PROCEEDINGS OF SCIENCE

Frascati Workshop 2023: Concluding Address

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Before officially concluding this workshop (and it is far beyond my powers to attempt some concluding remarks beyond those already dealt with on the various burning questions presented by Paolo Padovani, Maria Giovanna Dainotti, Janusz Ziółkowski, and René Hudec), I would like to comment on a few highlights coming from our fruitful week of discussions about *Multifrequency Behaviour of High Energy Cosmic Sources - XIV*, without any pretension of completeness.

Multifrequency Behaviour of High Energy Cosmic Sources - XIV - (MULTIF2023)
7-12 June 2023, Palermo, Italy

*Speaker.

PoS(MULTIF2023)086

1. My Personal Comments

During this workshop we have discussed about those experimental tools that have provided a huge amount of data useful for improving our knowledge of the physics governing our Universe. These data are coming from big and small experiments ground– and space–based. Thanks to these experiments we have collected a huge amount of experimental data, the use 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 advancement of knowledge.

From the many talks presented it appears, although often masked, a continuity between the infinitely small to infinitely big. And in this line we have discussed problems of:

- Cosmology: Cosmic Background, Dark Matter, Dark Energy, Clusters of Galaxies, Gravitational Waves.
- Extragalactic Sources: Active Galaxies, Normal Galaxies.
- Gamma-Rays Burst: Experiments versus Theories.
- Galactic Sources: Pre-Main-Sequence and Main-Sequence Stars, Cataclysmic Variables and Novae, Supernovae and SNRs, X-Ray Binary Systems, Pulsars, Black Holes, Gamma-Ray Sources, Nucleosynthesis.
- Science from large area multiwavelength surveys and deep-exposure pointings.
- The Astrophysics with the Ongoing and Future Experiments: Space-Based Experiments, Ground-Based Experiments.

It is important to remark that undoubtedly the advent of space-based observatories has given a strong impulse to astronomy. Starting roughly from the early-to-mid-seventies and over almost all of the electromagnetic spectrum, these observations have continuously surveyed the sky. Figure 1 schematically shows this immense quantity of data coming from all bands of the electromagnetic spectrum, much more numerous than those acquired by optical telescopes since the beginning of their operation. The area shaded in red is roughly proportional to the total amount of data.

We know for sure that "*The Bridge between the Big Bang and Biology*" undoubtedly exists, as discussed in the book edited by Giovannelli (2001). The big problem is how to cross this bridge, and the main question is: *what are the experimental tools for understanding the pillars of this Bridge*?

In order to cross this bridge, as always when we cross a bridge, we must advance slowly, step by step, with continuity, because everything is smoothly linked in the *magma* of the Universe: from the infinitely small to infinitely big, a shown in Fig. 2 (Rees, 1988).

In a more extensive way, the link between different components of the Universe is reported: Fig. 3 (Upper left) a metabolic network of a "simple" bacterium where each point is connected to any other point through the complexity of the network (Capra & Luisi, 2014). Fig. 3 (Upper right) shows the cosmic network (Credit: Andrew Pontzen/Fabio Governato, 2014; see also in (https://it.wikipedia.org/wiki/Cosmologia del plasma). Shandarin, Habib & Heitmann (2010)

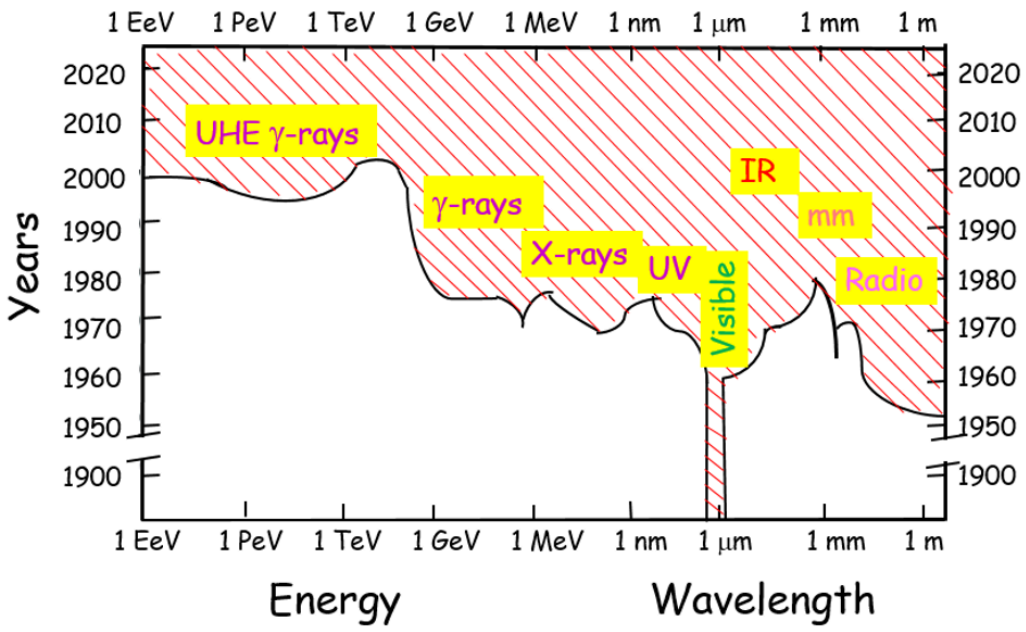

Figure 1: Schematic representation of the amount of data obtained along the electromagnetic spectrum since the beginning of space era (updated from Giovannelli & Sabau-Graziati (2004), after Lena (1988).

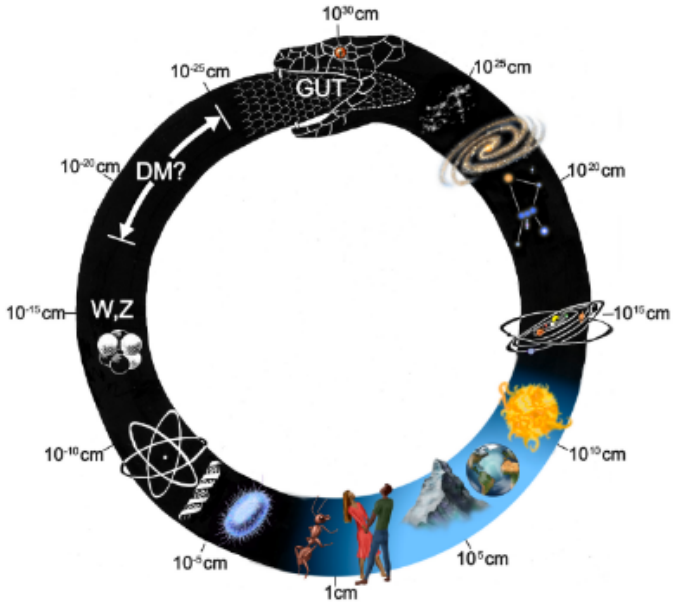

Figure 2: From the infinitely small to infinitely big (adopted from Rees, 1988).

quantitatively specified the underlying mechanisms that drive the formation of the cosmic network. Fig. 3 (Lower left and right) shows the human body network and the human society network, respectively (Capra & Luisi, 2014).

