Origin of Ultra-High-Energy Cosmic Ray

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Abstract In cosmic rays, the GZK cutoff is suggested to be between 50 EeV and 60 EeV, with observationally 57 EeV (HiRes, Pierre Auger Observatory) and theoretically and observationally 56 EeV being suggested as the representative value. In previous study, it was drawn that up, charm, and top quarks consist of inner boson particles located on 10D, 11D, and 12D and shell fermion particles located on 4D, 5D, and 6D, and their masses were calculated in detail. After plotting the log values of the calculated masses on 10D, 11D, and 12D and drawing its parabola, the masses on 3D are calculated to be 50.60 EeV in kinetic state, 60.82 EeV in steady state, and 56.94 EeV in combined state, which are consistent with the results of GZK cutoff. The above calculation is the property of space itself, which has nothing to do with supernova explosion, black hole jet, etc. In previous study, we argued that hydrogen is continuously generated in space. The above result implies that ultra-high-energy cosmic rays are the particles that suddenly appear at a cosmic void of 3D space from high dimensions.

1. Introduction

The Greisen–Zatsepin–Kuzmin limit (GZK limit or GZK cutoff) is an upper limit on the energy of cosmic ray protons traveling from other galaxies through the intergalactic medium to our galaxy. The value is suggested to be between 50 EeV and 60 EeV, with observationally 57 EeV (HiRes, Pierre Auger Observatory) and theoretically and observationally 56 EeV being suggested as the representative value.

Extreme-Energy Cosmic Rays exceeding the GZK limit have been observed, such as Oh-My-God particle with 320 EeV in 1991 and Amaterasu particle with 244 EeV in 2021, which are currently unexplained phenomena in physics. The aim of this study is to calculate the GZK limit and explain its origin by simply extending the results of previous studies.

2. Inner Boson of Up, Charm, Top

2.1 Shape of quarks

Fig. 1 shows the shapes of Up, Charm, and Top quarks which were already drawn in Fig. 12 of Ref. [1]. As can be understood from the figure, quarks are basically composed of normal inner boson particles located at 10D, 11D, and 12D, and normal shell fermion particles located at 4D, 5D, and 6D.

2.2 Kinetic state of inner boson

In Fig. 1, the inner bosons of up, charm, and top quarks are $\alpha_s^b\alpha_n^b$, $\beta_s^b\beta_n^b$, and γ_{sn}^b, and the kinetic state masses were calculated to be 52.803 eV, 131.57 eV, and 1813.0 eV in the kinetic state of Table 4 of Ref. [1]. The log mass values are plotted at the coordinates of 10.001D, 11.001D, and 12.002D, and the log parabola is shown in Fig. 2(a). On 3D, its mass is calculated to be 5.060E19 eV, which is almost equal to the minimum value 50 EeV of GZK limit.

2.3 Steady state of inner boson

The steady state masses were calculated to be 50.630 eV, 126.79 eV, and 1772.4 eV in the steady state of Table 4 of Ref. [1]. The log mass values are plotted at the coordinates of 10.001D, 11.001D, and 12.002D, and the log parabola is

