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The Digital Space Structure, Superconductor, and Superstar

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Abstract- In the digital space structure, space is digitalized by 1 and 0 for attachment space and detachment space, respectively. A special force field (the short-range extreme force field) can be derived from the digital space structure to generate superconductor at extremely low temperature and superstar at extremely high density. Singularity-free superstar is a model for the collapse of large stars and for GRBs, and as an alternative to black hole. Attachment space allows object to attach to account for rest mass and reversible movement, while detachment space allows no object to attach to account for irreversible kinetic energy. The combination of attachment space and detachment space brings about the three structures: binary partition space, miscible space, orbinary lattice space. Binary partition space $(1)_n(0)_n$ consists of separated continuous phases of attachment space and detachment space to account for quantum mechanics and extreme force field. In miscible space $(1+0)_n$, attachment space is miscible to detachment space without separation to account for special relativity.

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The Digital Space Structure, Superconductor, and Superstar

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Keywords: space structure, quantum mechanics, force fields, superconductor, superstar, black hole, gravastar, GRB, collapsar, singularity.

I. Introduction

In the conventional space structure, space is homogeneous. In the digital space structure, space can be homogeneous or heterogeneous, and is digitalized by 1 and 0 for attachment space and detachment space, respectively. Attachment space denoted as 1 allows object to attach to account for rest mass and reversible movement, while detachment space denoted as 0 allows no object to attach to account for irreversible kinetic energy. Different combinations of attachment space (as 1) and detachment space (as 0) result in different physical phenomena. The conventional space structure cannot explain clearly the important phenomena, such as the differences in measurement between quantum mechanics and special relativity, the origin of superconductivity, and singularity in black hole. These phenomena can be derived directly by the different combinations of 1 and 0 in the digital space structure. A special force field (the short-range extreme force field) can be derived from the digital space structure to generate superconductor at extremely low temperature and superstar at extremely high density. The extreme force fields are manifested as the bonds among electrons in superconductor, as the bonds among atoms in superfluid, and as the bonds among all materials in superstar. Singularity-free superstar is a model for the collapse of large stars and for GRBs (gamma-ray bursts), and as an alternative to black hole. In Section II, the digital space structure and superconductor are described. In Section III, various astronomical phenomena, such as neutron star, supernova, collapsar, GRB, and pair instability supernovae are described. In Section IV, superstar as a alternative to black hole is explained.

II. The Digital Space Structure and Superconductor

The digital space structure [1][2][3] consists of attachment space (denoted as 1) and detachment space (denoted as 0). Attachment allows object to attach, while detachment space allows no object to attach. Attachment space attaches to object permanently or reversibly. Detachment space detaches from the object at the speed of light. Attachment space relates to rest mass and reversible movement, while detachment space relates to irreversible kinetic energy. Different stages of our universe have different space structures[4].

The transformation between mass (massive particle) in attachment space and kinetic energy (massless particle) in detachment space is through the scalar Goldstone boson. For example, massive

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particles with n units of attachment space, denoted as $(1)_n$, are converted into massless particles with n units of detachment space, denoted as $(0)_n$ through the Goldstone bosons. The addition of the Goldstone bosons to massless particles in detachment space results in massive particles in attachment space, while the removal of removal of the Goldstone bosons in attachment space leads to massless particles in detachment space.

$$massive\ particles\ in\ (1)_n \xleftarrow[\text{boson}]{+Goldstone} massless\ particles\ in\ (0)_n$$

$$massive\ particles\ in\ (1)_n \xrightarrow[\text{boson}]{-Goldstone} massless\ particles\ in\ (0)_n$$

The Goldstone boson provides the longitudinal degree of freedom for massive particle in attachment space. The Goldstone boson itself is a zero-energy virtual particle by taking energy from and returning energy to the object transformed by the Goldstone boson. The Goldstone boson in the Standard Model for electroweak interaction is the Higgs boson[5].