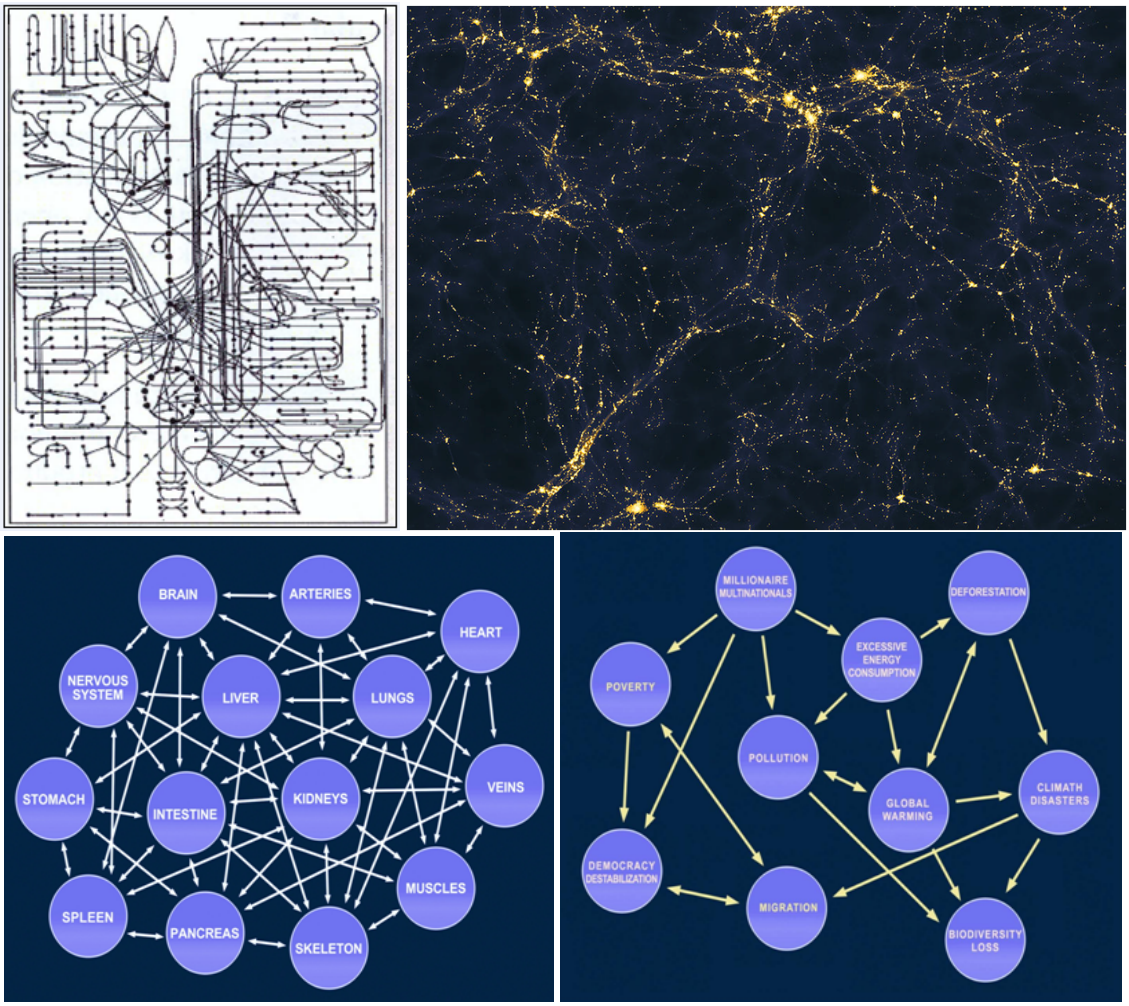

Figure 3: Upper left panel: Section of the metabolic network of a "simple" bacterium (Capra & Luisi, 2014). Upper right panel: the "cosmic network" (Credit: Andrew Pontzen/Fabio Governato, 2014) see also in (https://it.wikipedia.org/wiki/Cosmologia del plasma). Lower left panel: the human body network. Lower right panel: the human society network (Capra & Luisi, 2014); (adopted from Giovannelli, 2023).

Noting that all the components of the Universe are linked to each other in a more or less narrow, we try to find the glue that holds them together seamlessly.

Accretion is a universal phenomenon that takes place in the vast majority of astrophysical objects. The progress of ground-based and space-borne observational facilities has resulted in the great amount of information on various accreting astrophysical objects, collected within the last decades. The accretion is accompanied by the process of extensive energy release that takes place on the surface of an accreting object and in various gaseous envelopes, accretion disk, jets and other elements of the flow pattern. The results of observations inspired the intensive development of accretion theory, which, in turn, enabled us to study unique properties of accreting objects and

physical conditions in the surrounding environment. One of the most interesting outcomes of this intensive study is the fact that accretion processes are, in a sense, self-similar on various spatial scales from planetary systems to galaxies. Figure 4 shows a sketch of cosmic systems where accretion processes occur (Giovannelli & Sabau-Graziati, 2016, after Scaringi, 2015).

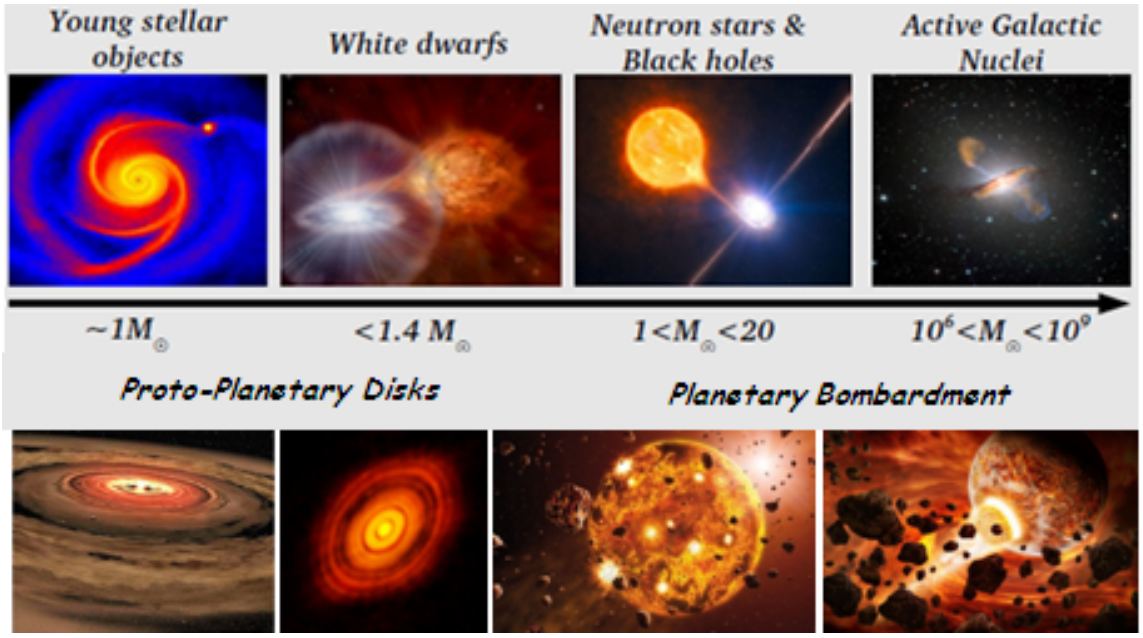

Figure 4: Accretion processes in different cosmic sources (adopted from Giovannelli & Sabau-Graziati, 2016, after Scaringi, 2015).

