CURRICULUM VITAE ET STUDIORUM OF GINO TAROZZI

Gino Tarozzi philosopher of science and non standard quantum theoretician, has investigated both the foundations of quantum physics, suggesting probabilistic generalizations of Bell's theorem and discussing some experimental tests of a proposed new realistic interpretation of the wave function, and the relationships between physics and epistemology, showing the success of a reformulation of the main metaphysical principles in the history of scientific and philosophical thought, like realism, causality, holism, nothing, and the mind-body problem, in terms of empirical meaningful philosophical principles, that can be usefully compared with the descriptions of the world provided by fundamental physical theories.

He carried out his academic studies with two masters of the Bologna Alma Mater Studiorum: Alberto Pasquinelli, philosopher of science, pupil of Rudolf Carnap, founding father of logical positivism, and Antonio Pignedoli, eminent mathematical physicist, in his youth deputy of the Constituent Assembly of the Italian Republic, who was very critical of the standard subjectivist interpretation of quantum mechanics. Tarozzi was thus influenced both by the neopositivistic anti metaphysical approach of the former and by the latter's yearning for a realistic and causal interpretation of quantum mechanics: Accordingly, he studied the foundations of physics, focusing on the open problems of quantum mechanics on the one hand, and general questions in the theory of knowledge on the other. He received his degree in philosophy in 1977, upon discussing a dissertion on the epistemological foundations of quantum theory. Part of this dissertation, appeared few months later on Il Nuovo Cimento, was considered "tres interessant" by Louis de Broglie.
At that time Tarozzi had already begun to work together with one of the most distinguished scholars of foundations of quantum mechanics, the theoretical physicist Franco Selleri, with whom he subsequently developed a research program on some crucial connections between physics and philosophy. He became then acquainted with the philosopher Evandro Agazzi, and was deeply influenced by the idea that philosophy of science cannot be restricted to the formal and linguistic problems of theories, but should tackle problems of content and of natural philosophy as well. The philosophy of physics should study both the conceptual foundations of theories and their epistemological implications. On the other hand, and this is his new proposal, those philosophical questions may be analyzed in a non-metaphysical way by applying the neopositivistic criteria of meaning: for, although they failed as a demarcation of scientific propositions, they allow the reformulation of some metaphysical propositions as philosophical principles endowed with empirical meaning.

After graduation, Tarozzi started a ten years long cooperation with the Institute for Cultural Heritage of the Region Emilia-Romagna, for which he took charge of the knowledge and preservation of historical materials of science, and in particular of scientific instruments, which are present in academies, universities, museums, and scientific laboratories. This investigation proved with perspicuous concreteness the continuity of our scientific tradition with respect to the Galilean one together with its fruitful experimental instances. From such research the methodological legacy of Galileo appeared implemented by scientists and technologists of the following centuries in Emilia and Romagna, to the point that their contribution to the history of science could not be separated from their role

in the design and in the construction of new instruments and apparatuses of investigation, as in the case of Campani's lenses, Ramazzini's barometer, Nobili's astatic galvanometer, Melloni's bench, Amici's telescopes, Righi's oscillator and Marconi's radio. These results can be easily extended from this specific case to the history of science in general in the sense that the history of (empirical) science is not only the history of scientific theories, but also the history of scientific instruments of measurement and observation. He has recently resumed his studies in the history of science, assuming in 2012 the coordination of the international network "Archimedes in the Renaissance: The Origins of Modernity", created between different institutions, such as the Max-Planck-Institut für Wissenschaftsgeschichte of Berlin, the Centro Internazionale di Studi "Urbino e la Prospettiva", the Department of History and Philosophy of Science of the Indiana University, the Dornsife College of Letters, Arts, and Sciences of the University of Southern California, the Department of Human Sciences of the Osaka Prefecture University, with the objective of promoting collaborative research, developing projects, organizing meetings and conventions, focusing especially on understanding of the history of science from its Greek and Latin roots to the present day, with particular emphasis on the period stretching from the Renaissance to the Scientific Revolution.

