argon gas is 4m. The interaction between the scattered particle and the 3.8 T magnetic field releases the corresponding energy and reaches the collision point of the corresponding detector. The energy released by the elastic collision of scattered particles at the trigger point of the detector is ignored in the table. The radius of the positive magnetic pole ring of the elementary particle

$$r_{ring} = \alpha r, \quad (2)$$

where α is the fine-structure constant and r is the radius of the elementary particle. For example, the radius of the positive magnetic pole ring of $7TeV$ high-energy protons is $1.17771171785662 \times 10^{-17}$.

The particle relativistic masses (the energy E) are calculated by equation (4) and equation (6). The particle radius (r) is calculated by equation (9). The data in Table 4 show that the sum of the relativistic masses (the energy) of the corresponding scattering particles is equivalent to the masses of the corresponding Higgs boson in Tables 1 and 2.

Data of high-energy particle collisions to verify the unified phase field theory

The high-energy particles collide in the collision energy field, and scattered particles collide in the detector energy field, all moving on a certain space-time curve. Every point on the space-time curve can be described by the unified phase field theory. High-energy protons, high-energy protonium, high-energy tau, from collision to decay, or from strong interaction to weak interaction can be described by the unified phase field curvature tensor equation (equation (11)). Take the data of $7TeV$ proton collision as an example (Tables 5, 6).

Table 5.1 | Strong interaction data of high-energy particle collision at the collision point

particles	λ_m	m	v	E, E_c	F	ϕ_{uv}
	$10^{-12} m$	MeV	m/s	MeV	N	m^{-1}
p^+, p^-	4.852621155	938.272046	299792455.306902	6999061.959	$1.9603782 \times 10^{-35}$	2.623138×10^5
p_{pp}^+, p_{pp}^-	4.8526245097	1876.54409	299792351.68073	2226292.685	6.235658×10^{-36}	1.206091×10^6
τ^+, τ^-	4.8526381084	1776.82	299791931.6211	946400.891	$2.6507918 \times 10^{-36}$	3.76423×10^6

In the table, λ_m , m , v , E , E_c , F and represent the motion wavelength, mass, velocity, energy and gravity of high-energy particles, respectively. ϕ_{uv} represents the curvature tensor when particles interact strongly. The masses of various elementary particles in the article use the recommended values of the 2012 International Particle Data Group ²⁹.

Table 5.2 | Strong interaction data of high-energy particle collision at the collision point

$\varphi_{\mu\nu}$	$R_{\mu\nu}$	r	R	r_F	$M_{\mu\nu}$	$T_{\mu\nu}$
m	m ⁻¹	m	m ⁻²	m	MeV, ρ_p/m^3	MeV, ρ_p/m^3
1. 36417×10 ⁻¹⁵	5.246276×10 ⁵	1.613889×10 ⁻¹⁵	3.84576×10 ²⁰	7.21147×10 ⁻¹¹	5916096.113	1.05464×10 ⁻²³
1. 99796×10 ⁻¹⁵	2.412181×10 ⁶	2.363689×10 ⁻¹⁵	1.20733×10 ²¹	4.07008×10 ⁻¹¹	1881818.059	3.35465×10 ⁻²⁴
2. 65627×10 ⁻¹⁵	7.528459×10 ⁶	3.142509×10 ⁻¹⁵	2.83422×10 ²¹	2.65643×10 ⁻¹¹	799964.7678	1.42607×10 ⁻²⁴

In the table, $R_{\mu\nu}$, r , R , r_F , $\varphi_{\mu\nu}$, $M_{\mu\nu}$, and $T_{\mu\nu}$ are the relevant variables of the curvature tensor equation. $\varphi_{\mu\nu}$ is the phase difference between the collided particle and the scattered particle. $M_{\mu\nu}$ is the energy (E_f) released when the high-energy particles collide.

The wavelength (λ_m) of the particle's motion is calculated by equation (5). The Ricci curvature scalar $R = 2K = 2/r_F^2$ of the particle and the Ricci curvature tensor $R_{\mu\nu} = R\varphi_{\mu\nu}$ of the particle. The particle energy (E or E_c) is calculated by equation (4) and equation (6). The particle gravitational energy (F or f) is calculated by equation (7). The particle radius (r) is the phase (r_ϕ) of the particle on the space-time curve and is calculated by equation (9). The radius of the gravitational field, that is, the maximum radius when high-energy particles collide

$$r_F = \sqrt{G(m + m_m)^2 / F}, \quad (3)$$

Let $M_{\mu\nu}$ be the Lagrangian density and $M_{\mu\nu}$ be the energy difference between the collided particle and the scattered particle, which can be calculated by equation (12), equation (13), and equation (14), respectively. $T_{\mu\nu}$ is the gravitational force difference between the collided particle and the scattered particle, which can be calculated by equation (15).