The combination of attachment space (as 1) and detachment space (as 0) brings about three different space structures: binary partition space, miscible space, or binary lattice space as below.

$$\underset{attachment\ space}{(1)_n} + \underset{detachment\ space}{(0)_n} \xrightarrow{combination} \underset{binary\ partition\ space}{(1)_n(0)_n}, \quad \underset{miscible\ space}{(1+0)_n}, \ or \ \underset{binary\ lattice\ space}{(1\,0)_n}$$

Binary partition space, $(1)_n(0)_n$, consists of two separated continuous phases of multiple quantized units of attachment space and detachment space. In miscible space, attachment space is miscible to detachment space, and there is no separation of attachment space and detachment space. Binary lattice space, $(1\ 0)_n$, consists of repetitive units of alternative attachment space and detachment space.

Binary partition space is the space for wavefunction in quantum mechanics. In wavefunction,

$$|\Psi\rangle = \sum_{i=1}^{n} c_i |\phi_i\rangle$$

Each individual basis element, $|\phi_i\rangle$, attaches to attachment space, and detach from the adjacent basic elements by detachment space. In binary partition space, a basic element contains both attachment space and detachment space. Neither attachment space nor detachment space is zero in binary partition space for a basic element. The measurement in the uncertainty principle in quantum mechanics is essentially the measurement of attachment space and momentum in binary partition space: large momentum has small non-zero attachment space, while large attachment space has low non-zero momentum. In binary lattice space, an entity is both in constant motions as wave for detachment space and in stationary state as a particle for attachment space, resulting in the wave-particle duality.

Detachment space contains no object that carries information. Without information, detachment space is outside of the realm of causality. Without causality, distance (space) and time do not matter to detachment space, resulting in non-localizable and non-countable space-time. The requirement for the system (binary lattice space) containing non-localizable and non-countable detachment space is the absence of net information by any change in the space-time of detachment space. All changes have to be coordinated to result in zero net information. This coordinated non-localized binary partition space corresponds to nilpotent space. All changes in energy, momentum, mass, time, space have to result in zero as defined by the generalized nilpotent Dirac equation by B. M. Diaz and P. Rowlands[6].

$$(\mp\mathbf{k}\partial/\partial t \pm \mathbf{i}\nabla + \mathbf{j}m)(\pm i\mathbf{k}E \pm \mathbf{i}\mathbf{p} + \mathbf{j}m)\exp i(-Et + \mathbf{p.r}) = 0.$$

where E, p, m, t and r are respectively energy, momentum, mass, time, space and the symbols ± 1, ± *i*, ±*i*, ± *j*, ± *k*, ± i, ± j, ± k, are used to represent the respective units required by the scalar, pseudo scalar, quaternion and multivariate vector groups. The changes involve the sequential iterative path from nothing (nilpotent) through conjugation, complexification, and dimensionalization. The non-local property of binary partition space for wavefunction provides the violation of Bell inequalities [7] in quantum mechanics in terms of faster-than-light influence and indefinite property before measurement. The non-locality in Bell inequalities does not result in net new information.

In binary partition space, for every detachment space, there is its corresponding adjacent attachment space. Thus, no part of the object can be irreversibly separated from binary partition space, and no part of a different object can be incorporated in binary partition space. Binary partition space represents coherence as wavefunction. Binary partition space is for coherent system. Any destruction of the coherence by the addition of a different object to the object causes the collapse of binary partition space into miscible space. The collapse is a phase transition from binary partition space to miscible space.

$$\underset{binary\ partition\ space}{(0)_n\,(1)_n} \xrightarrow{collapse} \underset{miscible\ space}{(0+1)_n}$$

Another way to convert binary partition space into miscible space is gravity. Penrose [8] pointed out that the gravity of a small object is not strong enough to pull different states into one location. On the other hand, the gravity of large object pulls different quantum states into one location to become miscible space. Therefore, a small object without outside interference is always in binary partition space, while a large object is never in binary partition space.

