PROCEEDINGS OF SCIENCE

Frascati Workshop 2017: Concluding Address

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Before I officially conclude this workshop – and far be it from me to attempt more conclusive remarks than those effected by Gennady Bisnovatyi-Kogan, Paul Mason, René Hudec, and Janusz Ziółkowski – I would like to comment on a few highlights coming from our very fruitful week of discussions about *Multifrequency Behaviour of High Energy Cosmic Sources*. I make no pretension of completeness in these brief remarks, but I hope to move the waters of a lake of conformism in which the international scientific community is immersed.

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[†]A footnote may follow.

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1. Introduction

As remarked by Giovannelli & Sabau-Graziati (this workshop), thanks to the new-born field of "exoplanetary science", we could finally prove that the "**Bridge between the Big Bang and Biology**" is not only obviously extant, but can in principle be crossed by the determined traveller. The big problem is how to cross this bridge. In this workshop we discussed the experimental tools for understanding the pillars of this bridge. Everything is smoothly linked in the "magma" of the Universe, from the infinitely small to infinitely big.

It has been remarked that the analogy between human life and its cycle: birth, growth, aging, and death, is exactly the same cycle experienced by all the components of the Universe. Therefore, for a complete understanding of the history of the Universe it is necessary to search through that cycle, namely from the Big Bang to Biology.

2. Some dribbles in science

Thanks to the numerous ground-based and space-based experiments, we have collected a huge amount of experimental data, the analysis of which is extremely difficult. This greatly limits the possibility of reaching a synthesis. In contrast, this immense amount of data generates a production of thousands of scientific articles that only in a few cases lead to a real advance of knowledge.

Science policy, which is now dominating the scientific world, measures the value of a researcher according to: i) the number of "scientific" publications regardless of the real contribution they make to a substantial advancement of knowledge, and ii) the number of citations.

This system foments only the increase of the production of articles at the expense of the synthesis that would be needed, and a chain of "friendly" citations.

Figure 1: The supernova "Livio Gratton" produced remnant-pupils, all of them rather well known within the international astrophysical community. (Giovannelli, 2010).

I remember a repeated suggestion of Livio Gratton – my professor of astrophysics at La Sapienza University of Roma – who felt a true incentive to scientific research: *Favour the quality against the quantity*! And he was completely right. Indeed he generated – like a supernova ex-

pelling heavy elements in the interstellar medium – a number of very famous pupils that pervaded the world of astrophysics. All the readers surely know at least two of them, sketched in Fig. 1.

After $\sim$ 44 years experience about Multifrequency Astrophysics, we can affirm that: there are many problems in performing Simultaneous Multifrequency, Multisite, Multiinstrument, Multi-platform Measurements due to i) objective technological difficulties; ii) sharing common scientific objectives; iii) problems of scheduling and budgets; and iv) political management of science. In our opinion the most critical point is the latter, which is moving on a "slippery ground".

An example of this point is clearly illustrated by the SIXE (**S**panish **I**talian **X**-ray **E**xperiment) (Giovannelli et al., 1993). SIXE was planned as a multifrequency (X-ray, Optical) payload for Long–Term continuous observations of few selected cosmic sources in order to clearly understand the physics governing their behaviour. Later the phase-A of SIXE was completed thanks to a funding of the Spanish PNIE (Plan Nacional Investigación Espacial, being Principal Investigators Jordi Isern and Franco Giovannelli, and Lola Sabau-Graziati as first Co-I (PNIE-CICYT Report, ESP97-1784-E grant).

SIXE was submitted to ASI (Agenzia Spaziale Italiana: Italian Space Agency) in order to ask a funding for sharing the costs of the payload with the PNIE, being the launcher (PEGASUS) provided by Spain. **No answer at all!!!**

After about 25 years from the original idea (Giovannelli, et al., 1993) SIXE papers are still read: up till now more than 1500 readings from all the World (source: Research Gate). It is the most read paper in all INAF Institutes!!!

