Chapter 19

Relationship between QED, QCD and the General Relativity of CFLE Theory

19.1 Solving the Proton Spin Crisis

According to the generally accepted Standard Model (Quark-Parton Model), there are two types of quarks in the proton (or nucleon)—one with spin $+\frac{1}{2}$ (known as the "up" quark) and the other with spin $-\frac{1}{2}$ (the "down" quark). Current theoretical physicists assume the proton to have a total spin of $+\frac{1}{2}$ along some axis, comprising two "up" and one "down" quark particles. That is,

$$+\frac{1}{2} = \left(+\frac{1}{2}\right) + \left(+\frac{1}{2}\right) + \left(-\frac{1}{2}\right) \qquad \text{19-1-1}$$

In 1987, the European Muon Collaboration (EMC), which had been scattering muons off polarized protons at CERN, imploded the particle physics community with their experimental news that not enough of the proton's spin could be contributed by the spin of its three constituent quarks. In other words, the overall quark contribution to the proton is only

$$\Delta\,\Sigma = (12 \pm 9 \pm 14)\ \% \qquad \text{19-1-2}$$

This result was called the EMC effect, and it precipitated what became known as the "Proton Spin Crisis."

Following the 1987 report, the EMC spent a further 30 years continuing the experiments at CERN. Concurrently, researches were being done by the Jefferson Lab and RHIC at Brookhaven National Laboratory, the HERMES experiment at DESY Laboratory, and the COMPASS experiment at CERN. It was found in experiments that the number of quarks with spin in the proton's spin direction was almost the same as the number of quarks whose spin was is in the opposite direction. Global analysis of data from all major experiments confirmed that the quark spin contributed only about 30% to the total spin of the proton (nucleon). That is,

$$\Delta\Sigma \sim 30\% \qquad 19\text{-}1\text{-}3$$

Therefore, it was believed that the remaining spin must be carried by a gluon and orbital angular momentum. Consequently, the related sum rule of the proton spin was changed to

$$\frac{1}{2_{\text{proton}}} = \frac{1}{2}\Delta\Sigma + \Delta G + L_z \qquad 19\text{-}1\text{-}4$$

where $\Delta\Sigma$ is the quark spin, ΔG is the gluon spin, and L_z is the orbital angular momentum.

Data on quark and gluon distributions have shown that

$$\Delta\Sigma = \int_0^1 \Delta\Sigma(x, Q^2)dx \qquad 19\text{-}1\text{-}5$$

(where Q^2 is the squared 4-momentum-transfer vector q of the exchanged virtual particle and x is the "Bjorken x" scaling variable) is constrained, but $\Delta G = \int_0^1 (x, Q^2)\,dx$ is largely unknown.

Experiments were (and are still being) continued to verify the particle contributions to the nucleon spin, and some current data have suggested that the valence quarks could make up ~60% of the nucleon's spin.

Descriptions of the experiments done and data collected over the past 30 years, as well the postulates and calculations behind the experiments (i.e., spin-dependent Parton density functions, sum rules and spin polarizability, quark-hadron duality, spin structure functions g_1 and g_2 and their moments, etc.), have already been published elsewhere, and do not need repeating here. [An excellent review is given by Kuhn SE *et al*., "Spin Structure of the Nucleon – Status and Recent Results," February 11, 2009. Accessible at http://arxiv.org/pdf/0812.3535.pdf]

Sufficed to say that, in spite of the global efforts to reconcile data with theory, the crisis remained that part of the proton's spin lay elsewhere. As summarized by Kuhn *et al*.,

> "Measurements of the polarized gluon density suggest that it is much too small to resolve the spin crisis."

But the essence of the proton spin crisis is that current physicists cannot understand why the value of $\Delta\Sigma$ can be 30%. CFLE theory (discussed below) will prove that this 30% result is not such a crisis at all.

19.2 Similarities Between the Missing Precession of Planet Mercury and the Missing Spin of the Valence Quark

In Chapter 1 of this book, I touched briefly on the precession of planet Mercury. It was Urbain Le Verrier (1811–1877) who discovered the missing precession of Mercury's perihelion in 1843, when he observed Mercury's motion around the Sun to be 574 arcsec per century. To account for this value using Newtonian mechanics, he totaled up the contributions made by the other known planets in our solar system to Mercury's precession. Venus contributed 277 arcsec, 153 arcsec was by Jupiter, 90 arcsec by Earth, and 10 arcsec by Mars and the remaining planets combined, for a total of 531 arcsec per century. This left 43 arcsec unaccounted for, giving rise to the crisis of "Mercury's missing precession."

This discovery shone a huge spotlight on the limits of Newtonian celestrial mechanics and, along with many other unresolved physics phenomena, signaled the need for some new physics concepts in the 19th century. From 1859 to 1915, many explanations of Mercury's missing perihelion precession were put forward, but all fell by the wayside. It was Einstein, in November 1915, who would eventually glean the magical number of 43 arcsec per century out of one of the first calculations from his new general relativity theory.

From the viewpoint of the general relativity of curved force line elements theory, we can find that the proton spin crisis is very similar to the Mercury precession crisis. As discussed in this book, Einstein's general relativity theory cannot be extended to the strong force as well as the weak force and electromagnetic force. Because Einstein's general relativity is entrenched in curved space and extra dimensions, his theory becomes incalculable and unextendable to these three forces.

Modern physicists also do not have a calculable general relativity for each force and it related phenomena. Therefore, such physics crises remain unresolved.

CFLE theory, on the other hand, is calculable and extendable to every known force, so this theory can identify similarities between the proton spin crisis and mercury's missing precession problem:

● Le Verrier and the Paris observatory ⇛ All members of the EMC and the EMC at CERN

● The solar system ⇛ the proton system

● The planet Mercury ⇛ the valence quarks

● The other planets ⇛ gluon and other quarks

● Mercury's missing precession ⇛ missing quark spin

● The numerous proposals ⇛ the numerous sum rules

● Newtonian celestial mechanics ⇛ quantum chromo dynamics

● No calculable theory of general relativity for gravitational interaction ⇛ no calculable theory of general relativity for electromagnetic interaction and strong interaction

19.3 Relation Between Quantum Mechanics and CFLE Theory

The 1922 particle deflection experiments (Figure19- 3-1) conducted by German physicists Otto Stern (1888–1969) and Walther Gerlach (1889–1979) are the gold standard used for explaining basic quantum mechanics. In the experiment, a beam of silver atoms was passed through a non-uniform magnetic field, with the aim to measure the values of the *z* component of the magnetic dipole moment for the atoms.

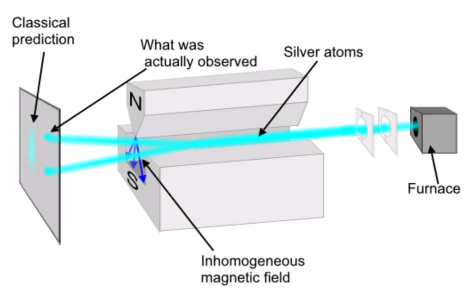


Figure 19-3-1. Schematic of the Stern–Gerlach Experiment

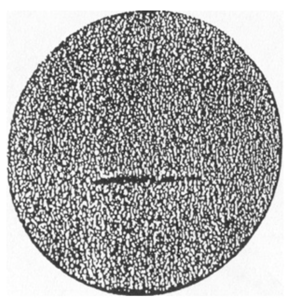
The classical prediction was that μ_{l_z} can have only discrete quantized values:

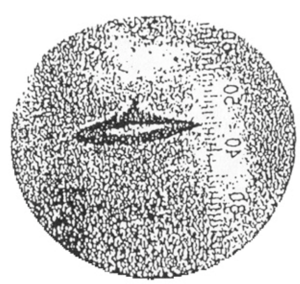
$$\mu_l = -\frac{g_l \mu_b}{\hbar} L, \quad \mu_{l_z} = -g_l \mu_b m_l, \quad \mu_{l_z} = -\frac{g_l \mu_b}{\hbar} L_z = -\frac{g_l \mu_b}{\hbar} m_l \hbar,$$
$$L = \sqrt{l(l+1)}\hbar \qquad 19\text{-}3\text{-}1$$

where m_l is one of the integers $\hbar$

$$m_l = -l, -l+1, \dots, 0, \dots + l - 1, +l \qquad 19\text{-}3\text{-}2$$

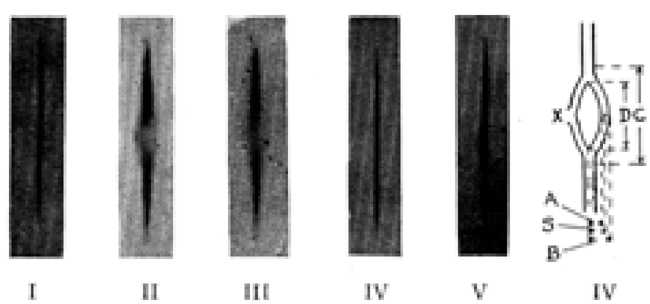
Thus, as seen in Figure 19-3-1 (and Figure 19-3-2), the deflected beam was predicted to be spread into a continuous band that corresponds to a continuous distribution of μ_{l_z} from each atom. Instead, the beam pattern was split into a positive z component and a negative z component (Figures 19-3-1 and 19-3-3).





In 1922 by Otto Stern and Walther Gerlach

Figure 19-3-2. Classically predicted **Figure 19-3-3. Observed**



In 1927 by T.E.Phipps and J.B. Taylor

Figure 19-3-4

This suggested the existence of some other unknown magnetic dipole moment in the atom. Samuel Goudsmit (1902–1978) and George Uhlenbeck (1900–1988) theorized that the magnitude S and the z component (S_z) of the spin angular momentum were related to two quantum numbers, s and m_s, by the same quantization relation as those for orbital angular momentum. That is

$$L = \sqrt{l(l+1)}\hbar \quad \rightarrow \quad S = \sqrt{s(s+1)}\hbar,\ S_z = m_s\hbar \qquad 19\text{-}3\text{-}3$$

$$\mu_l = -\frac{g_l \mu_b}{\hbar} L \quad \rightarrow \quad \mu_s = -\frac{g_s \mu_b}{\hbar} S \qquad 19\text{-}3\text{-}4$$

$$\mu_{l_z} = -g_l \mu_b m_l \quad \rightarrow \quad \mu_{s_z} = -g_s \mu_b m_s \qquad 19\text{-}3\text{-}5$$

Experimentally,

$$g_s m_s = \pm 1 \qquad 19\text{-}3\text{-}6$$

Because the beam of silver atoms is deflected into two equal and opposite z components, it stands to reason that μ_{s_z} can assume just two values, equal in magnitude but opposite in sign. Therefore,

$$m_s = -\frac{1}{2}, +\frac{1}{2} \qquad 19\text{-}3\text{-}7$$

and s has the single value

$$s = \frac{1}{2} \qquad 19\text{-}3\text{-}8$$

From Eq. 19-3-6, the possible value of g_s is

$$g_s = 2 \qquad 19\text{-}3\text{-}9$$

Spectroscopic measurements of Lamb, using a technique of extra accuracy, have actually shown that

$$g_s = 2.002319304 \qquad 19\text{-}3\text{-}10$$

According to CFLE theory, this g_s value is none other than the degree of the curved force line g, like the degree of curved space in the classical theory of general relativity.

From §7 of this book, the minimum g value of a proton is given as

$$g_{s_p} = 6.545979 \qquad 19\text{-}3\text{-}11$$

Extrapolating from Eq. 19-3-6, therefore, the possible value of m_{s_p} is

$$g_{s_p} m_{s_p} = \pm 1, \quad 6.545979 m_{s_p} = \pm 1 \qquad 19\text{-}3\text{-}12$$

Thus, the possible value of m_{s_p} is

$$m_{s_p} = -\frac{1}{6.5}, +\frac{1}{6.5} \qquad 19\text{-}3\text{-}13$$

The related s_p that has a single value (cf. Eq. 19-3-8) is

$$s_p = \frac{1}{6.5} \qquad 19\text{-}3\text{-}14$$

The permitted magnitude of the proton's constituents S_p and its permitted spin angular momentum S_{zp} are

$$S_p = \sqrt{s_p(s_p + 1)}\,\hbar \qquad 19\text{-}3\text{-}15$$

$$S_{pz} = m_{s_p}\hbar = \pm\frac{1}{6.5}\hbar \qquad 19\text{-}3\text{-}16$$

This final permitted value of S_{pz} for the proton's constituents can be compared to the typical value of S_{fz} (the fermion's spin angular momentum according to the Standard Model)

$$R_c = \frac{\pm(\frac{1}{6.5})\hbar}{\pm(\frac{1}{2})\hbar} = \frac{0.15\hbar}{0.5\hbar} = 0.3 = 30\% \qquad 19\text{-}3\text{-}17$$

$$\Delta\Sigma = \int_0^1 \Delta\Sigma(x, Q^2)dx \sim 30\% \qquad 19\text{-}1\text{-}5$$

This theoretical value of CFLE theory agrees very well with the experimental value of the proton's valence quarks spin from all the laboratories on Earth.

19.4 Relationship Between General Relativity and Quantum Chromo Dynamics

The Gravity Probe B satellite was designed to test one of the predictions of Einstein's general theory of relativity: the effect of the curvature of space–time on a body (vector) moving along the same surface as an orbiting body such as Earth—otherwise known as the geodetic effect. The phenomenon can be visualized as Earth sitting on and creating a dent in a trampoline, such that a gyroscope (like the one carried by GP-B) moving along the trampoline surface will be naturally drawn down the warped slope towards Earth (Figure 19-4-1).

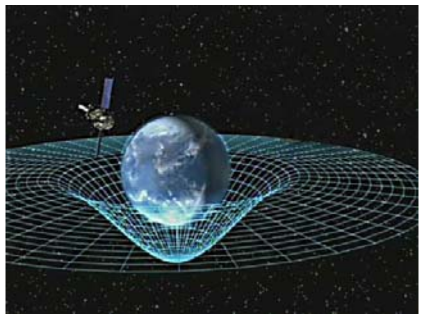


Figure 19-4-1

Francis Everitt, the principal investigator of GP-B, also describes the geodetic effect as the so-called "missing inch" (Figure 19-4-2).

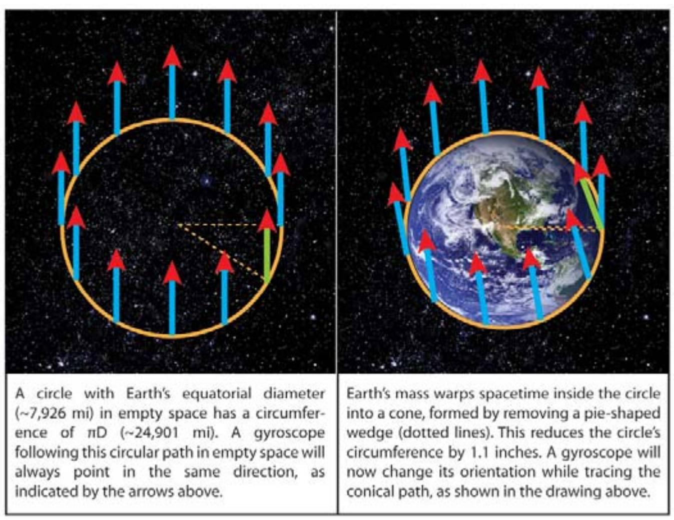


Figure 19-4-2

In this alternative view, we consider a circle with the same diameter (D) as Earth's (~7,900 miles) existing in empty space. Standard Euclidian geometry would put the circle's diameter as π × D (~24,800 miles). The gyroscope following this circular path in empty space would always point in the same direction, as Figure 19-4-2*left* illustrates. Now, were we to slip Earth inside of this circle, Earth's mass would warp the space–time inside the circle into a shallow cone, shrinking the circumference of the circle by a mere 1.1 inches.

We can visualize this effect by cutting out a pie-shaped wedge from the circle and closing the gap, as illustrated in Figure 19-4-3.