The information in miscible space is contributed by the miscible combination of both attachment space and detachment space, so information can no longer be non-localized. Any value in miscible space is definite. All observations in terms of measurements bring about the collapse of wavefunction, resulting in miscible space that leads to eigenvalue as definite quantized value. Such collapse corresponds to the appearance of eigenvalue, E, by a measurement operator, H, on a wavefunction,Ψ.

$$H\,\Psi = E\,\Psi$$

In miscible space, attachment space is miscible to detachment space, and there is no separation of attachment space and detachment space. In miscible space, attachment space contributes zero speed, while detachment space contributes the speed of light. A massless particle, such as photon, is on detachment space continuously, and detaches from its own space continuously. For a moving massive particle consisting of a rest massive part and a massless part, the massive part with rest mass, m_0, is in attachment space, and the massless part with kinetic energy, K, is in detachment space. The combination of the massive part in attachment space and massless part in detachment leads to the propagation speed in between zero and the speed of light. To maintain the speed of light constant for a moving particle, the time (t) in moving particle has to be dilated, and the length (L) has to be contracted relative to the rest frame.

$$t = = t_0 \Big/ \sqrt{1-\upsilon^2/c^2} \;=\; t_0\gamma,$$
$$L = L_0/\gamma,$$
$$E = K + m_0c^2 = \gamma\, m_0\, c^2$$

where $\gamma = 1/\sqrt{1-\upsilon^2/c^2}$ is the Lorentz factor for time dilation and length contraction, E is the total energy, and K is the kinetic energy.

As described in Reference 4, before the beginning of our current universe, the universe contained only attachment space, and at the beginning of the current universe, the 10d particle universe was sliced into six particles: 9d, 8d, 7d, 6d, 5d, and 4d equally by mass. Detachment space (0) involves in the slicing of dimensions. Attachment space is denoted as 1. For example, the slicing of 10d particles into 4d particles is as follows.

$$\underset{10d\ attachment\ space}{(1_{4+6})_m} \xrightarrow{slicing} \underset{4d\ core\ attachment\ space}{(1_4)_m} \quad \underset{6\ types\ of\ 4d\ units\ force\ fields\ in\ binary\ lattice\ space}{\sum_{k=1}^{6}((0_4)(1_4))_{n,k}}$$

where m is for the number of units of core particles, n is for the number of units of force fields, and k is number of types of force fields. The two products of the slicing are the 4d-core attachment space for core particle and 6 types of 4d quantized units for ordinary force fields. The 4d core attachment space surrounded by 6 types of many (n) 4d-quantized units corresponds to the core particle surrounded by 6 types of many small 4d particles. The ordinary force fields are the force fields in binary lattice space.

Unlike quantum mechanics for particle-wave based on the uncertainty principle in binary partition space, ordinary force fields in binary lattice space do not follow the uncertainty principle. The uncertainty principle for quantum mechanics is expressed as follows.

$$\sigma_x\,\sigma_p \;\geq\; \frac{\hbar}{2}$$

The position, x, and momentum, p, of a particle cannot be simultaneously measured with arbitrarily high precision. The uncertainty principle requires every physical system to have a zero-point energy (minimum momentum) greater than zero, and to have a maximum energy equal or less than the energy at the minimum wavelength as the Planck length. The uncertainty principle has non-zero momentum and non-zero wavelength. In terms of the space structure, detachment space relating to kinetic energy as momentum is σ_p, and attachment space relating to space (wavelength) for a particle is σ_x. Neither

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detachment space nor attachment space is zero in the uncertainty principle.