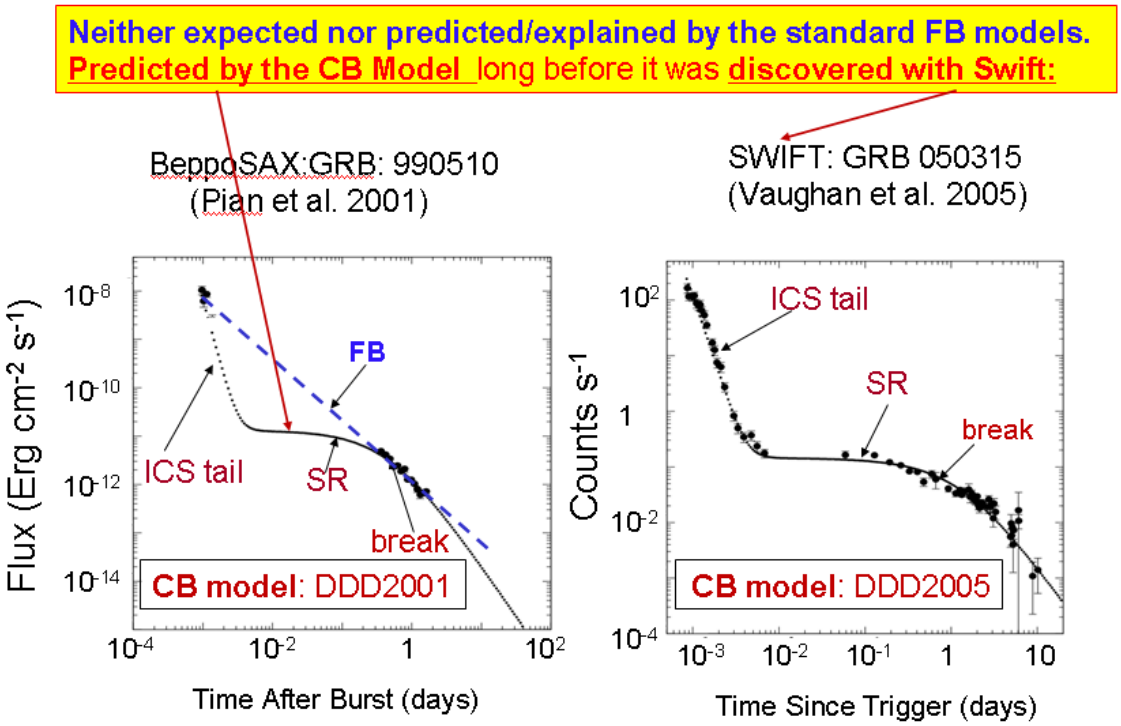

Figure 2: Cannonball model best fitting GRB 990510 and GRB 050315, contrary to Fireball model (adopted from Dar, this workshop).

Arnon Dar (this workshop) proposed again to the attention of the international community

his Cannonball (CB) model for explaining the physics of GRBs. This model was ignored by the community for many years, simply because it was not in line with the "popular" models. Moreover, the original papers about CB model were rejected in spite that it fitted perfectly the data of GRBs, like shown in Fig. 2!

Giovannelli & Sabau-Graziati (this workshop) affirm that the problem of the models for explaining the behaviour of GRBs can be considered closed. The CB model is the best in absolute for the description of the physics governing the GRBs.

I want to stress the importance of the *Great example of synergy between Astrophysics and History* discussed by Giovannelli & Sabau-Graziati (this workshop) for demonstrating that Sedov's formula for determining the age of SNRs can be revisited, thanks to the recalibration of the age of the SNR Vela Jr (Aschenbach, 2016) experimentally supported by an historical document. This is a great spur to search information about cosmic events in historical documents.

With the discovery of "exoplanets" (http://science.nasa.gov/astrophysics/focus-areas/exoplanet-exploration/) the most important questions about the possible origin of life in our Universe became a real scientific question. Indeed, the presence of numerous exoplanets in the vicinity of solar system – within a distance of ~ 0.8 pc – plays an important role in speculating about the possible number of such exoplanets within the whole habitable zone of our galaxy. In the habitable zone of our Galaxy we could expect $\approx 133 \times 10^6$ Earth-like planets (Giovannelli & Sabau-Graziati, this workshop). It is evident that the probability of finding numerous habitable planets becomes very high. Next generation instruments ground– and space–based will provide valuable information about this intriguing problem.

A strong support on the possibility of having numerous habitable planets is coming from the discovery of "usual" presence of water in the universe (Cleeves et al., 2014). The water now present in Earth's oceans, and is present in other solar system bodies, has remained virtually unchanged with respect to that in the interstellar medium. This means that this water has not changed during the process of planet formation. This allows us to understand that the initial conditions that have favored the emergence of life are not unique, i.e. not dependent on the unique characteristics of our solar system. They can, however, be common in space.

An intriguing question about the probability of finding a number of civilization in the Galaxy arises. It is now evident that Drake's formula (Drake, 1962) must be object of a robust revision.

For years, the search for manifestations of extraterrestrial civilizations has been one of humanity's most ambitious projects. Major efforts are now focused on the interception of messages from extraterrestrial civilizations, and the millimeter range is promising for these purposes (Dyson,1960). The Millimetron space observatory is aimed at conducting astronomical observations to probe a broad range of objects in the Universe in the wavelength range 20 μm to 20 mm, including the search for extraterrestrial life (Kardashev et al., 2014, and the references therein).