This fact gives us new opportunities to investigate objects that, by various reasons, are not available for direct study.

Cataclysmic variables (CVs) historically were the first systems that demonstrated the need for studies of the accretion disk processes around white dwarfs (WDs). In fact, these studies began in the early 1960's with the schools of Warsaw (Poland) and Cambridge (UK). However, CVs rapidly lost their primeval importance because of the advent of the first X-ray space experiments that, with their limited sensitivity, were mostly detecting X-ray binary systems (XRBs). These showed abundant X-ray emissions above the thresholds of their detectors. Of course, we now know that these sources emitted brightly thanks to the presence of neutron stars or black holes as companions of the optical low–mass or high–mass stars. The X-ray emission of CVs is about 2–3 orders of magnitude lower than that of XRBs. Thus the bulk of observations of CVs for a long time came from optical and UV regions, and sometimes from IR and occasionally from radio bands.

In the last decades, results coming from the new generation of satellites, especially in the hard X–ray and γ–ray regions, renewed the interest of scientific community on CVs.

Indeed, among the cosmic systems where accretion processes occur, undoubtedly, non-magnetic CVs, intermediate polars and polars constitute the most powerful probe to test our theories of the various modes of accretion. The reason is rather simple: CVs are enough close to us and their processes develop in time-scales relatively easy to be followed and enough energetic to be easily detected. The long term evolution of CV systems accreting at a prohibitive rate has become a hot

topic both in terms of the fate of such systems (all sorts of supernovae) and the microphysics of Eddington and super Eddington mass accretion and mass loss flows. In particular we stress one of the hottest topics in present day astrophysics, namely the progenitors of SN-Ia. This problem is connected with fundamental issues in cosmology. Novae and recurrent novae are the most promising progenitor candidates but so far could not be nailed down.

Following the old classification of CVs, in Fig. 5 it is possible to recognize "Classical Novae" (top panel), "Dwarf Novae" of the U Gem, Z Cam, and SU UMa types (lower three panels) (Ritter, 1992). They are all CVs independently of types, as the different humans depicted, which are of course "humans".

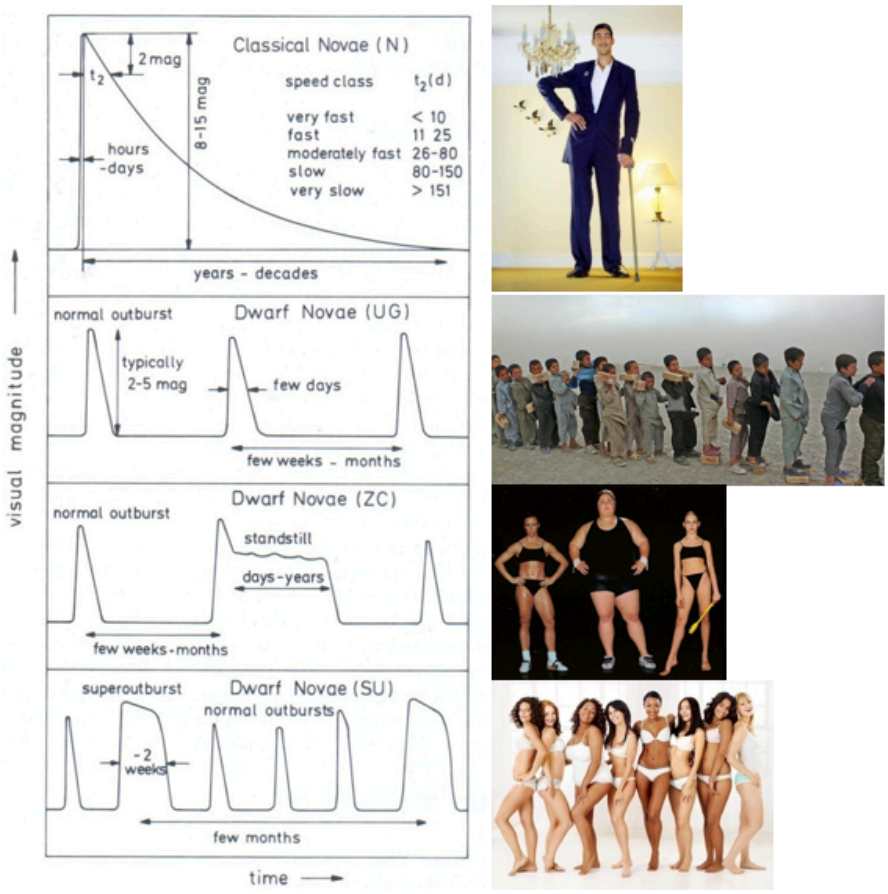

Figure 5: All the Cataclysmic Variables independent of the old classification types (Ritter, 1992) are Cataclysmic Variables, as all the "Humans" independent of their forms are "Humans" (adopted from Giovannelli, 2017).

Therefore, it is necessary to find a method as general as possible to describe the behavior of cataclysmic variables. This can be obtained looking at the Accretion Behaviour and Magnetic Field.

The nature in all its manifestations shows continuity, thus we have to abandon the "convenient method" of thinking everything in "Watertight Compartments" and to go toward a general model for compact accreting stars.

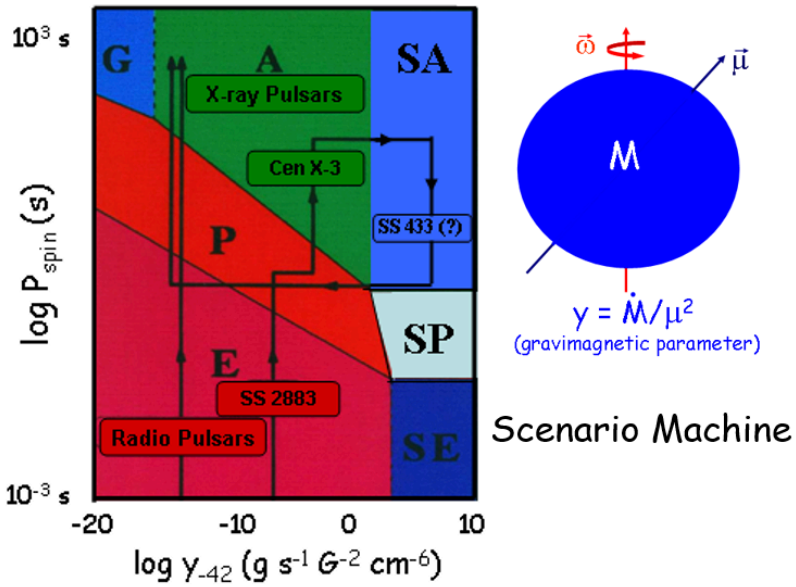

Figure 6: Distribution of magnetic rotators in the plane "Spin Period" – "Gravimagnetic Parameter" (adapted from Lipunov, 1995).