Quantum mechanics for a particle follows the uncertainty principle. It is proposed that at the extreme conditions of absolute zero and infinite density, the binary lattice space for ordinary force fields (electromagnetic, strong, weak, and gravitational force fields) follows the certainty principle $\sigma_x \ \sigma_p = 1/\infty \approx 0$ instead of the uncertainty principle. At absolute zero with infinitesimal movement, all detachment space (momentum) in binary lattice space virtually ceases to exist, so the binary space as the force field collapses into infinite attachment space (wavelength) with infinitesimal momentum, resulting in the inactivation of force field. At infinite density to produce infinite interacting energy (infinite momentum) from the interaction among particles, all attachment space (rest mass) in the binary lattice space virtually ceases to exist, so the binary lattice space as the force field collapses into infinite detachment space (momentum) with infinitesimal wavelength, resulting in singularity as infinite interacting energy.

To prevent the inactivation of force fields at absolute zero and singularity (infinite interacting energy) at infinite density in ordinary force fields requires the presence of the special force fields that follow the uncertainty principle. The special force fields are "extreme force fields" that are in binary partition space. Binary partition space has one continuous detachment space and one continuous attachment space. The binary partition space for extreme force fields follows the uncertainty principle. Neither detachment space nor attachment space is zero in the binary partition space. To follow the uncertainty principle, extreme force fields have non-zero momentum and non-zero wavelength to prevent the inactivation of force field at absolute zero and singularity (infinite interacting energy) at infinite density, respectively.

At the critical temperature above absolute zero and the critical extreme density below infinite density, extreme force fields emerge in between particles and their ordinary force fields (electromagnetic, strong, weak, and gravitational force fields) to prevent the inactivation of force fields at absolute zero and singularity (infinite interacting energy) at infinite density in ordinary force fields as follows.

$$\underset{\text{core particles}}{\begin{pmatrix}1\end{pmatrix}_m} \quad \underset{\text{ordinary forces in binary lattice space}}{\sum_{k=1}^{k}\left(\begin{pmatrix}0\end{pmatrix}\begin{pmatrix}1\end{pmatrix}\right)_{n,k}} \xrightarrow{\text{extremely low temperature or high density}} \underset{\text{core particles}}{\begin{pmatrix}1\end{pmatrix}_m} \quad \underset{\text{extreme forces in binary partition space}}{\left\{\sum_{k=1}^{k}\begin{pmatrix}0\end{pmatrix}_{n,k}\begin{pmatrix}1\end{pmatrix}_{n,k}\right\}} \quad \underset{\text{ordinary forces in binary lattice space}}{\left\{\left(\sum_{k=1}^{k}\left(\begin{pmatrix}0\end{pmatrix}\begin{pmatrix}1\end{pmatrix}\right)_{n,k}\right\}}$$

where m is for the number of units of core particles, n is for the number of units of force fields, and k is number of types of force fields. The whole system of core particles, extreme force fields, and ordinary force fields never reaches absolute zero and infinite density. Extreme force fields do not change the normal properties of ordinary force fields in the same system.

All extreme force fields are identical and short-range, and are the dominant force fields over ordinary force fields in the interior of core particles, such as superconductor and superfluid. In the BCS theory of superconductivity [9], the superconducting current is explained as a superfluid of Cooper pairs, pairs of electrons interacting through the exchange of phonons. In the explanation by the extreme force, the Cooper pairs correspond to pairs of electrons interacting through the exchanges of extreme force bosons. The overlapping (connection) of two extreme bosons from two different sites brings about the "extreme bond". The product is the "extreme molecule". Therefore, at extremely low temperature, the extreme force fields are manifested as the bonds among electrons in a superconductor and as the bonds among atoms in superfluid.

The extreme force field is incompatible to the ordinary force field. The incompatibility of the extreme force field and the ordinary force field manifests in the Meissner effect, where superconductor repels external magnetism. The energy (stiffness) of external magnetism can be determined by the penetration of ordinary force field into extreme force field as expressed by the London equation for the Meissner effect.

$$\nabla^2 H = -\lambda^{-2} H$$

where H is an external ordinary force field (magnetism) and λ is the depth of the penetration of magnetism into the extreme shell.The Meissner effect is explained by the outward pressure of the extreme force fields to eject applied magnetic fields from the interior of the superconductor as it transitions into the extreme force fields at nearly absolute zero temperature.