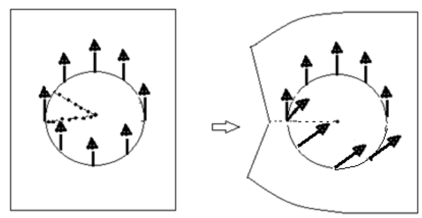


Figure 19-4-3

The circumference of the resulting cone is slightly diminished, and the orientation of the moving gyroscope shifts as shown in Figure 19-4-3*right*. Measuring this shifting orientation of the gyroscope's spin axis as it moves through warped space–time is the essence of the GP-B experiment.

By correlating the geodetic effect with the proton spin value, we can understand why the valence quarks' spin is smaller than expected for a proton. When we liken the spin of the proton to the spin of the gyroscope in the GP-B experiment, Figure 19-4-3*left* corresponds to the bound (flat) state of the proton, $g = 2$.

Now, the orientation of a single gyroscope can only be one, but were we to test many gyroscopes, the orientation of each gyroscope would be different. Likewise, testing the spin of several proton constituents in each location in the EMC experiments would give many different spin orientations, like Figure 19-4-3*right* (the curved state, or $g = 6.545979$).

Figure 19-4-4 shows qualitatively and more simply how a curved system produces different orientations of gyroscopes or different spin orientations of a proton's constituent particles. When the proton is in the bound state, the whole sytem is flat relative to the base line of the rest frame. All spin components have only one orientation (Figure 19-4-4*left*). When the proton system decays as constituent particles under the given degree of curved force line $g = 6.545979$, the whole system is curved relative to the base line of the rest frame.

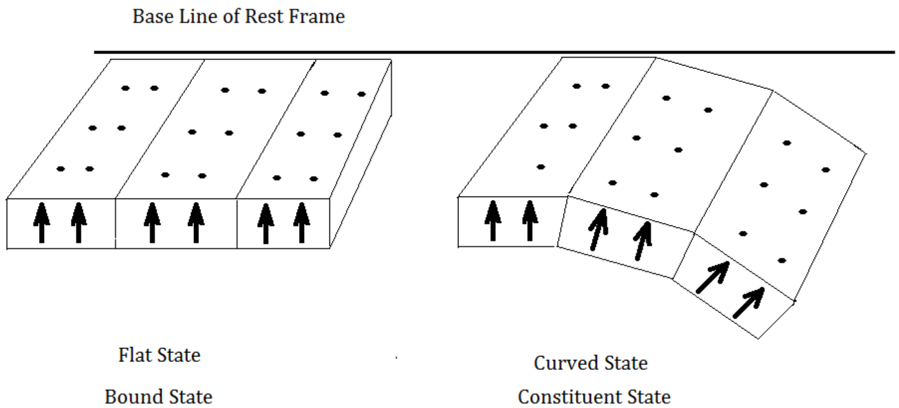


Figure 19-4-4

In such condition, the spin orientation of each constituent particle is different by as much as the degree of the curved force line (Figure 19-4-4*right*). Qualitatively, this is the same as the "missing inch" effect, which is why the valence quarks' spin is smaller than expected for a proton.

$$\Delta\Sigma = \int_0^1 \Delta\Sigma(x, Q^2)dx \sim 30\% \qquad 19\text{-}1\text{-}5$$

Equation 19-3-17 shows that the general relativity of CFLE theory is quantitatively correct too:

$$R_c = \frac{\pm(\frac{1}{6.5})\hbar}{\pm(\frac{1}{2})\hbar} = \frac{0.15\hbar}{0.5\hbar} = 0.3 = 30\% \qquad 19\text{-}3\text{-}17$$

This agreement in calculated and observed values leads to my conviction that the general relativity of CFLE theory is correct and extendable to each known physical force. This means that fermions' spin can decrease discretely

19.5 Solving unexpected split between parallel and anti-parallel spins of protons

In the Standard Model, fermions' spin increases discretely as

$$S_z = \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{5}{2}, \pm\frac{7}{2}, \pm\frac{9}{2}, \pm\frac{11}{2}, \pm\frac{13}{2} \ldots. \qquad 19\text{-}5\text{-}1$$

But, in CFLE theory, fermions' spin can decrease discretely as

$$S_z = \pm\frac{1}{2}, \pm\frac{2}{5}, \pm\frac{2}{7}, \pm\frac{2}{9}, \pm\frac{2}{11}, \pm\frac{2}{13} \ldots$$

$$= \pm\frac{1}{2}, \pm\frac{1}{2.5}, \pm\frac{1}{3.5}, \pm\frac{1}{4.5}, \pm\frac{1}{5.5}, \pm\frac{1}{6.5} \cdots \qquad 19\text{-}5\text{-}2$$

Therefore, the permitted spin of the proton's constituent particles (valence quarks) over g = 6.545979 as fermions is

$$S_z = \pm\frac{2}{13}, \pm\frac{4}{13}$$

$$= \pm\frac{1}{6.5}, \pm\frac{2}{6.5} \qquad 19\text{-}5\text{-}3$$

The sum rule of valence quarks for building the proton system (at maximum permitted force line curve of g = 2) is

$$S_{zp} = +\frac{2}{6.5} + \frac{2}{6.5} - \frac{1}{6.5} = \frac{3}{6.5} = \frac{1}{2.2} \approx +\frac{1}{2} \qquad 19\text{-}5\text{-}4$$

The sum rule for building up the neutron (maximum permitted force line curve of g = 2) is

$$S_{zn} = -\frac{1}{6.5} - \frac{1}{6.5} - \frac{1}{6.5} = \frac{3}{6.5} = \frac{1}{2.2} \approx -\frac{1}{2} \qquad 19\text{-}5\text{-}5$$

Finally, the possible permitted sum rule of the constituent state for the proton (permitted maximum force line curve of g = 6.545979) is

$$S_{zc} = +\frac{2}{6.5} - \frac{2}{6.5} + \frac{1}{6.5} = \frac{1}{6.5} = 0.15 \approx 30\% \qquad 19\text{-}5\text{-}6$$

$$S_{zc} = +\frac{1}{6.5} - \frac{1}{6.5} + \frac{1}{6.5} = \frac{1}{6.5} = 0.15 \approx 30\% \qquad 19\text{-}5\text{-}7$$

Expressing Figure 19-4-4 directly with force line elements only gives Figure 19-5-1.

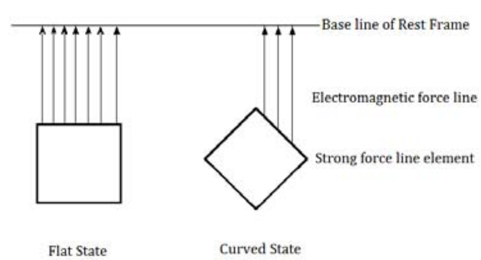


Figure 19-5-1

According to CFLE theory, in Figure 19-5-1 we can find that when the force line element is curved, the static electric charge is decreased, as discussed in §6. Therefore, the number of related magnetic force lines for the angular momentum and spin angular momentum, according to Eqs. 19-3-1, 19-3-4, and 19-3-5, is also decreased.

However, the static electric charge of an "up" quark is

$$Q_u = T_z + \frac{1}{2}(B + S) = +\frac{1}{2} + \frac{1}{2}\left(\frac{1}{3} + 0\right) = +\frac{2}{3} \qquad \text{19-5-8}$$

Those of the "down" quark and "strange" quark are

$$Q_d = T_z + \frac{1}{2}(B + S) = -\frac{1}{2} + \frac{1}{2}\left(\frac{1}{3} + 0\right) = -\frac{1}{3}$$

$$Q_s = 0 + \frac{1}{2}\left(\frac{1}{3} - 1\right) = -\frac{1}{3} \qquad \text{19-5-9}$$

Therefore, according to CFLE theory, the permitted maximum spin of an "up" quark is

$$S_{zu} = (\frac{1}{2})(+\frac{2}{3}) = +\frac{2}{6} \approx +\frac{2}{6.5} \qquad \text{19-5-10}$$

and that of the "down" quark and "strange" quark is

$$S_{zd,s} = (\frac{1}{2})(-\frac{1}{3}) = -\frac{1}{6} \approx -\frac{1}{6.5} \qquad \text{19-5-11}$$

This result means that the possible quarks spin are $\pm\frac{1}{6}$ or $\pm\frac{2}{6}$, not $\pm\frac{1}{2}$, despite that quarks are fermions.

With this result, we can also solve the 35-year-old mystery of the unexpected split between parallel and anti-parallel spins of protons that was discovered in 1978 by Alan D. Krisch and his group at the Michigan Spin Physic Center, as demonstrated in Figure 19-5-2.

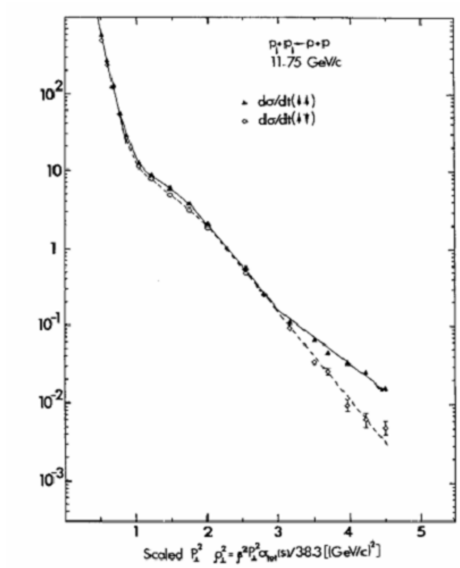


Figure 19-5-2. The scale of the y-axis is logarithmic and x > 4; the interaction of protons with parallel-spin is about 4 times stronger than those with anti-parallel spins. **(Adapted from Alan D. Krisch. 2007. *The European Physical Journal A* 31: 417–423. © Alan D. Krisch)**

According to quantum chromodynamics (QCD), the interaction between parallel and anti-parallel spinning proton beams should be the same. But, experimentally, it was found that protons with parallel spins interact 4 times stronger than protons with anti-parallel spins.

This means that if the collision of protons is made in an effectively shorter distance, then the spin effect is relatively higher. This contradicts QCD, whose asymptotic freedom implies that force in a short distance becomes weaker. Sheldon Glashow called this effect "the thorn in the side of QCD."

However, CFLE theory can easily extract this toxic thorn from QCD.

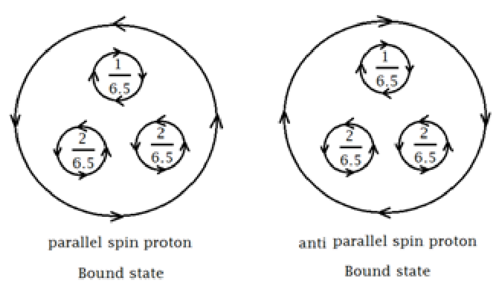


Figure 19-5-3

Figure 19-5-3 shows the same intrinsic spins of quarks and different proton spins as spins of a particle of protons (called particle spin) in the bound state(cf.§8-6-1).

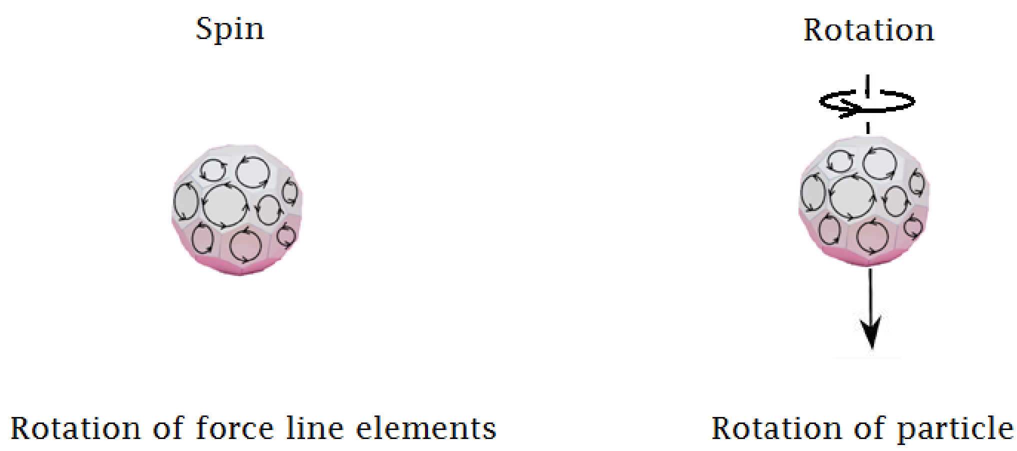


Figure 8-6-1

The permitted intrinsic spin value of quarks is only $-\frac{1}{6.5}$ and $+\frac{2}{6.5}$.

In this phase, the interaction effect between intrinsic spin and particle spin does not appear.

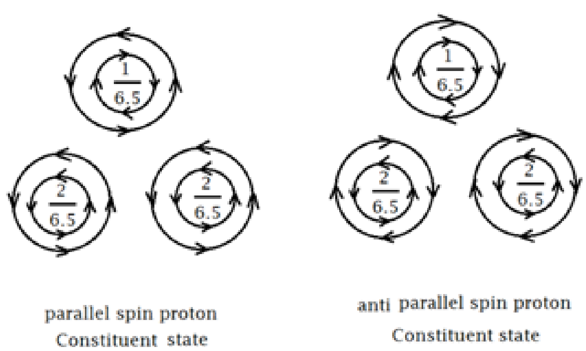


Figure 19-5-4

However, immediately after collision, the effect of the interaction between intrinsic spin and system spin appears. Figure 19-5-4 shows each component of the spin–spin interaction, the effect of which remains only effective for reaction between protons of parallel spin and anti-parallel spin. Figure 19-5-5 shows the effective remain spin state of each quarks.

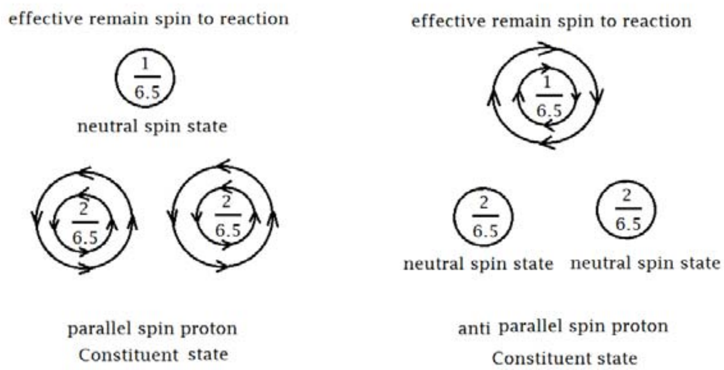


Figure 19-5-5

The remain spin of 2 quarks from protons of parallel spin is strongly effective, at $+\frac{2}{6.5}$. The remain spin of only 1 quark from protons of anti-parallel spin is also strongly effective, at $-\frac{1}{6.5}$. Because the strength of the other quark spins reaches a neutral state, the reaction strength by such quarks is relatively weaker.

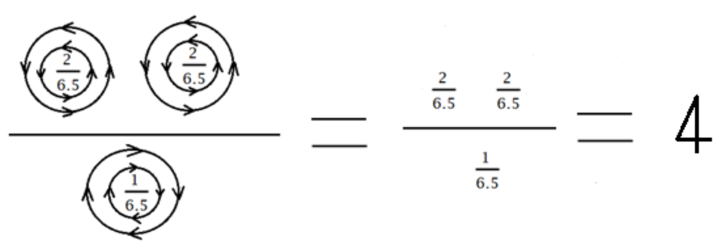


Figure 19-5-6

Figure 19-5-6 shows the result of the relatively strong reaction by 2 different quark spins from 2 different system spins of protons. The 4 times larger spin strength is proof that the intrinsic spins of the proton quarks are $+\frac{2}{6.5}, +\frac{2}{6.5}, -\frac{1}{6.5}$ and not $+\frac{1}{2}, +\frac{1}{2}, -\frac{1}{2}$.

This chapter has tried to solve only the 2 most important phenomena among 21 that are incompatible with QCD, which is the currently accepted standard model of the strong interaction without calculable general theory of relativity. Current modern physics that is armed with the seriously out-dated and incalculable curved space–time theory of general relativity has to be modified in order to alleviate the poor situation of the standard model. CFLE theory is the key to this solution. Only then we can expect to explain the remaining 19 phenomena that are incompatible with QCD.

