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A Realistic Method of Interstellar Travel

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ABSTRACT: There is a lot of literature on interstellar travel, including fantasy from the past to the present. However, there seems to be no breakthrough method based on the idea of a realistic new highly advanced interstellar travel. This paper systematically summarizes the papers published by the author so far, and introduces a realistic method of interstellar travel based on the framework of physics centered on the concept. Interstellar travel within human life is not possible as long as we rely solely on propulsion systems. Even if the spaceship moves at the speed of light, it will require an extremely long time. It is said that superluminal speed is simply indispensable to conquer this enormous distance and time. Unfortunately, it becomes an unrealistic expectation due to the limitations of the basic theory and propulsion theory of physics. The reason is that there is a wall of light speed according to Special Relativity, and more there is no propulsion theory that exceeds the speed of light. In fact, the problem of interstellar travel lies in navigation theory rather than propulsion theory. A realistic interstellar exploration made possible by a combination of propulsion theory and navigation theory is introduced.

Keywords: *interstellar travel; star system; Special Relativity; space-time; navigation theory; propulsion theory; wormhole; time-hole; imaginary time; hyper-space.*

I. INTRODUCTION

Until now, interstellar travel to the star system has been considered impossible. For example, regarding the arrival of extraterrestrial life on Earth, there were opinions from experts who called it impossible to find out how extraterrestrial life could come to Earth from stars hundreds to thousands of light-years away. However, such an opinion is due to not being familiar with space propulsion theory and space navigation theory. On the other hand, there are people who call it superluminal speed in simplistic thinking, but there is no propulsion theory that can exceed the speed of light.

As a navigation theory, a method using Special Relativity and a method using a wormhole by space warp have been often said from past to present [1]. Navigation based on Special Relativity is unrealistic because it causes the Urashima effect (twin paradox) and is like a one-way ticket to the star system.

Further, since the size of wormhole (~10^{-35}m) is smaller than the atom (~10^{-15}m), and the size is predicted to fluctuate theoretically due to instabilities, space flight through the wormhole is technically difficult. Also, it is unknown how to go to the star system and how to return to the Earth.

A combination of space propulsion theory and space navigation theory is indispensable for interstellar travel to a realistic star system. Such concepts and theories are rarely found so far. Since there is no theory in the framework of physics so far, it may be inevitable that negative people will have such an opinion. Below, we will introduce space propulsion and space navigation that are realistic for interstellar travel.

(In this paper, the concept is prioritized and the explanation by mathematical formula is omitted. See References for a detailed explanation using mathematical formulas [2 - 12])

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II. PROBLEM FOR INTERSTELLAR TRAVEL

Interstellar travel within human life is not possible as long as we rely solely on propulsion systems. Even if the spaceship moves at the speed of light, it will require an extremely long time. It is said that superluminal speed is simply indispensable to conquer this enormous distance and time. In this way, the superluminal speed is often expected simply, but unfortunately it becomes an unrealistic expectation due to the limitations of the basic theory and propulsion theory of physics. The reason is that there is a wall of light speed according to Special Relativity, no propulsion principle can exceed the speed of light, and there is no energy source as a power source to accelerate to the speed of light. Special Relativity works correctly in real space, and matter cannot cross the speed of light barrier, that is, there is no propulsion theory that exceeds the speed of light. Even with the most advanced field propulsion system, the speed of light cannot theoretically be exceeded, and the limit is up to the quasi-speed of light near the speed of light.

A new navigation theory, not a propulsion theory, is indispensable for star system exploration, which requires a light-year unit cruising range. Navigation by Special Relativity is well known as this type of navigation theory, but it is useless and unrealistic navigation due to the extreme time difference between Earth time and spaceship time. This is well known as the Urashima effect (twin or time paradox). Even if it takes a few years to reach the target star, when you return to your hometown, hundreds to thousands of years have already passed on Earth, so it is a different era, and there are no friends or acquaintances. It's literally a one-way ticket space trip. In fact, the problem of interstellar travel lies in navigation theory rather than propulsion theory. Realistic interstellar exploration is made possible by a combination of propulsion theory and navigation theory.

III. REALISTIC INTERSTELLAR TRAVEL METHOD

This chapter describes one of the means of realizing space propulsion and space navigation that travels to the galaxy far away. It is not a fantasy, but a content that shows the possibility in the framework of physics that has already been established. The distance to the star system is tremendous. It is well known that current propulsion technologies such as chemical rockets are not possible for star system exploration that requires light-years, not to mention planetary exploration in the solar system. In order to overcome the limits of interstellar space travel, research and development of new propulsion theory and navigation theory are indispensable. As one solution, the promising concept of the propulsion mechanism of the space drive propulsion theory which is a typical example of field propulsion, and the hyper-space navigation theory (time hole) obtained by space-time with the characteristics of imaginary time are introduced.