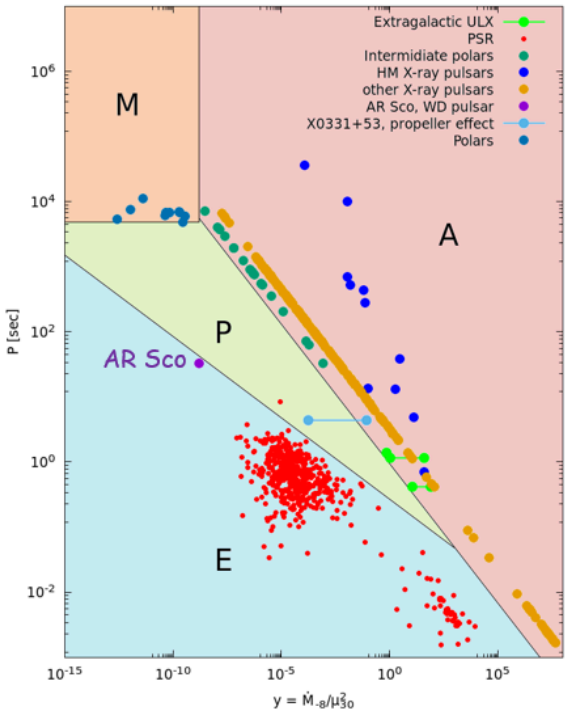

Figure 7: Universal period-gravimagnetic parameters diagram for most of the observed types of neutron stars and white dwarfs. Intermediate Polars are shown in green; X-ray accreting pulsars, are ochre; ULX pulsating sources are in light green; radiopulsars with standard magnetic field ($\sim 10^{12}$ G) on neutron stars are in red, millisecond radiopulsars with low magnetic field ($\sim 10^{8-10}$ G) on neutron stars are in green and Magnetars ($> 10^{14}$ G) are in magenta (adopted from Lipunov, Grinshpun & Vlasenko, 2021).

Such a general model called "Scenario Machine" was developed many years ago by Vladimir Lipunov and collaborators (Lipunov, 1982, 1987, 1991; Lipunov & Postnov, 1988; Lipunov, 1995) and updated by Lipunov, Grinshpun & Vlasenko (2021).

Each compact object is considered as a "gravimagnetic rotator", rotating with $\vec{\omega}$ velocity and with a magnetic moment $\vec{\mu}$, with the axises not necessarily coincident. Introducing a "gravimagnetic parameter" as y = $\dot{M}/\mu^2$, it was possible to construct a Period-Gravimagnetic parameter diagram log P_{spin} vs log y in which all the accreting sources lie, as shown in Fig. 6.

Figure 7 shows the updated Universal Period-Gravimagnetic Parameters diagram for most of the observed types of neutron stars and white dwarfs, Intermediate Polars, X-ray accreting pulsars, ULX pulsating sources, radiopulsars with standard magnetic field ($\sim 10^{12}$ G) on neutron staars, millisecond radiopulsars with low magnetic field ($\sim 10^{8-10}$ G) on neutron stars, and Magnetars ($> 10^{14}$ G) (adopted from Lipunov, Grinshpun & Vlasenko, 2021). In this Period-Gravimagnetic Parameter diagram is reported also the recent detected AR Sco as the first white dwarf-pulsar (Buckley et al. (2017).

2. Something wrong in science?

I would like to remind several observations that apparently could appeared obvious, but unfortunately they are not. Indeed, sometimes theoreticians are tempted to force their models fit to experimental data using too many free parameters. In this way it is possible to fit everything, but often the physics is violated. So, be careful: use very few free parameters with physical meaning.

Woe to discover the umbrella ... or hot water again! For instance, many publications in ApJ report the same results which had appeared many years before in Soviet Literature, and elsewhere.

Never confuse the effect with the cause. There is a general law in the Universe: Cause and Effect. The Cause generates an Effect and NOT vice versa!. X-ray and γ-ray emissions is produced because of accretion of matter onto (compact) cosmic sources... Accretion is a general process, as sketched in Fig. 4.

In my opinion, another critical point in evaluating a researcher's scientific career is linked to the number of publications. This causes a hunt to publish the greatest number of articles regardless of their real contribution to the advancement of knowledge.

And the value of an article is often linked to the number of citations in international literature. This unfortunately gives rise to a series of "friendly quotes".

In my opinion, these two evaluation methods should be drastically revised. In fact, today we are witnessing the presence of researchers who publish more than one hundred articles in a year. This often derives from the researcher's belonging to very large groups involved in large experiments. Common sense leads us to say that a reasonably good scientific paper takes at least about three months to complete. This results in a reasonable upper limit of articles per year of ~ 4. We can add some publications (say ~ 6) in international conference proceedings. Therefore the number of publications where the researcher is directly involved would be $\sim 10 \pm 3$/yr.

Hence the contradiction of evaluating a researcher's career by the number of publications.

In this regard I want to quote a phrase that my Astrophysics professor at the "La Sapienza" University of Rome always said: **favor the quality of the articles instead of the quantity**.

And this phrase came from the mouth of Professor Livio Gratton who with his far-sighted energy and knowledge, similar to the explosion of a supernova, generated a multitude of pupils (like supernova remnants) who became famous. Figure 8 schematically shows the "Livio Gratton Supernova" entering the world its first, second and third generation pupils of science. Certainly the reader of this article will know at least a couple of these disciples.

Figure 8: This is the explosion of Supernova "Livio Gratton" who has expelled a number of "well-known" pupils. Surely each astrophysicist will know at least two of these “students” of Professor Livio Gratton.

To gloss my previous statements on the situation of research in astrophysics, I want to present some graphs that depict, alas, the state of the art on the problem of community publications and the number of authors for each publication, as well as the number of citations of the published articles, referring to Paolo Padovani’s talk during the Frascati Workshop 2019.

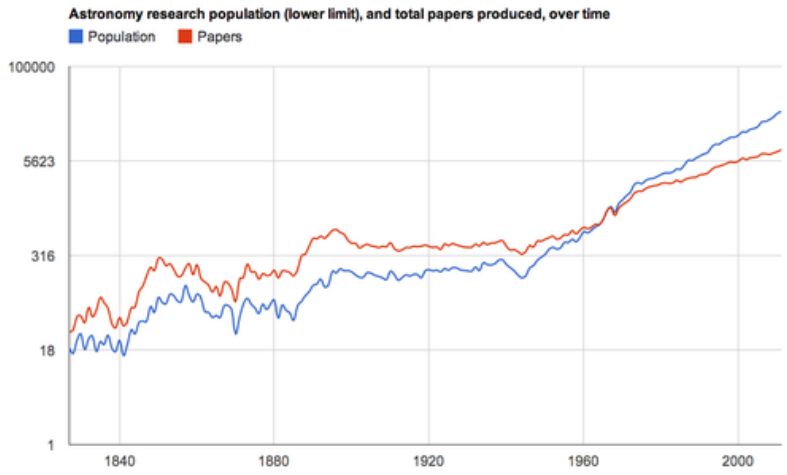

Figure 9: Lower limit of the astronomy research population (blue color) and the total papers produced over time (red color) (https://orbitingfrog.com/2012/08/04/authorship-in-astronomy/).

Figure 9 shows the lower limit of the astronomy research population and the total papers produced over time (https://orbitingfrog.com/2012/08/04/authorship-in-astronomy/).