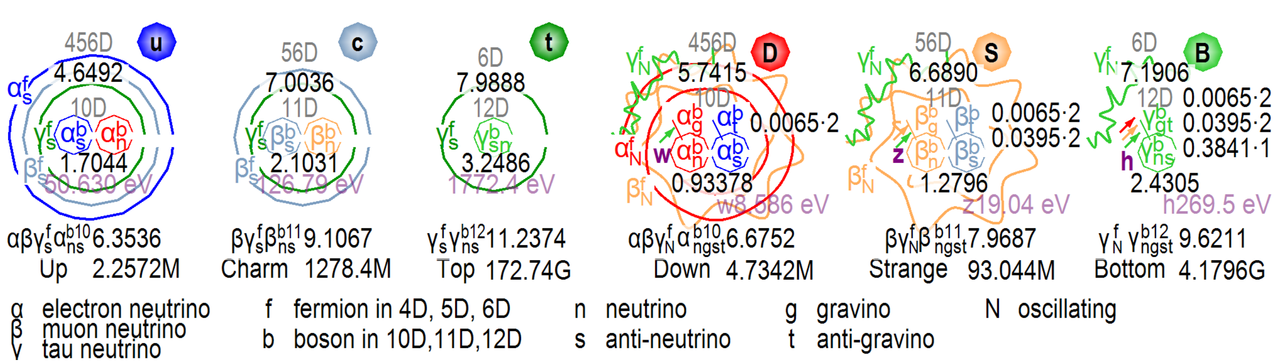
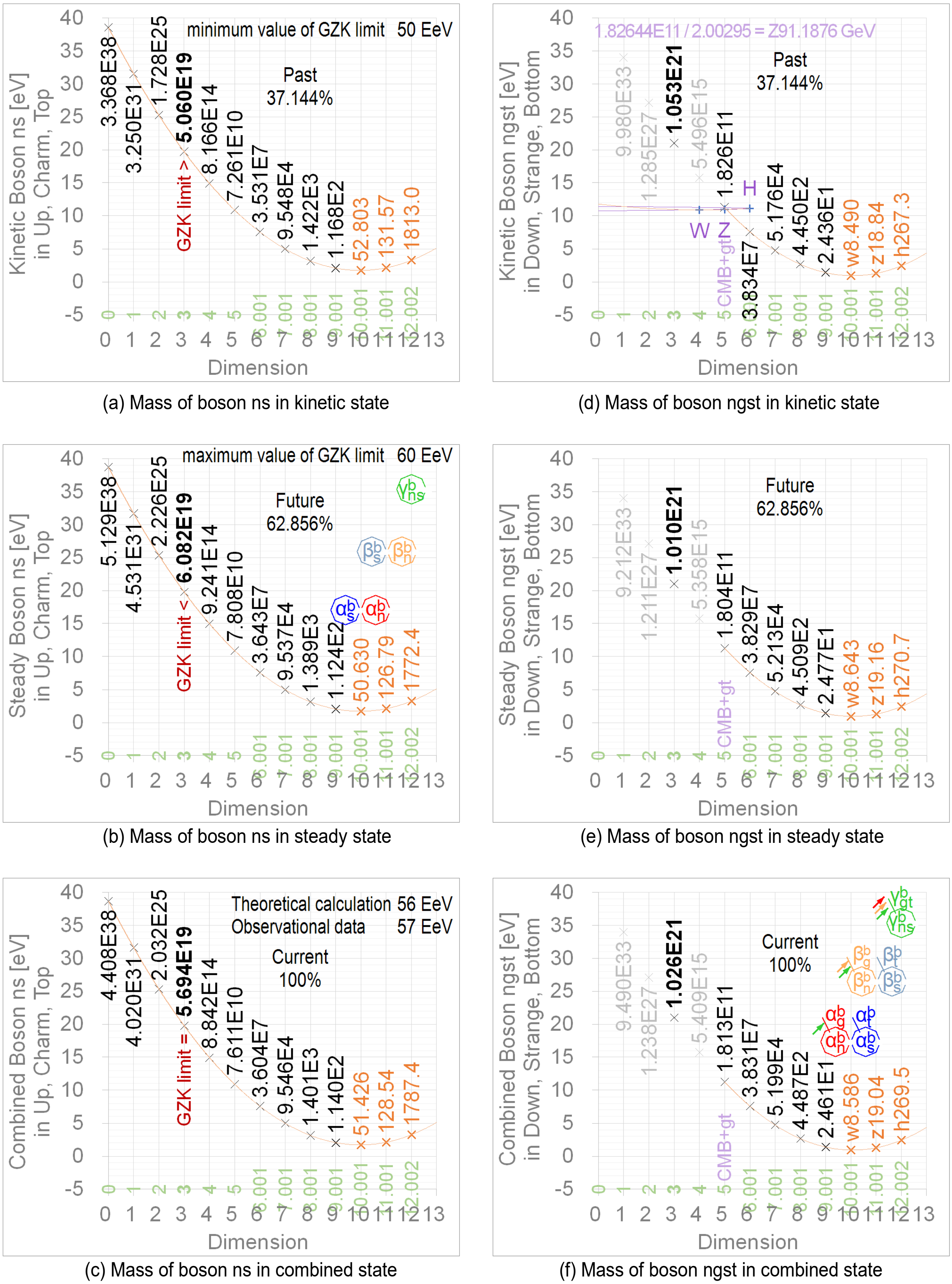