III. Neutron Star, Supernova, Collapsar, GRB, and Pair Instability Supernova

The formation of neutron star involves the core collapse of a large star. When a star with the initial mass of about 8 to 25 solar masses depletes its nuclear fuel, it has no outward radiation pressure to support its bulk. The core of the star collapses into a neutron star by fusing electrons and protons into neutrons, sending out huge numbers of neutrons. The neutrino shock wave from these neutrinos causes a violent expulsion of the surrounding material, resulting in supernova [10]. The collapse in terms of the compression from a large size progenitor to a very small neutron star leads to a fast-rotating neutron star with a high angular momentum and a strong magnetic field.

Gamma-ray bursts (GRBs) are the flashes of focused gamma rays associated with extremely energetic explosions that have been observed in distant galaxies. The energy of a GRB is approximately equal to turning a star like the Sun into pure energy. GRB can be explained typically by collapsar (collapsed star) [11] that refers to a specific model for the gravitational collapse of a fast-rotating star, resulting in a stellar mass black hole.

In the collapsar model, when a star with initial mass about 25 to 90 solar masses collapses into a fast-rotating black hole, the black hole immediately begins to pull in more stellar material, and very quickly a rotating disk of material as black hole accretion disk (BHAD) forms. The inner portion of the disk spins around the superstar at near light speed. With rotating conducting fluids, the BHAD creates a strong magnetic field. Because the inner portion of the BHAD is rotating more quickly than the outer portion, the magnetic field lines twist violently. This causes a jet of material to blast outward at almost the speed of light perpendicularly to the BHAD. The jet contains matter and antimatter in the form of electrons, positrons, and protons. The gamma rays are produced by the "internal shocks" as the collisions of the shells of matter and energy pushed by the jet.

One of the problems in the collapsar model of GRB is to explain how some gamma-ray bursts may convert as much as half or more of the explosion energy into gamma-rays [12]. Another problem in the collapsar model of GRB is to explain the complexity of the light curves of GRBs [13]. The duration of observable emission can vary from milliseconds to tens of minutes. The numbers, the shapes, and the intensities of the peaks in the light curves vary. No two light curves are identical.

A hypernova [14] is a type of supernova with energy much higher than standard supernovae. One of the models for hypernova is pair instability supernova. Pair-instability supernova occurs in stars with an initial mass range from around 130 to 250 solar masses. The stellar core is occupied by gamma rays whose outward pressure keeps the star from collapse by the inward gravity. Electron-positron pairs can be created from gamma rays, resulting in the reduction of outward pressure by the decrease of gamma rays. This outward pressure drop leads to a partial collapse, resulting in an accelerated thermonuclear burning in a runaway thermonuclear explosion which blows the star completely apart without leaving a star remnant behind. The result is a hypernova.

For the star with an initial mass of 100 to 130 solar masses as in Eta Carinae [15], the partial collapse is not large enough to cause a runaway thermonuclear explosion. The thermonuclear explosion to only leads to the ejection of a part of outer layer. The repetition of the partial collapse finally depletes enough mass, resulting in a normal supernova. For a star with an initial mass higher than about 250 solar masses, the energies from the thermonuclear reactions are absorbed in photodisintegration.The stellar collapse continues without explosion.

IV. Superstar

Black hole has been a standard model for the collapse of a large star. Singularity in black hole remains contentious. Gravastar (gravitational vacuum star) [16] by P. O. Mazurand and E. Mottola is a model for the collapse of a large star without singularity. In gravastar, quantum effects would change space-time around a collapsing star, initiating a radical phase transition like when liquid water becomes ice, for the infalling matter. For gravastar, the phase transition involves the transformation into a "gravitational vacuum" with an interior de Sitter condensate surrounded by a Bose-Einstein condensate (BEC) bubble, similar to the transformation of a cloud of atoms into one huge "super-atom", a BEC at an extremely low temperature above absolute zero degree. The BEC is prevented from complete collapse by the interior de Sitter condensate exerting a balance pressure outwards on the condensate. A thin phase boundary (shell) for the phase transition is in between the interior region and the exterior region.

