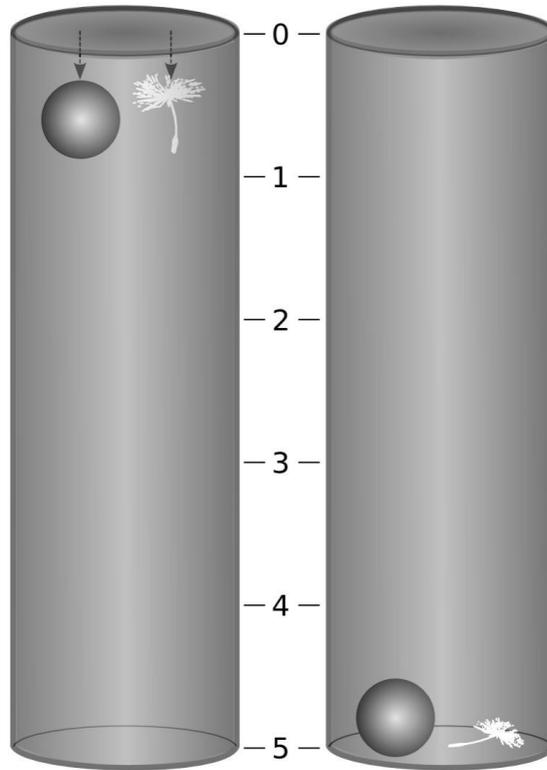


# A Brief Experiment of Space

The Infinite Emptiness of Space

空間的實驗

Cres Huang



Free Fall in Vacuum Chamber

ISBN 978-957-43-2027-1



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Edition: 2014(01)-preview  
2014/11

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## Abstract

Among the three fundamental elements of the universe; space is as real, intimate, yet illusive. We have learned to manipulating matter and energy since our first existence on Earth, however, never space even it is in our hands and everywhere. Nevertheless, it has caused some confusions of our understanding of the universe, when dominating and proportional cosmic redshift has been interpreted as the result of space expansion.

I believe it is fundamental to have clear understanding of this fundamental of the universe. Even it is impossible to study it hand-on, h However, there is vacuum sharing some properties of space. The truth is, even vacuum can not exist without space. We can consider space is analogous to an infinite vacuum, and vacuum the window to view the nature of space.

Luckily, we can create and shape vacuum to some extent. This experiment will observe the actions of vacuum, mass and energy to derive a logical understanding of space.

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# 1 Introduction

Among the three fundamental elements of the universe; space is as real, intimate, yet most illusive. It has existence but not physical. It is intangible, however, felt very tangible by us. It is beyond any measurement. It's always right there, but can never be detected by any instrument. It is intimate, but, distanced beyond our imagination. It is very hard to give it a definition, or prove it's existence mathematically. However, we can not deny it's always here with us and we all live in it. Nevertheless, it has caused some confusions of our understanding of the universe, when dominating and proportional cosmic redshift has been interpreted as the result of space expansion. I believe it is fundamental to have a clear understanding of this fundamental of the universe.

An event in the universe is analogous to a baseball game, there are many participants, field, people, facilities, soil, air, gravity, light, etc. The presences and actions of all participant complete the game. And, a participant at the game is the extension of it's past. For example, a bucket of water was spilled by a kid in other side of the world; The vapor of the water has traveled across; And the moisture crosses path of a pitched ball. It is very unlikely we will ever know it's significance to the outcome. However, it has participated the game. And, what would happened to the kid who spilled that water is another endless story, of which could be of significance in history, or neglected. Here, water vapor (matter and energy) has traveled across the globe to participate the game. The truth is, all participants, regardless of their differences in the past, come to the location precisely to create the event. Nevertheless, it could not happen without the presence of space.

The question is, does space do anything else besides providing the playing-field? Considering all participants are riding on the combined trajectory of the Earth, Solar System, Milky Way, and possible beyond, the whole event does not play out at the same location in space. However, we can not consider space is a participant in this event. It is indifference before and after any event. We have learned to manipulating matter and energy since our first existence on Earth, however, never space.

Even it is impossible to study space hand-on. However, there is vacuum that shares many properties of space. Fortunately, we can create and shape vacuum to an extent. By isolating matter and energy, we can create man-made vacuum that is observable. When matter and

energy are absent, the important nature of space would surface.

We can consider space is an infinite perfect vacuum, and vacuum a window to view the nature of space. Studying the actions of vacuum, mass, and energy would help us deriving a logical understanding of space.