Table 6.1 | Weak interaction data of the decay of high-energy particles at the collision point

particles	λ_m	m	v	E , E_c	F	$\phi_{\mu\nu}$
	10 ⁻¹² m	MeV	m/s	MeV	N	m ⁻¹
p^+, p^-	4.852633411	938.272046	299792076.7222	1112307.768	3.1154834×10 ⁻³⁶	3.592779×10 ⁶
p_{pp}^+, p_{pp}^-	4.8526227909	1876.54409	299792404.77431	354412.8256	9.9268145×10 ⁻³⁷	1.654746×10 ⁷
τ^+, τ^-	4.8526234466	1776.82	299792384.51835	150801.5006	4.2238227×10 ⁻³⁷	5.169288×10 ⁷

Table 6.2 | Weak interaction data of the decay of high-energy particles at the collision point

$g_{\mu\nu}$	$R_{\mu\nu}$	r	R	r_F	$M_{\mu\nu}$	$T_{\mu\nu}$
m	m ⁻¹	m	m ⁻²	m	MeV, ρ_p/m^3	MeV, ρ_p/m^3
2. 97806×10 ⁻¹⁵	7.185559×10 ⁶	2.978062×10 ⁻¹⁵	2.41283×10 ²¹	2.87907×10 ⁻¹¹	1112307.768	1.98287×10 ⁻²⁴
4. 36164×10 ⁻¹⁵	3.309492×10 ⁷	4.361645×10 ⁻¹⁵	7.58772×10 ²¹	1.62353×10 ⁻¹¹	354412.8256	6.31799×10 ⁻²⁵
5. 79878×10 ⁻¹⁵	1.033858×10 ⁸	5.798778×10 ⁻¹⁵	1.78289×10 ²²	1.05914×10 ⁻¹¹	150801.5006	2.68828×10 ⁻²⁵

In the table, $g_{\mu\nu}$ $M_{\mu\nu}$ is equal to the energy (p) of the

scattered particle, and $T_{\mu\nu}$ is equal to the gravitational force (f) of the scattered particle.

Scattered particles of $7TeV$ proton-antiproton collisions are incident in the corresponding detector, elastically collide or inelastically collide with the corresponding nucleus or outer electrons and transfer energy to the corresponding final state (Tables 7, 8).

Table 7.1 | Strong interaction data of the collision of the scattered particle in the detector

particles	λ_m	m	v	E, E_c	F	$\phi_{\mu\nu}$
	$10^{-12}m$	MeV	m/s	MeV	N	m^{-1}
e^+, e^-	4.8526210703	0.510998928	299792457.921986	22398.512538	$6.2736344 \times 10^{-38}$	6.455059×10^6
$\mu_{\mu\mu}^+, \mu_{\mu\mu}^-$	4.8526210703	1.02199804	299792457.921325	44608.457752	$1.2494452 \times 10^{-37}$	5.130592×10^6
p^+, p^-	4.8527596967	938.272046	299788175.88	174609.88126	$4.8906754 \times 10^{-37}$	1.053971×10^7
$\tau_{\tau\tau}^+, \tau_{\tau\tau}^-$	4.8526235538	211.316581	299792381.2095	295028.69198	$8.2635133 \times 10^{-37}$	8.904007×10^6
μ^+, μ^-	4.8526238075	105.6583715	299792373.3725	140513.19142	$3.9356559 \times 10^{-37}$	1.813595×10^7

The scattered particles interact with the corresponding nucleus in the detector. The mass of the lead nucleus is approximately $3.441592 \times 10^{-24} kg$, the mass of the brass nucleus is approximately $1.05549906 \times 10^{-24} kg$, and the mass of argon is approximately $6.6353628 \times 10^{-25} kg$.

Table 7.2 | Strong interaction data of the collision of the scattered particle in the detector

$\phi_{\mu\nu}$	$R_{\mu\nu}$	r	R	r_F	$M_{\mu\nu}$	$T_{\mu\nu}$
m	m^{-1}	m	m^{-2}	m	$MeV, \rho_p/m^3$	$MeV, \rho_p/m^3$
9.25747×10^{-15}	1.291019×10^7	1.095208×10^{-14}	1.39456×10^{21}	3.78701×10^{-11}	18932.7938	3.37508×10^{-26}
7.358×10^{-15}	1.026118×10^7	8.704906×10^{-15}	1.39456×10^{21}	3.78701×10^{-11}	37706.19387	6.72174×10^{-26}
4.66054×10^{-15}	2.107941×10^7	5.513673×10^{-15}	4.52295×10^{21}	2.10283×10^{-11}	147592.5203	2.63108×10^{-25}
3.91901×10^{-15}	1.780801×10^7	4.636405×10^{-15}	4.5440×10^{21}	2.09795×10^{-11}	249378.9463	4.44559×10^{-25}
5.01827×10^{-15}	3.627189×10^7	5.936885×10^{-15}	7.22797×10^{21}	1.66344×10^{-11}	118771.6062	2.1173×10^{-25}

In the table, $\phi_{\mu\nu}$ is the phase difference of scattering particles from collision to decay. $M_{\mu\nu}$ is the energy transfer by the scattered particle to the final state, which is very consistent with the data of the ATLAS and CMS experiments, such as the energy range of the final state in table (1,2).