The same phenomenon in a different research field had already been observed, namely the Fractional Quantum Hall Effect (FQHE), discovered in 1982 by Daniel Tsui and Horst Störmer, in experiments performed on gallium arsenide heterostructures developed by Arthur Gossard. Tui, Störmer, and Laughlin were awarded the 1998 Nobel Prize for this work. However, this phenomenon cannot be explained clearly with modern physics. Therefore, this issue became one of the unsolved problems in physics; as what mechanism explains the existence of the $\nu = \frac{5}{2}$ state in the FQHE?

The FQHE is a collective behavior in a two-dimensional system of electrons. In particular magnetic fields, the electron gas condenses into a remarkable liquid state, which is very delicate, requiring high quality material with a low carrier concentration, and extremely low temperature. As in the integer quantum Hall effect, the Hall resistance undergoes certain quantum Hall transition to form a series of plateaus. Each particle value of the magnetic field corresponds to a filling factor that is the ratio of the electrons to magnetic flux quanta $\nu = \frac{P}{q}$, where P and q are integers with no common factors. Here, q turns out to be an odd number with the exception of two filling factors, $\frac{5}{2}, \frac{7}{2}$. The principal series of such tractions are $\frac{1}{3}, \frac{2}{5}, \frac{3}{7}$… etc and $\frac{2}{3}, \frac{3}{5}, \frac{4}{7}$…etc.

There have been several major steps in the theory of the FQHE. That is, the introduction of the Laughlin states and fractional-charged quasiparticles, fractional exchange statistics of quasiparticles, hierarchy states, and composite fermions.

However, according to modern particle physics, this mechanism is surely still a mystery. But according to the general relativity of CFLE theory, the essence of this mechanism is none other than the discrete spin decrease and related discrete charge decrease by the curve of force line elements,

$$S_z = \pm\frac{1}{2}, \pm\frac{2}{5}, \pm\frac{2}{7}, \pm\frac{2}{9}, \pm\frac{2}{11}, \pm\frac{2}{13} \dots \qquad 19\text{-}5\text{-}2$$

The discrete spin decrease and related discrete charge decrease are collectively quantized as quasiparticles as

$$S_z = \pm\frac{2}{5}, \pm\frac{2}{7}, \pm\frac{2}{9}, \pm\frac{2}{11}, \pm\frac{2}{13} \dots \Rightarrow$$

$$S_z = \left(\pm\frac{2}{5}\pm\frac{1}{5}\right), \left(\pm\frac{2}{7}\pm\frac{1}{7}\pm\frac{1}{7}\right), \left(\pm\frac{2}{9}\pm\frac{2}{9}\pm\frac{1}{9}\right),$$

$$\left(\pm\frac{2}{11}\pm\frac{2}{11}\pm\frac{1}{11}\pm\frac{1}{11}\right), \left(\pm\frac{2}{13}\pm\frac{2}{13}\pm\frac{2}{13}\pm\frac{1}{13}\right) \ldots$$

19-5-12

Such fractional quantized state can occur only through the curve of force line elements, as shown in Figure 19-5-1.

In 1995, the fractional charge of Laughlin quasiparticles was measured directly in a quantum antidote electrometer at Stony Brook University, New York. In 1997, two groups of physicists at the Weizmann Institute of Science in Rehovot, Israel, and at the Commissariat a l'energie atomique laboratory near Paris, detected such quasiparticles carrying an electric current, through measuring quantum shot noise.

Both of these experiments have been confirmed with needed certainty.

This means that general relativity of CFLE theory is quantitatively and qualitatively correct with needed certainty.

In conclusion:

● The Standard Model of particle physics is incorrect.

● The permitted sum rule for the bound state of a proton should be

$$\frac{1}{2_{bp}} = \Delta\Sigma = \Delta u + \Delta u - \Delta d \quad 19\text{-}5\text{-}13$$

● The permitted sum rule for the constituent state of a proton should be

$$\frac{1}{6.5_{cp}} = \Delta\Sigma = \pm\Delta u \pm \Delta u \pm \Delta d \quad 19\text{-}5\text{-}14$$

19.6 Collapse of Dirac equation and Einstein's general relativity in hydrogen Atom: Origin of Lamb shift

The Dirac equation is a most fundamental equation. In 1928 Paul Dirac putted relativistic energy in sch$r\ddot{o}d$inger's quantum wave equation. His equation accounted for the fine detail of the hydrogen spectrum in a completely rigorous way (fine structure). The equation also can predict the existence of spin and positron as antiparticle. More ever, in the limit of zero mass, Dirac equation reduces to the Weyl equation. Such results represent one of the great triumphs of the theoretical physics.

By Einstein's notation his equation is

$$-i\hbar\gamma^{\mu}\partial_{\mu}\psi + mc\psi = 0 \qquad 19\text{-}6\text{-}1$$

By Feynman notation his equation is

$$(i\partial\!\!\!/ - m)\psi = 0 \qquad 19\text{-}6\text{-}2$$

The Klein-Gordon equation is

$$(\partial^2 + m^2)\psi = 0 \qquad 19\text{-}6\text{-}3$$

By factorization Klein-Gordon equation is expressed

$$(i\partial\!\!\!/ + m)(-i\partial\!\!\!/ + m)\psi = 0 \qquad 19\text{-}6\text{-}4$$

Therefore any solutions of Dirac equation satisfy Klein-Gordon equation. However, Klein –Gordon equation cannot predict incorrectly and become meaningless when atom number is over$A = 69$, because energy level appear with imaginary number. According to Dirac equation energy level $2S_{1/2}$ and $2P_{1/2}$of Hydrogen atom should have the same energy. However, experimental result by Lamb and R. Retherford in 1947 and prediction of Dirac equation is contradicted. Cause of this contradiction is explained by interaction between electron and the vacuum which is not accounted for by Dirac equation. However, such explain is not enough why Dirac equation should be having such serious defect.

Energy level of hydrogen atom by Dirac equation is started

$$\left[E + \frac{Ze^2}{r} - c\vec{\alpha}\cdot\vec{p} - mc^2\beta\right]\psi = 0 \qquad 19\text{-}6\text{-}5$$

Multiply by

$$\left[E + \frac{Ze^2}{r} + c\vec{\alpha}\cdot\vec{p} + mc^2\beta\right] \qquad 19\text{-}6\text{-}6$$

Then the equation finally become

$$[E^2-\left(mc^2\right)^2+2E\frac{Ze^2}{r}+c^2\hbar^2\left(\frac{1}{r}\frac{d^2}{dr^2}r-\frac{l(l+1)+Z^2\alpha^2\pm iZ\alpha\vec{\sigma}\cdot\vec{r}}{r^2}\right)\Big]\psi=0$$

19-6-7

The non-trivial point with this equation is to deal with the numerator

$l(l+1)+Z^2\alpha^2\pm iZ\alpha\vec{\sigma}\cdot\vec{r}$. The trick is note that it commutes with $\vec{j}=\vec{L}+\frac{1}{2}\vec{\sigma}$.Therefore, we can look at the subspace of the Hilbert space with fixed j and hence $\pm\frac{1}{2}$. On this space, the numerator has the form

$l(l+1)+Z^2\alpha^2\pm iZ\alpha\vec{\sigma}\cdot\vec{r}=$

$$\begin{bmatrix}\left(j+\frac{1}{2}\right)\left(j+\frac{3}{2}\right)+Z^2\alpha^2 & \mp iZ\alpha \\ \mp iZ\alpha & \left(j-\frac{1}{2}\right)\left(j-\frac{1}{2}\right)+Z^2\alpha^2\end{bmatrix}$$

19-6-8

Finally we find the energy levels of the Dirac equation

$$E=mc^2[1+\frac{(Z\alpha)^2}{(n-\left(j+\frac{1}{2}\right)+\sqrt{(j+\frac{1}{2})^2-Z\alpha^2})^2}]^{-\frac{1}{2}}$$

19-6-9

Here, important point is that physical essence of term $j+\frac{1}{2}$ is $\vec{j}=\vec{L}+\frac{1}{2}\vec{\sigma}$. This physical essence cannot be changed by any trick. Namely

$$j\pm\frac{1}{2}=l$$

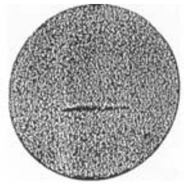
19-6-10

Therefore, according to this equation energy level of any S orbital $[(l=0,j=0,s=0)]$ is impossible or meaningless or don't permitted as

$$E=mc^2[1+\frac{(Z\alpha)^2}{(n-0+\sqrt{(0)^2-Z\alpha^2})^2}]^{-\frac{1}{2}}=iE$$

19-6-11

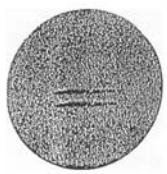
However, experiment by Stern-Gerach say that $[j=0\ (\ l=0,s=0)]$ is exists.



One result of Stern-Gerlach experiment

Figure 19-6-1

Figure 19-6-1 is expected results when ground state $l = 0$ when silver atoms were used. When energy state of $[l = 0, s = 0]$is not exists, beam of silver atom were perfectly split into two component as Figure 19-6-2



[$j = 0$ ($l = 0$,$s = 0$)] is not exists

Figure 19-6-2

[$j = 0$ ($l = 0$,$s = 0$)] is exists

Figure 19-6-3

However, real result is figure 19-6-3.Figure 19-6-3 means that energy state of silver atoms of [$j = 0$ ($l = 0$,$s = 0$)] and [$\neq 0$ ($l = 0$,$s = \frac{1}{2}$)] must be exists. Therefore, Dirac equation cannot treat energy state of [$j = 0$ ($l = 0$,$s = 0$)] and cannot distinguish energy state of $2S_{1/2}$ and 2 $P_{1/2}$. this is serious defect of Dirac equation.

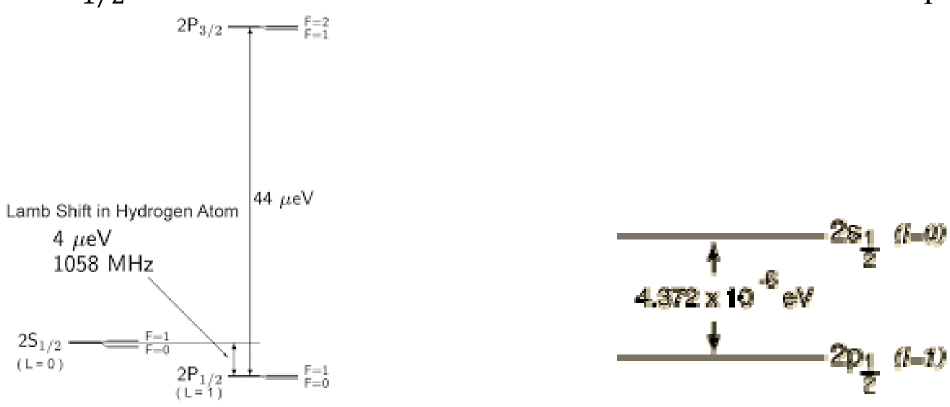


Figure 19-6-4

Lamb and Retherford experiment in 1947 show this contradiction so-called Lamb shift as Figure 19-6-4. About lamb shift QED explain as

Effect	Energy contribution
Vacuum polarisation	-27 MHz
Electron mass renormalisation	+1017 MHz
Anomalous magnetic moment	+68 MHz
Total	+1058 MHz

Table 19-6-1

Existence of spin can explain quantitatively by special relativity with electric force line. In Dirac equation for energy level of iE as EQ 19-6-12 to avoid is used trick of$j+\frac{1}{2}$.

$$E=mc^2[1+\frac{(1\alpha)^2}{(n-0+\sqrt{(0)^2-1\alpha^2})^2}]^{-\frac{1}{2}}=iE \qquad 19\text{-}6\text{-}12$$

With this trick to use same times should be lose ability to distinguish energy level [$j=0, l=0, s=0$] and [j$\neq 0$, $l=0, s=\frac{1}{2}$] for S orbital.

However, distinguishing of energy level [$j=0, l=0, s=0$] and [j$\neq 0$, $l=0, s=\frac{1}{2}$] in same S orbital is phenomenon of general theory of relativity. This problem type is same problem type as Lorentz objection (cf.§8), because g of spin are not flat ($g_{spin}=2$). Because Dirac equation use only special relativity, rotation of vector or rotation of electron cannot calculate by flat frame of reference as H. Lorentz (electron cannot rotate).

However, CFLE theory can solve problems of Dirac equation qualitatively and quantitatively.

According to Bohr model energy is given by

$$E_n=\frac{m_e c^2\alpha^2}{2n^2}, \frac{m_e e^4}{8h^2\varepsilon_0^2}=1\ Ry=13.60569253\ eV \qquad 19\text{-}6\text{-}13$$

For energy of $n=2$ for S orbital is

$$E_2=\frac{13.61}{4}eV=3.403\ eV \qquad 19\text{-}6\text{-}14$$

Because spin phenomenon is general theory of relativity, should be considered degree of curve of force line $g_i^2=(6.545979)^2$=42.849841

$$E = mc^2[1 + \frac{(Z\alpha)^2}{(n-\left(j+\frac{1}{2}\right)+\sqrt{(j+\frac{1}{2})^2 - Zg_i^2\alpha^2)^2}}]^{-\frac{1}{2}} \quad \text{19-6-15}$$

This g_i^2 is changed negative when $j+\frac{1}{2}=0$ is by curve (rotate) of vector $v \times v \times E$

Therefore, needed energy between [$j=0, l=0, s=\frac{1}{2}$] and[$j=\frac{1}{2}, l=0, s=\frac{1}{2}$] without imaginary quantity iE is

$$E_d = \frac{3.403\ eV}{Zg_i^2\alpha^2} \quad \text{19-6-16}$$

Because of gravitational permittivity $x_g = 1.016774$ effective value of curve of force line is

$$g_{eff} = \frac{6.545979}{1.016774} = 6.437988 \quad \text{19-6-17}$$

The energy between [$j=0, l=0, s=\frac{1}{2}$] and [$j=\frac{1}{2}, l=0, s=\frac{1}{2}$] of S orbital of $n=2$ is

$$E_d = \frac{3.403\ eV}{Zg_i^2\alpha^2} = \frac{3.403\ eV}{1\cdot(6.437988)^2(137.0359)^2}$$

$$= \frac{3.403\ eV}{(41.447689)(18778.84)}$$

$$= 4.372 \times 10^{-6}\ eV = 4.372\mu eV = 1057.8\ MHz \quad \text{19-6-18}$$

Observed value is

$$E_d = 4.372\mu eV = 1057.8\ MHz \quad \text{19-6-19}$$

Total energy from $-S_z\ to\ S_0\ to\ +S_z$ is

$$E_{tot} = E_d \times 2 = 8.744\ \mu eV = 2115.6\ MHz \quad \text{19-6-20}$$

With this result we can reconstruct hydrogen energy level as Figure 19-6-6. $2S_{1/2}$ can split 3 components as$2S_{+1/2}, 2S_{0,}\ 2S_{-1/2}$.

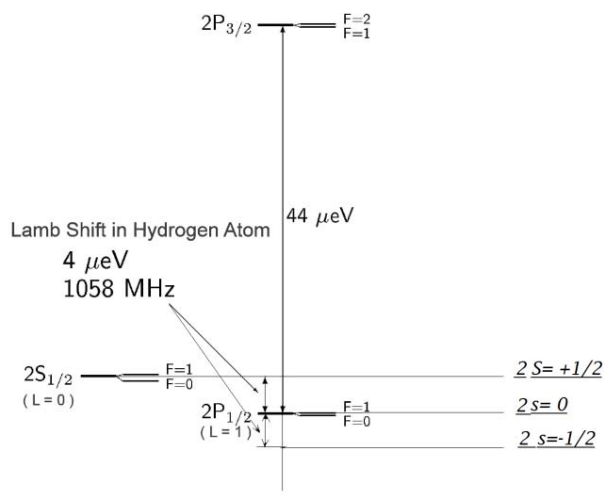


Figure 19-6-5

Same contradiction is found $1S_{1/2}$ in hydrogen atom as Figure 19-6-7

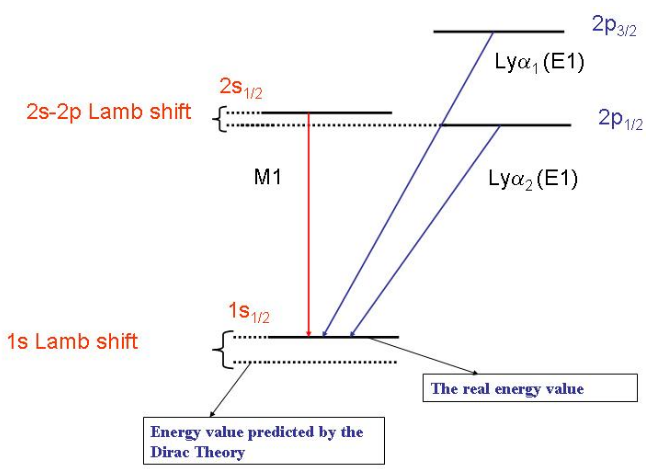


Figure 19-6-6

However, CFLE theory can calculate exactly.