## 35 2 Outline of The Experiment

I believe it is crucial to clear the confusions of our view of all fundamentals of the universe. There is no better experiment to study the nature of space with man-made vacuum. This experiment will proceed with the following studies:

- Space and vacuum, Section 3.
- 40 • Space and friction, Section 4.
- Space and motion, Section 5.
- Space and expansion, Section 6.
- Space and compression, Section 7.
- Space and energy, Section 8.

45 Finally, Section 10 summarizes our observations of the fundamental principles. It is proposed here to assist the study of the space.

Logically, we can not detect vacuum, or emptiness. We can only detect the absence of detectable. Absence of detectable is not absolutely equal to emptiness. The same logics that we can only prove the absence of detectable matter and energy. It is impossible to prove the  
50 absence of space.

### 3 Space and Vacuum

We often consider space is vacuum, or emptiness. However, there is no perfect vacuum in real world. Completely absent of matter and energy also means absolute zero. We can not completely remove particles from a volume, not even in outer space. I don't think it is possible to isolate subparticles with walls made of particles and energy. The size and rapid action of subparticles make them beyond restriction.

However, when we remove most of the detectable matter from a volume, the nature of vacuum can be observed. Here we summarize the properties of vacuum:

- It has no mass,
- contains no energy,
- actionless or absolute zero ,
- frictionless or zero viscosity,
- incapable of any interaction, and
- weightless.

The nature of vacuum basically is the property of absence, or emptiness. The fact is, even vacuum can not exist without space. Nevertheless, space also posses the property of absence.

Man-made vacuum is confined, but space is limitless. It is larger than any matter and energy we can detect. Even if we have a perfect telescope that is limitless in range; And, we don't see anything if we could look pass all objects; Can we say that we have reached the edge of the space?

The logical interpretation of space without any paradox can only be, the space is an infinite emptiness. It has existence, however, it's shape and size can not be measured.

## 4 Space and Friction

Here, we repeat the famous Galileo's experiment with  
 75 a ball and a dandelion seed free-falling in a vacuum  
 chamber, Figure: 1. It shows us that falling objects  
 would fall with uniform acceleration in vacuum, re-  
 gardless of their shape, size, or compositions. The  
 truth is, a simple experiment since 1589 tells more  
 80 than just gravity.

Even the ball and the seed have structure and sur-  
 face, and both are capable of surface interactions,  
 however, vacuum is not. It would not disrupt the fall.  
 The ball and the seed will descend in identical accel-  
 85 eration and land at the same time. It shows the truth  
 that the vacuum has no friction. It also shows the re-  
 verse truth that the motion of the ball and the seed  
 can not disturb vacuum.

We know the chamber is vacuum, however, there is space. It also shows the fact that the  
 90 space would not alter the fall, it is also frictionless, and neither does it have surface and it is  
 unable to interact.

Note that it is gravity powers the fall. It also shows the truth that, gravity can act on  
 mass, but vacuum and space can not be disturbed by gravity.

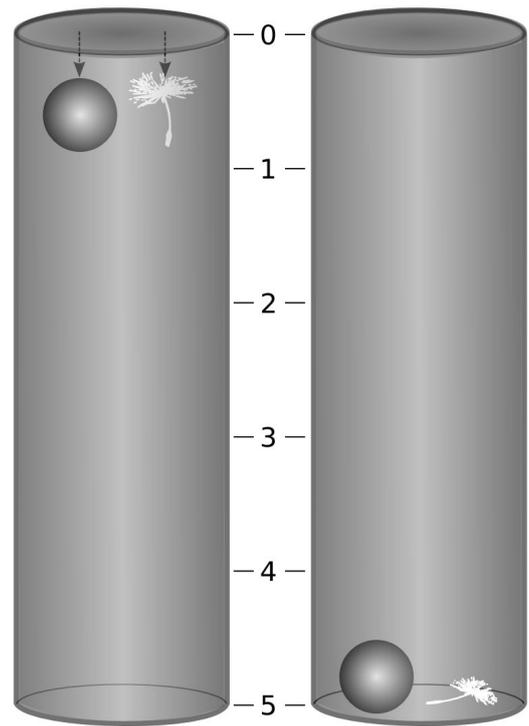


Figure 1: Free Fall in Vacuum Cham-  
 ber

## 5 Space and Motion

95 Suppose the chamber is moving upward during the fall, as depicted in Figure 2. The only difference is the shorter distance of fall and the landing impact. The motion of the chamber would not intervene the fall, as long as it does not contact the ball and the seed during the fall.