Table 8.1 | Weak interaction data of the decay of the scattered particle in the detector

particles	λ_m	m	v	E, E_c	F	$\phi_{\mu\nu}$
	$10^{-12}m$	MeV	m/s	MeV	N	m^{-1}
e^+, e^-	4.8526211675	0.510998928	299792454.920131	3564.40437	$9.9835959 \times 10^{-38}$	1.409004×10^7
$\mu_{\mu\mu}^+, \mu_{\mu\mu}^-$	4.8526211683	1.02199804	299792454.894038	7098.79821	$1.9883135 \times 10^{-38}$	1.119901×10^7
p^+, p^-	4.8580999405	938.272046	299623360.196	27001.0843	$7.5627759 \times 10^{-38}$	2.235554×10^7
$\tau_{\tau\tau}^+, \tau_{\tau\tau}^-$	4.8527192113	211.316581	299789426.417636	46777.5902	$1.3102022 \times 10^{-37}$	1.936437×10^7
μ^+, μ^-	4.8527292278	105.6583715	299789117.02207	22274.5267	$6.2389069 \times 10^{-38}$	3.943446×10^7

Table 8.2 | Weak interaction data of the decay of the scattered particle in the detector

$g_{\mu\nu}$	$R_{\mu\nu}$	r	R	r_F	$M_{\mu\nu}$	$T_{\mu\nu}$
m	m^{-1}	m	m^{-2}	m	$MeV, \rho_p/m^3$	$MeV, \rho_p/m^3$
2.02096×10^{-14}	2.818008×10^7	2.020955×10^{-14}	1.39439×10^{21}	3.78723×10^{-11}	3564.40437	6.35413×10^{-27}
1.60629×10^{-14}	2.2398×10^7	1.60629×10^{-14}	1.39439×10^{21}	3.78724×10^{-11}	7098.79821	1.26548×10^{-26}
1.01742×10^{-14}	4.471108×10^7	1.017422×10^{-14}	4.39455×10^{21}	2.13333×10^{-11}	27001.0843	4.81338×10^{-26}

8.55542×10^{-15}	3.872874×10^7	8.555419×10^{-15}	4.52681×10^{21}	2.10193×10^{-11}	46777.5902	8.33887×10^{-26}
1.09552×10^{-14}	7.886893×10^7	1.095516×10^{-14}	7.19925×10^{21}	1.66675×10^{-11}	22274.5267	3.9708×10^{-26}

In the table, $g_{\mu\nu}$ is the radius of the scattering particles.

The unified phase field theory and curvature tensor equation based on the interaction of positive and negative magnetic poles naturally and perfectly describe the unified strong interaction, weak interaction, electromagnetic interaction and gravitational interaction during the collision and decay of high-energy particles. When the scattering particles collide with the detector nucleus or outer layer electrons, $\phi_{\mu\nu}$

represents the phase field curvature tensor of the scattered particle, $R_{\mu\nu} - \frac{1}{2}\phi_{\mu\nu}R$ represents the differential geometric curvature tensor of the scattered particle, $\frac{r}{f_{\mu\nu}r_F^2}T_{\mu\nu}$ represents the curvature

tensor of the gravitational field of the scattered particle, and $\frac{r}{p_{\mu\nu}r_F^2}M_{\mu\nu}$ represents the curvature

tensor of the electromagnetic (energy) field of the scattered particle.

Discussion

It is assumed that the elementary particle is a magnetic pole field formed by the interaction of positive and negative magnetic poles (Fig. a). The positive magnetic pole ring at the core of the elementary particle condenses the negative magnetic pole into a magnetic pole field, and the interaction of the positive and negative magnetic poles drives the rotation of the elementary particle. In other words, the interaction between the positive magnetic pole ring and the negative magnetic pole field forms elementary particles that rotate continuously. The so-called elementary particle spin refers to the interaction motion of the continuously rotating elementary particle and the external energy field.

Free quark, gluon, and W and Z boson were not found in the universe and physics experiments. High-energy particles based on the interaction of positive and negative magnetic poles do not need to be constructed with third-generation quarks and gluon, and their decay does not require the mediation of W and Z intermediate bosons. The interaction between elementary particles and external fields (elementary particles are each other's external fields) based on the interaction of positive and negative magnetic poles can explain black-body radiation experiments, photoelectric effect experiments, double-slit experiments, β decay experiments, various high-energy particle collision experiments, etc.

The interaction between elementary particles and the external field strictly follows the principle of conservation of energy, accelerating condensed energy, and decelerating released energy. The inelastic collision of the elementary particles can cause two positive magnetic pole rings to merge or can cause two positive magnetic pole ring fissions. Using this interaction principle to explain the collision and decay of high-energy particles is more in line with physical reality. This article takes the European Large Hadrons Collider as an example to discuss related issues.