The propulsive force (thrust) of the spaceship utilizes the proximity action of the field caused by the interaction between the space-time around the spaceship and the spaceship itself, and the spaceship is propelled against the space-time continuum structure. On the other hand, interstellar travel using Special Relativity is well known as a navigation theory in Japan, but it is an unrealistic navigation theory. This is because there is an extreme time gap between Earth time and spaceship time. This is a well-known phenomenon as the Urashima effect. Even if it takes several years to reach the target star, hundreds or thousands of years have passed when it returned to its home Earth. Here Earth in another era and there is no one who knows us, it's literally a one-way ticket space trip.

Also, space warp navigation using wormholes based on General Relativity is well known [1]. Concerning the wormhole, regrettably, since the size of wormhole (~10^{-35}m) is smaller than the atom, and moreover the size is predicted to fluctuate theoretically due to instabilities, space flight through the wormhole is difficult technically. And it is unknown where to go and how to return. Moreover, since the solution of wormhole includes a singularity, this navigation method theoretically includes fundamental and technical problems: it is reported from numerical calculation that the wormhole solution considered by Thorn is an unstable solution. Furthermore, it is premised on the existence of negative energy with high density (about the center of a neutron star) which is difficult with the current technology, and it is completely unknown how to go through the wormhole or where the exit is.

Fig.1 shows such a realistic method for the interstellar travel using Hyper-Space navigation system (i.e., Time Hole). In order to reach the target star, the starship which left the Earth at a velocity of approximately 0.1c to 0.2c moves and escapes completely from the Solar System (with Fig.1). After that, the starship is accelerated to nearly the speed of light in Real-Space and plunges into Hyper-Space at point "A". In Hyper-Space, the time direction is changed to the imaginary time direction and the imaginary time direction is at right angles to real time. The course of starship is in the same direction, i.e., x-axis.

With the help of equations, the crew can calculate the range by the measurement of starship time. After the calculated time has just elapsed, the starship returns back to Real-Space from Hyper-Space at a point "B" nearby the stars. Afterward, the starship is decelerated in Real-Space and reaches the target stars. It is immediately seen that the causality principle holds. Indeed, the starship arrives at the destination ahead of ordinary navigation by passing through the tunnel of Hyper-Space (Time Hole). The ratio of tunnel passing time to earth time is 1.4:1 and both times elapse. Hyper-Space navigation method can be used at all times and everywhere in Real-Space without any restrictions to the navigation course.

This implies that Real-Space always coexists with Hyper-Space as a parallel space. The factor that isolates Real-Space from Hyper-Space consists in the usual-experience "real time" of the former as opposed to the "imaginary time" characterizing the latter. And each space is isolated by the potential barrier.

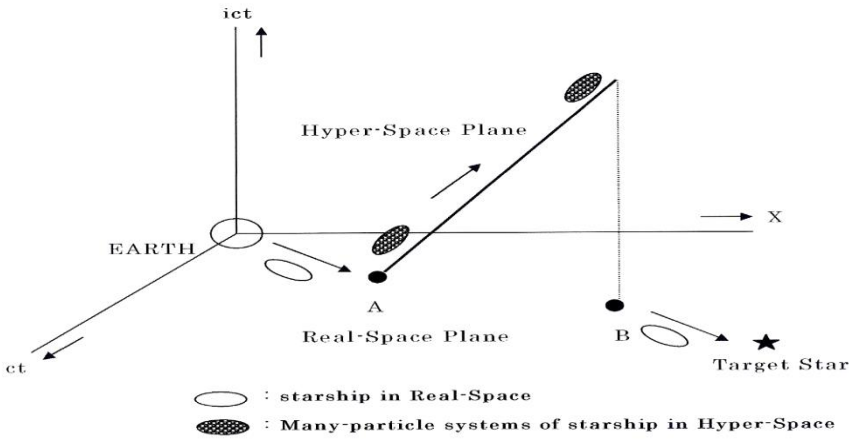

Fig.1 Interstellar travel to the star.

In general, in case that a diverse two kinds of phase space coexist or adjoin, a potential barrier shall exist to isolate these two kinds of phase space. Starship shall overcome the potential barrier by some methods. One and only difference is either real time or imaginary time.