3. Some reflections

We are going to study $\sim$ 50,000 Clusters of Galaxies (Thomas Boller, this workshop), and we have millions more. We know now more than 4000 planets clearly recognized in the Milky Way (Mullally, 2015). We know the lower limit of the extrapolated number of Earth-like planets in the

habitable zone of our Galaxy that is $\approx 133 \times 10^6$. Thus I can dare to say that we are approaching to the philosophical results obtained by two great free thinkers:

- Siddhartha Gautama also known as Shakyamuni (the sage of Shaka – between the VI and V century B.C.) who exposes a grandiose vision of the universe: through the concept of "major system of worlds", a concept on huge scale that implies both the existence of countless galaxies and the possibility of sentient life on other planets other than our own (from the Lotus Sutra – the central text of Mahayana Buddhism).

- Giordano Bruno (Nola 1548 – Roma 17th February 1600) who was burned alive in Campo dei Fiori by the "Saint Inquisition" because of his thought – summarized in *De l'infinito, universo e mondi* (Giordano Bruno, 1584) (see Fig. 3)– that produced the same conclusions of Siddharta. Moreover he was saying that "*Whether we like it or not, we are the cause of ourselves. Being born in this world, we fall into the illusion of the senses: we believe in what appears. We ignore that we are blind and deaf. Then the fear attacks us and we forget that we are "divine". We can change the course of events*". These philosophical lucubrations were not exactly in agreement with the position of the Roman (Catholic) Church!


GIORDA=
NO BRVNO
Nolano.

De l' infinito vniuerſo
et Mondi.

All' illuſtriſſimo Signor di
Mauuiſsiero.

Stampato in Venetia.
Anno. M. D. LXXXIIII.

[N. 69].

Figure 3: Frontispiece of the original publication of *De l'infinito, universo e mondi* (Giordano Bruno, 1584).

Of course we must wait scientific confirmation for the "alien life". We must wait even more for the discovery of "intelligent life". But, the number of discovered planets is growing very fast. Thus, I can reasonably affirm that the **Universe is full of life**, hoping to avoid to be burned alive like Giordano Bruno.

4. Conclusions

During this fruitful workshop, we hope to have demonstrated once more the "Vulcano Theorem" enunciated in 1984 in my concluding address of the first historical workshop on "Multifrequency Behaviour of Galactic Accreting Sources" (Giovannelli, 1985): **It is possible to develop science seriously even if smiling**.

But, as you probably suspected, this workshop has been organized under peaceful and friendly surroundings, as also shown in Fig. 4, representing one scene of the performance of Anna Lisa and Flavia.

Figure 4: Anna Lisa Amodio (left) and Flavia Giovannelli (right) in a scene of their performance: *Tele-Moon: It all started with the Big Bang*.

In this workshop, the presence of women has been particularly pleasant and intentional as well as the presence of many young colleagues, some of them still PhD students.

This is the age of the youth. Young people do not depend on anyone or draw strength from others. The courage of young people is unparalleled. It fears nothing. The courage of youth is boundless, is the strength to never give up (Daisaku Ikeda, 2001a).

And I would like to remind one famous sentence of Leonardo Da Vinci: *Tristo ? lo discepolo che non supera lo maestro suo!*, that in English is *Grim is the disciple who does not exceed his master!*

And finally, I would like to conclude with few wonderful words of Dr Daisaku Ikeda (2001b), president of the Soka Gakkai International (SGI), and reported in the booklet entitled *For Today and Tomorrow* as the thought of the 30th of May: "*The one who has many friends has greater opportunities for growth. In this way, one both makes society a better place, and lives happier and more satisfied. In all cases, human relations, the inter-personal interaction and communication are of vital importance. We must establish and nurture friendship and contacts with many people, both in our environment, and in society in general. In this manner our life will open up and will flourish*".

We could go back to early childhood when we were as the "Little Prince", who says that One sees clearly only with the heart. What is essential is invisible to the eye (from *The Little Prince* by Antoine de Saint Exupéry, 1943).

The search for the essential is of extreme interest to a large number of men of great learning. These are in agreement with Paul Salahuddin Armstrong, who said in his 2014 talk "*Human Family; Past, Present and Future*", at the "*New Humanity Movement-Event*" (Paul Salahuddin Armstrong, 2014): *Today we travel the world, making connections, doing business, and building relationships in person or online with fellow members of our Human Family from all parts of the Earth. We are becoming more conscious that what happens in one place affects people everywhere. We are not alone... We are not isolated... Only through building bridges of Love and Understanding can we ensure the well-being of everyone in our Human Family*.

