

Preparata Medal Lecture - A Tribute to Giuliano Preparata, a TRUE Pioneer in Cold Fusion Theory

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ABSTRACT

Anyone who attended an ICCF meeting before 2000 has a vivid memory of the brilliant and fiery theoretical physicist, Giuliano Preparata. He provided new insight into the deep mysteries of cold fusion, and greatly enlivened the meetings with his pointed comments and heated debates. My own discussions with him usually concerned my concepts for thin-film electrolysis. I recall encountering him after one of his ICCF talks and questioning one of his conclusions. Giuliano snapped back – “George, you haven’t read Chapter 8 of my book!! Read it before you talk to me again!” I responded that I had read it but still didn’t understand!! Giuliano took pity on me and just laughed (As others knowing him will recognize, this was a “mild” response). His book, *QED Coherence in Matter*, is a gem; it provides a view into Giuliano’s unique approach to the coherence of matter and to cold fusion (the “famous” Chapter 8). It is not easy reading; so, I subsequently put his book in the front of my bookcase to read whenever I had time. When I sadly learned of his untimely passing, I pulled his book out and stared at the cover, then moved to the dedication page where Giuliano credits his father for teaching him the meaning of “honour and honesty”. His father must have been proud since Giuliano learned the lesson well. The community lost a leading light that day. This lecture includes some recollections of Giuliano’s participation and interactions in ICCF meetings. In addition, the historical steps in the development of his QED coherence theory are briefly outlined.

Introduction

Giuliano was born in Padova, Italy in 1942. After receiving his Ph.D. in 1964, he became immersed in strong interaction physics theory. In 1967, he joined Princeton University and after several positions, ended up in 1970 as Associate Professor at NYU. From 1980 until his death, he was the Chair Person of High Energy Nuclear Physics at Milan University.

In the early days of cold fusion, Giuliano joined the activities of the National Cold Fusion Institute in Salt Lake City. This experience initiated his interest in the physics of this exciting new field. His later cold fusion research was done at Milan University in collaboration with the ENEA Fascati Laboratory where he played a key role in both theory and interpretation of cold fusion experiments. This work has a continuing impact on directions in cold fusion research worldwide.

In preparation for this lecture, I contacted a number of Giuliano’s close associates and colleagues and asked for any materials or thoughts they might be willing to provide to portray his life and accomplishments. A list of contributors is given in the acknowledgements section. For the most part I agreed not to associate names with the quotations or cite names of persons actually involved in specific episodes. With this understanding, quotes extracted from the contributed materials are incorporated freely throughout the lecture.

Giuliano did forefront research in theoretical physics, covering a wide range of topics from high energy to condensed matter physics. This amazing breath of interests is evident from the following chronological listing of his activities taken from one of his own files.

Curriculum

- 1942 Nasce a Padova
- 1964 Si laurea summa cum laude in fisica teorica, relatore Raoul Gatto,
all'Università di Roma
- 1964-65 Borsista CNR (I posto della graduatoria nazionale) all'Università di
Firenze.
- 1965-67 Professore incaricato di Fisica dei Neutroni all'Università di Firenze.
- 1967-68 Research Associate alla Princeton University.
- 1968-69 Research fellow alla Harvard University.
- 1969 Libera docenza in Fisica Teorica.
- 1969-70 Assistant Professor alla Rockefeller University.
- 1970-72 Associate Professor alla New York University.
- 1972-74 Assistente di Fisica Superiore all'Università di Roma.
- 1974-80 Staff Member nella Theory Division del CERN di Ginevra.
- 1975 Vincitore del concorso a cattedra di Fisica Teorica.
- 1976-86 Straordinario-Ordinario di Fisica Teorica all'Università di Bari.
- 1986 Ordinario di Teoria delle Interazioni Subnucleari all'Università di Milano

His reputation rapidly spread throughout the physics community and in the nineteen eighties he has gained a reputation as a leader in the field of theoretical Quantum Electro-Dynamics (QED). Subsequently some viewed him as the new star of the younger generation of theoretical physics, destined to replace Richard Feynman. This aspect of his rising career is beautifully portrayed in the following poem by Tomek Ferbelski:

Tomek Ferbelski ha dedicato questa poesia a Giuliano Preparata

**You are old, Father Feynman, Preparata declared,
and you hair has turned visibly grey:
and yet you keep tossing ideas around –
At your age, a disgraceful display!**

**In my youth, said the master, as he shook his long locks,
I took a great fancy to sketching:
I drew many diagrams, which most thought profound
while others thought just merely fetching.**

**Yes I know, said the youth, interrupting the sage,
that you once were so awfully clever;
but now is the time for quark sausage with chrome!
Do you think you can last-on forever?
In your words, my young fellow, the crone did retort,
As his face turned perceptibly redder;
In your words I detect an impatience, I'm sure,
which makes me decidedly madder.**

**You are old, quoth the youth,
In his accented speech,
while eyeing the throne of the Master:
Let me help you relinquish your sceptre next day.
Or would you prefer that much faster?**

**No, thanks, Giuliano, the sage did rebuff.
Enough of your own brand of sass:
Do you think I can listen all day to such stuff?
Be off. Or I'll kick-in your!**

Those who knew Giuliano will appreciate how well Tomek Ferbelski portrayed the spirit of the times.

Some Insights – Preparata's "New" QED

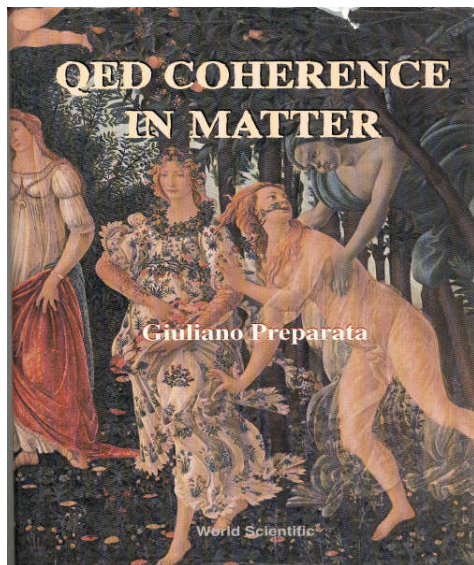
Since QED theory was such a major part of Giuliano's contribution to physics in general, and to cold fusion in specific, it is worthwhile to briefly review some of his thinking that lead to his "new" QED. The following brief note is abstracted from papers contributed by Emilio del Giudice, a close friend and collaborator of Giuliano's.

- In 1916 Walter Nernst proposed that a complex body could emerge from its component atoms just when they become able to tune together their fluctuations, producing a common phase of oscillation that could be regarded as the "identity" of that complex object. Conventional forces, electrostatic or chemical, produce a further binding in the basic structure created by the tuning of quantum oscillations.
- This pioneering proposal was left unanswered for a long time, until, starting in the fifties, a sequence of theorists, from Robert Dicke to Klaus Hepp and Elliott Lieb, to Herbert Fröhlich worked on revisions. Finally in the eighties Giuliano combined and extended these contributions to work out a new vision of the dynamics of the transition from gaseous matter. This theory explains how an ensemble of basically independent particles can become coherent to form condensed matter (liquids and solids).
- The essential result of Giuliano's theory can be stated as follows. An ensemble of a very large number N of particles can assume two different configurations and are coupled with the E.M. field (as every particle made up of charged components, for instance atoms and molecules, does). This configuration then enters a coherent state

when its density exceeds a threshold while its temperature lies below a critical value. This coherent state has energy lower than the original gas-like state. In this coherent state the particles oscillate between the two configurations in unison and in tune with an E.M. field arising from the vacuum fluctuations trapped within the assembly of co-resonating particles. This coherent regime of both matter and E.M. fields holds within a region of space whose size is the wavelength of the E.M. oscillations; this region is called the "coherence domain" (CD). Its size ranges from a fraction of a micron for liquids and metal electrons to some microns for solids to several tens of microns for ions in solution. The CD is then the sum of two mesoscopic components, a coherent fraction made up by a large number of CD's and a gas-like non coherent fraction made up by particles filling the interstices among CD's. CD's are able to establish bounds among themselves through the tails (evanescent fields) of the quite intense E.M. fields that exist inside the domains. A large "cage" of the CD's develops. Inside this cage there is a definite phase and zero entropy, trapping a "gas" of non coherent particles to form the so-called "EDG" state.