Concerning a concept on technical method of plunging into Hyper-Space and returning back to Real-Space, the following study is necessary: 1) Many-Particle Systems for Starship, 2) Wave function of Starship by Path Integrals, 3) Quantum Tunneling Effect, 4) Reduction of Wave function, 5) Starship Information Content Restoring.

The above-mentioned hyper-space navigation can be freely performed at any time in any place of real space, and there is no restriction. Starship navigation is free to fly to the destination with the intended path and time, unlike navigation using a wormhole that does not know where to go and where to return. Furthermore, we may say that the present theoretical limitation of interstellar travel by Special Relativity is removed. The Hyper-Space navigation theory discussed above would allow a starship to start at any time and from any place for an interstellar travel to the farthest star systems. The whole mission time is within human lifetime.

As described above, Hyper-Space navigation system requires two types of propulsion systems. One is a propulsion system capable of accelerating the starship to the quasi-light speed in a short time. The other is an interstellar propulsion system for Hyper-Space navigation that rushes into the Hyper-Space after achieving the quasi-light speed and jumps out of the Hyper-Space into the Real-Space. It is essential that the starship is equipped with these two types of propulsion engines. Their propulsion engines are named as field driver, that is, space drive propulsion engine using in Real-Space, and interstellar propulsion engine using between Real-Space and Hyper-Space. Interstellar propulsion engine is fine grained engine making the many-particle system of starship to jump over barrier and enter Hyper-Space.

The practical a journey to the stars combines propulsion theory with navigation theory as shown in Fig.2.

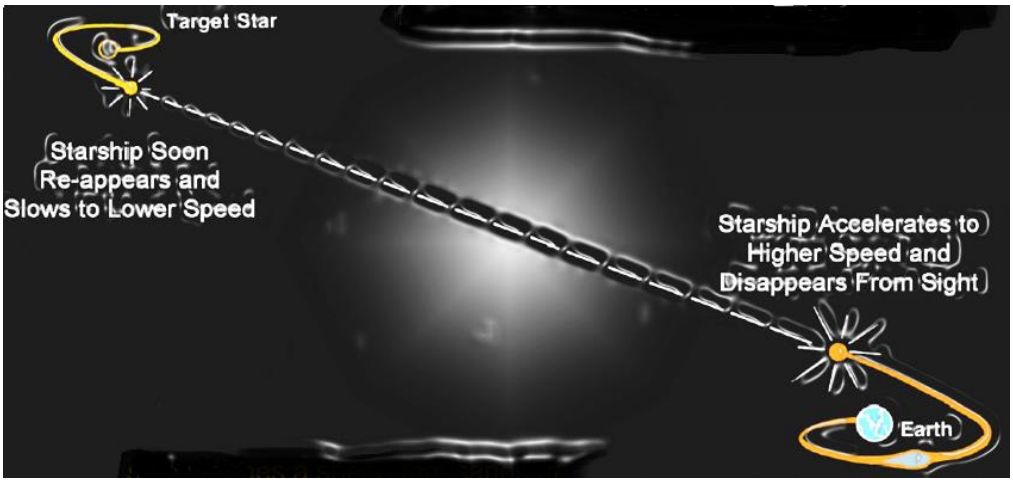

Fig.2 Practical a journey to the stars (H.D. Froning [2, 9]).

Starship accelerates away from the Earth, disappears from view after entering Hyper-Space, and re-appear after Hyper-Space navigation. But during these Hyper-Space navigation, the starship effectively jumps over space-time and travels tremendous distances, effectively reaching billions of times the speed of light. Starship flight can also be viewed from the perspective of an Earth observer who is watching a starship fly away – accelerating in the direction of its target (a planet in another solar system) and then vanishing from sight as its initial acceleration ends. The starship then re-appears after Hyper-Space navigation - at the speed it disappeared. But the starship is now suddenly 400 light-years away - very near to its destination. By plunging into Hyper-Space featuring an imaginary time (i.e., Imaginary Time Hole), the starship detours the imaginary time tunnel, apparently exceeds the speed of light.

Finally, we compare the navigation features of the wormhole and the time-hole as shown in Table-1.

Both navigation methods allow interstellar travel in a short period of time, but the features of the navigation, theoretical and technical issues are different.