Starting from around the 1970s, the two curves, which had an almost parallel trend, began to diverge. The number of published works increases less than the number of the researcher population. This fact is highlighted by Fig. 10 where it is clearly seen that the number of publications for each member of the researcher population drops drastically, going from around 2-4 publications/year for each researcher until around the 1960s to approximately 0.3 publications/year, starting from the first decade of 2000.

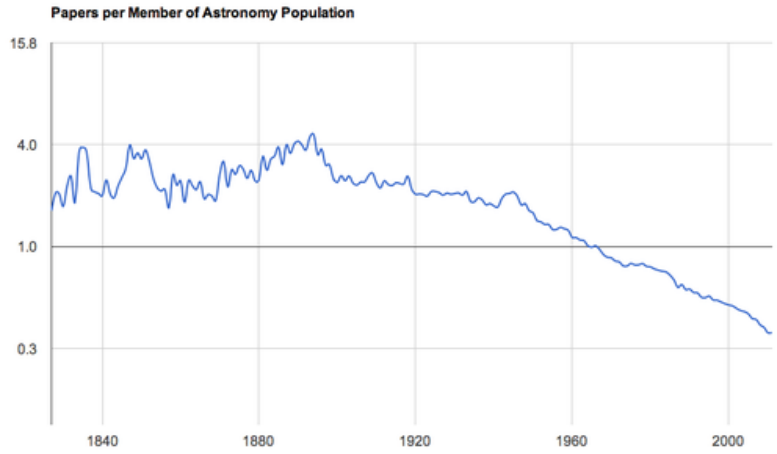

Figure 10: Number of yearly papers for each member of the astronomy research population (https://orbitingfrog.com/2012/08/04/authorship-in-astronomy/).

Figure 11 shows the average and maximum number of authors for papers, per year, in astronomy. It is clear that the number of authors for each paper underwent a surge starting around the 1980s: this means that large collaborations began with a consequent increase in the number of collaborators. And this explains why many authors publish up to more than 100 articles per year.

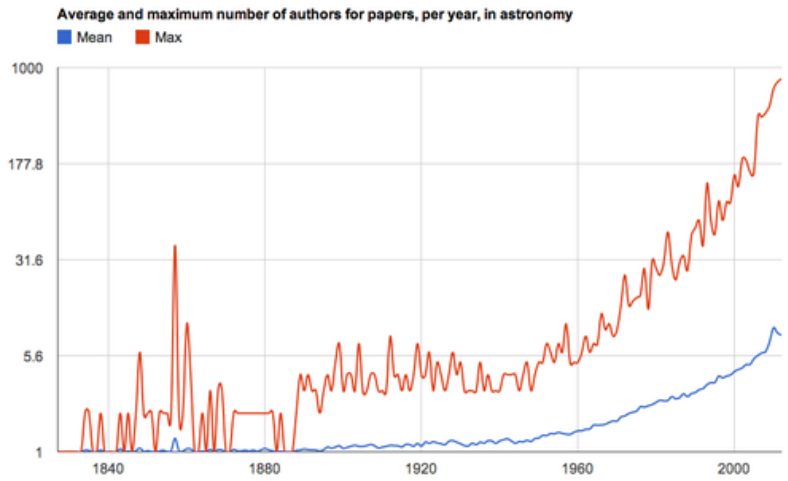

Figure 11: Average and maximum number of authors for papers, per year, in astronomy (https://orbitingfrog.com/2012/08/04/authorship-in-astronomy/).

Figure 12 shows the fraction of astronomical papers published with 1, 2, 3, 4 or more authors.

Even from these curves it is clear that the era of individual works is waning in favor of those coming from collaborations involving more and more researchers. Consequently, the fraction of citations also follows the same trend, as shown in Fig. 13.

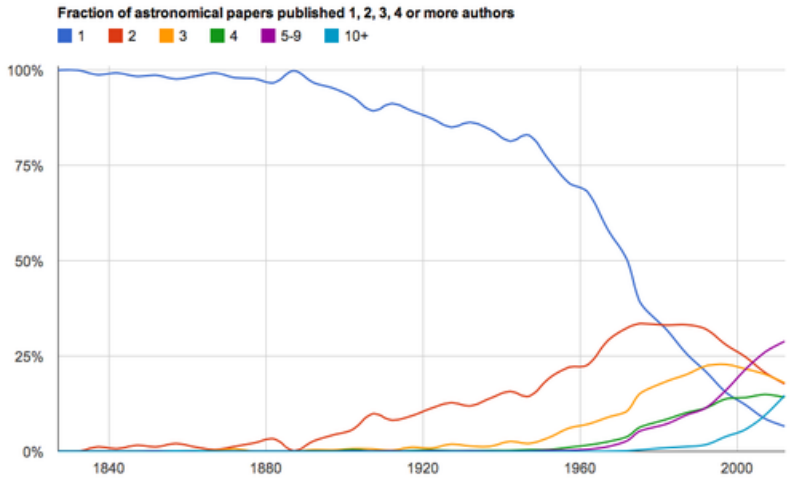

Figure 12: The fraction of astronomical papers published with 1, 2, 3, 4 or more authors (https://orbitingfrog.com/2012/08/04/authorship-in-astronomy/).

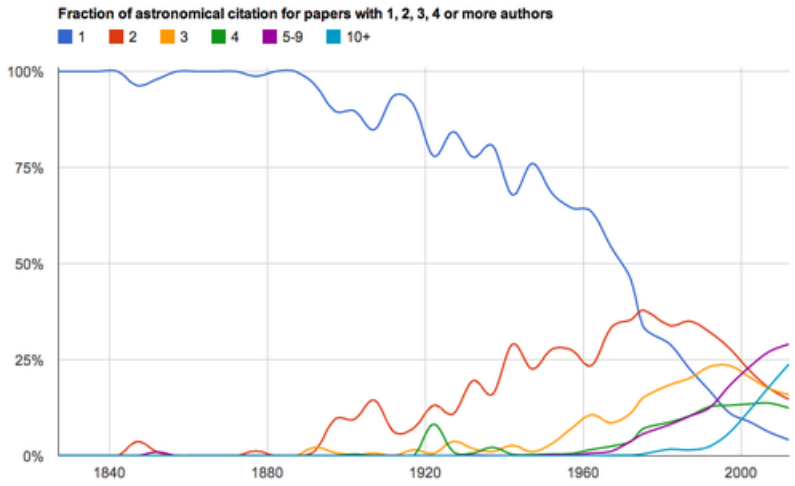

Figure 13: Fraction of astronomical citation for papers with 1,2,3,4 or more authors (https://orbitingfrog.com/2012/08/04/authorship-in-astronomy/).

A very interesting PhD thesis by Dag Westreng Aksnes (2005) discuss *Citations and their use as indicators in science policy. Studies of validity and applicability issues with particular focus on highly cited papers*.

A publication is considered as highly cited if the number of citations received is more than a certain multiple of the mean citation rate of the particular subfield. In his PhD thesis, Aksnes reports a paper (Aksnes, 2003) in which two interesting diagrams analysing the scientific publications in Norway from 1981 to 1995 (see Fig. 14).