100 seed during the fall.

Here the vacuum has moved up with the chamber. It shows the fact that the motion of the vacuum would not alter the fall. I would say the space also does not disturb the fall. However, there is no clue

105 that space has changed in any way. It has to remain undisturbed, otherwise, there will be illogical paradoxes.

Suppose we do the same experiment in zero gravity field. Here we right-shift the chamber, as depicted

110 in Figure 3:

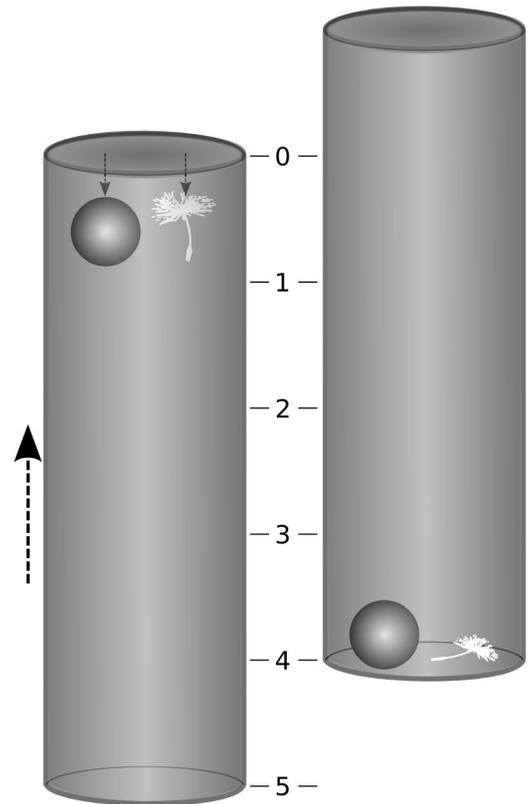


Figure 2: Free Fall in Rising Vacuum Chamber

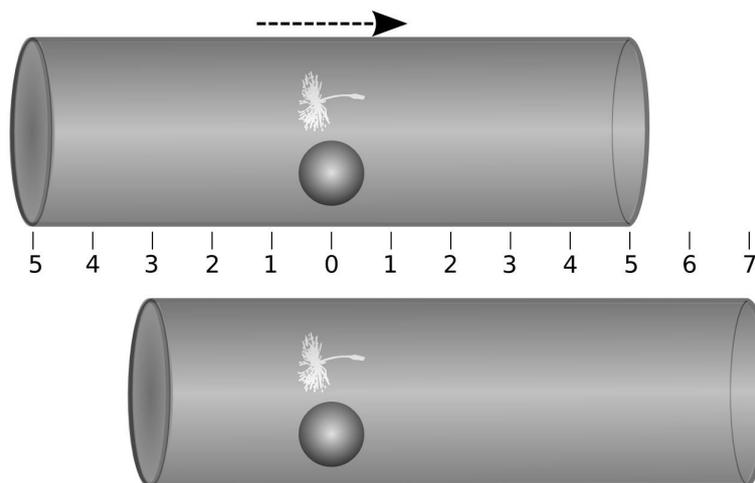
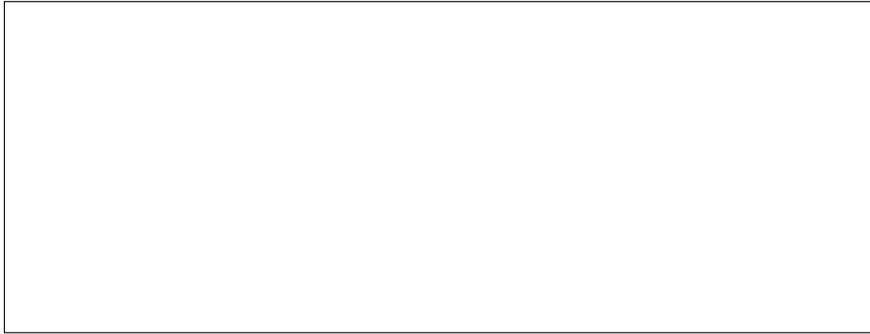


Figure 3: Vacuum Chamber in Zero Gravity Field

Again, vacuum has shifted with the chamber, however, the result can only be the same as in gravity field, the ball and the seed would not move along. The motion of vacuum would

115 not disturb the ball and the seed as long as there is no physical contact. I would say neither the vacuum nor the space will carry objects, and space remains independent of all objects

and actions, even the displacement of vacuum. Figure 4 is an animated illustration. Please note that some PDF viewer might not display it properly.



