THE ARRIVAL OF THE GREAT FILTER AND THE FERMI PARADOX

DANIELE ZAMORI

ABSTRACT: The purpose of this paper is to seek an explanation to the following questions: “What is the Great Filter?” and “When it will arrive?”. Creating a theoretical model capable to provide an objectively valuable solution over those issues, it is also possible to hypothesize a valid solution for the Fermi paradox: “Where is everybody?”. The ultimate aim of this theory is to give a solution using only the facts we can see and evaluate, finding a logical path that could give a full solution, and to raise awareness to the notion that we have of technological developement.

1 INTRODUCTION

“Where is everybody?” a deceptively simple question gave birth to one of the most mesmerizing and challenging trouble of the physics and humanity. The cryptic essence and lack amount of information known to us, render this paradox extremely flexible and open to lots of different solutions. Several theories have been made trying to solve this existential enigma. Thereby, what makes this theory different from others? In my humble opinion, the key to understanding and solving the Fermi paradox, is in the definition of the Great Filter[1] itself.Through that we could build a hypothesis regarding our – percieved – loneliness, and defining what life is we could conceive what may cause the arrival of the Great Filter. Explaining the underlying reason to the preparation of the civilization to its collapse, since their birth, we could explain the reason why we have no contact with the extra-terrestrials and why it is impossible to assume the non-existance of other species in the Universe.

2 MODEL

Having to give a solution to the Fermi Paradox, we should first conceive a proper definition of the Great Filter. In order to do that we need, primarily, to examine the concept of life. In a particular way we need to evaluate when a species is defined as intelligent, and what are the implications of the technological developement – indicated by Td – on the preservation – indicated by P – of a civilization.

2.1 Life

Let’s start with life; the *circle of life* teaches us that everything has a beginning and an ending. During this course the life of everyone is defined by sequential events. Those events will lead to different kind of situations, which will require different choices. Those choices will define the course of the life of any individual. The sum of the lives of the individuals will lead to the life of the society, which will establish what kind of civilization we are. If the sum of events that happens to the individual is equal to the events of the mass caterers, this means that the events in general will shape life. This definition allows us to introduce the following formula $L=\sum_{\vec{E}g=1}^{\infty}\vec{E}g\cdot\frac{S}{D}$ (f.1) – it is

important to emphasize that this formula works only as a visual concept for what is said before -. This formula defines the variable L equal to the sum of the general events **Eg** – tending to infinite -, multiplied for the ratio between the situations(S) and the decisions(S). The general events(Eg) are closely influenced by the integral among the positive events(Ep) and the negative events(En), formalising that we could have $\vec{Eg} = \int_{\vec{En}}^{\vec{Ep}} d\,\vec{E}$ (f.2). For every event taken, during our lives, corresponds an outgrowth $\forall E \exists C$ which will be used to map out the path that will establish our life and our Universe line. If we think about it, life is dotted with everlasting choices and branches and do not choose is a choices to. As life is an ongoing process of decision, even others species, if alive, shall serve the same outcome.

2.2 Intelligence

Now that we have seen the concept of life, we need to define the notion of intelligence. To do that it is necessary an example with our world. There are a lot of species on our planet, but, beside that, we are the smartest one. So, what exactly qualifies us as the smartest species in the world? To respond to the demand we need to take into consideration several factors. First of all, we know that the other species are prey of their instincts, while we use our intellect with the ultimate aim to improve us continually, and, meanwhile, to preserve our species. This assumption could be summarised through such formula $K = P \cdot Td$ (f.3). That equation could summarize the entire role of an intelligent species, which is to mantain the variable **K>0**. It would be equal to the product between the preservation – indicated by P – , which would indicate the capability of a civilization to not undermine their livelihood, and the technological developement – stated by Td - , which would enclose into itself the number of phases that a spcecie has had to make during their evolutionary process $\sum_{i=0}^{\infty} P_i$ (f.4). The technological developement and the preservation pursue likewise two distinct process. The first one would see them directly proportional $P \propto Td$. The second one would propose them as inversely proportional $P \propto \frac{1}{Td}$. This happens since if the technological developement increases, the risks related to the developement will increase with it. If we wanted to graph this report, we could consider the function of the *Gaussian curve*[2]. Readjusting the formula in accordance with our variables would result $f(k) = Pe^{-\frac{(k-Td)^2}{t}}$ (f.5). Now there is a problem, the technological developement is not a negative event, but, as an event, brings with it consequences and with them some associated risks $\forall P \exists Rp$. Those risks might damage the whole survival of a species, infact the preservation is subject to the sum of the risks that provides every phase $\sum_{i=0}^{\infty} Rp_i$ (f.6).

3 SOLUTION

Now that we have all the necessary elements, we need to start to hypotesize a potential solution for the Great Filter and the Fermi paradox.