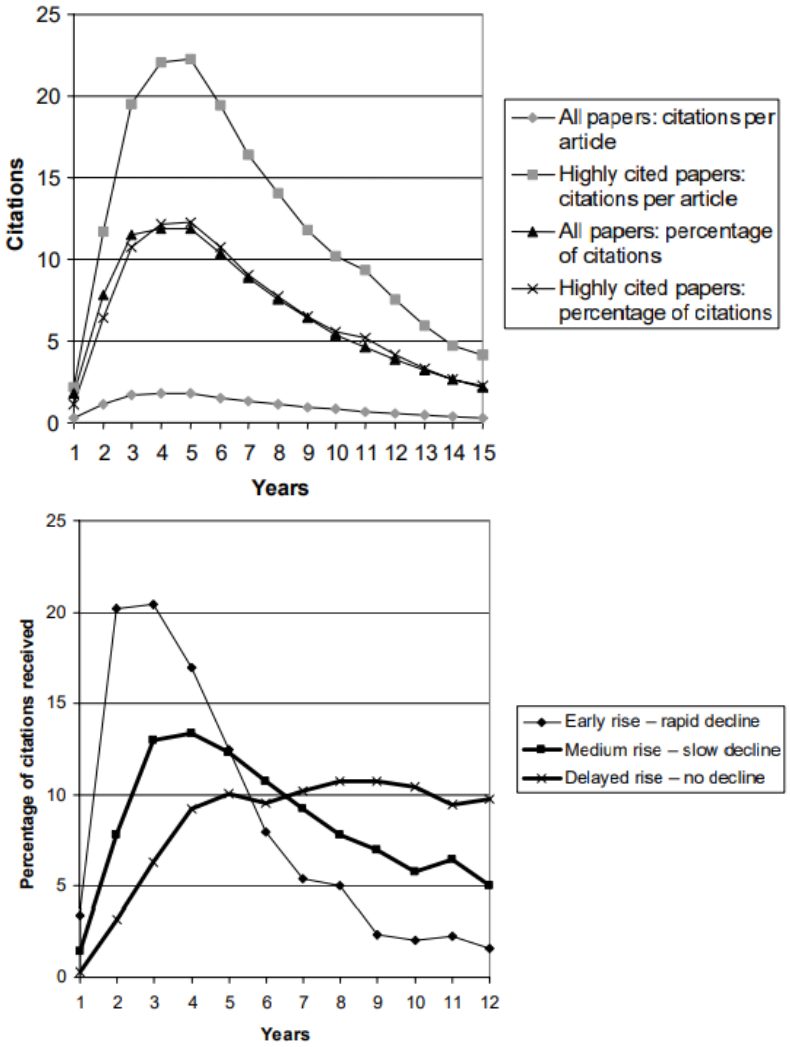

Figure 14: Upper panel: Citations* received vs. time following publication (* The citation counts have been scaled up according to year of publication. Lower panel: Citation curves for three different clusters of highly cited papers* (* Based on the 1981–1989 publications, and a 12-year citation window) (adopted from Aksnes, 2003).

It is generally known that citations follow a typical pattern of rise and decline. An article is poorly cited the first year, reaches a citation peak a few years after publication and then shows a slowly decreasing pattern of citedness the following years. This pattern is clearly illustrated in the citation curve of the highly cited papers. On average these papers reach a top of 22 citations in the fourth and fifth years following publication (that is three to four and four to five years, respectively, after publication). In comparison, the average for all papers is a maximum of 1.78 citations at identical time periods. Calculated as the percentage of all citations received during the 15-year period, the highly cited papers do not differ much from the average. Both groups of papers receive a maximum of 12% of their citations during each of these peak years. Still, the highly cited papers age slightly more slowly and peak a bit later than the other papers, but the differences are only marginal (upper panel of Fig. 14).

As we can see from the lower panel of Fig. 14, two categories account for the large majority of the papers: One type of papers is characterised by a moderate period of initial increase followed by a gradual decline (medium rise – slow decline). The other type is characterised by a relatively slow rise, with a stable citation level thereafter (delayed rise – no decline). Also, the categories 'early rise – rapid decline' and 'medium rise – no decline' account for a significant share of the papers. The other categories are non-existent or marginal.

The results reported by Aksnes (2003) are substantially the same reported by Abt et al. (1981). However, this latter paper reports that 6.1%, or 20 papers, contained in their sample of 326 papers published in 1961 were never cited during the 18 years after publication.

Trimble & Ceja (2007) report that 3.3% of the papers in a sample of 7768 papers have never been cited after 4 years after the publication.

The result reported by Meho & Rogers (2008) is even worst: It is a sobering fact that some 90% of papers that have been published in academic journals are never cited. Indeed, as many as 50% of papers are never read by anyone other than their authors, referees and journal editors. And this is one more point in favour of the Professor Livio Gratton's phrase: **favor the quality of the articles instead of the quantity**.

3. The era of even bigger data

After this workshop it appears evident once more the importance of Multi-frequency Astrophysics. However, there are many problems in performing simultaneous multi-frequency, multi-sites, multi-instruments, multi-platform measurements due to:

- objective technological difficulties;
- sharing common scientific objectives;
- problems of scheduling and budgets;
- politic management of science.

Furthermore, with the advent of new experiments, such as those listed below (Padovani, 2019), the scientific community will be forced to manage an immense amount of data, such as those expected from SKA (Square Kilometer Array) which will be approximately 4.6 EB. Are we ready for handling these amount of data? How will it be possible to arrive at a synthesis?

- Radio band: ASKAP, MeerKAT, e-MERLIN, APERTIF, SKA
- IR band: JWST, Tokyo Acatama Observatory, Euclid, WFIRST, SPICA
- Optical/NIR bands: Zwicky Transient Facility, LSST, GMT, ELT, TMT
- X-ray band: eROSITA, IXPE, SVOM, eXTP, XIPE, Athena, Theseus, FORCE, XRISM, Colibrì
- γ-ray band: CTA, Large High Altitude Air Shower Observatory

- And more, including CubeSats

Among the problems in performing simultaneous multi-frequency, multi-sites, multi-instruments, multi-platform measurements, the *political management of science* is particularly important.

3.1 Political Management of Science

Far be it from me to accuse the entire scientific community of the sometimes very questionable choices regarding the methods of selecting experiments, especially space experiments where there are multiple interests at stake. However, I want to mention a couple that concern me personally and which, if they had been treated with greater attention, could have certainly brought important results for the advancement of knowledge of our Universe.

Way back in 1993, Giovannelli et al. (1993) published a short paper in which they proposed a payload for a small satellite, named SIXE (Spanish Italian X-ray Experiment). This is a multifrequency (X-ray and Optical) payload for Long Term continuous observations of few selected cosmic sources.

Later Giovannelli et al. (1999) conducted the feasibility study of SIXE as Co-PI, together with Prof. Jordi Isern (co-PI on the Spanish side), carried out by groups of IAS, CNR (Italy) – IEEC & INTA & UPC & CNM (Spain). The study, which began in early 1998, was funded by the PNIE (Plan Nacional Investigación Espacial) of Spain [ESP97-1784-E grant of PNIE (CICYT)]. The results of Phase-A study have been summarized in the papers by Giovannelli et al. (2001, 2002) and Isern et al. (2001).