Because energy difference between n_2 and n_1 is

$$E = \frac{n_i^2}{n_f^2} = \frac{4}{1} \qquad 19\text{-}6\text{-}21$$

Therefore energy between [$j = 0, l = 0, s = \frac{1}{2}$] and [$j = \frac{1}{2}, l = 0, s = \frac{1}{2}$] is

$E_{dn=1} = 2115.6\ MHz\ \times 4$

$= \ 8462.4\ MHz$ 19-6-22

Because such phenomenon occur at $g = 2$, permittivity different is influenced as

Gravitational permittivity at $g = 2$ is

Q_g =0.016774× 2=0.033548

$x_g = 1.033548$ 19-6-23

Electrical permittivity at $g = 2$ is

Q_e =0.000589× 2=0.001178

$x_e = 1.001178$ 19-6-24

Electrical permittivity difference at $g = 1$ for flat frame is

$x_{ef} = 1.000589$ 19-6-25

Total difference is

$d_x = x_g . x_e . x_{ef} = (1.033548)(1.001178)(1.000589)$

$= 1.035375$ 19-6-26

Final theoretical value by CFLE theory is

$E_{dn=1} = \frac{8462.4\ MHz}{1.035375}$

$= 8173.3\ MHz$ 19-6-27

Observed values are

Hänsch et al	$8600 MHz$
Wieman and Hänsch	$8200\ MHz$
Beausoleil et al	$8173.3\ MHz$
Boshier at al	$8172.6\ MHz$
Weitz et al	$8172.8\ MHz$
Garching 1S-2S and Paris 2S-8S	$8172.8\ MHz$
M.Weitz et al	$8172.1\ MHz$

Table 19-6-2

With this new result we can reconstruct $1S_{1/2}$ energy level of Figure 19-6-7.

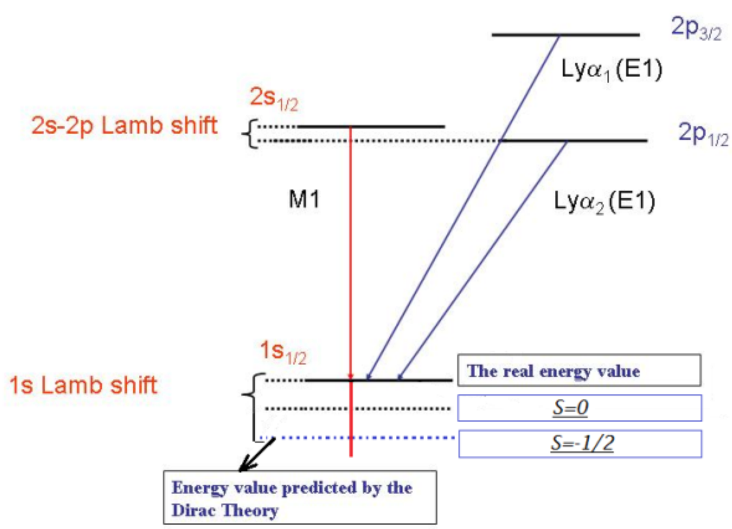


Figure 19-6-7

When prediction of CFLE theory is correct, can we observe this new energy level of Hydrogen atom? Answer is yes.

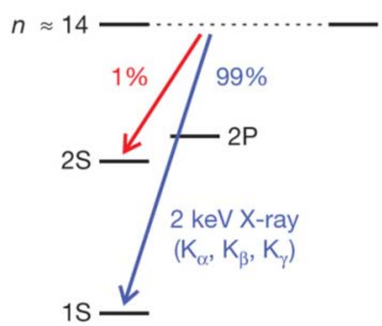


Figure 19-6-8

Figure 19-6-9 is take from Nature 466,231-216(08July 2010) “The size of the proton” by Randolf Pohl ~22~ Paul Rabinowitz et al

Figure 19-6-9 show that measurement result of the Lamb shift in muonic hydrogen of the 2S-2P transition. Here 1% of transitions show that energy level of 2S is under energy level of 2P

Why Klein-Gordon equation can calculate under mass number A=69?

This problem is problem of general theory of relativity too.

Maximum curve of force line is

$$g_{max} = 8 \qquad 19\text{-}6\text{-}28$$

Therefore, possible maximum mass number is

$$g^2 = 8^2 = 64 \qquad 19\text{-}6\text{-}29$$

However, gravitational permittivityx_g of $g = \frac{6.545979}{1.5} = 4.363986$is

$$Q_g = 0.016774 \times 4.363986$$

$$= 0.073202$$

$$x_g = 1.073202 \qquad 19\text{-}6\text{-}30$$

Electrical permittivity at $g = 8$ is

$$Q_e = 0.000589 \times 8$$

$$=0.004712$$

$x_e = 1.004712$ 19-6-31

Total effect is

$d_{tot} = x_g . x_e$

$= (1.073202)(1.004712)$

$= 1.078259$ 19-6-32

Maximum possible calculating mass number$A$ is

$A_{max} = (64)(1.078259)$

$= 69.008$

$= 69$ 19-6-33

Spin is effect of curved force line (instead curved space) as Figure 19-6-10. Every small area of electron surface there are curved vector by force line elements by magnetic divergence. This is observed spin of electron and proton.

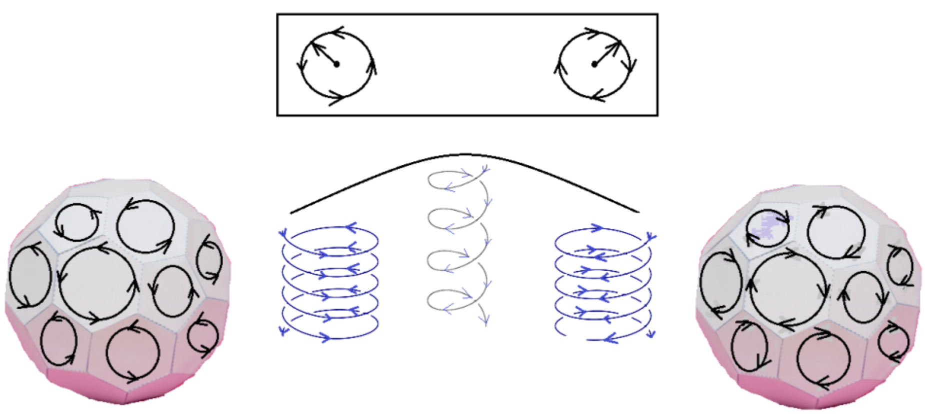
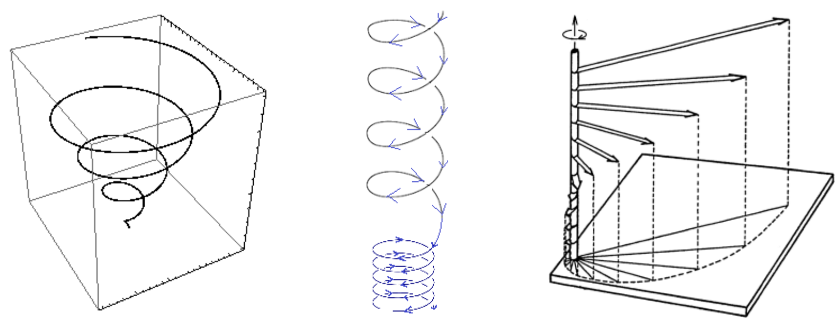


Figure 19-6-9

However, real electron on spin of force line element of proton is observed as real rotation of electron by force line helicity of proton as Figure (cf.§4)19-6-1

Proton surface



Proton core

Figure 19-6-10

Therefore formula can be changed from EQ 19-6-34

$$E = mc^2\{1 + \frac{(Z\alpha)^2}{(n - \left(j + \frac{1}{2}\right) + \sqrt{(j + \frac{1}{2})^2 - (Z\alpha^2)^2}}\}^{-\frac{1}{2}}$$

19-6-34

To EQ 19-6-35

$$E = mc^2\{1 + \frac{(Z\alpha)^2}{(n - (j + \frac{1}{2})_l + \sqrt{(j + \frac{1}{2})_l^2 - (Zg_{0=i}^2\alpha^2)^2}}\}^{-\frac{1}{2}}$$

19-6-35

Where $g_{0=i}^2$ is curved fore line and $0 = i$ means when $l = 0\ become\ g^2 = -\ g^2$

Electromagnetic field and its force line are related very deep with special relativity. For one observer of one frame it is electric field. However, for other observer on other frame, it is magnetic field. That is result of special relativity for electrodynamics as theoretical Lorentz Force as

$$F = \frac{QE}{\sqrt{1-\frac{V^2}{C^2}}} = QE\left(1 + \frac{1}{2}\frac{v^2}{c^2}\right)$$

$$= QE + Q\left(V \times \frac{V}{C^2}E\right)$$

$$= QE + Q(V \times B)$$

$$= Q(E + VB) \qquad 19\text{-}6\text{-}36$$

Conclusion: Electric force line and magnetic force line must exists when theory of relativity apply to electromagnetic dynamics. Therefore when theory of relativity applies to gravito magnetic dynamics, gravito magnetic force line must be required. Therefore, any theory of relativity without force line becomes useless and meaningless theory.

There cannot be any general theory of relativity with curve of space-time.

19.7. Solving the Contradiction between Cosmological Constant and Zero-Point Energy

19.7.1 Existence of Zero-Point Energy

A major outstanding problem is that most quantum field theories predict a huge value for the quantum vacuum. A common assumption is that the quantum vacuum is equivalent to the cosmological constant. Although no theory exists that supports this assumption, arguments can be made in its favor.

Such arguments are usually based on dimensional analysis and effective field theory. If the universe is described by an effective local quantum field theory down to the Planck scale, then we would expect a cosmological constant of the order of M_{planck}^4.

$$\rho_{vac}^{EW} \sim (100GeV)^4 \sim 10^{46} erg/cm^3 \qquad 19\text{-}7\text{-}1\text{-}1$$

$$E_p = \left(\frac{\hbar c^5}{G}\right)^{1/2} \sim 10^{19} GV \qquad 19\text{-}7\text{-}1\text{-}2$$

Observed value is

$$E_{ob} = 0.01 \text{ eV} \qquad 19\text{-}7\text{-}1\text{-}3$$

As noted above, the measured cosmological constant is smaller than this by a factor of 10^{-120}. This discrepancy has been called "the worst theoretical prediction in the history of physics!". Therefore, this problem becomes

Why can't the zero-point energy of the vacuum be interpreted as a cosmological constant? What causes the discrepancies? and Why doesn't the zero-point energy density of the vacuum change with changes in the volume of the universe ? And related to that, why doesn't the large constant zero-point energy density of the vacuum cause a large cosmological constant? What cancels it out?

Dirac expressed the state of a particle and the state of any physical system with vectors that were unrelated to any specific representation (e.g., co-ordinate representation or momentum representation). Thus, the potential of a harmonic oscillator can describe a ket vector and bra vector too. That is,

$$H\,|n> = \hbar\omega(N + \tfrac{1}{2})\,|n>$$

$$= \hbar\omega\,(n + \tfrac{1}{2})\,|n> \qquad 19\text{-}7\text{-}1\text{-}4$$

where $|n>$ is the eigenvector of the Hamiltonian H, and the eigen value is $\hbar\omega(n + \frac{1}{2})$. Therefore, $|n>$ can be the state of the quantized energy level of a harmonic oscillator. The benefits of this method is that, in some cases, we can describe systems that form the same quantum state (same dynamic state) of number n without interaction with each other, $\hbar\omega\,(n + \frac{1}{2})$. This means that $n\hbar\omega$ is the energy of n quanta. At this time, $|0>$ represents the state which there is no quanta, called the vacuum state. However, according to $\hbar\omega\,(n + \frac{1}{2})\,|n>$, the quantum dynamical oscillator can have minimum energy.

$$E = \frac{1}{2}\hbar\,\omega \qquad 19\text{-}7\text{-}1\text{-}5$$

Experimental evidence about this result is as follows: let us consider the molecules H2, HD, and D2, where D represents a deuterium atom. Because the electrical forces are identical in all cases, the same potential energy curve VCR is obtained for all 3 molecules, as illustrated in Figure 7-11-1, and so the energy required to dissociate the molecule is

$E = V_o - \delta$ 19-7-1-6

If the ground state energy δ were zero, then the dissociation energies would be the same; $E = V_o$ for each type of molecule. Quantum theory gives a finite zero-point energy; namely, $\delta = \frac{1}{2}\hbar\omega$. However, because the reduced mass μ enters the formula for V_o, δ has a different value for each type of molecule, so their dissociation energies should in fact be different, with

$\mu D_2 = 2\mu H_2, \quad \mu HD = \frac{4}{3}\mu H_2$ 19-7-1-7

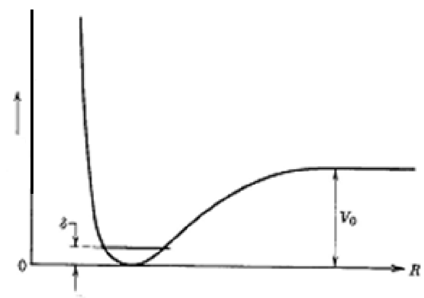


Figure 19-7-1

The difference in observed dissociation energies is exactly as that predicted, thereby verifying the existence of a zero-point energy, which is in agreement with the requirement of the uncertainty principle and provides justification of Dirac's formula too. Therefore, according to Dirac's formula, a vacuum should have non-zero energy. Now, because gravity is supposed to interact with every form of energy, it should interact with this vacuum energy as well, and a vacuum would have a weight (an equivalent mass energy) so to speak, and would produce a gravitational field. The gravitational field produced by the energy in the electromagnetic field in a vacuum (where there is no light, just quiet nothingness) should be very obviously enormous, but the fact that "it is zero" means it is too small to be observed, which is completely in disagreement with what physicists would expect from the field theory. This problem is called the cosmological constant problem.

In quantum field theory,

$\rho = 10^{\infty}$ 19-7-1-8

For quantum gravity,

$\rho = 10^{90}$ 19-7-1-9

For super symmetry,

$\rho = 10^{30}$ 19-7-1-10

For the Higgs potential,

$\rho = 10^{-25}$ 19-7-1-11

Such theories cannot decide whether vacuum energy can exist at all, or how big it should be if it does exist.

Therefore, this problem becomes most serious problem in modern physics why doesn't the zero-point energy density of the vacuum change with changes in the volume of the universe and related to that, why doesn't zero-point energy density of the vacuum cause a huge cosmological constant and what cancels it out.

Historically speaking, concept of zero-point energy is started to one's surprise by Albert Einstein and Otto Stern in 1913!!!before age of quantum mechanics , as a corrective term added to a zero-ground formula of a single energy radiator develop by Max Planck in 1900 .

$$\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} \qquad 19\text{-}7\text{-}1\text{-}12$$

Then in 1913, just two years before publishing of general relativity, using this formula as a basis, they published a paper as "Einige Argumente $f\ddot{u}r$ die Annahme einer molekularen Agitation beim absoluten Nullpunkt" to Annalen der Physik Volume 345, Issu3, page 551-560, 1913 in which they suggested for the first time the existence of a residual energy that all oscillators have at absolute zero.