Fig. 1 Shape and mass of quarks (See Fig. 12 of Ref. [1])



(a) Mass of boson ns in kinetic state

(d) Mass of boson ngst in kinetic state

(b) Mass of boson ns in steady state

(e) Mass of boson ngst in steady state

(c) Mass of boson ns in combined state

(f) Mass of boson ngst in combined state

Fig. 2 Calculation of GZK limit 5.694E19 eV shown in Fig. 2(b). On 3D, its mass is calculated to be 6.082E19 eV, which is almost equal to the maximum value 60 EeV of GZK limit. The above idea was already implemented in Fig. 5 on page 34 of Ref. [2], but the 3D values were not calculated in that chart.

2.4 Combined state of inner boson

As described in section 3.28 of Ref. [1], the current 100% (combined state) universe is composed of the mixture of past 37.144% (kinetic state) and future 62.856% (steady state), and the calculation is shown in Fig. 2(c). On 3D, its mass is calculated to be 5.694E19 eV, which is almost equal to the observational value 57 EeV of GZK limit.

2.5 Origin of GZK limit

As described in the introduction, the GZK limit is based on proton coming from external galaxy. However, the values calculated in Fig. 2 are completely unrelated to proton and galaxy. Fig. 2 is the intrinsic properties of the quantum space brane or particles that are released from the brane. The values in Fig. 2 are the same everywhere in the universe. Where, $\alpha_s^b \alpha_n^b$ is a boson electron neutrino pair, $\beta_s^b \beta_n^b$ is a boson muon neutrino pair, and γ_{sn}^b is a boson tau neutrino pair, and they are inside of up, charm, and tap quarks.

As can be seen in Table 4 of Ref. [1], the calculated masses of up, charm, and top quarks are calculated to be 2.2572 Mev, 1278.4 MeV, and 172.74 Gev, which are almost in agreement with the values in physics. Also, the GZK limit value of 57 EeV was calculated from 51.426 eV, 128.54 eV, and 1787.4 eV in Fig. 2(c). The probability that this calculation is correct by chance is close to zero.

2.6 Extreme-Energy Cosmic Ray

Oh-My-God particle with 320 EeV in 1991 and Amaterasu particle with 244 EeV in 2021 have been observed. These have a mass far exceeding the GZK limit of 57 EeV, and cannot be explained by physics. The author believes that Einstein's theory interprets 3D, particle physics interprets 4D5D6D, and Planck's units interpret 0D. Therefore, it would be natural that physics cannot understand masses larger than 3D in Fig. 2(c).

Higher-dimensional particles with energies greater than 5.694E19 eV are continuously penetrating our 3D universe, and these particles are boson neutrino pairs that are the seed of up quark.

2.7 Number of particles during 13.8 billion years

These particles are said to occur at a rate of about one per km2 per 100 years. 1 particle / 100 years / km2 * the universe age 13.8E9 years is 138 particles / m2. If it is m3, it could be 0.138 particles. The overall average energy density of our universe is 6 protons / m3, and the baryon average energy density is 0.3 protons / m3. It can be said that the above two values are approximately similar. These particles occur uniformly throughout the universe, and, probabilistically, the majority of them originate from cosmic voids.

2.8 Generation of up quark seed

Fermion particles make up our universe, and are located on 4D, 5D, and 6D in Fig. 2. Therefore, fermion particles appear from 4D to 3D direction. Boson particles are the opposite of fermions, so they appear from 2D to 3D direction, and lose energy little by little, hide in 10D, and become the seed of up quark.