Figure 15 shows the synthesis of the characteristics of SIXE. The fundamental characteristic of SIXE: Effective Area x Observing Time $\simeq 10^{10}$ cm^2 s. This value is at least an order of magnitude higher than those of all other experiments of the time.

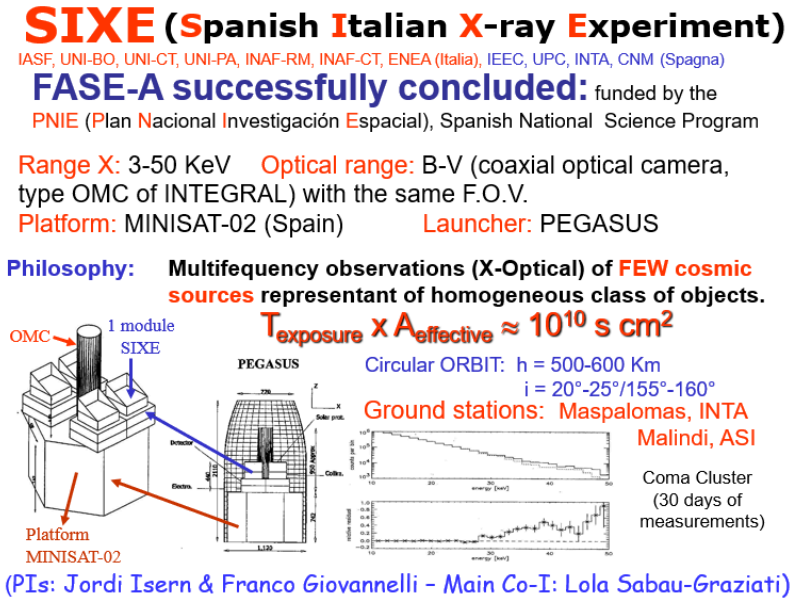

Figure 15: Summary of the main characteristics of SIXE (Spanish Italian X-ray Experiment), after phase-A study (deduced from Giovannelli et al., 2001, 2002).

SIXE was presented to ASI (Italian Space Agency) to ask for support for the phase-B study, also having the certainty that it would be the ideal payload for the Spanish MINISAT-02. Furthermore, the cost of the payload would have been shared with the Spanish Space Plan.

Absolutely no response from ASI.

Thirty years have passed since the idea of SIXE was published (Giovannelli, F., Sabau-Graziati, L., La Padula, C. et al., 1993). Currently the papers dealing with SIXE are the most read among all those of all INAF Institutes ($\gtrsim$ 2000 readers from all over the world) (source: Research Gate).

Another even older example dates back to 1975. Our group proposed a high angular resolution experiment for the observation of extragalactic sources in the 20-100 keV band, in particular galaxy clusters, through the use of a coded mask and our position-sensitive X-ray detectors (Auriemma et al., 1975). The experiment was supposed to fly aboard a stratospheric balloon on a long-duration flight from the Milo base (Trapani, Italy) along the 38th parallel. The proposal was presented during the conference "Italian Extragalactic Astronomy" (April 3, 1975). The Italian theorists strictly rejected the proposal, judging it impossible for galaxy clusters to emit hard X-ray radiation.

Twenty-four years later, BeppoSax revealed this issue (Fusco-Femiano et al., 1999)!

Figure 16 shows the cover of the internal report of the LAS-CNR (Laboratory of Astrophysics-CNR).

PROPOSTA IN UN ESPERIMENTO AL ALTA RISOLUZIONE
ANGOLARE PER L'OSSERVAZIONE DI SORGENTI
EXTRAGALATTICHE NEL RANGE 20-100 KeV

G.Auriemma, E.Costa, F.Giovannelli*
G.Medici, P.Ubertini

Laboratorio di Astrofisica Spaziale, C.N.R.,
Frascati

*Attualmente presso l'Istituto di Fisica della
Atmosfera, C.N.R., Roma.

Comunicazione presentata al Convegno di Astrono-
mia Extragalattica Italiana del G.N.A.
Asiago, 3 Aprile 1975

LAS-75-26 Luglio 1975

Figure 16: Proposal of a high angular resolution experiment for the observation of extragalactic sources in the 20-100 keV band (Auriemma et al., 1975).

The authors of this proposal: Giulio Auriemma, Enrico Costa, Franco Giovannelli, Pietro Ubertini were disciples of Professor Livio Gratton; Gastone Medici was the mechanical engineer of our group.

4. The reason for the Etruscan Wine Party

My full name is Franco Giovannelli Seghieri (father name: Flavio Giovannelli; mother name: Teresita Seghieri).

My ancestors of both families arrived to SUVERETO (a small medieval village close to Populonia, one of the most important Etruscan towns, before Romans) between the beginning and the middle of 19th Century. Giovannelli: an agricultural labourer family whose member Francesco – grandfather of my great-grandfather Francesco – arrived from Tuscan-Emilian Appennini Mountains for searching farm work. Seghieri: a blazoned family from Montecarlo di Lucca whose member Metello – my great-grandfather – arrived as town clerk.

Figure 17: Suvereto. First line, from the left to right: The southern gate "La Porta" (1300 A.C.); The northern gate "La Porticciola" (∼ 1300 A.C.); The loggia of judges (XIII Century); The village hall (XIII Century); Romanesque church of San Giusto "Ecclesia S. Justi" (IX-XII Centuries); St. Francis cloister "Il Chiostro di San Francesco" (XII Century). Second line, from the left to right: The tower "Il Torrione" (XIV-XV Centuries); My House (∼ XV Century); Great staircase "Gli Scaloni" (∼ XIII-XVI Centuries); The flag bearers of the fifteenth century "Gli Sbandieratori"; The Palio of Santa Croce of the barrels. Third line, from the left to right: Goblets of stars "Calici di stelle" (10th August); The source of the angels "La Fonte degli Angeli" (∼ 1500); Fortress Aldobrandesca "Rocca Aldobrandesca" (XII Century); Partial panorama of Suvereto. Fourth line, from the left to right: General panorama of Suvereto; PETRA Vineyard in San Lorenzo (hamlet of Suvereto); PETRA Olive grove in San Lorenzo (hamlet of Suvereto). These two last photos show a part of the farm built by my great-grandfather Francesco and belonging to Giovannelli's family until 1961.

Suvereto, considered one of the most beautiful villages in Italy, is located between the hills and the shining sea of the Etruscan Coast. Immersed in the green Val di Cornia, the village is a real treasure: its walls preserve treasures made up of characteristic medieval streets, stone houses, historic buildings and evocative churches. All around exterminated forests of chestnuts, oaks and,

of course, corks, hence the name of the locality. Indeed, the toponym is attested for the first time in 973 and derives from the Latin suber, "cork", in Italian "sughero". Then the name of the village was Sughereto (foresta di sughero = cork forest) that was changed to Suvereto due to the local pronunciation of sughero as suvero. Therefore, Suvereto is the "cork forest".

Suvereto, the small medieval village, is the town of wine and olive oil. Figure 17 shows some important parts of the village and surroundings.