Accelerating proton to condense more magnetic poles

The composite particles cannot approach the speed (c) of light in any gravitational field in the universe or on any particle accelerator that people make (will disintegrate when approaching the speed of light). Only elementary particles (the particles of one positive magnetic pole ring) can approach the speed of light. When the elementary particles accelerate, a more negative magnetic pole (negative magnetic pole absorbed from the external field) will condense, and the number of magnetic poles in the positive magnetic pole ring will not increase, but the two positive magnetic poles will be closer together. Therefore, the interaction between the positive magnetic pole ring and the negative magnetic pole field is stronger. If the protons accelerate, their relativistic mass or energy keeps increasing, the motion wavelength and radius keep decreasing, and the related variables covariant. The motion mass of the elementary particle according to Einstein's mass-energy equation

$$m_m = m / \sqrt{1 - (v^2/c^2)} - m, \quad (4)$$

where v is the equivalent velocity of the elementary particles and c is the speed of light. The equivalent velocity (v) of the elementary particle is equal to the actual displacement velocity of the particle in the external field plus the equivalent velocity of the energy density of the external field. An external field with a certain energy density has a certain resistance to the movement of the particle, and c is the velocity (v) of photons in absolute zero vacuum. The equivalent velocity of the elementary particle

$$v = k / \sqrt{\lambda_m}, \quad \lambda_m = (k/v)^2, \quad (5)$$

where λ_m is the particle motion wavelength and $k = 6.60402779758742 \times 10^2$ is the conversion constant between the particle motion wavelength and the particle equivalent velocity. When the actual displacement velocity of the particle in the external field is equal to zero, v is the equivalent velocity of the energy density of the external field, and λ_m is the wavelength of the energy density of the external field or the motion wavelength of the particle. Newtonian kinetic energy equation based on the theory of relativity

$$E = r \frac{1}{2} (m + m_m) v^2 = m_m c^2, \quad (6)$$

Where r is the correction value from 1 to 2. Newtonian gravitational equation based on the theory of relativity

$$F = \sqrt{G(m_1 + m_{1m})(m_2 + m_{2m})} / r^2, \quad (7)$$

There is a ratio between the gravitational force (F) and the energy (E) of the particle in the interaction between particles and external fields; for example, the ratio of the gravitational force (F) to the energy (E) of an electron is $1.78266326294376 \times 10^{-30}$. The free falling speeds of simultaneous particles of different masses are the same in the gravitational field. Therefore, the equivalent speeds of particles of different masses in the external field of the same energy densities are also the same.

The relativistic mass (M) of the elementary particle moving in an external field with a certain energy density can be divided into the core field mass in the positive magnetic pole ring and the gradient field mass outside the ring. The relativistic mass is not the rest mass. The rest mass is the mass when the

particle is in an external field of absolute zero and there is no displacement. Although the rest mass of a proton is determined based on the relativistic mass, it is almost equal to its rest mass in an external field of absolute zero. The elementary particle spin magnetic pole field (or energy field) equation based on relativity

$$M = e \int_{i=1}^{i=\alpha} \left((m + m_m) / e \right) \left((i + \delta)^3 - i^3 \right) dV, \quad (8)$$

$$= (m + m_m) \int_{i=1}^{i=\alpha} \left((i + \delta)^3 - i^3 \right) dV$$

where e is the natural constant, which is the convergence limit constant of the elementary particle's positive magnetic pole ring; $i = 1$ is the particle's positive magnetic pole ring wavelength, which is the initial value of the elementary particle gradient field; and $i = \alpha$ is the elementary particle motion wavelength, which is the boundary value of the elementary particle gradient field. δ is the wavelength difference of the elementary particle gradient field, $\int_{i=1}^{i=\alpha} \left((i + \delta)^3 - i^3 \right) dV = 1$. dV is the gradient volume of the particle gradient energy field corresponding to the gradient wavelength difference. Equation (8) reflects the physical reality of the movement of the elementary particle; there is no ultraviolet divergence or infrared divergence, and no renormalization is required.

The unified phase field theory and the curvature tensor equation of collision and decay of high-energy particles

Unified phase field theory

The so-called unified phase field theory is the theory that the differential geometric^{30, 31, 32, 33} variables and physical variables are covariant and to realize the unification of gravity, electromagnetic force, strong force, and weak force in the interaction of the magnetic pole field of particles based on the theory of relativity. Four forces are all produced by the interaction of positive and negative magnetic poles, which are four manifestations of the interaction of positive and negative magnetic poles. The negative magnetic pole acts as a mediator in these four interactions, and no other mediator is needed. This is more in line with physical reality.

Gravity refers to the cohesive force of the particle magnetic pole field (the gravitational field) to its magnetic poles and is the gravitational force. High-energy protons and antiprotons act as gravitational fields for each other, are in the gradient magnetic pole field of each other, and have a strong attractive force, and the gravitational force increases as the distance between them decreases when it collides. Scattering particles are incident in the gradient magnetic pole field of the crystal lattice of the relevant element and are attracted by nuclear gravity and enter the corresponding gradient energy field of the nucleus. The gravitational force of the scattering particles increases as the distance from the nucleus decreases.

The electromagnetic force refers to the spin force of the particle gradient magnetic pole field in the external field (the gravitational field). High-energy protons and antiprotons act as gravitational fields for each other and spin in each other's gradient magnetic pole field to generate a spin electromagnetic force (or energy) when it collides. The gradient magnetic pole field of the scattering particles spins in the atomic (or outer electron) gradient magnetic pole field to generate a spin electromagnetic force (or energy).

The strong force refers to the maximum interaction force when high-energy particles collide. The

strong force is the maximum interaction force when scattering particles collide with the atomic gradient magnetic pole field or the outer electron.

The weak force refers to the interaction force when the positive magnetic pole ring of the high-energy particles decays in the process of the interaction between the high-energy particle and the external field. For example, a positive pole ring of a high-energy particle splits into a positive pole ring of leptons and a positive pole ring of neutrinos when it decays; that is, high-energy particles decay into leptons and neutrinos.