3. Inner Boson of Down, Strange, Bottom

3.1 Shape of quarks

Fig. 1 shows the shapes of Down, Strange, and Bottom quarks which were already drawn in Fig. 12 of Ref. [1]. As can be understood from the figure, quarks are basically composed of normal inner boson particles located at 10D, 11D, and 12D, and oscillating shell fermion particles located at 4D, 5D, and 6D. In the symbols in Fig. 1, n and s are neutrinos that form the shape of particle, and g and t are gravinos (new word) that cause the force of particle.

3.2 Kinetic state of inner boson

In Fig. 1, the inner bosons of down, strange, and bottom quarks are $\alpha_n^b \alpha_g^b \alpha_s^b \alpha_t^b$, $\beta_n^b \beta_g^b \beta_s^b \beta_t^b$, and $\gamma_{ns}^b \gamma_{gt}^b$, and the kinetic state masses were calculated to be 8.490 eV, 18.84 eV, and 267.3 eV in the kinetic state of Table 5 of Ref. [1]. The log mass values are plotted at the coordinates of 10.001D, 11.001D, and 12.002D, and the log parabola is shown in Fig. 2(d). On 3D, its mass is calculated to be 1.053E21 eV.

3.3 Steady state of inner boson

The steady state masses were calculated to be 8.643 eV, 19.16 eV, and 270.7 eV in the steady state. The log mass values are plotted at the coordinates of 10.001D, 11.001D, and 12.002D, and the log parabola is shown in Fig. 2(e). On 3D, its mass is calculated to be 1.010E21 eV.

3.4 Combined state of inner boson

The combined state masses were calculated to be 8.586 eV, 19.04 eV, and 269.5 eV in the combined state of Table 5 of Ref. [1]. The log mass values are plotted at the coordinates of 10.001D, 11.001D, and 12.002D, and the log parabola is shown in Fig. 2(f). On 3D, its mass is calculated to be 1.026E21 eV.

3.5 Limit energy

Such as the GZK limit, the limiting mass of those particles can be determined as 1.026E21 eV. That is, particles flow from the 3D left side of Fig. 2(f) to the 3D right side.

3.6 Generation of down quark seed

In Fig. 1, the circle $\alpha_n^b \alpha_s^b$ in the down quark makes the shape of particle, and the straight line $\alpha_g^b \alpha_t^b$ induces a force on particle. It is peculiar that there is a gt in the down quark that causes force. It is thought that the ngst particle entering from the left side of 3D reacts with gt and cosmic background radiation in 3D, releases intense energy, and then immediately changes into a particle in 5D. After that, it gradually loses energy, hides in 10D, and becomes the seed of a down quark. If this were true, the ngst particle would never be discovered experimentally.

3.7 Relationship between W, Z, and H bosons

The relationships between W, Z, and H bosons are shown on the left side of Fig. 2(d), and their exact values are shown in Fig. 11 and Fig. 10 of Ref. [1]. It is judged that the coordinates of 10D change to 5D along the parabola, and the relationship of W Z H is formed due to the reaction of gt and CMB.

3.8 Universal brane : ngst

In Fig. 1, n is neutrino, s is anti-neutrino, g is gravino, and t is anti-gravino. The universal brane is composed of ngst, and the inner boson of down quark is also composed of ngst. However, the inner boson in up quark is composed only of ns. It is questionable why gt was separated and where it disappeared to.

4. Conclusions

In this study, the CGK limit was calculated to be 5.694E19 eV, and the particle is a boson neutrino pair flowing into 3D space from a high-dimensional universe. After that, it gradually loses energy and forms a 10D seed of up quark. Also, a boson neutrino-gravino pair with energy greater than 1.026E21 eV is introduced into 3D and immediately reacts with CMB, and then it is located on 5D. After that, it gradually loses energy and forms a 10D seed of a down quark.

Since this phenomenon occurs uniformly throughout the universe, most of the particles are probabilistically generated in the cosmic void.

References

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