Suvereto became, thanks to Ildebrandino VIII of the Aldobrandeschi, the first free municipality of Tuscany, with the issue of the "Charta Libertatis" in 1201, October 14th, which granted freedom of trade and government to the inhabitants of the town. It is from this period the construction of the "Palazzo Comunale" (village hall) with the loggia of judges ("Loggia dei Giudici"), where disputes between citizens were resolved. Baroncello, the first mayor of Suvereto elected by the people for treating with Ildebrandino VIII Aldobrandeschi, Count Palatino, the "Charta Libertatis". This important historical event is celebrated each year on December 8th in occasion of the "Sagra di Suvereto" (Suvereto Festival) after the historical cortege.

Baroncello is interpreted by Franco Giovannelli as shown in Fig. 18 (left panel), and Fig. 18 (right panel) shows a part of the historical cortege.

Figure 18: Left panel: Franco Giovannelli as Baroncello in his old house in Suvereto. Right panel: a part of the historical cortege celebrating the conquest of the "Charta Libertatis" in 1201.

Despite having lived almost all my life in Rome, I have maintained a strong bond with Suvereto and with all my childhood friends. Until the harvest of 1960 I used to bring with a cart pulled by oxen the grapes to be fermented in a big vat, whose location was in "Casetta" - a typical farmhouse of the Maremma - belonging to the Casini and Petricci families. The Casini family moved to another place and the Petricci family instead continued to live there, where their vineyard thrives in the surrounding area. The young Petricci, who married a woman from the Del Pianta family, founded the Petricci-Del Pianta farm (Azienda Agricola Petricci-Del Pianta). From this company, which still uses the original vines of the area, come the wines consumed during the Etruscan Wine Party. Fig. 19 shows some pictures of the vineyard and wines produced by such a farm.

Figure 20 shows some of the participants during the Etruscan Wine Party of this workshop.

Figure 19: First line: a partial view of Petricci-Del Pianta vineyard. Second line from left to right: wine tasting cellar; Bianco di Casetta (white); Cerosecco (red); Buca di Cleonte (red); Fabula (white).

Figure 20: Left panel: Some of the young participants. Middle panel: Some of the young and old participants. Right panel: Enrico Costa and René Hudec.

5. The reason for the night performance

The reason is very simple: every type of art increases knowledge and tones the soul.
Physics is not just a science, but it is also a form of art, according to my judgment as I clearly pointed out in my concluding remarks of the "*XIVth Cracow Summer School of Cosmology: The structure of space and time* (Giovannelli, 1996).

Figure 21 shows few moments of the performance **Science's got talent** interpreted by Anna Lisa Amodio and Flavia Giovannelli.

6. The reason for the violin concert

For the same reason I expressed for the night performance, a violin concert is a moment of extreme pleasure for the audience. Music is a universal language that unify the souls of the humanity, and even is a relax for animals, as demonstrated for the cows producing milk in a better quality and quantity listening classical music. Moreover I am happy to sponsor young artists, like Isabella Perpich, excellent violinist in spite of her young age.

Figure 22 shows two moments of the violin concert **Perpich**[2]: Left panel: Alessandro Perpich and Isabella Perpich during the concert; Right panel: the artists thank the enthusiastic audience.

Figure 21: Left panel: Science's got talent by Anna Lisa Amodio and Flavia Giovannelli. Middle panel: Flavia Giovannelli. Right panel: Anna Lisa Amodio.

Figure 22: Left panel: Alessandro Perpich and Isabella Perpich during the concert. Right panel: The artists thank the enthusiastic audience.

7. Some General Remarks

This workshop again affirms the importance of Multifrequency Astrophysics.

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*: **It is possible to develop science seriously even if smiling** (Giovannelli, 1985).

But, as you probably suspected, this workshop was organized under the aegis of peace. For this reason I want to conclude with a few wonderful words of Dr. Daisaku Ikeda (2001a)$^{(*)}$ – president of the Soka Gakkai International (SGI) – reported in the booklet *For today and tomorrow* - the thought of May 30th:

"*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, 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".

(*) While preparing this article I received the sad news of Dr. Daisaku Ikeda's death on November 15, 2023, at the age of 95. Honorary President of the SGI (Soka Gakkai International, which means Society for the Creation of Value) leaves fundamental teachings for the achievement of world peace through the **Human Revolution** that every living being can experience.

Dr Daisaku Ikeda has made dialogue the fundamental tool for building a peaceful society, also through meetings with numerous leaders of our time. Among these, dozens of scholars, philosophers and prominent figures such as Mikhail Gorbachev, Aurelio Peccei and Arnold J. Toynbee.

Daisaku Ikeda promoted Peace by testifying throughout the world to the affirmation of the universal values of humanism and, thanks to his tireless activity, this universal philosophy has spread to every part of the planet. Testifying to the importance of respecting the dignity of the life of every single human being, it has allowed millions of women and men to embrace the philosophy of the *Human Revolution*, based on a process of inner transformation and personal development as the basis for social change and Global Peace.

We could go back to early childhood when we were as the "Little Prince". To quote:
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 insure 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 reviewed 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) those 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 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 essentially the concept of balance between science - responsible for material and technological progress - and spirituality, responsible for the internal growth of individuals and ethical limitations imposed by the excessive consumption of the resources of the planet. The balance between science and spirituality determines the welfare of society.

The Bridge between the Big Bang and Biology (e.g. Giovannelli, 2001) 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 the 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.

8. Conclusions

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. They fears nothing. The courage of youth is boundless, is the strength to never give up (Daisaku Ikeda, 2001b).

Probably the most important scientist and artist ever born, Leonardo da Vinci, said *Tristo è lo discepolo che non supera lo maestro suo!*. Expressed in English, that reads as *Grim is the disciple who does not exceed his master!*

9. Special thanks

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- The super-efficient Local Organizing Committee (Bruno Luigi Martino, Rosa Poggiani, Francesco Reale,... and myself) shown in Fig. 23 from left to right.

Figure 23: The extraordinary LOC. From left to right: Bruno Luigi Martino, Rosa Poggiani, Francesco Reale, Franco Giovannelli.

- Many thanks to the Directors of the: ASCR-AIO & CTU, DCUCE-INTA, IAA, University Tübingen, INAF-IASF, MPE, SJC RAS-AI, WITS University

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- The actresses Flavia Giovannelli and Anna Lisa Amodio for their splendid Performance *Science's got talent*.
- To all the staff of the SPLENDID Hotel La TORRE.
- Finally, on behalf of all participants, I would like to express my warm thanks to the Chèf, Mr Salvo Spada, who prepared for us a large number of delicacies.

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- Rosa Poggiani: Physics Dpt, Pisa University with a smiling face behind her professional camera.

Without the presence of Francesco it would not have been possible to organize the workshop!

Francesco, alias FIGARO, is shown in Fig. 24 during one of his usual runs for something urgent.

I would like to close these "conclusions" of mine by showing a photo (Fig. 25) that in my opinion could become historic: Enrico Costa, Franco Giovannelli and Pietro Ubertini, finally together, with their mentor Giulio Auriemma who, wherever he is, will surely rejoice over this photo. All four coming from the explosion of the "Livio Gratton Supernova".

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

Figure 24: Francesco Reale, alias Figaro, running.

Figure 25: From left to right: Enrico Costa, Franco Giovannelli and Pietro Ubertini, and their mentor Giulio Auriemma; all four coming from the explosion of the "Livio Gratton Supernova".

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