The phase of the elementary particle can be obtained according to the motion wavelength of its

$$r_\phi = \alpha \lambda_m / 2\pi, \quad (9)$$

where λ_m is the motion wavelength of the elementary particle, r_ϕ is the phase of the elementary particle, or the radius r of the spin phase field of the elementary particle. The difference in the phase before and after the particle moves along the space-time curve

$$\phi_{\mu\nu} = g^{\mu\nu} (\partial q_{\mu\nu} / q), \quad (10)$$

where q is the velocity of the particle and the metric $g_{\mu\nu} = e_\mu \cdot e_\nu$.

Unified phase field curvature tensor equation

The interactions of particles and external fields can be described with tensors. The so-called tensor refers to a multi-stress vector function or a multi-linear function of point, line, area, and volume with a certain energy density. The particle's spin phase field is a gradient energy field and can be described with tensors of points, vectors, areas and volumes, which are represented as scalar, first-order tensor, second-order tensor, third-order tensor, etc. In addition to scalar, other tensors belong to the gradient tensor, and the average is taken as its unit tensor.

The interaction between particles and the external field can be represented by a tensor, and each tensor is covariant with the space-time curvature of the particle motion. Particles with a certain radius (r) represent the momentum-energy tensor ($p_{\mu\nu}$), the gravitational momentum-energy tensor ($f_{\mu\nu}$), and the phase difference momentum-energy tensor ($M_{\mu\nu}$). The external field with a certain radius (r_F) represents the gravitational field phase difference momentum-energy tensor ($T_{\mu\nu}$)^{34,35}, Ricci curvature

tensor ($R_{\mu\nu}$), phase field curvature tensor ($\phi_{\mu\nu}$), gravitational field curvature tensor ($\frac{r}{f_{\mu\nu} r_F^2} T_{\mu\nu}$), and

electromagnetic field curvature tensor ($\frac{r}{p_{\mu\nu} r_F^2} M_{\mu\nu}$). The curvature tensor equation of the interactions

between the spin phase field of particles and the spin phase field of an external field, which is the curvature tensor equation of the unified phase field

$$\phi_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} \phi_{\mu\nu} R = \frac{r}{f_{\mu\nu} r_F^2} T_{\mu\nu} = \frac{r}{p_{\mu\nu} r_F^2} M_{\mu\nu}, \quad (11)$$

where $\varphi_{\mu\nu}$ is the phase difference metric and is used to calculate the curvature tensor of the particle's phase difference. Replace $\varphi_{\mu\nu}$ with the phase metric or Riemann metric ($g_{\mu\nu}$) to calculate the curvature tensor of the particle. r is the radius of particle's spin phase field, $1/r_F^2$ is Gauss curvature (K)³⁶, r_F is the radius of spin phase field of external field (gravitational field), $R = 2K = 2/r_F^2$ is the scalar of Ricci curvature^{37,38}, $R_{\mu\nu} = R\varphi_{\mu\nu}$ is Ricci curvature tensor of the particle's phase difference, μ and ν is the tensor subscript (the basis vector of local coordinate system, which represents the radius of which before and after particles is translated along space-time curve). The particle's momentum-energy tensor $p_{\mu\nu} = \rho_p V$, namely, the momentum-energy density (ρ_p) of the particle multiplied by the particle volume (V). The particle's gravitational momentum-energy tensor $f_{\mu\nu} = \rho_f V$, namely, the gravitational momentum-energy density (ρ_f) of the particle multiplied by the particle volume (V).

Lagrangian of particle phase field motion

The curvature tensor equation of the unified phase field describes the space-time curve or Ricci curvature flow of particle motion. The phase difference momentum-energy tensor ($M_{\mu\nu}$) of the particle is a relativistic Lagrangian density of the particle and is equivalent to the Lagrangian density (L_F) described by the Yang-Mills gauge field equation³⁹. $M_{\mu\nu}$ of the curvature tensor equation of the unified phase field can be expressed as a Lagrangian function of energy, wave function and gauge field of particle motion. The Lagrangian function of Einstein's mass-energy equation

$$L_E = E \frac{i\partial}{\partial r} = \left(m / \sqrt{1 - (v_{i1}/c)^2} - m \right)^2 - \left(m / \sqrt{1 - (v_{i2}/c)^2} - m \right)^2 \quad (12)$$

where E is the energy of the colliding particle. $\frac{i\partial}{\partial r}$ is the particle phase vector between the colliding particle and the scattering particle, is the ratio of the phase difference between the colliding particle and the scattering particle to the phase of the colliding particle, and i is a complex number.

v_{i1} and v_{i2} are the velocities of the colliding particle and the scattering particle, respectively. The energy of the particle is covariant with the phase difference of the particle phase field. Lagrangian function of the Schrodinger particle differential motion wave function based on the theory of relativity

$$L_\psi = E\psi \frac{i\partial}{\partial r} = i\beta h_m \frac{\partial}{\partial t} \psi(\bar{r}, t) = \left[-\frac{\beta^2 h_m^2}{2m + m_m} \nabla^2 + V(\bar{r}, t) \right] \psi(\bar{r}, t) \quad (13)$$

where $E\psi$ is the energy wave function of the colliding particle. β is the factor of the relativistic

kinetic energy operator, $\beta = \frac{p}{kh_m}$. p is the kinetic energy of the particle, $k = \frac{4\pi}{\alpha\lambda}$, λ is the

wavelength of the particle motion, and α is the fine structure constant. h_m is the rest mass constant

based on the wavelength of the particle motion, $h_m = 5.45025577174353 \times 10^{-65} \text{ kg} \cdot \text{m}^3$.