The term of zero-point energy originate from the "Null punkts energie" from zero of energy ϵ

$$\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2} \quad \rightarrow \quad \epsilon = 0 + \frac{h\nu}{2} \qquad 19\text{-}7\text{-}1\text{-}13$$

According to this expression, an atomic system at absolute zero retains energy of $\frac{h\nu}{2}$.

After 23, Mar.1927 zero-point energy was related to the Heisenberg uncertainty principle. That is: the lowest-energy state (the ground state) of the system must have a distribution in position and momentum that satisfies the uncertainty principle, which implies its energy must be greater than minimum of the potential well.

According to uncertainty principle the expectation value of the energy must be at least

$$< \hat{H} > \geq E_0 + \frac{\hbar}{2}\sqrt{\frac{k}{m}} = E_0 + \frac{\hbar\omega}{2} \qquad 19\text{-}7\text{-}1\text{-}14$$

Furthermore, this zero-point energy $E = \frac{\hbar\omega}{2}$ is associated with the ground state of the quantum harmonic oscillator. In quantum field theory, it is said that the fabric of space is visualized as consisting of fields, with the field at every point in space and time being a quantum harmonic oscillator, with neighboring oscillator interacting. In this case, one has a contribution of $E = \frac{\hbar\omega}{2}$ from every point in space, resulting in a calculation of infinite zero-point energy in any finite volume: this is one reason renormalization is needed to make sense of quantum field theories. The zero-point energy is again the expectation value of the Hamiltonian; however, here, the phrase Vacuum expectation value is more commonly used, and this energy is called the vacuum energy. In quantum perturbation theory, it is sometimes said that the contribution of one-loop and multi-loop Feynman diagram to elementary particle propagators are the contribution of vacuum fluctuation or the zero-point energy to the particle masses. A phenomenon that is commonly presented as evidence for the existence of zero-point energy in vacuum is the Casimir effect or Casimir-Polder force, proposed in 1948 by H.B.G. Casimir and D.Polder who considered quantized electromagnetic field between a pair of grounded, neutral metal plates. This force has been measured and found to be good agreement with the theory. Even the experimentally measured Lamb shift has been argued to be, in part, a zero-point energy effect. Therefore, it is believed that the existence of huge zero-point energy or huge vacuum energy is real. However, observed value of real vacuum energy as cosmological constant is smaller than $\frac{1}{10^{120}}$.

This results show directly serious contradicted situation of modern physics.

19.7.2. Collapse of Einstein's general relativity in Vacuum

In the CFLE theory, it is a natural phenomenon that a vacuum would not have any energy; however, a problematic formula in existing quantum field theory is

$$H \mid n> = \hbar\omega\,(N + \tfrac{1}{2}) \mid n>$$

$$= \hbar\omega\,(n + \tfrac{1}{2}) \mid n> \qquad 19\text{-}7\text{-}2\text{-}1$$

Right side of EQ 19-7-2-1 is constituted three terms.

First term is$\hbar\omega$. This term is expression of unit energy quantum

Second term is $(n + \frac{1}{2})$. This term is only for number of energy levels or number of oscillators or number of radiators. Therefore this term is called number term

The last term $|n>$ is simply Dirac's Vector.

n among the term of $(n + \frac{1}{2})$ is called flat number term.

$\frac{1}{2}$ among the term of $(n + \frac{1}{2})$ is called curved number term or mixed number term.

This means that n is number of energy levels of flat frame of reference or number of oscillators of flat frame of reference.

However, term of $\frac{1}{2}$ means that number of energy levels of curved frame of reference or number of oscillators of curved frame of reference. According to such CFLE theoretical point of view, equation 19-7-2-1 is definitely defective, because this equation is only for g =1 state. Therefore this formula can be corrected in accordance with CFLE theory. That is,

$$H\,|n> = \hbar\omega(\pm g)\,(N + \tfrac{1}{2})\,|n>$$

$$= \hbar\omega(\pm g)\,(n + \tfrac{1}{2}) \mid n> \qquad 19\text{-}7\text{-}2\text{-}2$$

The $\pm g$ term is normally placed before$\hbar\omega$; that is,

$H \mid n> = \pm g\ \hbar\omega\ (N + \frac{1}{2}) \mid n>$

$$= \pm g\ \hbar\omega\ (n + \frac{1}{2}) \mid n> \qquad 19\text{-}7\text{-}2\text{-}3$$

When $n = 0$, the $\pm g$ term renders the results as zero (cf.§17,§24); that is,

$$H \mid n>= \pm g\ \hbar\omega\ (0 + \frac{1}{2}) \mid n> \qquad 19\text{-}7\text{-}2\text{-}4$$

Now, meaning of this state of quantum system is that number of energy levels (or quantum oscillators) of only flat flame is zero. However, energy levels (or quantum oscillators) of curved frame of reference is not zero. When degree of curve of force line is $g = 2$, number of energy levels(or quantum oscillators) of curved frame of reference is one as

$H \mid n>= 2.\ \hbar\omega\ (0 + \frac{1}{2}) \mid n>$

$$= \hbar\omega \mid n> \qquad 19\text{-}7\text{-}2\text{-}5$$

This energy state is first energy state of curved frame of reference and can be ground state, but cannot be vacuum energy state or energy of vacuum expectation value.

Such physical situation can be expressed simply as Figure 19-7-2-1

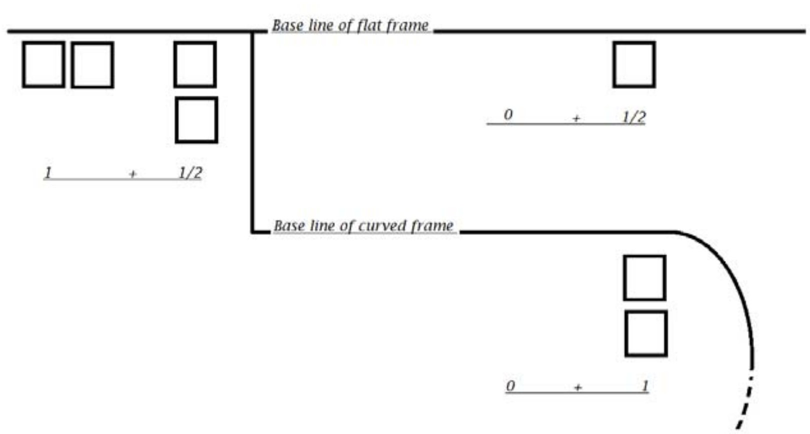


Figure 19-7-2-1

Left side of Figure 19-7-2-1 show original stationing of two oscillators.

One is normal position for flat frame; however, second one is curved for flat frame.

When observer in flat frame consider only flat frame, observer of flat frame is concluded that there is no more oscillator, but exists energy of$E = \frac{1}{2}\hbar\omega$. Therefore, for observer of flat frame like Einstein and Stern this energy must be energy of vacuum for curve of space −time. However, for observer of curved frame is experimental result very different. For observer of curved frame there is one more oscillator with energy of$E = \hbar\omega$. For observer of curved frame, globally total energy should be

$$H \mid n> = \pm g\ \hbar\omega\ (n + \tfrac{1}{2}) \mid n>$$

$$= [+(g\ \hbar\omega\ (n + \tfrac{1}{2}) \mid n>)] + [-(g\ \hbar\omega\ (n + \tfrac{1}{2}) \mid n>)]$$

$$= 0 \qquad 19\text{-}7\text{-}2\text{-}6$$

Now, a vacuum in which there is no oscillator has no energy.

Einstein's Null punkts energie formula is not perfect too according to CFLE theory. Because Einstein-Stern calculated only flat frame of reference. When we considers curved frame of reference too, Einstein's formula is changed

$$\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2} \quad \rightarrow \quad \epsilon = \pm g\left(\frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}\right) \qquad 19\text{-}7\text{-}2\text{-}7$$

When energy level (or quantum oscillators) is zero, formula is changed

$$\epsilon = \pm g\left(\frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}\right) \quad \rightarrow \quad \epsilon = \pm g\left(0 + \frac{h\nu}{2}\right) \qquad 19\text{-}7\text{-}2\text{-}8$$

When degree of curved frame of reference is $g = 2$ is changed

$$\epsilon = \pm g\left(0 + \frac{h\nu}{2}\right) \quad \rightarrow \quad \epsilon = 2\left(0 + \frac{h\nu}{2}\right) = h\nu \qquad 19\text{-}7\text{-}2\text{-}9$$

This energy is not vacuum energy, but energy of first energy level (or oscillator) of curved frame of reference at $g = 2$.

Here, important point is that zero-point energy can be quantum mechanically ground state energy. However, ground state energy always cannot be vacuum energy.

According to Eq. 19-7-2-9 energy difference between at $n = 1, g = 1$ and $n = 0, g = 2$ is 1.5(cf.§7.10).

This factor of 1.5 between $g = 2, n = 0$ and $g = 1, n = 1$is repeated

between force line curve of neutron and proton for electric charge between $e = 0$ and $e = 1$.

Because surely Einstein and Stern couldn't consider this point, they called residual energy of $\epsilon = \frac{h\nu}{2}$ zero-point energy for preparatory work of general theory of relativity. Therefore I can guess why Einstein enforced going to curved space-time theory none the less of Max Planck, because Einstein, he believed strongly that this residual energy of $\epsilon = \frac{h\nu}{2}$ is not energy of another oscillator (he called originally resonator), but energy of vacuum.

Now, we know globally total energy for resonators should be

$$\epsilon = \pm g\left(\frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}\right)$$

$$= \left[+g\left(\frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}\right)\right] + \left[-g\left(\frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}\right)\right]$$

$$= 0 \qquad \text{19-7-2-10}$$

Globally there cannot be any remaining energy for vacuum.

Therefore, we can conclude that origin of Casimir-Polder force (or Casimir effect) is too energy of first energy level of curved frame of reference at $g = 2$, not vacuum. Vacuum polarisation of electron-positron pair should be only by self energy with uncertainty principle. Therefore, the CFLE theory can obtain real results that agree with the experimental facts. This vacuum state is called the "perfect symmetry state," and therefore any "spacesism" cannot stick its feet in the absolute empty space. Here, "spacesism" means any attempt or any "ism" that theoretically reaches, imposes, and avoids any theoretical difficulty by using empty space (viz., to break symmetry of empty space, or to give the energy to absolute empty space, or to give physical property to empty space).

However, because real vacuum is not absolute vacuum, this relative vacuum can have energy with that gravity cannot interact.

With this condition we can obtain permitted maximum vacuum energy that CFLE theory can predict.

Because maximum electromagnetic energy of hydrogen $g = 1, n = 1$ is $|13.6|$ eV, Permitted energy level number n before energy level for gravity is only energy level $n = 6$ for weak force.

Therefore, predicted value of electromagnetic energy for vacuum with that gravity can interact, is

$$E_{vacuum} = \frac{|13.6|eV}{n_{elec}^2 \cdot n_{weak}^2} = \frac{|13.6|eV}{(6)_{elec}^2 (6)_{weak}^2} = 0.01\text{eV} \qquad 19\text{-}7\text{-}2\text{-}11$$

Observed value is

$$E_{vacuumobserve} = 0.01 \text{ eV}. \qquad 19\text{-}7\text{-}2\text{-}12$$

Historically, the cosmological constant was proposed by Einstein too as a modification of his original theory of general relativity to achieve a stationary universe. This constant Λ appears in his field equation in the form of $R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$. Because gravity would cause a universe initially at dynamic equilibrium to contract, Einstein added this cosmological constant to counteract such contraction.

The physical essence of this cosmological constant can only be repulsive gravity (the existence of negative gravitational mass or gravitational monopoles). Because Einstein's general theory of relativity does not permit gravitational $\pm$monopoles (cf. §15, §17, §18), adding such a term is self-contradictory, since according to CFLE or any physical theory, vacuum energy cannot exist in a absolute vacuum. When vacuum energy is introduced in absolute vacuum, to retain any theory of spaceism, the results should be always being the same. Simply put, we currently cannot explain it, or we don't know the answers. Einstein's equation can predict only unlimited expansion into energy-zero state or unlimited contraction into an inevitable singularity, according to Alexander Friedman and singularity theorem.

Therefore, the concept of accelerating expansion of the universe (cf. § 17 and §18) cannot permit the existence of a cosmological constant. There is only one consequence from verification of the accelerating expansion of the universe (by the I_a supernova experiment in 1998):

> "… if a future experiment should show that antiparticles have a negative gravitational mass, it would deliver a painful blow to the entire Einstein theory of gravity by disproving the principle of equivalence. In fact, if an observer inside an accelerated Einstein's chamber released an apple having a negative gravitational mass, the apple would "fall upward " (in respect to the space ship), and, as observed from outside, would move with an acceleration twice that of the space ship without being subject to any outside forces. Thus we will be forced to choose between Newton's Law of Inertia and Einstein's Principle of Equivalence — a very difficult choice indeed." [George Gamow (1904–1968)]

Can we find direct physical evidence about wrong Einstein-Stern's zero-point energy and Einstein's general relativity. That is collapse of Bose-Einstein condensate in next secession.

19.8. Collapse of Bose-Einstein Condensate as Coldest Tomb of General Relativity

A Bose- Einstein condensate is a state of matter of a dilute gas of boson cooled to very close to absolute zero. Historically first Satyendra Nath Bose sent a paper to Einstein on the quantum statistics of light quanta in 1924. Einstein extended Bose's idea to atom. The first pure Bose-Einstein Condensate was created by E.Cornell, C Wieman and co-workers at JILA on 5 Jun 1995.They cooled a dilute vapor of approximately 2000 rubidium atoms to below 170 nK using a combination of laser cooling and magnetic evaporative cooling. About four month later, an independent effort led by W. Ketterle at MIT condensed Sodium 23. Cornell, Wieman and Ketterle won the 2001 Nobel Prize in physics for their achievements. A system of N identical boson with a temperature T and chemical potential μ and ignore interaction between the bosons, than the Bose-Einstein energy distribution function is

$$f(\varepsilon) = \frac{1}{e^{(\varepsilon-\mu)/kT}-1} \qquad 19\text{-}8\text{-}1$$

For boson, as Tapproaches zero, the occupation of lowest energy level of system ($\varepsilon = 0$) can become macroscopically large. When this happen, the sample undergoes a phase transition: a Bose-Einstein condensate forms. Because the particles in the BEC are all in a single quantum state (i.e. the ground state), they can be described by a single wave function. The constituent particles in a BEC can thus be likened to a super atom, a system in which thousands or millions of atoms behave like a single particle. The phase transition can be understood in term of the particles' thermal de Broglie wavelength,λ_{db}

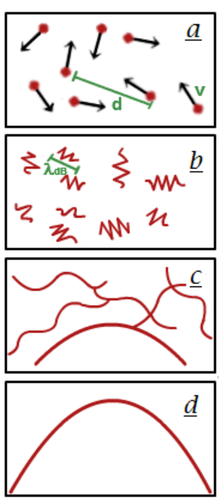
$$\lambda_{db} = \sqrt{\frac{2\pi\hbar^2}{mkT}} \qquad 19\text{-}8\text{-}2$$

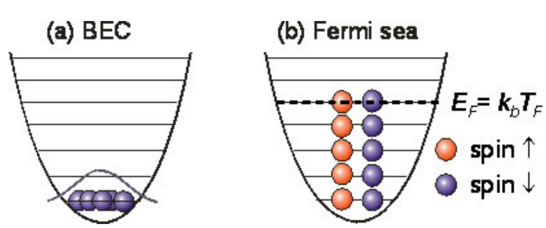
At sufficiently low temperatures, the de Broglie wave length is long enough that the individual atomic wave function overlap and condensate form. The total number of the particles in exited states can be written

$$N_{ex}\left(T_{c,}\mu = 0\right) = N = \int_0^\infty g(\varepsilon)\frac{1}{e^{(\varepsilon-\mu)/kT}-1}d\varepsilon \qquad 19\text{-}8\text{-}3$$

Critical temperature is

$$T_c = \left(\frac{n}{\zeta(3/2)}\right)^{\frac{2}{3}}\frac{2\pi\hbar^2}{mk_B} \approx 3.3125\frac{\hbar^2 n^{\frac{2}{3}}}{mk_B} \qquad 19\text{-}8\text{-}4$$





a:High temperature T_H: Thermal velocity v_T, density d^3, [Billiard balls]

b:Low temperatureT_L: $\lambda_{db} = h/_{mv} \propto T^{-\frac{1}{2}}$ [wave packet]

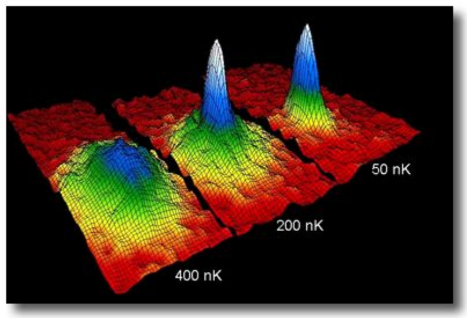
where λ_{db} is De Broglie wave length

c:Temperature $T = T_{critic}$, , $\lambda_{db} \approx d$ [Matter Wave overlap]

Bose-Einstein Condensation

d:Temperature $T = 0$, [Huge macroscopic wave]

Pure Bose-Einstein Condensation Figure 19-8-1



JILA &MIT 1995

Typical parameters of experiment:

T: 10-100nk, ρ: $10^{13} - 10^{14} cm^{-3}$, N: $10^3 - 10^7$, R: $10\mu m - 1mm$,t: $10s$,
Species:$87Rb$, Na, $7Li$, H, $85Rb$, $4He^*$, $41K$, Cs. $174Yb$,

Figure 19-8-2

According to Einstein-Stern zero-point energy $\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}$ and theory of Bose-Einstein condensate state of such condensation should be very stable and any more to fall into another lower energy level or transition to condense into another lower energy level. Because such a field should be stable intrinsically, the system is now in ground state and coldest atoms $(170nK)$ cannot have any such overwhelmed the zero-point energy.