3.1 Are we alone?

First of all, we need to examine the probability that we are indeed alone in the Universe. Thanks to the *Kardašëv scale*[3], we are aware of the fact that there, hypothetically, are several intelligent

civilization in our Universe, classifiable in addition in a sort of hierarchy. For example, according to *Carl Saegan*[4], we are a type 0.71 civilization. By all means, additionally to the hypothetical Kardašëv scale, we should consider the fact that, as the *entropy*[5] implies – which asserts that the chaos is much more common than the order -, it is statistically far more likely that there is a random distribution of intelligent civilizations in the Universe. The possibility that we are the sole currently alive is truthful only in one case and, in addition, it would become erroneus for every case whereby the number of intelligent species, except us, greater than or equal to 1. While, on the other side, asserting that our civilization is only one among many other civilization, would be true for an almost infite number of probabilities and untrue for only one case, namely in the event that there is an overall number of civilizations, besides our, equal 0. Appears obvious how it is nigh on impossible surmise that we are alone throughout the Universe.

3.2 The fallout

Now that we have seen how it is impossibile to envisage that we are alone. We need to assess what are exactly the consequences of the evolutionary process.The *Third law of dynamics*[6] sets out as "for every action, there is an equal and opposite reaction". If we applied this definition thereto what we said for the decisions and the fallout, we could deduce that for every decision exist a consequence $\forall D \exists C$, which could be translated into the following formula $\vec{D}_n AB = -\vec{C}_n BA$ (f.7).

3.3 The Arrival of Great Filter

Using what we talked about in the previous parts, it is now possible to discuss regarding the Great Filter. It is indeed possible to assume that the Great Filter isn't actually an event, but it is a direct consequence of the decision taken by a civilization, with the ultimate aim of evolving. Sure enough, in my opinion, the greatest threat for a species is the species itself. For instance, the decisions that we take during our evolving process, leads to "the risks of phases"(f.6), which menace the preservation of an intelligent civilization. We have a shining example of it in our world with the atomic bomb, which could seriously jeopardise our survival. Not to mention what is happening to our planet with the pollution, itself arising from the decision taken by us, during our technological developement. We can formalize this concept via this formula $\frac{[(\sum_{\vec{E}g=1}^{\infty} \vec{E}g)\cdot\sum_{i=0}^{\infty} Rp_i]}{\Delta t_c}\cdot k = 0$ (f.8), which streamlined is $\frac{L\cdot C_i}{\Delta t_c}\cdot k = 0$ (f.9). This formulation describes the necessary conditions for the arrival of the Great Filter. The product between the fallout and the decisions taken by a species – pertaining to the events and the situations – are devided by Δt_c , indicating elapsed time of a particular species during their evolutionary process. The whole thing has to be multiplied by the variable **K**, which must be >0, because if **K** turns into negative we'll run into the Great Filter. Now, considering an intelligent species, randomly. If they are far more developed than us, they must have passed several times the danger of the Great Filter, insofar it isn't a single event rather a repeated threat. Considering that, an intelligent civilization must do everything possible in order to protect themselves and, in doing so, it would be disastrous for them to seek contact with other unknown civilizations. Therewith, we can assume that, regardless of their date of origin, could exists type 2/3 civilizations, but we can't see them because they must be beyond our reach. This because such an amount of energy and technology should surely be detectable. However, there is another not

insignificant problem, which is the threshold quantities at their disposal. As mentioned before, nothing is infinite and everything has a lifespan, indicated in the formula with Δt_c . Clearly the material problem is solvable using the material of another planet, if necessary, but for doing this we need to be advanced enough to travel between other planets, before we ran out of material, and be prepared enough for interstellar travels. Considering how much it is colplex for a species to develop, an intelligent civilization would hardly risk to nullify all their efforts. A war, for example, would be the dumbest possible thing to do, because there are only two possible endings for an interstellar war: or the specie X wins and the specie Y loss, or vice versa. In the majority of cases, at the end of a war, even who wins loses something. Following this example it is possible to assume that there is the 50% of probabilities to loom into the Great Filter and, in my humble opinion, it is too much of a risk. Regarding the probability that they would not be interested to us, as we do with insects, it is not a completely correct hypothesis. After all, in our planet, there is large number of insects's scholars, concerned to their abilities and their behavior. In the future, for example, there will doubtless be jobs inherent to the study of the story of other planets and, if encoutered, other intelligent species. Furthemore, in case they are watching us, we would certainly be able to perceive them – unless they have technologies beyond any limits, and they could observe us from an immense distance -, at least, we should be able to perceive their existance, as an insect is capable to perceive us, but it is unable to understand us, due to the short intellectual abilities. We must consider one last aspect regarding the developement of a specie, which is the Game *theory*[7] – the greatest result for the individual is reached by the success of the group -. As in economy, the key of the success for the progress of each is the progress of everyone, so we need to start to cooperate among us to maximize the results, instead of line up one against the other.

4 REDUCTIO AD ABSURDUM

In the attempt to give a demostration of the theory, there is the necessity of a "reductio ad absurdum".