$-\frac{\beta^2 h_m^2}{2m + m_m} \nabla^2$ is the particle kinetic energy operator ($\hat{T}$), and ∇^2 is the Laplacian operator.

$V(\vec{r}, t)$ is the particle potential energy, and $\vec{r}$ represents the potential energy vector. The wave function of the particle is covariant with the phase difference of the particle phase field. Lagrangian density of Yang-Mills gauge field equation³⁹ in the first-order form

$$\begin{aligned} L_F &= F_E \frac{i\partial}{\partial r} = \frac{1}{4} F_{\mu\nu} \cdot F^{\mu\nu} - \frac{1}{4} F_{\nu\mu} \cdot F^{\nu\mu} \\ &= \frac{1}{4} F_{\mu\nu} \cdot F^{\mu\nu} - \frac{1}{2} F_{\nu\mu} \cdot (\partial^\mu A^\nu - \partial^\nu A^\mu + g A^\mu \times A^\nu) \end{aligned} \quad (14)$$

where F_E is the energy field of the colliding particle. $F_{\mu\nu}$, $F_{\nu\mu}$, A_μ and A_ν are independent coordinates, which represent the spin vector, and the dot product and cross product represent the operation between them. The gauge field is the spin gradient phase field in which the particle interacts with the external field. The energy of the gauge field is covariant with the phase difference of the particle phase field. The Yang-Mills Lagrangian density (L_F) is the energy ($\frac{i\partial}{\partial r} m_m c^2$) field of the particle motion mass covariant with the particle phase difference.

The Lagrangian function of the gravitational field phase difference momentum-energy tensor ($T_{\mu\nu}$) of the Newtonian gravitational equation based on the theory of relativity (see equation (7))

$$L_T = F \frac{i\partial}{\partial r} = \sqrt{G(m_1 + m_{1m})(m_2 + m_{2m})/r_{F1}^2} - \sqrt{G(m_1 + m_{1m})(m_2 + m_{2m})/r_{F2}^2} \quad (15)$$

where F is the gravitational force of the colliding particle. r_{F1} and r_{F2} are the gravitational field radii of the colliding particle and the scattering particle, respectively. The gravity of a particle is covariant with the phase difference of the particle phase field.

The curvature tensor equation of the unified phase field obeys the principle of relativity, realizes the unity of Einstein's special theory of relativity and general relativity, and profoundly reveals the physical reality of the interaction between particles and external fields. The Lagrangian function of Einstein's mass-energy equation, the Lagrangian function of Schrodinger particle differential motion wave function based on the theory of relativity, the Lagrangian density of Young-Mills gauge field equation, and the particles phase difference momentum-energy tensor of the curvature tensor equation of unified

phase field is completely consistent, namely, $L_E = L_\psi = L_F = M_{\mu\nu}$, realizes the unity of relativity and quantum mechanics.

Methods

The high-energy field produced by the collision of high-energy protons and antiprotons

High-energy protons and antiprotons condense a large number of magnetic poles (or energy) in the process of acceleration and release the corresponding magnetic poles when colliding. High-energy proton-antiproton collides, and the released magnetic pole is superimposed with certain external field magnetic poles to form the energy field of high-energy particle collision.

High-energy protons are a gradient magnetic pole field or gradient energy field. Most proton and antiproton elasticity collides, and a few proton and antiproton inelasticity collide in protons and antiprotons collide. The instantaneously released magnetic poles or energy (E_f) in the inelastic

collision of high-energy protons (or elementary particles) is equal to the energy (E_c) when its collision

subtracts the energy (E_d) when its decay is $E_d = E_c / 2\pi$ $E_f = E_c - E_d$.

The European Large Hadrons Collider (LHC) uses high-energy proton beams to collide with high-energy antiproton beams to increase the probability of high-energy proton and antiproton collisions. When the high-energy proton beams collide with the anti-proton beam, the leading proton and anti-proton inelasticity collide, which will produce new particles, release a large amount of energy, and form an energy field. If the subsequent proton and antiproton inelastic collisions, the released energy will be superimposed with the external energy field to form a high-energy field of collision. The proton and antiproton elastic collide, release a certain amount of energy, and run away along the beam tube.

When protons and antiproton beams collide, the high-energy field of the collision is a gradient energy field whose energy density decreases from the inside to the outside or an energy field whose energy density wavelength increases from the inside to the outside. The energy of the energy field is a spherical wave radiating outward. This is the magnetic pole wave.

High-energy proton and antiproton beams collide once, which is a collision event. There was an approximately 10^{11} proton in each beam, which was compressed into a filament with a diameter of 16 μm and a length of 7 cm. Approximately 23 pairs of proton inelasticity collide in a collision event. The energy of the collision energy field is less than the superposition state of the energy released by the collision of 23 pairs of protons because the magnetic pole wave diffusion speed of collision energy is greater than the motion speed of high-energy protons.