Giuliano ultimately put many of his thoughts on QED together in a book, *QED Coherence in Matter*, published in 1995 by World Scientific Press. This book contains chapters on a range of applications of the new QED to leading physics problems – superconductivity, Ferromagnetism, thermodynamics of water, ..., including the famous Chapter 8 on cold fusion, with the surprisingly modest title of "*Towards a Theory of Cold Fusion Phenomena*".

The cover Giuliano chose for the book, shown below, again portrays his complex compassionate but fiery spirit. On the inside flap of the book's cover (below) Giuliano focused on his view of the quantum domain causes a "network" of interactions between particles and the radiation field inherent in matter.



QED COHERENCE IN MATTER

by Giuliano Preparata

(Univ. Statale di Milano, Italy)

Up until now the dominant view of condensed matter physics has been that of an "electrostatic MECCANO" (erector set, for Americans). This book is the first systematic attempt to consider the full quantum-electrodynamical interaction (QED), thus greatly enriching the possible dynamical mechanisms that operate in the construction of the wonderful variety of condensed matter systems, including life itself.

A new paradigm is emerging, replacing the "electrostatic MECCANO" with an "electrodynamical NETWORK," which builds condensed matter through the long range (as opposed to the "short range" nature of the usual electrostatic forces) electrodynamical interaction: this interaction creates "coherent configurations" of the elementary systems (atoms and molecules), which oscillate in phase with a coherent macroscopic (and classical) electromagnetic field that, through the strong interaction with matter, remains trapped inside it.

Cover and flap page from Giuliano's' 1995 book on QED

Some Recollections from Colleagues

Giuliano was a unique individual with very strong opinions which he made sure were heard. Martin Fleischmann has described him as “the smartest person I ever knew”. Martin adds however, that Giuliano “turned out to be his own worst enemy. Indeed he was viewed early on as replacing Schwinger as the leader in cold fusion theory. But his personality slowed development of a wide discipleship (such as envisioned in the earlier poem comparing him to Feynman). Giuliano’s talents extended well beyond physics. He read widely and could delve deeply into an amazing range of topics in and out of physics.”

Some of my own personal memories of him include:

- During a discussion of x-ray diffraction-like patterns observed in experiments in his lab in Milan that he described in a presentation at an ICCF meeting, I questioned how such a pattern was possible. What could the mechanism be? Giuliano immediately snapped: “George, you still haven’t read Chapter 8 of my book!! Read it before we continue this discussion!!” (This is the second time he had told me to read Chapter 8 - see the abstract for this lecture). And he quickly walked away before I could respond...
- In the middle of a talk by a well known cold fusion theorist at another ICCF meeting, Giuliano jumped up and announced “The Italian delegation is leaving – we will not listen to this nonsense any longer.” He then proceeded to walk out of the conference room (but without the Italian delegation who sat still in amazement along with the rest of the audience.)
- My last meeting with Giuliano shortly before his death was when we served together on a paper review committee for an ICCF meeting coming up in Italy. At the time I did not realize how sick he was. His high level of energy while talking about science disguised his weakened physical condition. We were assigned to review the contributed theory papers. After a few minutes Giuliano pronounced. “Reject all of these papers – they are nonsense!!” It took several hours of diplomacy on my part, helped by others on the committee, to get him to admit a series of papers, “pending serious modifications.” At one point in the discussions he turned to me and said: “You and your Americans are all arrogant, trying to control all physics publications.” This outburst came from a lingering bitterness that one of his recent submissions to an American physics journal had been rejected, probably by a reviewer out of step with the new QED theory. I finally convinced him that while I was an editor for *Fusion Technology*, a US journal, I had nothing to do with the rejection of his paper.
- In retrospect, I suspect that we would have normally required a day or so more to get Giuliano to concede these points had he not been in a weakened condition due to his battle with cancer!