In this paper, singularity-free superstar is proposed as a model for the collapse of large stars and GRBs. Superstar is an alternative to black hole and gravastar. When a star with initial mass of about 25 to 90 solar masses collapses, the huge amount of collapsing materials allows the neutrino shock wave to have a weak or no supernova. The stellar collapse by inward gravity continues. The fast-rotating star resulted from the stellar collapse creates a strong magnetic field.The stellar core is a small size gamma ray core. The outward pressure from this small size gamma ray core is too weak to stop the stellar collapse. The stellar collapse continues. When the stellar core reaches the critical extreme density by the stellar collapse, the stellar core is transformed into the super matter core with the extreme force fields that prevent singularity in the ordinary force fields by infinite density.

For a pre-superstar, the ordinary matter region is outside of the super matter core. The phase boundary is in between the super matter core and the ordinary matter region. The phase boundary is for the phase transition from ordinary matter to super matter. As in the Meissner effect to repel applied magnetic field in short-range, the super matter core exerts an outward pressure to repel the phase boundary in short-range with the strength proportional to the total mass of the super matter.

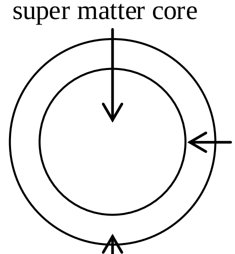

Figure 1 : The pre-superstar

During the stellar collapse, the infalling energy that reaches the phase boundary is stored first as gamma rays in the phase boundary that is repelled by the super matter core. The infalling matter particles that reach the phase boundary are also stored first in the phase boundary. The density in the phase boundary is less than the critical extreme density. The further stellar collapse that increases the density in the phase boundary to the critical extreme density converts the gamma rays and matter particles in the phase boundary into super matter particles that move to the super matter core. The whole conversion process then starts over again. As a result, the stellar collapse increases the super matter core, and decreases the ordinary matter region.

Eventually, the ordinary matter region becomes small, and the inward gravity of the ordinary matter region is too weak to allow the ordinary matter region and the phase boundary to attach to the super matter core that repels the phase boundary. The result is the stellar breakup to detach the phase boundary and the ordinary matter region from the super matter core. The stellar breakup starts from the phase boundary that is repelled by the super matter core. During the stellar breakup, the detached phase boundary and ordinary matter region that are broken into pieces by the fast-rotation become the superstar accretion disk (SAD) as the black hole accretion disk (BHAD) in the collapsar model of GRB. With the additional energy from the gamma rays in the phase boundary, the SAD contains much higher energy than the BHAD. As the BHAD, the SAD produces a jet of material in the forms of electrons, positrons, and protons to blast outward at almost the speed of light perpendicularly to the SAD. The higher energy SAD produces the higher energy jet than the jet from the BHAD. The higher energy jet from the SAD produces more gamma rays from the internal shocks than gamma rays produced from the jet from the BHAD. The different parts of the ordinary matter region in a compact pre-superstar break up nearly simultaneously, so the GRB duration is short [17], and there is only one light peak in the light curve. The different parts of the ordinary region in a large pre-superstar do not break up at the same time, so the GRB duration is long, more than one light peak are in the light curve, and different light peaks are different in intensities and shapes. The short duration GRBs have the average about 0.3 seconds and the long duration GRBs have the average about 30 seconds [18].

The observed high conversion of the explosion energy into gamma rays in a pre-superstar breakup comes from the SAD that contains higher energy than the BHAD. For the light curves of GRBs, the additional complication that is not in the collapsar model is from the complex stellar breakup in a pre-superstar. Therefore, the superstar model of GRB solves the two problems of the collapsar model of GRB for the high conversion of the explosion energy into gamma rays and the complex light curves in GRBs. After the stellar breakup, the remnant is a pure superstar with only the super matter core. A pure superstar with a high gravity hinders the emission of light.For the stellar breakup of a non-rotating pre-superstar, energies are not focused by the magnetic field of a fast-rotating superstar. The stellar breakup is similar to a supernova.