Collision and decay of high-energy protons and antiprotons

The so-called elastic collision refers to the collision between the gradient magnetic pole field of two protons (or elementary particles) with opposite spin directions, not necessarily equal energy and

deviating the collision line. The so-called inelastic collision refers to the merging or fission of the positive magnetic pole ring due to the collision between two protons (or elementary particles) with opposite spin directions and equal energy (Fig. b, c, d); the second refers to positive magnetic pole ring fission with small energy due to the collision between two high-energy elementary particles with opposite spin directions and unequal energy; and the third refers to the deep collision between the high-energy elementary particles and the atomic nucleus or outer electrons. **The so-called merging of positive magnetic pole rings indicates that the positive magnetic pole rings of two elementary particles merge into the positive magnetic pole ring of a particle. For example, the positive magnetic pole rings of protonium are composed of the positive magnetic pole rings of proton and antiproton collision and merging (Fig. b,c).** So-called positive magnetic pole ring fission refers to a positive magnetic pole ring of the elementary particle splitting into a positive magnetic pole ring of a lepton and a positive magnetic pole ring of a lepton neutrino (Fig. b, d) or a positive magnetic pole ring of the particle pair splitting into two positive magnetic pole rings of the elementary particles with equal energy and opposite spins (Fig. b, c).

Figure | The magnetic pole field of the elementary particle and the collision and decay of high-energy protons and antiprotons. (a) The positive magnetic pole ring of the elementary particle drives the negative magnetic pole field to spin in the external field, forming a magnetic pole field that conforms to the right-hand or left-hand rule. (b) Inelastic collision between proton and antiproton. (c) Inelastic collisions of protons and antiprotons may produce protonium or antiprotonium. (d) Inelastic collisions between protons and antiprotons may produce tau, anti-tau and tau-neutrinos, and anti-tau-neutrinos. Inelastic collisions of three levels of high-energy particles occur successively in the high-energy proton collision energy field.

The inelastic collision of the first level is inelastic collision of the high-energy proton and antiproton. The collisions of high-energy protons and inelastic antiprotons, one is that protonium may be produced, whose energy is the sum of the energy of two high-energy protons when it decays (Fig. b,c), and the other is that it may produce tau, anti tau and tau-neutrinos, anti tau-neutrinos (Fig. b,d). The spin direction of Tau is the same as that of protons, and the spin direction of tau-neutrino is opposite to that of protons. The sum of the energy of tau and tau-neutrinos is equal to the energy of protons when it decays. Tau neutrinos scatter as the collision energy field expands.

The inelastic collisions of the second level are the inelastic collisions of high-energy protonium and the inelastic collisions of high-energy tau and anti-tau. The inelastic collisions of high-energy protonium (or the collision between protonium and incident proton) produce protons and antiprotons with relativistic energy, which are scattered as the collision energy field expands. The inelastic collision of high-energy tau and anti-tau may produce tauium, whose energy is the sum of the energy of two taus when they decay. The tauium has a relativistic mass and scatters as the collision energy field expands. The inelastic collision of high-energy tau and anti-tau (or the collision between tau, anti-tau and

incident proton) may produce muon, anti-muon and muon neutrino, anti-muon neutrino, which will be scattered as the collision energy field expands. The direction of the muon spin is the same as tau, and the direction of the muon neutrino spin is opposite to that of tau. The sum of the energy of muon and muon neutrino is equal to the energy of tau when it decays. If in a high-energy proton and antiproton collision event, there are two inelastic collisions of high-energy tau and anti-tau (or the collision between tau, anti-tau and incident proton), it may produce the so-called "golden decay channel".

The inelastic collision of the third level is the inelastic collision of high-energy muon and anti muon. The inelastic collision of high-energy muon and anti muon may produce muonium, whose energy is the sum of the energy of the two muons when they decay. Muonium has a relativistic mass and scatters as the collision energy field expands. The inelastic collisions of high-energy muon and anti-muon (or collision between muon and proton or muon and tau) may produce electron, positron and electron-neutrino, positron-neutrino, which will be scattered as the collision energy field expands. The spin direction of the electron is the same as that of the muon, and the spin direction of the electron neutrino is opposite to that of the muon. The sum of the energy of electrons and electron neutrinos is equal to the energy of the muon when it decays.

When the high-energy particle beam collides, if the scattered particles have "simultaneity", an injection phenomenon is produced. The ratio of the energy to volume of the tauium incident to the hadron calorimeter is relatively large, and the track curvature is small; therefore, collinear scattering occurs.