Extracts from memories of interactions and observations provided by other colleagues include:

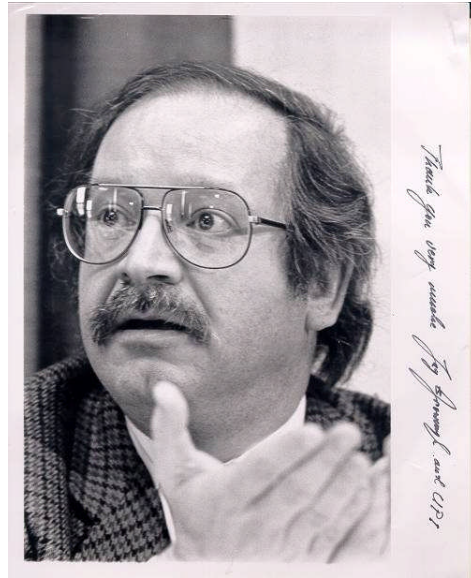
- I remember especially one sentence he was used to explain his “strong” interactions with other physicists: “I love physics like a woman, like a lover. While I know that I am not the only one entitled to love her, and I am not jealous in a conventional way, —still, to see her abused drives me crazy!”
- A comment I vividly remember Giuliano making on several occasions is: “There is nothing more wrongful than setting things on the same level that are very different

instead". In all of his activities, despite heated arguments with other scientists, he consistently maintained a very strong sense of honor and of honesty.