For a star with an initial mass of 100 to 130 solar masses, the stellar core is a medium size gamma ray core that has a strong outward pressure to stop the stellar collapse and to prevent the formation of the super matter core. The core collapse by pair instability leads to a thermonuclear explosion, but not a runway thermonuclear explosion. The thermonuclear explosion leads to the ejection of a part of the ordinary matter region.

For a star with an initial mass of 130 to 250 solar masses, the stellar core is a large size gamma ray core that has a strong outward pressure to stop the stellar collapse and to prevent the formation of the super matter core. The core collapse by pair instability leads to a runway thermonuclear explosion, resulting in a hypernova (pair instability supernova) without any star remnant. For a star with an initial mass of higher than about 250 solar masses, photodisintegration prevents thermonuclear explosion, resulting in continuing stellar collapse to convert the stellar core into the super matter core for a supermassive pre-superstar.

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From outside, black holes, gravastars, and superstars look the same. From inside, they are different in terms of information. The extreme force field that prevents singularity in gravity is an alternative to a gravitational vacuum (with the equation of state $p = -\rho$) in a gravastar. In a gravastar, the gravitational vacuum is located in one specific region. In a superstar, while the extreme force fields alone without other materials are not in one special region. The phase boundary in superstar is an alternative to the phase boundary in gravastar for the phase transition with equation of state $p = +\rho$ between the interior region and the exterior region (with the equation of state $p = \rho = 0$). In a gravastar, infalling matter that hits the phase boundary is converted into energy by proton decay, adding to the energy of the space-time vacuum within the phase boundary. Some information such as baryon number conservation is lost during the transition from the exterior region to the interior region. In a black hole, all information other than the total mass, charge, and angular momentum is lost. In a superstar, all ordinary force fields in the super matter core are recoverable under ordinary condition, so no ordinary information is lost in a superstar.

Black holes and gravastars lose the information about ordinary force fields, while superstars keep all information about ordinary force fields. Quantum mechanics is built on the principle that information cannot be lost. Violating this basic principle of quantum mechanics, black holes and gravastars do not exist. In compliance with this basic principle, superstars exist.

V. Summary

It is proposed that the digital space structure consists of attachment space (denoted as 1) and detachment space (denoted as 0). Attachment space (as 1) allows object to attach to account for rest mass and reversible movement, while detachment space (as 0) allows no object to attach to account for irreversible kinetic energy. The combination of attachment space and detachment space brings about the three structures: binary partition space, miscible space, or binary lattice space, Binary partition space $(1)_n(0)_n$ consists of separated continuous phases of attachment space and detachment space to account for quantum mechanics and extreme force field. In miscible space $(1+0)_n$, attachment space is miscible to detachment space without separation to account for special relativity. Binary lattice space $(1\ 0)_n$ consists of repetitive units of alternative attachment space and detachment space to account for ordinary force fields as force orbitals.

Through the detachment space, a higher dimensional particle in attachment space is sliced into infinitely surrounding a lower dimensional core attachment space, resulting in a particle surrounding by ordinary force fields (gravitational, weak, electromagnetic, and strong) in the form of binary lattice space. At extreme conditions, such as extremely low temperature and high density, the ordinary force field in the form of binary lattice space is transformed into the short-range extreme force field in the form of binary partition space to avoid inactivation and singularity. Unlike the ordinary force fields, the extreme force fields are free of inactivation at extremely low temperature and singularity at extremely high density. The extreme force fields are manifested as the bonds among electrons in a superconductor, as the bonds among atoms in superfluid, and as the bonds among all materials in superstar.The Meissner effect is explained by the outward pressure of extreme force fields to eject applied magnetic fields from the interior of the superconductor as it transitions into the extreme force fields at nearly absolute zero temperature.