120

Figure 4: Vacuum Chamber in Zero Gravity Animation

On the other hand, we know that chamber, ball, seed, and resin will all shift together if the chamber is filled with resin, as depicted in Figure 5.

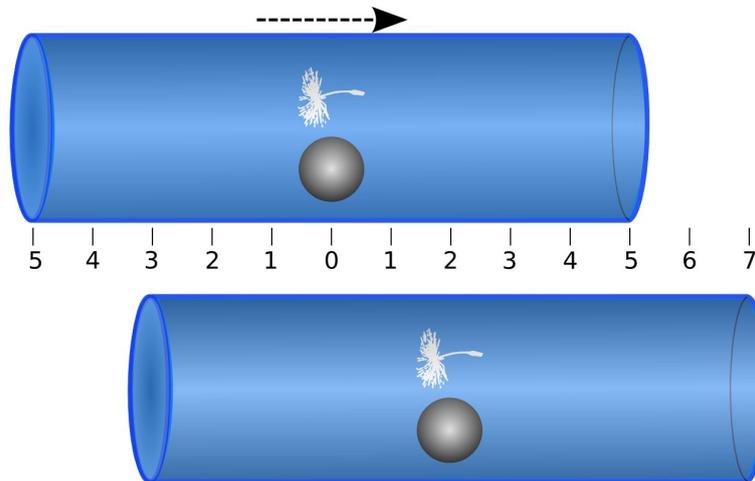


Figure 5: Resin Filled Chamber in Zero Gravity Field

125 Certainly, the result will be different if the chamber is filled with gas or liquid. There will be interactions playing out by the laws of motion and fluid dynamics, which is not within the scope of this study. Figure 6 is an animated illustration. Please note that some PDF viewer might not display it properly.



130

Figure 6: Filled Chamber in Zero Gravity Animation

## 6 Space and Expansion

Suppose we have a vacuum cylinder equipped with piston, as depicted in Figure 7.

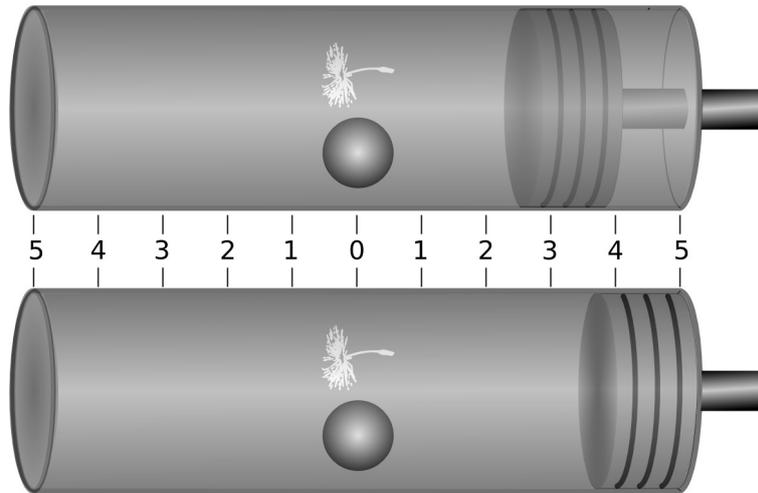


Figure 7: Vacuum Cylinder in Zero Gravity Field

135 Here we can compress or expand the volume of vacuum with this device. However, neither the compression nor the expansion of vacuum would displace the ball and the seed, as long as the piston does not come in contact with the ball and the seed. In this experiment, I would say neither space is capable of displace object, nor the space has been compressed or expanded. Figure 8 is an animated illustration. Please note that some PDF viewer might  
140 not display it properly.

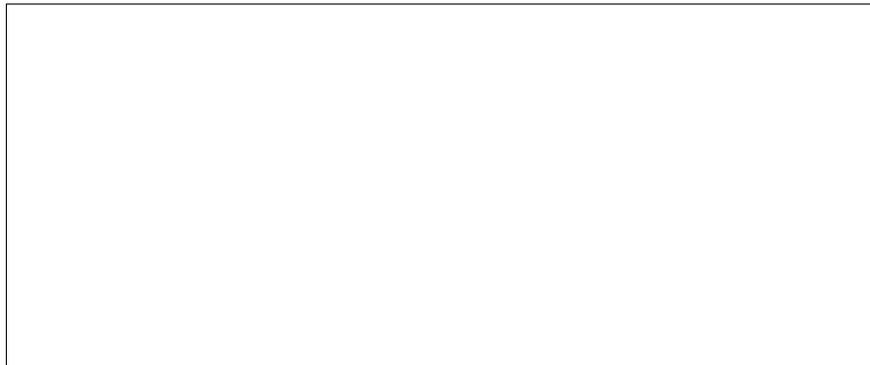


Figure 8: Vacuum Cylinder in Zero Gravity Animation

## 7 Space and Compression

Suppose we have two cylinders. One is filled with air, and the second one is vacuum, as depicted in Figure 9:

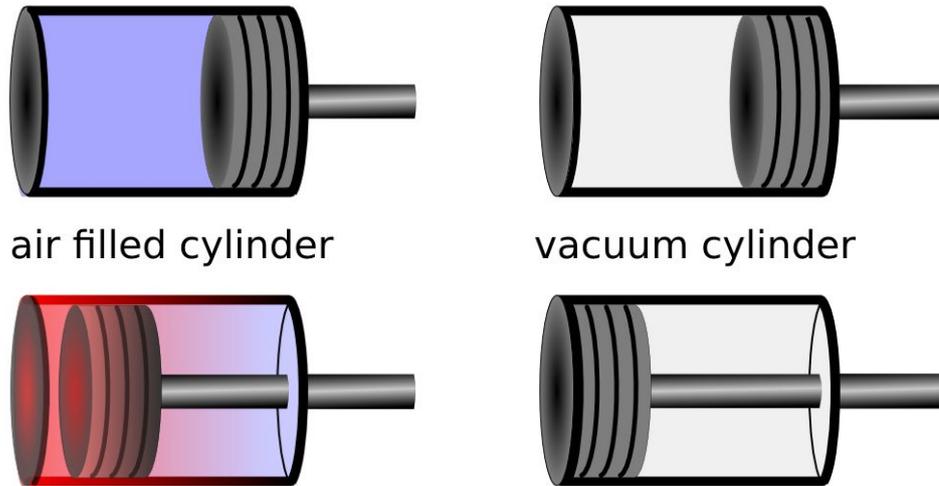


Figure 9: Compression of Cylinders

Here, we ignore the surface interaction (friction) of the cylinder walls and the pistons. The interior space would get smaller when the piston is pushing in. We understand the air filled cylinder will heat up when the air is compressed, and the piston can never fully reach to the end, unless in the cases of cracked cylinder or airtightness is lost.

On the other hand, the piston of the vacuum cylinder will reach to the end, and there is no energy released. The piston has relocated, and the vacuum has disappeared. In this case, vacuum is finite, and it can be created and shaped.

Nevertheless, we can not detect the edge nor the surface of the space has changed in both cases. We can only say the space is not effected, and it can not be confined. It remains independent as is. It is not disturbed by the existence of the pistons and cylinders, and the motion of pistons.

## 8 Space and Energy

160 Suppose we have two sealed capsules made of heat resisting material. One is air filled and another one vacuum, Figure 10.

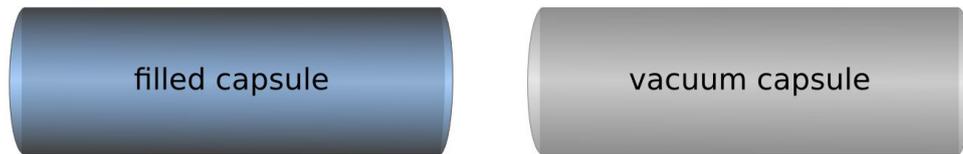
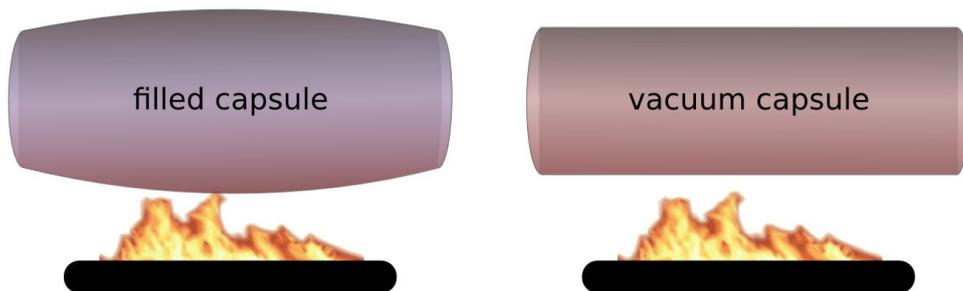


Figure 10: Filled and Vacuum Capsules

Suppose extra energy, heat, is applied to both capsules. We understand the added energy  
165 to the filled capsule will cause the air molecules to get excited and expand. The interior pressure will increase. It will force the capsule wall to bulged out. I believe "likely to explore" is also your answer to the filled capsule, since we know the internal pressure can exceed the capsule wall can withstand, as depicted in Figure 11.