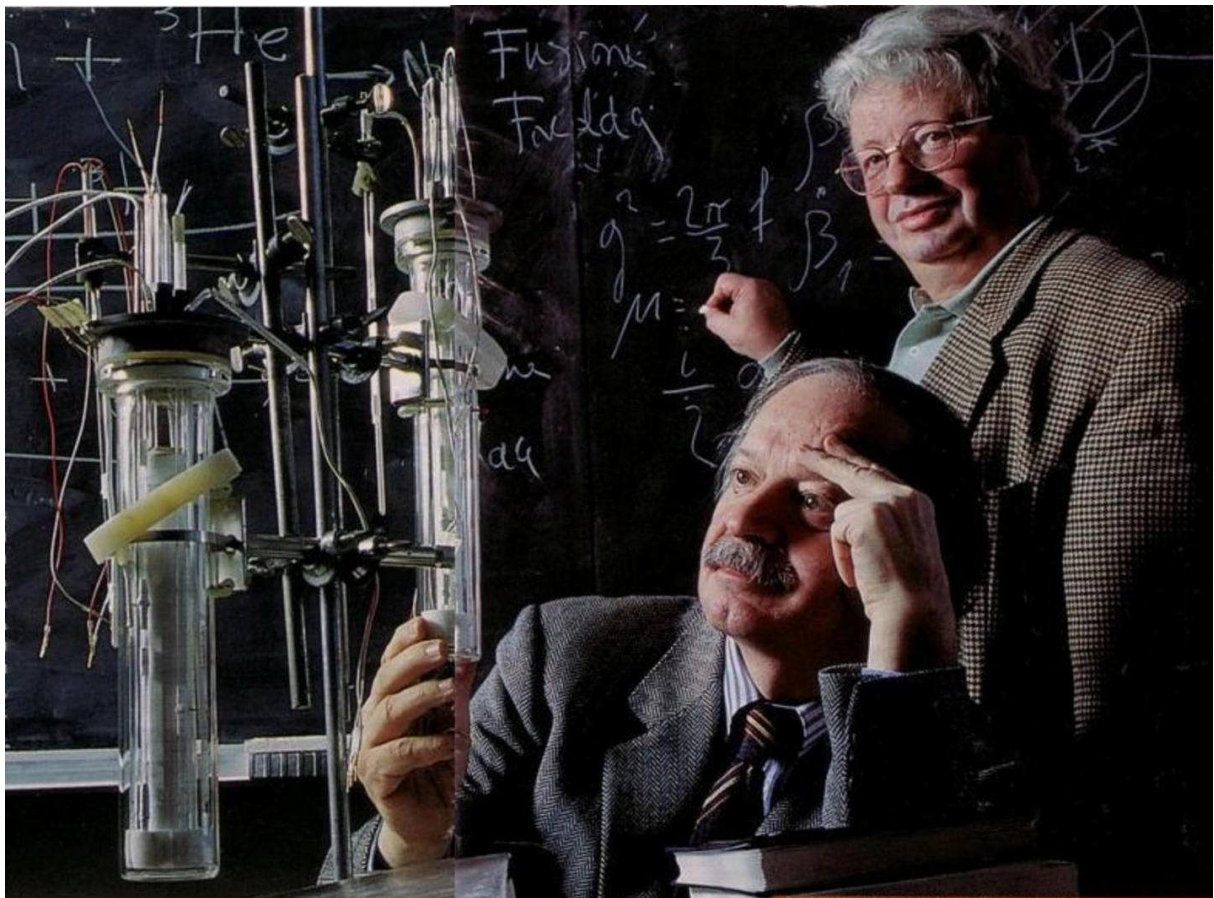
- He was not an easy man, but the opportunity to know him and work closely with him really changed my way of thinking about science and the duties of a “true” scientist. He was really a wonderful teacher for me.
- I first met him at NCFI (National Cold Fusion Institute) in Utah in 1990. He was thinking beyond light speed – much more than c !! I simply could not keep up with his reasoning.
- He was an excellent and very serious physicist, and above all, one very nice guy.
- One event that comes to mind is a discussion between (...) and Preparata during ICCF4 in Hawaii. As I recall, (,,,,,) had just published a review article on cold fusion theories in which Preparata's model did not fare well. (...) had a microphone and Preparata had a microphone. Only Preparata didn't need one since he usually spoke with so much energy. As the exchange progressed, the volume increased. At some point, Preparata yelled a response into the microphone that sounded to all like the voice of an angry God from above.
- Many of my interactions with him involved Giuliano forcefully explaining to me that his theory was right, that mine was wrong!
- I have only now acquired considerably admiration for the theory Giuliano suggested.
- I only wish that I could talk to Giuliano now and extend my heart-felt apologies for not recognizing the significance of what he suggested and for not expressing my admiration for his intuitive genius. One episode that captures this took place after ICCF in Nagoya, Japan. I decided to walk to Nagoya harbor. When I got there, by chance, I ran into Giuliano. We were very cordial, at first, but soon, all civility ended as we argued about what was relevant in cold fusion theory. What an impression this gave me, and continues to be for me. If I could meet Giuliano again I would tell him how nicely what I am now proposing fits with the model he suggested back then.
- I would sum up Giuliano Preparata's “enigma” as follows: He was difficult to get along with, he was loud and demanding, but this grew from his deep, deep, love of physics.
- Above all else, Giuliano was a penultimate idealist. I miss him. I really do.

Photo Memories

Some photographs of Giuliano contributed by colleagues follow below. I am sure they will bring back fond memories to all who know him.



Making a point



In the lab with Emilio del Giudice



Conclusion

Hopefully this lecture has provided some insights into Giuliano's life and work in his most loved field of physics. In closing, I am sure all will agree that the cold fusion community and the broader physics community lost a leading light that day. Yes, we all miss him. However, his brilliance and his energy and his insight live on!!

Acknowledgements

It has been an honor and joy for me to prepare this tribute to Giuliano. I would like to recognize and thank the following for their contributions to this tribute: Emilia Preparata, Francesco Celani, Antonella de Nino, Emilio del Giudice, Vittorio Violante, Scott Chubb, Peter Hagelstein, Mike McKubre, Akito Takahashi, John Bockris, Heinz Hora and Martin Fleishmann.