Table-1

	Wormhole	Time-hole
method	Fig.3	Fig.4
Features of navigation	★Wormhole method is unknown where to go and how to return. ★Wormhole location unknown. ★Wormhole navigation cannot be used anytime and anywhere; Limited navigation.	★ Hyper-Space navigation (Time -hole) method can be used at all times and everywhere without any restrictions on the navigation course .
Disadvantage	★ Size of wormhole is smaller than the atom, i.e., ~10^{-35}m and moreover the size is predicted to fluctuate theoretically due to instabilities. ★ Solution of wormhole includes a singularity, this navigation method theoretically includes fundamental problems . ★Energy necessary to expand wormhole size.	★Real-Space always coexists with Hyper-Space as a parallel space. Each space is isolated by potential barrier. One and only difference is either real time or imaginary time . ★Nothing in particular: TBD

In contrast to this, as described above, a plunging into Hyper-Space characterized by imaginary time would make the interstellar travel possible in a short time. We may say that the present theoretical limitation of interstellar travel by Special Relativity is removed. The Hyper-Space navigation theory discussed above would allow a starship to start at any time and from any place for an interstellar travel to the farthest star systems, the whole mission time being within human lifetime (Fig.1, Fig2).

<Supplemental explanation>: Three Ways to the Interstellar Travel

Three methods are considered to reach the star rapidly. The basic principle is the following equation which is known to every one:

$$L_{star} = V_{starship} \times t$$

where, L_{star} is the distance to star, $V_{starship}$ is the speed of starship, t is the time.

The distance to a stellar system "L_{star}" is enormous. An extremely long time is required, even if the starship would travel at the speed of light "c".

To reach the star rapidly, three parameters, such as "speed", "distance" and "time" shall be controlled.

1). **<Change speed>** $L_{star} = (nc) \times t$

where, "nc" is n-fold increase in speed of light "c". Here, n is real number greater than 1.

There is no propulsion theory exceeds the speed of light, moreover, Special Relativity restricts the maximum speed to the speed of light; therefore, this method is impossible.

2). **<Change distance>** $\frac{L_{star}}{n} = c \times t$

The so-called "wormhole" is utilized. By using wormhole, shorten the distance as $L_{star} / n \approx a\ few meters$, as shown in Fig.3. For example, one meter in a wormhole corresponds to a few light years in actual space.

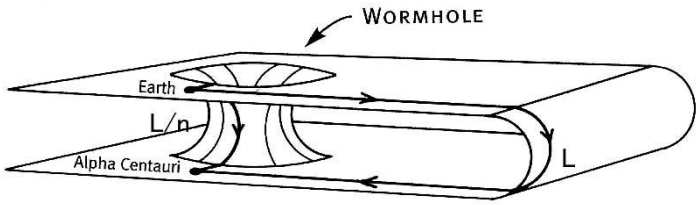

Fig.3 A wormhole creates a shortcut from Earth to Alpha Centauri.

3). **<Change time>** $L_{star} = c \times (nt)$

Hyper-Space featuring an imaginary time (i.e., Imaginary Time Hole): The time "t" in an imaginary time hole is equivalent time of n-fold time in actual space, as shown in Fig.4.

For example, one second in an imaginary time hole corresponds to one million seconds in actual space.

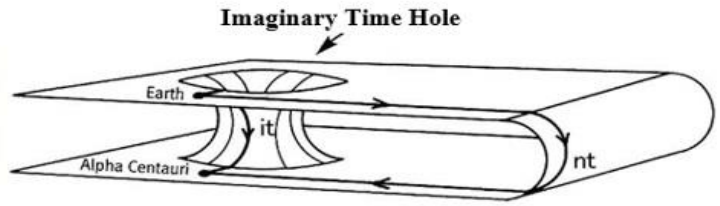

Fig.4 An Imaginary Time Hole creates a shortcut from Earth to Alpha Centauri.

IV. CONCLUSION

Combined field propulsion theory and new navigation theory based on physical structure of space time were introduced as the means of realistic galaxy travel. For galaxy exploration, navigation technology such as a wormhole that bypasses the wall of light speed is indispensable. Hyper-space navigation theory for jumping light barriers was explained.

The promising concept of space drive propulsion theory, which is a representative example of field propulsion, and hyper-space navigation theory (time hole) obtained by Hyper-Space characterized by imaginary time are indispensable. The propulsive force of the starship is a pressure thrust that arises from the interaction of space-time around the starship and the starship itself; the starship is propelled against the space-time continuum structure.

In this way, not only the propulsion theory but also a new navigation theory is indispensable for exploring star systems that require a cruising range of light years. Realistic star exploration can be realized by combining propulsion theory and navigation theory.

A systematic book entitled "STAR FLIGHT Theory: By the Physics of Field Propulsion" containing the detail contents will be useful [10].

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