170 Figure 11: Heated Capsules

However, is your answer the same for vacuum capsule? Here the issues become:

1. Would vacuum expand?
2. Would space expand?
3. Would space react if the filled capsule explores?

175 Can we answer yes to these questions?

The added heat can only be absorbed by the vacuum capsule wall. It would maintain it's shape as long as the extra heat is within the tolerance of the capsule material. However, instead of explore, the capsule would collapse if atmospheric pressure excess the capsule wall can withstand.

180 Here, matter, air, and capsule, would react to applied energy, but not vacuum. The added heat has no direct effect on vacuum, neither space.

## 9 Summary

We can only best describe space is an infinite vacuum, or endless emptiness. It's boundary and surface can not be defined. If it is finite, there must be something outside, yet, it can only  
185 be described as an endless vacuum outside. However, even vacuum can not exist without space, then space has to be outside of the finite space. It can only be infinite in this endless chase.

The properties of space is summarized as:

- Playing-field for mass, energy, and action.
- 190 • Massless, weightless.
- Shapeless, no surface and boundary.
- Actionless or absolute zero.
- Contains no energy.
- Frictionless or zero viscosity.
- 195 • Incapable of any interaction.
- Coexists with all objects.
- Beyond measure.
- Absolute independent.
- Absolute integrity. It's properties and location never alter.

200 The power of space is it's shapeless, actionless, and timeless. It is not affected by mass or force, even hyper-nova can not dent it. Consider space has room for the universe. Let anything move free without any restriction. Not even disallowing objects to share the same location, but let objects to work out sharing or rejecting. It has nothing, but nothing can come to exist without it, and nothing can escape from it.

205 I believe space is the only element that can exist by itself. No event can take place unless the playing field is set first. No construction can start unless the space is readily available. I would say if we would ever discover the origin of the universe, space comes first. Isn't it the ultimate power mightier than anything?

## 10 Appendix- Fundamental Principles

210 Matter, energy and space represent the very minimum elements necessary for the completion of an event in the universe. Matter is the physical aspect of any object, energy is the motivation of the action, and space is the playing-field allowing the existence of the matter and it's action to play out. All three elements contribute to the dynamic of the universe and none of them can be absent.

215 It is unlikely we will even know the true beginning and future of the universe. We can only consider the universe is perpetual. The infinite dynamic of the universe is maintained by the natural principles of the fundamental elements. The underlying logic is shown in the natural phenomena we observe. It is summarized below:

- **Infinite Principle.**

220 The existence of fundamental elements is forever. Matter will forever exist; Energy will never disappear; The action of matter will never stop; And, space always has room for all matter and action. Since the universe has come to existence, it can only continue. Never-ending

- **Independent Principle.**

225 Mass, energy, and space are free and uncommitted to each other. They trade in complete freedom to make the dynamic of the universe.

- **Physical Identity Principle.**

230 Physical matter has it's own identity. From single particle to a large structure of galaxy. Separate elements can be indistinguishable but their own uniquenesses can not be denied.

- **Perfect Recycle Principle.**

235 All three fundamental elements are able to return to original properties. However only space can be considered absolutely perfect. It is the only element remains at it's original condition and location. Matter and energy, on the other hand, are able to return to their original condition, but unlikely back to the original location.

- **Coherent Principle.**

Real world is the extension of atomic world. A structure has to inherit the properties

of it's substructures. Despite the sublevel attributes can be hidden by the structure of the complex compound, however, never disappear. Hence, the phenomena observed in real world can not conflict with atomic world.

- **Complement Principle.**

The environment (or surroundings) is the absolute complement of an object, regardless of it's size, from fundamental particle to large complex structure of galaxy. It has to match precisely and absolutely when it's environment changes, and vise versa. Here the environment is the rest of the universe other than the object itself.

- **Interaction Principle.**

Any object ceaselessly interacts with it's complement. Mass and energy exchange will never stop.

Your advices and corrections are appreciated. Please send your correspondence to: [cres@mail.org](mailto:cres@mail.org)