4.1 The Great Filter

So, in case I'm wrong, the Great Filter couldn't be definable as a consequence of the developement, but only as an indefinable event – and for that reason it would be unprovable and invaluable -. This can't be possible, because, despite all, the evolutionary process follows in an essential way the decisions taken by the species that is evolving, and those decisions brings necessarily consequences – whether the results are positive or negative -, If not, a discrepancy would be created with the *Third law of dynamics*[6] and should also be in contrast with the formulas and the hypothesis made earlier (f.1) and (f.4). Moreover, in the event that the Great Filter shouldn't exists, we could hypothesize a possible immortality of the species. This is patently absurd, because even on Earth, for example, other civilizations has fallen already, just like other animal species, giving us the definitive proof that it is possible – for external or internal root -.Furthemore we already saw that nothing is neverlasting. We also know that the technological developement brings along with it tremendous consequences, if carelessly performed. We have the proof of that directly on our skin with the wars, the damages and the improper use of resourced created with different purposes.

4.2 The Fermi paradox

Regarding the Fermi paradox, we know – thanks to statistics and the concept of entropy – that it is almost impossible to consider ourselves as the only one in the entire Universe. Primarily, we can say that it is very probable that the civilization are randomly allocated in space. If not, we should be

full of civilization - even close to us – but this is impossible, because we should have noticed them if they were around us. In case they passed before our birth on Earth, this would be almost inconsequential in relation to the paradox, because we couldn't prove it for sure. In case I'm wrong and the species are predisposed to face other spceies. This would mean that they are preapared to risk everything and they would be willing to sacrifice their preservation, but, following our definition of intelligence, this would declassify their status of intelligent specie and they wouldn't be considered as such.

5 CONCLUSION AND DISCUSSION

After all, we can assume that the Great Filter is a developmental direct conseqence of a species, and it will arrive at the time the variable **K** reaches the value of 0. The fermi paradox is linked to the definition of Great Filter and the concept of life and intelligence. We've seen how it is impossible to consider ourselves as the only intelligent species in the Universe – even if we can't see/contact them -, and we have examinated also the reason why it is impossible that we have type 2/3 civilizations around us, because we surely would have noticed them. Assuming that, we can deduce that in case there are intelligent species close to us, they couldn't be much more developed than us – or at least below the type 2/3 -. Said that, the possible answer for the question **"Where is everybody?"** is **"Somewhere, but not here and not now."** A deceptively simple question deserves a deceptively simple answer, in my opinion. Beside all, the goal of this theory isn't only to give a solution for the Great Filter and the Fermi paradox, but also – and most of all – to give a message. We are not alone out there, in the vastness of the Universe it is unduly pretentious to define us lonely. There is so much in the Universe that we wouldn't probably ever know. It is senseless to fight among us. If we don't help ourselves and we don't start to cooperate, who should do that for us? We could continue on this path, or we can change our mindsets and start being the intelligent civilization that we pretend to be. Anyway, one day, the consequences of the decision that we are going to take will arrive, and we must be sure to be prepared.

6 REFERENCES

[1] Robin Hanson, *The Great Filter – Are We Almost Past It?*, 15 september 1998.
[2] *Gaussian curve*, Carl Friedrich Gauss.
[3] Nikolaj Kardašëv, *Kardašëv scale*, 1964.
[4] Carl Sagan, *Carl Sagan's formula*.
[5] *Entropy*, 1824/1861 (first definition).
[6] *Third law of dynamics*, Isaac Newton, 1687.
[7] *Game theory*, Blaise Pascal and Pierre de Fermat, 1654/ John Forbes Nash, Jr., 1994.

*Nessuna organizzazione ha supportato la realizzazione di questa teoria.

7 FORMULARY

$L=\sum_{\vec{Eg}=1}^{\infty}\vec{Eg}\cdot\frac{S}{D}$	(f.1)Formula of Life, which describe how the life is a sum of events, moltiplicated for the quotient of the situations and the decisions.
$\vec{Eg}=\int_{\vec{En}}^{\vec{Ep}} d\,\vec{E}$	(f.2)Formula of the general events, that describes how they are equal to the integral from the negative events to the positive events.
$k=P\cdot Td$	(f.3)Formula of the status of an intelligent species, with K equal to the product of the Preservation and the Technological developement.
$\sum_{i=0}^{\infty} Pi$	(f.4)The sum of the technological phases, related to the technological developement.
$\sum_{i=0}^{\infty} Rpi$	(f.5)Sum that describes the risks that a species runs in relation to the amount of phases of the technological developement.
$f(k)=Pe^{-\frac{(k-Td)^2}{t}}$	(f.6)Function that describes the Gaussian curve, relative to the Great Filter.
$\vec{D}_n AB=-\vec{C}_n BA$	(f.7)Equation that describes the consequences of the decisions.
$\frac{[(\sum_{\vec{Eg}=1}^{\infty}\vec{Eg})\cdot\sum_{i=0}^{\infty}Rp_i]}{\Delta t_c}\cdot k=0$	(f.8)Formula that describes the moment of the possible arrival of the Great Filter.
$\frac{L\cdot C_i}{\Delta t_c}\cdot k=0$	(f.9)Formula semplified that describes the moment of the possible arrival of the Great Filter.