However, Collapse of Bose-Einstein condensate is detected through a sudden onset of atom loss from trap as implosion and explosion. Experiments led by R.Hulet at Rice university from 1995 ~ 2000 showed that Lithium condensates with attractive interactions could stably exist up to a critical atom number. Quench cooling the gas, they observed the condensate to grow, and then collapse as the attraction overwhelmed the zero-point energy of the confining potential with an explosion preceded by an implosion.

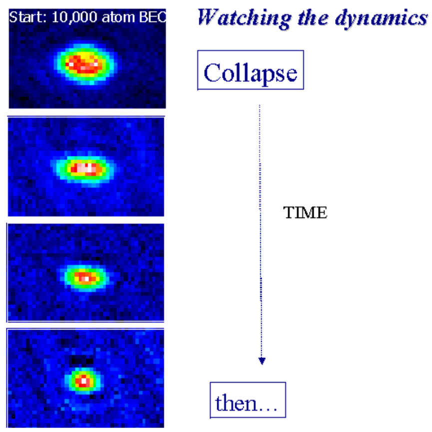
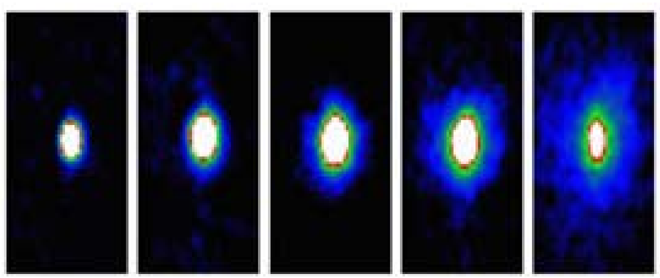


Figure19-8-3

When the JILA team raised the magnetic field strength further, the condensate suddenly reverted to attraction, imploded and shrank beyond detection, then exploded, expelling about $\frac{2}{3}$ of its 10,000 atoms. About half of the atoms in the condensate seemed to have disappeared from the experiment altogether, not seen in the cold remnant and expanding gas cloud.



Atomic burst

Figure19-8-4

Recently the JILA group utilized the Feshbach resonance to switch the sign of interaction from repulsive to attractive, and caused a BEC to collapse. After a switch, the atomic cloud shrank and eventually disappeared because the cloud become too small, That is, the BEC collapsed. Just after the collapse it is observed a burst of atoms emanating from the remnant BEC. The JILA experiments demonstrate that the collapse is partial. This means that the collapse occurs only in an extremely localized region and nowhere else in the BEC is the primary reason that the collapse occurs only partially and remained a remnant BEC. Researcher fined that when $T_{burst} < 200nK$ mean burst energy is indeed proportional to $\frac{g^2}{K_3} \propto \frac{a^2_{collapse}}{K_3}$

$$E_{mean\ burst} = k_B T_{burst} \cong 2.6\hbar^3 \frac{a^2_{collpase}}{m^2 K_3} \qquad \text{19-8-5}$$

Where, K_3 is the three-body recombination loss rate coefficient, a is the s-wave scatterings length, k_B is Boltzmann constant. The implosions occur not once but several times intermittently, and at each implosion only several tens of atoms are lost from BEC. The slight surplus of kinetic energy is the origin of the atom burst and explains why the energy of the burst atoms is as low as $100nK$. As soon as the atom burst occurs, the peak height decreases very rapidly, this makes the attractive interaction again dominate the zero-point pressure, thereby including the subsequent implosion.

In the JILA experiments, prolonged atomic cloud, referred to "jets," were observed when the collapse was interrupted by switching the sign of the interaction from attractive to repulsive. The experimental observations of jets strongly suggest that atoms emanating from the spike are coherent.

The time evolution of the integrated column density of collapsing BEC creates pattern formation.

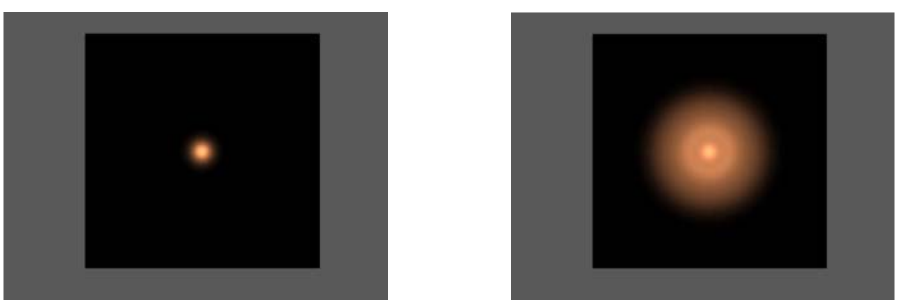


Figure 19-8-5

Finally, in repulsive BEC is created vortex, however, attractive BECs cannot hold vortices in any thermodynamically stable state.

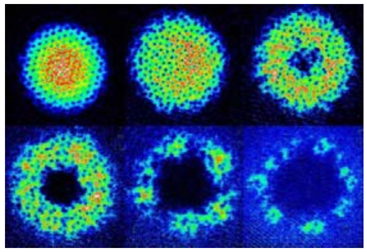


Figure 19-8-6

When Theory of Bose-Einstein condensate was right, their theory can predict behavior of atoms generally well in the Bose-Einstein condensate, and their effect can be calculated by Theory of Bose-Einstein. However, unexplained implosion and unexpected explosion is observed and Theory of Bose-Einstein cannot predict the fact that coldest atoms in the universe have energy with that can make implosion and explosion, nevertheless according to Einstein's zero-point energy $\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}$ and $H \mid n\rangle = \hbar\omega\,(n+\frac{1}{2}) \mid n\rangle$ coldest atoms cannot have any such huge energy.

Because in collapse of a Bose-Einstein condensate ideal gas ground state of a spherical trap is

$$\Psi(r,0) = \sqrt{N}\frac{-\frac{1}{2}(r/a_{ho})^2}{(\pi a_{ho}^2)^{3/4}} \qquad 19\text{-}8\text{-}6$$

Total energy is

$$E/N = \frac{3}{2}\hbar\omega_{ho} + \frac{Ng}{2(2\pi)^{2/3}a_{ho}^3} \qquad 19\text{-}8\text{-}7$$

Non-linearity parameter is

$$\frac{Ng}{4\pi a_{ho}^3} = -2.2\,\hbar\omega_{ho}, \frac{Ng}{4\pi a_{ho}^3} = -0.5\,\hbar\omega_{ho} \qquad 19\text{-}8\text{-}8$$

Necessary condition for collapse is

$$\frac{Ng}{4\pi a_{ho}^3} < -0.5\hbar\omega_{ho} \qquad 19\text{-}8\text{-}9$$

Sufficient condition for collapse is

$$\frac{Ng}{4\pi a_{ho}^3} \leq -\frac{7}{8}\sqrt{2\pi}\,\hbar\omega_{ho} \approx -2.2\,\hbar\omega_{ho} \qquad 19\text{-}8\text{-}10$$

Now, temperature in trap is $\sim 200nK$ for $\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}$ $(now, E = 0.5\hbar\omega)$ and energy level n is zero for $H\,|n\rangle = \hbar\omega\,(n + \frac{1}{2})\,|n\rangle$ $(now\ E = 0.5\hbar\omega)$. However, how can energy of sufficient condition for collapse of Bose-Einstein condensate can be$E \approx 2.2\,\hbar\omega_{ho}$.

Therefore, this serious contradiction becomes unsolved problem how existence of Bose-Einstein condensates can be rigorously proved for general interacting system.

Under current physical theory this characteristic collapse of Bose-Einstein condensates cannot be explained because the energy state of an atom near absolute zero should not be enough to cause an implosion and explosion.

Zero-point energy, also called quantum vacuum zero-point energy, is the lowest possible energy according to Einstein $\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2}$ that a quantum mechanical physical system may have; it is the energy of its ground state $H\,|n\rangle = \hbar\omega\,(n + \frac{1}{2})\,|n\rangle$.Vacuum energy is the zero-point energy of all the fields in space, which in the standard model includes the electromagnetic field, other gauge fields, fermionic fields and the Higgs field. It is the energy of the vacuum, which in quantum field theory is defined not as empty space, but as the ground state of the fields. Real serious problem is that in cosmology, the vacuum energy is possible explanation for the cosmological constant. Collapse of Bose-Einstein condensate cannot be explained because the energy state of an atom near absolute zero ($\sim 70nK$) should not be enough to cause an implosion and explosion.

Einstein predicted that cooling bosonic atoms to a very low temperature would cause them to fall or to condense into lowest accessible quantum state (ground state according to zero-point energy formula), resulting new form of matter

However, Collapse of Bose-Einstein condensate shows that theory of Einstein's zero-point energy or vacuum energy is not true and makes contradiction. In contrast CFLE theory can solve this problem simply.

Collapse of Bose-Einstein condensate show only that another lower energy level of atoms should be exists.

That is none other than first energy level of curved frame at $g = 2$ of

$$\epsilon = \frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2_E} \quad \rightarrow \quad \epsilon = \pm g\left(\frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2_E}\right) \quad \text{19-8-11}$$

$$H\,|\,n\rangle = \hbar\omega\,(n_E + \frac{1}{2_E})\,|\,n\rangle \;\rightarrow\; H\,|\,n\rangle = \pm g\;\hbar\omega\,(n_E + \frac{1}{2_E})\,|\,n\rangle$$

19-8-12

In the CFLE theory term of ($\frac{h\nu}{e^{\frac{h\nu}{kT}}-1}$) or (n_E) is energy level of only flat frame. Term of ($\frac{h\nu}{2_E}$) or ($\frac{1}{2_E}$) is only first energy level of curved frame not energy of vacuum, not energy of ground state.

Therefore, we can explain energy of sufficient condition for collapse of Bose-Einstein condensate $E \approx 2.2\,\hbar\omega_{ho}$. That is none other than energy of curved flame $n = 0, g = 1\ or\ g = 4$

$$E = g\left(\frac{h\nu}{e^{\frac{h\nu}{kT}}-1} + \frac{h\nu}{2_E}\right) = g\left(0_{n_E} + \frac{h\nu}{2_E}\right) = 1_g \cdot \frac{h\nu}{2_E} = 0.5h\nu < 0.5\,\hbar\omega_{ho}$$

19-8-13

$$E = g \cdot \hbar\omega \cdot (n_E + \frac{1}{2_E}) = 4_g \cdot \hbar\omega \cdot \left(0_{n_E} + 0.5_E\right) = 2.0\hbar\omega \leq 2.2\,\hbar\omega_{ho}$$

19-8-14

By this result we can explain why collapse of Bose-Einstein condensate creates pattern formation as Figure 19-8-5 and 19-8-7

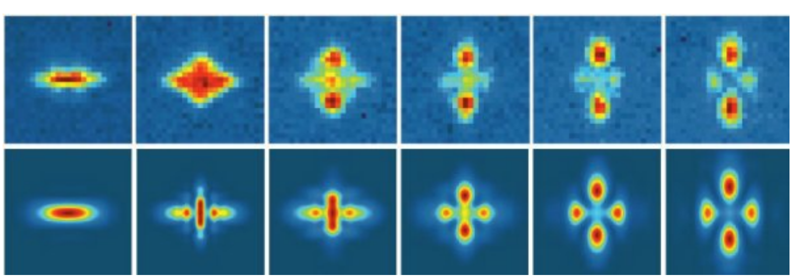


Figure 19-8-7

Essence of this pattern formation is huge macroscopic probability density function form at $g = 2\sim 8$ on curved frame of reference of force line same as shape of supernova remnants and shape of planetary nebulas (cf.§11). Fraction of Bose gas atoms reach same another lower energy level with different spin state (running spin). According to Pauli's exclusion principle each atoms want to occupy different energy levels. For such occupation processes appear as explosion. Where, running spin is changed temporal spin value during the change of curve of force line of atoms. In Supernova implosion occur by strong gravitational pressure. That is onset of implosion of supernova and follows same process as implosion and explosion of BEC.

Atoms with different spin and different energy occupy different energy levels. Because the Quantum state of this different energy levels is appeared various huge macroscopic probability density function forms by atoms with various energy as probability density function forms of one atom system at supernova remnant and planetary nebula.

Fraction of the atoms in the condensate seemed to have disappeared from the experiment altogether, not seen in the cold remnant and expanding gas cloud. Essence of this disappearing is perfect neutralizing by curved force line of leptons. Because implosion of BEC is another condense (or fall) into another lower energy level from$g = 2\ tog = 8$, degree of curve of force line of electron is changed from $g = 2\ to\ g = 8$. When degree of curve of force line reach $g = 6.546$ as proton, each charge of proton is neutralized (no gravitational charge, no weak charge, no electric charge, no strong charge) as pair annihilation by this electron that is called 6.5electron. This 6.5electron play as anti proton roll. Therefore this particle system is called 6.5 protonium. Like 6.5 electron neutron can be neutralized by 6.5 muon. This neutron is called 6.5 neutronium. Generally expression is nucleonium. In other word 87 rubidium atoms becomes nucleonium 87.

Naturally violated gravitational CP symmetry (weak symmetry too) of nucleon by curve of force line is changed gravitational CP symmetry state (electrical neutral$e_E = 0$, weakal neutral$e_W = 0$, gravitational neutral$e_m = 0$) by change of curve of force line of electron. In other word, electrical neutral 87 rubidium with mass become electrical neutral nuleonium 87 without mass (gravitational neutral). Essence of this result is same as reverted gravitational CP violation.

Conclusion: absolute vacuum cannot have any energy. Alphabetically absolute vacuum can be only empty state of space. Curved space time theory is wrong. Theory of Einstein's general relativity mathematically can be established possible. But physically is it impossible, because now absolute vacuum cannot have any energy with that can interact with gravitational charge (mass) and curve.