The inelastic collision of the three levels of high-energy particles reveals the production mechanism of protonium, tauium, muonium, positronium, third-generation leptons and neutrinos, and jets. The three generations of neutrinos all have the speed of light after they are produced. This is because when a neutrino is produced, the energy density and the positive magnetic pole density of the neutrino are the same as those of the leptons, but the mass and radius of the neutrino are smaller than those of the lepton. Relatively speaking, the interaction force between the positive magnetic pole ring of the neutrino and its negative magnetic pole field is greater than that of the lepton. The rest mass of the electron neutrino is approximately $1.319849eV$, the rest mass of the muon neutrino is approximately $0.272903167keV$, and the rest mass of the tau neutrino is approximately $4.58942073879939keV$. The speed of neutrinos is equal to the speed of photons and is approximately $299792457.9999999335677253410648m/s$. Troitzk^{40, 41} experiments obtained an upper limit of mass less than $2.05eV$. In 2017, the KATRIN experiment⁴² in Germany limited the neutrino mass from the end of decay electron spectroscopy, and the obtained neutrino mass upper limit was 1 eV.

Collision and decay of scattered particles in the detector

The scattered particles produced by the collision of high-energy particles are scattered with the expansion of the collision energy field. The scattered particles are detected by the detectors. Take the CMS detector as example⁴³. The central feature of the CMS apparatus is a superconducting solenoid with a 6 m internal diameter, which provides a magnetic field of 3.8 T. Within the field volume are a silicon pixel and strip tracker, a lead tungstate crystal electromagnetic calorimeter (ECAL), and a brass/scintillator hadron calorimeter (HCAL). Muon is measured in gas ionization detectors embedded in the steel flux-return yoke. Extensive forward calorimeters complement the coverage provided by the barrel and endcap detectors.

The scattered particles have relativistic energy and motion wavelengths when they leave the collision energy field and enter the detector energy field, which is a spin magnetic pole field with a certain

$7.5 \times 10^{-6} m$.

Various scattering particles interact with the 3.8 T uniform magnetic field or interact with the element gradient energy field. Particles with a large ratio of energy to volume will be incident in the element deep gradient energy field, and elasticity collides or inelastically collides with the outer electrons or the nucleus in the element. The kinetic energy of the scattering particle is larger, and the kinetic energy of the nucleus or outer electrons is smaller. The scattering particle will transfer the energy () to the nucleus or outer electrons or transfer to a hadron shower or electromagnetic shower when inelastically colliding.

Various scattered particles are incident in the multilayer silicon microchip lattice of the inner detectors and elastically collide with the semiconductor electrons, thereby generating signals and showing tracks. The three types of neutrinos have a large ratio of energy to volume and no tracks in various detectors; the ratio of energy to volume of muonium is large, and the tracks curvature is small, similar to photon; the ratio of energy to volume of proton and tauium is large, and the tracks curvature is relatively small, tauium similar to photon; the ratio of energy to volume of muon is small, and the tracks curvature is slightly larger (or show a weak neutral current); the ratio of energy to volume of electron is small, and the tracks curvature is large.

The electrons are incident in the lead tungstate crystal, and elasticity collides or inelastically collides with the outer layer electrons in the element to produce electromagnetic showers, which become free electrons. Muonium is incident in the lead tungstate crystal and inelastically collides with the outer electrons in the element to produce electromagnetic showers and decays into muon and anti muon. Muons inelastically collide with outer electrons and decay into electrons and electron neutrinos. The decay vertex of muon produces vertices of electrons and electron neutrinos. Electrons with a certain energy collide with the outer electrons, which may produce positronium (annihilated as gamma photons), and then collide with the outer electrons to become free electrons. Proton, tauium and muon are incident in the lead tungstate crystal, and elasticity collides with the outer electrons and the nucleus, releasing part of the magnetic poles, thereby generating a signal, showing tracks, and passing through the electromagnetic calorimeter.

The proton and tauium are incident in the hadron calorimeter and elastic collide or inelastically collide with the nucleus of the brass/scintillator, thereby generating signals and showing tracks. The scattered proton elastic collision or inelastic collision with the nucleus of the brass/scintillator will produce hadron showers. The scattered protons inelastically collide with the nucleus, causing a certain angle of refraction, and finally decay into baryons and precipitate in the brass/scintillator crystal. Baryons are protons with a certain relativistic mass in a certain energy field. Tauium elasticity collides or inelastically collides with the nucleus of the brass/scintillator, produces a meson shower, and finally decays into the corresponding meson, which precipitates in the brass/scintillator crystal. The muon is incident in the brass/scintillator crystal, and elasticity collides with the outer electrons and the nucleus, releasing part of the magnetic poles and passing through the hadron calorimeter.

The muon is incident in the gas chamber of the muon detector, and elasticity collides with the mixed gas of argon and carbon dioxide to ionize the gas, thereby generating a signal and showing tracks. The kinetic energy of the muon is determined according to the curvature of the muon's tracks in the gas chamber. Finally, muon decays into electrons and electron neutrinos, and the electrons precipitate in the mixed gas of argon and carbon dioxide.

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Original image file

Figure | The magnetic pole field of the elementary particle and the collision and decay of high-energy protons and antiprotons.

(a) The positive magnetic pole ring of the elementary particle drives the negative magnetic pole field to spin in the external field, forming a magnetic pole field that conforms to the right-hand or left-hand rule.

(b) Inelastic collision between proton and antiproton magnetic pole fields.

(c) Inelastic collisions of protons and antiprotons may produce protonium or antiprotonium.

(d) Inelastic collisions between protons and antiprotons may produce tau, anti-tau and tau-neutrinos, and anti-tau-neutrinos.