The search for the essential is so important that even famous, noble-minded scientists try to attempt the difficult way of the possible convergence of science and life in its more sublime meaning. For instance, Pier Luigi Luisi founded in 1985 the *International Week of Cortona "Science and the Wholeness of Life"*, dedicated to the integration of Scientific Disciplines and Humanities. Later he published the book "*The emergence of Life. From Chemical Origins to Synthetic Biology* (Luisi, 2006) in which he resumed the consecutive stages from prebiotic chemistry to synthetic biology, uniquely combining both approaches. Indeed, the origin of life from inanimate matter has been the focus of much research for decades, both experimentally and philosophically. Friedrich Rolle, a German philosopher and biologist, wrote "*The general reasons for this assumption are so categorical that I have no doubt that sooner or later it will be possible to demonstrate such an assumption in an unambiguous and scientific way, or even repeat the process experimentally* (Rolle, 1863).

In the book "*The Systems View of Life: A Unifying Vision*" (Capra & Luisi, 2014) the authors integrate in a single framework of coherent thought the ideas, models and theories that are the foundation of the systemic vision of life, highlighting its the economic, ecological, political and spiritual implications.

Personally, I would like to reiterate and underscore some fundamental concepts in the book which I completely share.

Life is a network of complex and inseparable relationships that renders the understanding of an individual phenomenon indivisible from the understanding the entire ecosystem in which it occurs. Therefore the answers can not be found by relying exclusively to the scientific method. A "holistic" approach is now required, one that is able to reflect on connectivity, relationships and contexts as well as properties and functions of the individual parts.

The discipline that best reflects the systemic vision of life is ecology, which reconnects the life sciences with the earth sciences and studies the interaction of organisms with each other and

with the surrounding environment. The new ecological science - that has emerged from organismic biology only in the late twentieth century, when the concept of ecosystem developed - is not anthropocentric but eco-centric, that is characterized by the awareness that all living things are tied together in networks of interdependence.

Ecology is the ideal bridge between science and spirituality. In fact, within the systemic view of life, it is essential the concept of balance between science - responsible for the material and technological progress - and spirituality, responsible for the internal growth of individuals and ethical limitations imposed by the excessive consumption of resources of the planet. The balance between science and spirituality determines the welfare of society.

The bridge between the Big Bang and Biology ferries us from the original point to the biologically active side where sentient life and then science start. But to close correctly the “run" of it, it is necessary to cross one bridge more: The bridge between science and spirituality. If this bridge is properly covered, our society will flourish.

Personally, I feel obligated to point out some observations that seem fundamental about the philosophical and social implications of contemporary science. These observations lead to interesting conclusions about the origin of life and self-organization of natural and synthetic systems. These findings are in keeping with the Buddhist view of the universe. It is understood as a living organism being composed of myriads of components all related and interacting with one another. Life can be seen as a system of interconnected autopoietic systems. The organism interacts with the environment in a "cognitive" way. At the same time, the organism "creates" its own environment and the environment allows the creation of the organism. But this is the concept of dependent origin. According to this concept, every phenomenon is the product of the interaction of every other phenomenon in the universe.

The consequence of this view are of extraordinary importance, above all in ethics: it asserts that all living beings and their environment are inextricably linked, and that their essence is not absolute but "of relationship." It leads us to respect every individual being and its inherent rights. In other words, this view leads us to live and act without distinguishing our own happiness from that of others. Ultimately this view leads to the **TOTAL RESPECT OF LIFE** in the most general meaning.

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- Franco Giovannelli - INAF/IAPS, Roma, Italy (Chairperson)
- René Hudec - ASCR/AI, Ondrejov & CTU, Prague, Czech Republic

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- Lola Sabau-Graziati - INTA/DCUCE, Madrid, Spain
- Andrea Santangelo - IAA, Universit?t T?bingen, Germany

- The super-efficient Local Organizing Committee, shown in Fig. 5 (Paolo Persi not present):

- Franco Giovannelli - INAF/IAPS, Roma, Italy (Chairperson)
- Daniela Giovannini - CNR/IBCN, Roma, Italy
- Paolo Persi - INAF/IAPS, Roma, Italy
- Francesco Reale - CNR/ISC, Roma, Italy (co-Chairperson)
- Bruno Luigi Martino - CNR/IASI, Roma, Italy
- Rosa Poggiani - Dpt of Physics, University of Pisa, Italy

Figure 5: Local Organizing Committee of the Frascati Workshop 2017. From left to the right: Franco Giovannelli, Daniela Giovannini, Francesco Reale, Bruno Luigi Martino, Rosa Poggiani.

- The Directors of sponsoring Institutions

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I hope to meet all of you once again during our next Frascati Workshop.

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