19.9. Solving Problems of Origin of Pauli's Exclusion Principle and Spin Statistics Theorem

The Pauli Exclusion Principle is the quantum mechanical principle that states that two identical fermions (particles with half-integer spin) cannot occupy the same quantum state simultaneously. In the case of electrons, it can be stated as follows: it is impossible for two electrons of a poly-electron atom to have the same values of the four quantum numbers (n, ℓ, m_ℓ and m_s). For two electrons residing in the same orbital, n, ℓ, and m_ℓ are the same, so m_s must be different and the electrons have opposite spins. This principle was formulated by Austrian physicist Wolfgang Pauli in 1925. However, Integer spin particles, bosons, are not subject to the Pauli Exclusion Principle: any number of identical bosons can occupy the same quantum state, as with, for instance, photons produced by a laser and Bose–Einstein condensate. The Pauli Exclusion Principle governs the behavior of all fermions (particles with "half-integer spin"), while bosons (particles with "integer spin") are not subject to it. Fermions include elementary particles such as quarks (the constituent particles of protons and neutrons), electrons and neutrinos. In addition, protons and neutrons (subatomic particles composed from three quarks) and some atoms are fermions, and are therefore subject to the Pauli Exclusion Principle as well. Atoms can have different overall "spin", which determines whether they are fermions or bosons — for example helium-3 has spin 1/2 and is therefore a fermions, in contrast to helium-4 which has spin 0 and is a boson. As such, the Pauli Exclusion Principle underpins many properties of everyday matter, from its large-scale stability, to the chemical behavior of atoms. The proof that particles with half-integer spin (fermions) obeys Fermi–Dirac statistics and the Pauli Exclusion Principle, and particles with integer spin (bosons) obey Bose–Einstein statistics, occupy "symmetric states", and thus can share quantum states, are known as the spin-statistics theorem.

The theorem states that:

•The wave function of a system of identical integer-spin particles has the same value when the positions of any two particles are swapped. Particles with wave functions symmetric under exchange are called bosons.

•The wave function of a system of identical half-integer spin particles changes sign when two particles are swapped. Particles with wave functions anti symmetric under exchange are called fermions.

In other words, the spin–statistics theorem states that integer-spin particles are bosons, while half-integer–spin particles are fermions.

The spin–statistics relation was first formulated in 1939 by Markus Fierz and was rederived in a more systematic way by Wolfgang Pauli. Fierz and Pauli argued by enumerating all free field theories, requiring that there should be quadratic forms for locally commuting observables including a positive-definite energy density. A more conceptual argument was provided by Julian Schwinger in 1950. Richard Feynman gave a demonstration by demanding unitarily for scattering as an external potential is varied, which when translated to field language is a condition on the quadratic operator that couples to the potential.

The essential ingredient in proving the spin/statistics relation is relativity that the physical laws do not change under Lorentz transformations. The field operators transform under Lorentz transformations according to the spin of the particle that they create, by definition. The proof requires the following assumptions:

The theory has a Lorentz-invariant Lagrangian.

The vacuum is Lorentz-invariant.

The particle is a localized excitation. Microscopically, it is not attached to a string or domain wall.

1. The particle is propagating, meaning that it has a finite, not infinite, mass.

2. The particle is a real excitation, meaning that states containing this particle have a positive-definite norm.

Therefore, the proof cannot be perfect. Spin statistics theorem implies that half-integer spin particles are subject to the Pauli Exclusion Principle, while integer-spin particles are not. Only one fermion can occupy a given quantum state at any time, while the number of bosons that can occupy a quantum state is not restricted. The basic building blocks of matter such as protons, neutrons, and electrons are fermions. Particles such as the photon, which mediate forces between matter particles, are bosons. There are a couple of interesting phenomena arising from the two types of statistics. The Bose–Einstein distribution which describes bosons leads to Bose–Einstein condensation. Below a certain temperature, most of the particles in a bosonic system will occupy the ground state (the state of lowest energy). Unusual properties such as super fluidity can result. The Fermi–Dirac distribution describing fermions also leads to interesting properties. Since only one fermion can occupy a given quantum state, the lowest single-particle energy level for spin-1/2 fermions contains at most two particles, with the spins of the particles oppositely aligned. Thus, even at absolute zero, the system still has a significant amount of energy. As a result, a fermionic system exerts an outward pressure. Even at non-zero temperatures, such a pressure can exist. This degeneracy pressure is responsible for keeping certain massive stars from collapsing due to gravity. Here, important point is that spin and related principle and theorem is huge important for physics. Why we cannot proof justification of spin statistics theorem perfectly?

Because, since 1925 Wolfgang Pauli formulated exclusion principle without direct physical reason of spin, we have to only accept this exclusion principle only as principle with that can explain only related phenomena, to date.

However, CFLE theory can give answer by simply physical base what is spin, why establish exclusion principle for fermions by spin, why bosons can occupy same energy state? Why Bose-Einstein condensate can collapse?

In §4.4 I introduced electromagnetic force line elements as figure 4-4-3

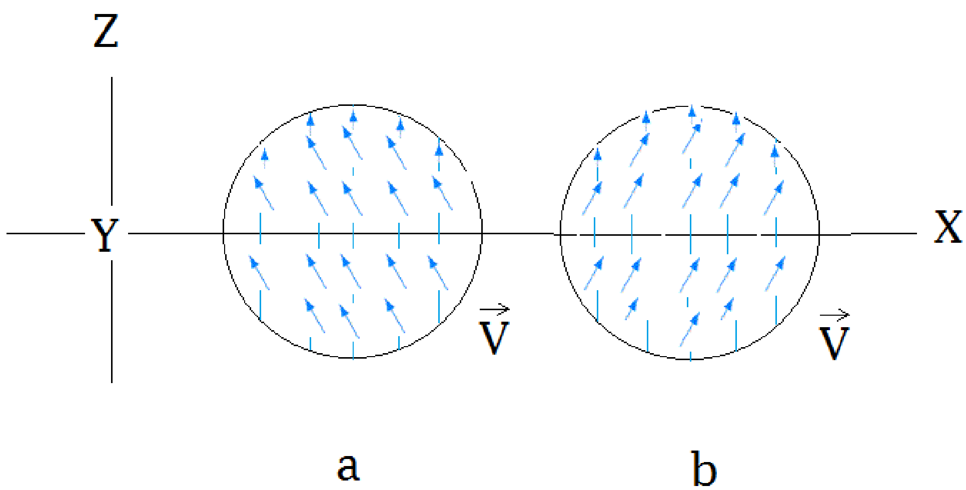


Figure 4-4-13

In this situation magnetic force line elements of particle "a" collectively rotate left and magnetic force line elements of particle "b" collectively rotate right. Results of rotating of magnetic force line elements is ±Spins according to §4.4.

When this situation observes different direction at zy plain, we can recognize clearly what is physical essence of spin.

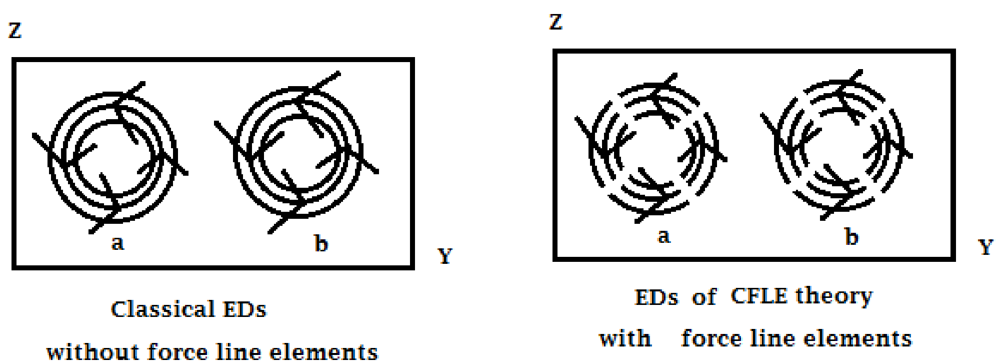


Figure 19-9-1

According to the viewpoint of zy plain, results of behavior of magnetic force line elements of particle "a" and "b" in figure 4-4-13 is

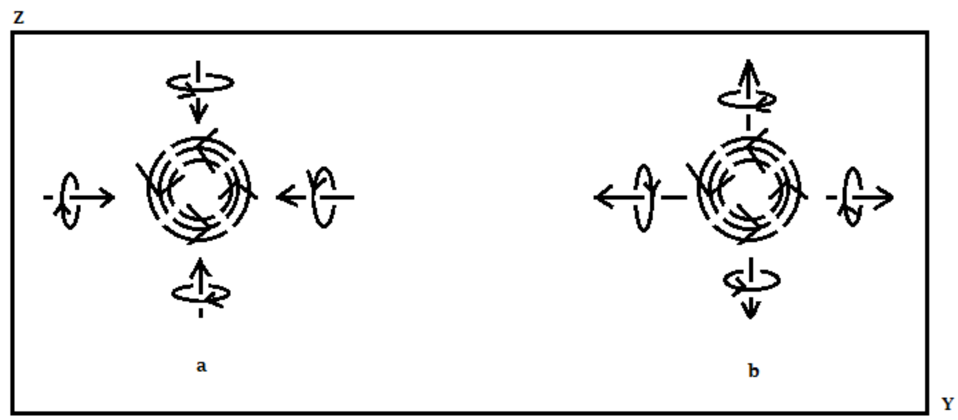


Figure 19-9-2

In figure 19-9-2 we can clearly recognize direction of spin angular momentum from particle "a"and "b".

In Stern-Gerlach experiment particle "a" and "b" is separated as figure 4-4-14 because different direction of collective rotation of magnetic force line elements not direct rotation of particle.

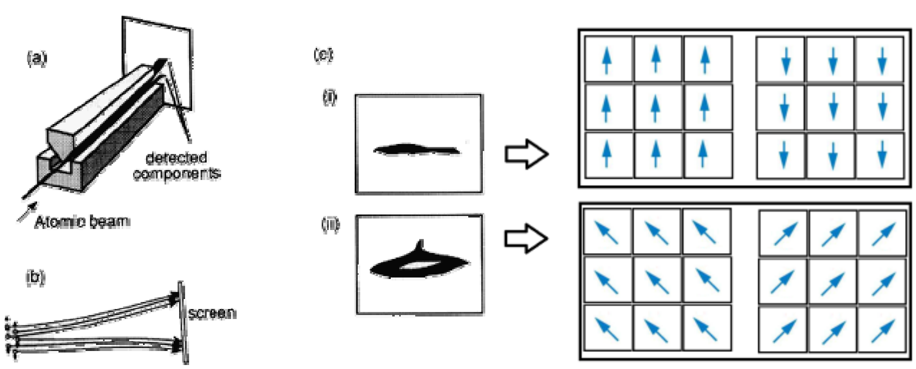


Figure 4-4-14

For physical property of spin clearly to recognize, we can express only direction of spin angular momentum as Figure 19-9-3

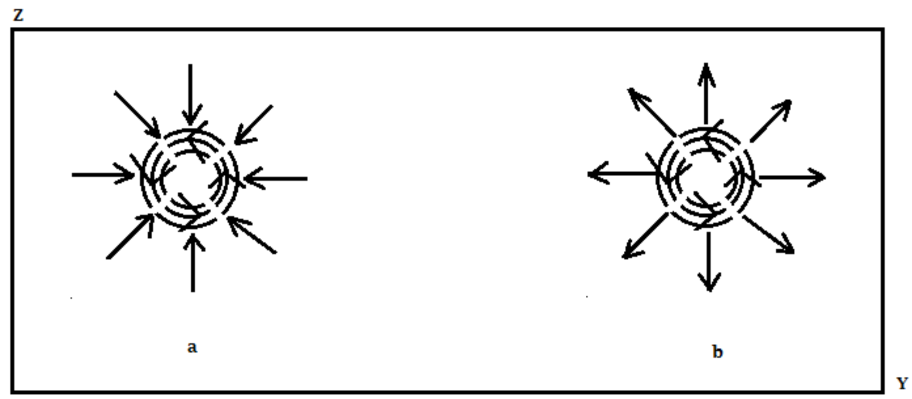


Figure 19-9-3

At same energy level in atom system particles react as figure 19-9-4

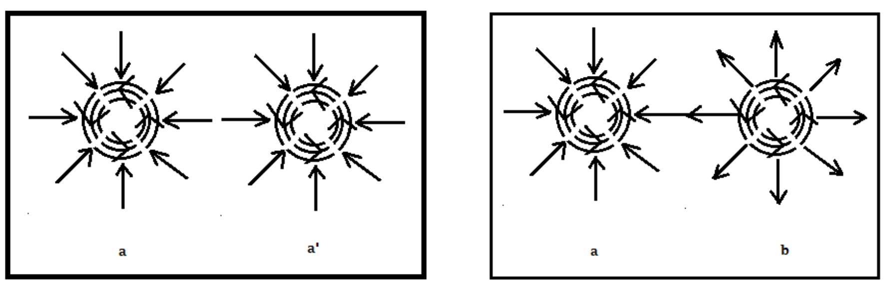


Figure 19-9-4

Fermion is all particles that constitute with odd number (proton, electron, neutron, muon …) like every structural fermion decay of $n = p + e + \nu$.

Therefore possible spin is

$$\text{Spin} = \frac{1}{2}, \frac{3}{2}, \frac{5}{2} \ldots \qquad 19\text{-}9\text{-}1$$

Figure 19-9-5 shows electric force line arrangement how they change by reaction between same charge and different charge.

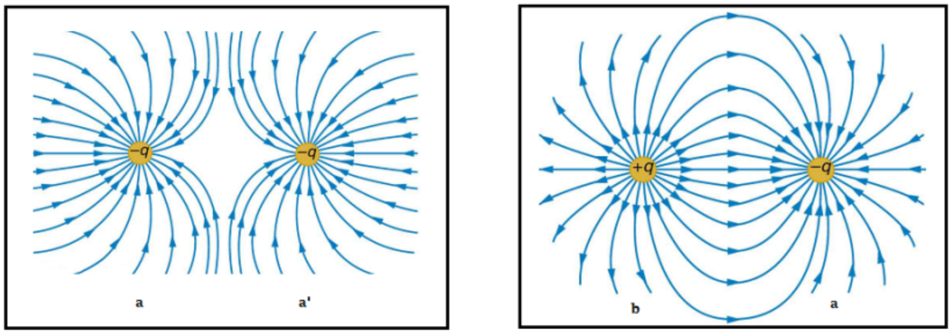


Figure 19-9-5

Because particle with direction of same spin angular momentum interact repulsively as figure 19-9-5(a, a') , particle should be disappeared (or probability is zero) at same energy level. Therefore such physical state must be written as EQ 19-9-2

$$\Psi^{F}_{anti-sym} = \frac{1}{\sqrt{2}}[\psi_a(x_1)\psi_b(x_2) - \psi_a(x_2)\psi_b(x_1)] \qquad 19\text{-}9\text{-}2$$

This is none other than physical base of spin statics theorem for fermion

When Particle has different direction of spin angular momentum can build spin dipole as figure 19-9-6

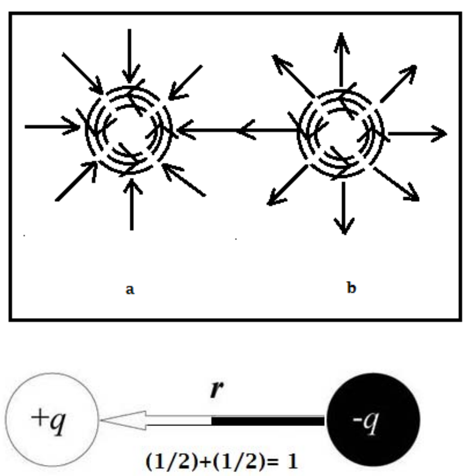


Figure 19-9- 6

Only such particle pair can occupy same energy level as dipole of spin angular momentum as figure 19-9-7