When the stellar core of a large star reaches the critical extreme density during the stellar collapse, the star is transformed into a pre-superstar containing the super matter core with extreme force field, the ordinary matter region with ordinary force fields, and the thin phase boundary between the super matter core and the ordinary matter region. The stellar collapse increases the super matter core by converting the infalling ordinary energy and matter from the ordinary matter region into the super matter, and decreases the ordinary matter region. As in the Meissner effect to repel applied magnetic field in short-range, the super matter core exerts an outward pressure to repel the phase boundary in short-range with the strength proportional to the total mass of the super matter. Eventually, the stellar breakup occurs to detach the ordinary matter region and the phase boundary from the super matter core, resulting in GRB to account for the observed high amount of gamma rays and the observed complex light curves in GRBs. Unlike black holes and gravastars that lose information, singularity-free superstars that keep all information exist.

References Références Referencias

1. D. Chung and V. Krasnoholovets, *The Space Structure, Force Fields, and Dark Matter.* Journal of Modern Physics **4A**, 27-31 (2013).
2. D. Chung and V. Krasnoholovets. *The Cosmic Organism Theory*. Scientific Inquiry **8**, 165-182 (2007).
3. V. Krasnoholovets and D. Chung, *The Space Structure, Force Fields and Quantum Mechanics*, International Journal of Anticipatory Computing Systems, 191-197 (2006).
4. D. Chung and V. Krasnoholovets, *The Light-Dark Dual Universe for the Big Bang and Dark Energy*, Journal of Modern Physics**7A**, 77-84 (2013).

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5. D. Chung and R. Hefferlin. *The Higgs Boson in the Periodic System of Elementary Particles*. Journal of Modern Physics **4A**,21-26 (2013).
6. B. M. Diaz and P. Rowlands. *A Computational path to the Nilpotent Dirac Equation*. American Institute of Physics Proceedings of the International Conference of Computing Anticipatory Systems, 203-218 (2003) arXiv:cs/0209026
7. J. S. Bell, *On the Einstein-Podolsky-Rosen paradox*, Physics **1**, 195–199 (1964).
8. R. Penrose, *Wavefunction Collapse as a Real Gravitational Effect*. In: A. Fokas, A. Grigoryan, T. Kibble & B. Zegarlinski, Eds. Mathematical Physics, Imperial College, London, 266-282 (2000).
9. J. Bardeen,L. N. Cooper,and J. R. Schrieffer. *Theory of Superconductivity*. Phys. Rev, **108**(5), 1175–1205 (1957).
10. [1]S. Woosleyand H. T. Janka.*The Physics of Core-Collapse Supernovae*. Nature Physics **1** (3);147–154 (2005).
11. A. L. MacFadyen and S. Woosley. *Collapsars: Gamma-RayBursts and Explosions in Failed Supernovae*. Astrophysical Journal **524**, 262–289 (1999).
12. Y. Fanand T. Piran.*Gamma-ray burst efficiency and possible physical processes shaping the early afterglow*. Monthly Notices of the Royal Astronomical Society **369**,197–206 (2006).
13. J. I. Katz.*The Biggest Bangs*. Oxford University Press, Oxford, p. 37 (2002).
14. G. S. Fraley. *Supernovae Explosions Induced by Pair-Production Instability*. Astrophysics and Space Science **2** (1), 96–114 (1968).
15. A.Kashi and N. Soker. *Possible implications of mass accretion in Eta Carinae*. New Astronomy**14**,11-24 (2008)
16. P. O. Mazur and E.Mottola. *Gravitational Vacuum Condensate Stars*. Proceed. Nature Academy Science, **111**, 9545-9550 (2004)
17. E. Nakar, *Short-hard gamma-ray bursts*, Physics Reports,**442**, 166–236 (2007).
18. C. Kouveliotouet al. *Identification of two classes of gamma-ray bursts*. Astrophysical Journal Letters, **413**, 101-104 (1993)