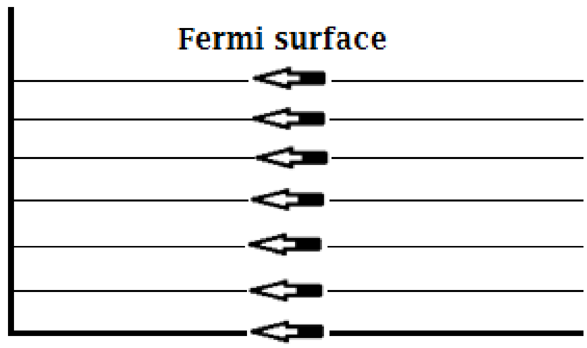


Figure 19-9-7

Because such occupation appear relation as figure 19-9-8

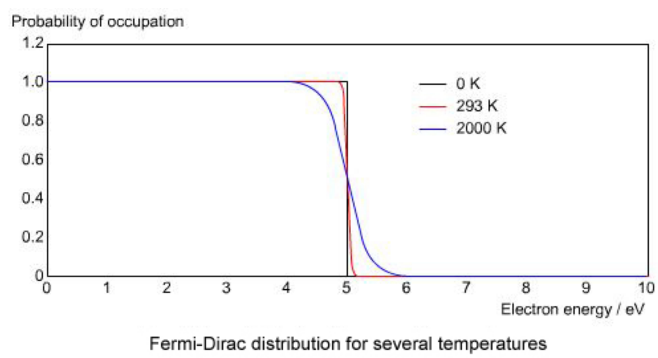


Figure 19-9-8

Therefore, the expected number of particles in energy state *i* for F–D statistics should be expressed

$$n_i(\epsilon_i) = \frac{g_i}{e^{(\epsilon_i-\mu)/kT}+1} \quad 19\text{-}9\text{-}3$$

Boson is all particles that constitute with even number (Photon,He^4,$W^{\pm}$, Meson ($\pi^{\pm}$, $\pi^{o}, K^{\pm}, K^{o}$ ...)) as figure 19-9-9

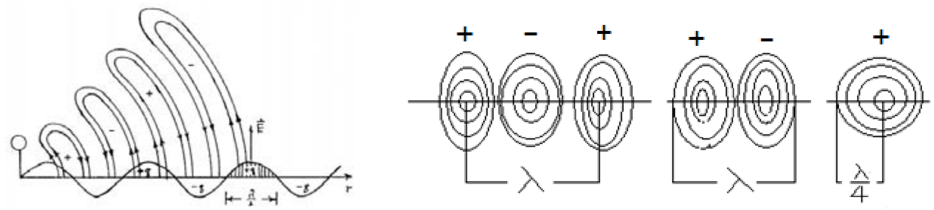


Figure 19-9-9

Therefore possible spin is

Spin= 1,2,3 ... 19-9-4

Because particle with direction of same spin angular momentum interact repulsively as figure 19-9-5(a, b) , particle should be disappeared (or probability is always not zero) at same energy level. Therefore such physical state must be written as

$$\Psi^{B}_{sym} = \frac{1}{\sqrt{2}}[\psi_a(x_1)\psi_b(x_2) + \psi_a(x_2)\psi_b(x_1)] \quad 19\text{-}9\text{-}5$$

This is none other than physical base of spin statics theorem for boson

When Particle has different direction of spin angular momentum can build spin dipole as figure 19-9-10

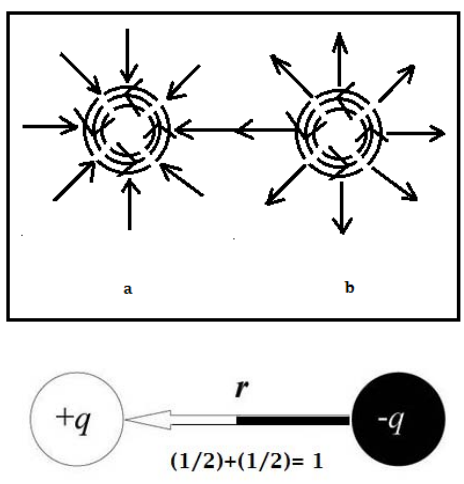


Figure 19-9-10

All of such particle pair can occupy one same energy level as dipole of spin angular momentum as figure 19-9-11

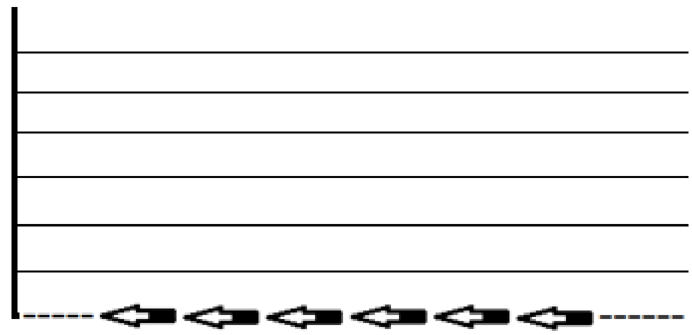


Figure 19-9-11

Because such occupation appear relation as figure 19-9-12

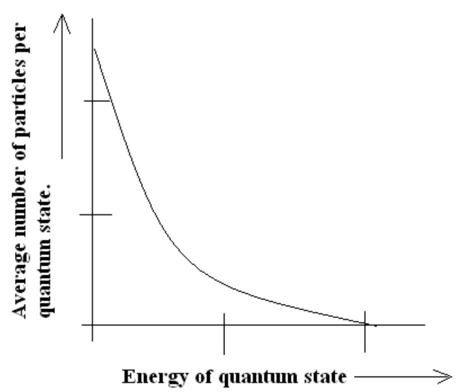


Figure 19-9-12

The expected number of particles in an energy state *i* for B–E statistics

Should be expressed

$$n_i(\varepsilon_i) = \frac{g_i}{e^{(\varepsilon_i-\mu)/kT} - 1} \qquad 19\text{-}9\text{-}6$$

Figure 19-9-13 shows difference between Bose-Einstein distribution, Fermi-Dirac distribution and Boltzmann-Maxwell distribution.

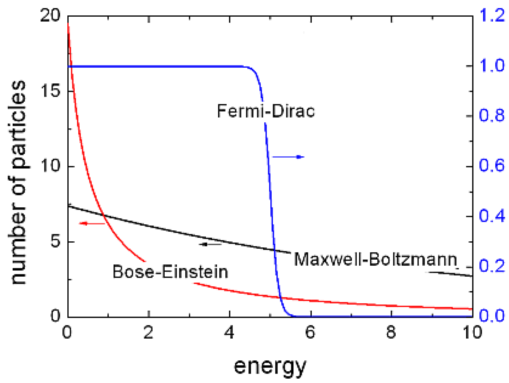


Figure 19-9-13

Bose-Einstein condensation is state that all particles can be in ground state. Therefore, this state must be stable.

However, scientists observed directly growth and collapse of a Bose-Einstein Condensate with attractive interactions.

Compared to more commonly encountered states of matter, Bose–Einstein condensates are extremely fragile. The slightest interaction with the external environment can be enough to warm them past the condensation threshold, eliminating their interesting properties and forming a normal gas. Nevertheless, they have proven useful in exploring a wide range of questions in fundamental physics, and the years since the initial discoveries by the JILA and MIT groups have seen an increase in experimental and theoretical activity.

The dynamical behavior of Bose-Einstein condensation (BEC) in a gas with attractive interactions is striking. Quantum theory predicts that BEC of a spatially homogeneous gas with attractive interactions is precluded by a conventional phase transition into either a liquid or solid.

When confined to a trap, however, such a condensate can form provided that its occupation number does not exceed a limiting value. The stability limit is determined by a balance between self-attraction and a repulsion arising from position-momentum uncertainty under conditions of spatial confinement. Near the stability limit, self-attraction can overwhelm the repulsion, causing the condensate to collapse. Growth of the condensate, therefore, is punctuated by intermittent collapses, which are triggered either by macroscopic quantum tunneling or thermal fluctuation. Previous observation of growth and collapse has been hampered by the stochastic nature of these mechanisms. Here we reduce the stochasticity by controlling the initial number of condensate atoms using a two-photon transition to a diatomic molecular state. This enables us to obtain the first direct observation of the growth of a condensate with attractive interactions and its subsequent collapse.

Therefore, scientists are in agony how they rigorously prove the existence of Bose-Einstein condensates for general interacting systems.

Here, important point is that energy state of Einstein's Null Punkt (Zero Point) is not ground state (cf.§9.7, §9.8). According to general relativity of CFLE theory this energy state is only curved state of force line at $g = 2$.
However, because curved state of force line is finished at $g = 8$, energy state of $g = 2$ is unstable.

Therefore, more interaction with implosion and explosion has to occur by force line curve from $g = 2$ to $g = 8$ as so called collapse of Bose-Einstein condensate.

Conclusion: Einstein's general relativity collapse here with collapse of Bose-Einstein condensate.

19.10. Solving the Left handedness Problems in weak interaction

By the mid-20th Century, it had been suggested by several scientists that parity might not be conserved (in different contexts), but without solid evidence these suggestions were not considered important. Then, in 1956, a careful review and analysis by theoretical physicists Tsung Dao Lee and Chen Ning Yang went further, showing that while parity conservation had been verified in decays by the strong or electromagnetic interactions, it was untested in the weak interaction.

They proposed several possible direct experimental tests. They were mostly ignored, but Lee was able to convince his Columbia colleague Chien-Shiung Wu to try it. She needed special cryogenic facilities and expertise, so the experiment was done at the National Bureau of Standards.

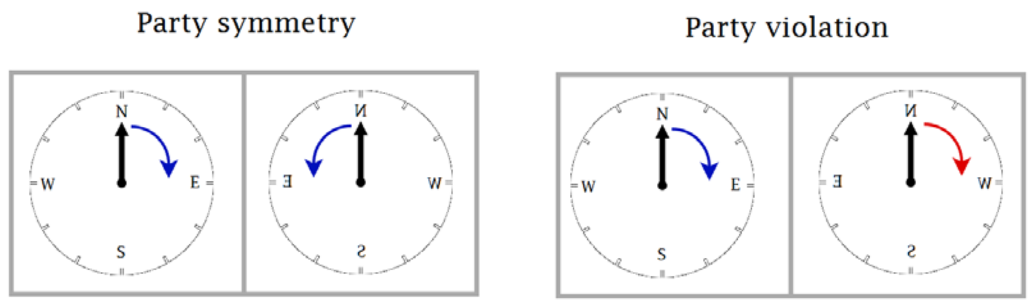


Figure 19-10-1

In 1957 C. S. Wu, E. Ambler, R. W. Hayward, D. D. Hoppes, and R. P. Hudson found a clear violation of parity conservation in the beta decay of cobalt-60. As the experiment was winding down, with double-checking in progress, Wu informed Lee and Yang of their positive results, and saying the results need further examination, she asked them not to publicize the results first. However, Lee revealed the results to his Columbia colleagues on 4 January 1957 at a "Friday Lunch" gathering of the Physics Department of Columbia. Three of them, R. L. Garwin, Leon Lederman, and R. Weinrich modified an existing cyclotron experiment, and they immediately verified the parity violation. They delayed publication of their results until after Wu's group was ready, and the two papers appeared back to back in the same physics journal.

After the fact, it was noted that an obscure 1928 experiment had in effect reported parity violation in weak decays, but since the appropriate concepts had not yet been developed, those results had no impact.The discovery of parity violation immediately explained the outstanding τ–θ puzzle in the physics of kaons($\theta^+ \to \pi^+ + \pi^o, \tau^+ \to \pi^+ + \pi^+ + \pi^-$).

In 2010, it was reported that physicists working with the Relativistic Heavy Ion Collider (RHIC) had created a short-lived parity symmetry-breaking bubble in quark-gluon plasmas. An experiment conducted by several physicists including Yale's Jack Sandweiss as part of the STAR collaboration, suggested that parity may also be violated in the strong interaction. Wolfgang Pauli could only say “I cannot believe God is a weak left-hander”. To date we cannot explain why party violation exists in weak interaction. However, CFLE theory can give answer about this question.

Wu’s experimental results is

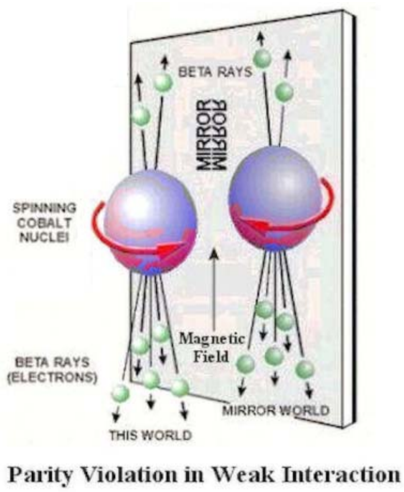
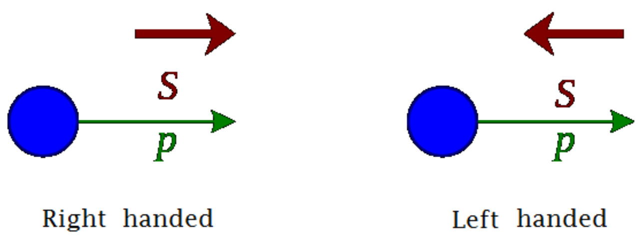


Figure 19-10-2

relation between momentum and spin is



P is the particle's momentum and S is its spin.

Figure 19-10-3

This relation can be expressed by CFLE theory as figure 19-10-4

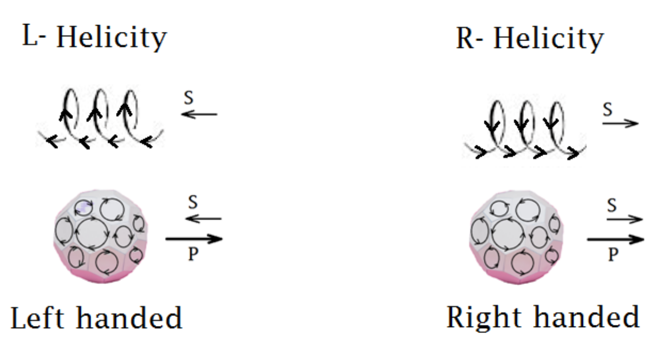


Figure 19-10-4

Difference of degree of curve of electromagnetic force line elements for electro-static force between two particles is

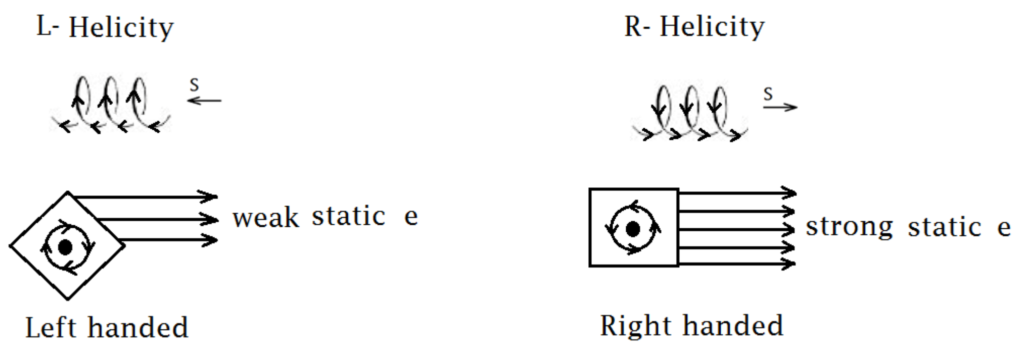


Figure 19-10-5

Because force line element of left handed particle can stay deeper place than force line element of right handed particle, electro-static charge of left handed particle is now weaker than right handed particle.

Therefore, weak attractive electro-static interaction of particle decay between left handed particles is energetically selected more than right handed particles that should be experienced strong attractive electro-static interaction. This phenomenon was observed as party violation.

Force line arrangements of Spin 0 of Higgs boson is

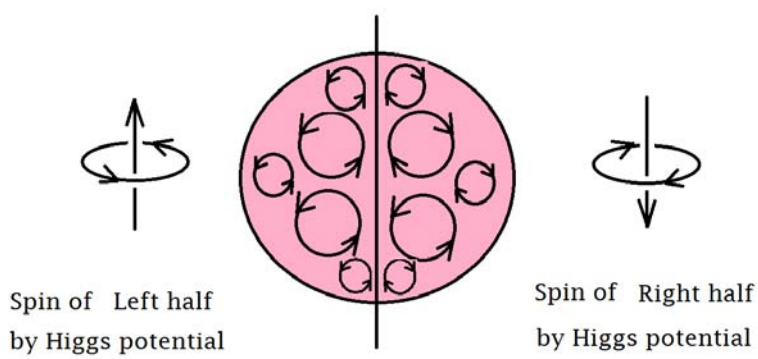


Figure 19-10-6