In 1985 Tarozzi begun his collaboration with the University of Urbino, organizing one of the main international congresses for the 50th anniversary of the Einstein, Podolsky, Rosen paradox (EPR), a subject he has always been particularly interested in, and "to the examination of which has made a substantial and original contribution" according to the collegial judgement expressed in 1987 by the commission of the competition for associate professor of Complements of General Physics, from which he withdrew his candidature having been approved in the meantime winner in another competition for professor of Philosophy of Science. With the result of this, the University of Urbino appointed him as associate professor in Philosophy of Science (1987-93), then full professor in Logic and Philosophy of Science in 1994. In earlier years he served as Chairman of the Corso di laurea (B.A. program) in philosophy (1995-98), Head of the Institute of Philosophy "Arturo Massolo" (1998-2004), Coordinator of the Dottorato di Ricerca (Ph.D. program) in Philosophical Anthropology and Foundations of the Sciences (2001-2009), Chairman of the Corso di studi specialistico (M.A. program) in Theories of Knowledge, Morals and Communication (2004-05), Dean of the Faculty of Literature and Philosophy (2005-09), Head of the Department of Philosophy (2009-10) and then of the Department of Pure and A pplied Sciences. Within the Urbino University he has gathered one of the prominent groups of research in the philosophy of science, and especially in the foundations of quantum physics, a group including Vincenzo Fano, appointed to a second chair of associate professor of Logic and Philosophy of Science, with whom he is fruitfully cooperating for several years, Mario Alai, associate professor of Theoretical Philosophy, Claudio Calosi, lecturer of Philosophy of Nature, Pierluigi Graziani, lecturer of Logic and Informatic, Isabella Tassani, lecturer of History of Science, and moreover Alexander Afriat, now maitre de conference in History and Philosophy of Science at the University of Brest, Gennaro Auletta aggregate professor of Philosophy of Science at the Pontifical Gregorian University, Rossella Lupacchini, associate professor of Logic and Philosophy of Science at the Bologna University, Giulia Giannini, researcher at the Max Planck Institute for the History of Science in Berlin, Flavia Marcacci, professor of History of Scientific Thought at the Pontifical Lateran University. As it was recently pointed out by Evandro Agazzi: My contacts with Urbino were further consolidated after the arrival in this University of Gino

Tarozzi, a philosopher of science who carried out important studies in the field of philosophy of physics and who, in particular, shares with me a realist conception of science. (...) On these occasions I also had the opportunity to know and appreciate some of his valuable collaborators and disciples, which ensure to this University a solidity in the field of the studies of philosophy of science that, despite appearances, it is not easy to achieve in most Italian universities. From 1995 to 2000, and again since 2005, he has been the Director of the Centre for Research in the Philosophy and Foundations of Physics of the Universities of Bologna, Insubria, Salento and Urbino.

Tarozzi is corresponding member of the Accademia Nazionale di Scienze, Lettere e Arti of Modena (1989-), of the Accademia delle Scienze dell'Istituto of Bologna (1994-), and of the New York Academy of Sciences (1997-), permanent member (2009-) and from 2015 vice president of the Académie Internationale de Philosophie des Sciences (AIPS). From 1996 to 1999, he chaired the Società Italiana di Logica e Filosofia delle Scienze (SILFS).

His research aims to contribute to the critical analysis and conceptual clarification of some of the foundational problems still unsolved in the standard interpretation of quantum theory. They cluster around three main questions: (a) the interpretation of the wave function, and the related problem of the dual behaviour of microphysical objects; (b) the theories of measurement and the postulate of reduction of the wave function, along with the problems concerning the formal description of measurement instruments in quantum formalism; (c) the incompatibility, displayed by the EPR argument and Bell's theorem, between the empirical prescriptions of the principle of local reality and the predictions of quantum theory.

Concerning the interpretation of the wave function, he rejected Born's probabilistic (and corpuscular) approach, developing some ideas originally due to de Broglie and Selleri and suggesting a new realistic interpretation based on "quantum waves", viewed as objects endowed with merely relational properties. He then conceived some experiments able to discriminate between such a realistic interpretation and the orthodox one, which has been realized by experimental physicists like Mandel and Hardy, confirming a smooth form of complemetarity. More recently he has proposed with G. Auletta a further experiment, where wave-like properties are associated to quantum states endowed with surprising formal analogies with entanglements, discriminating between the reality of quantum waves and the reality of the predictable properties.

On the Einstein-Bell contradiction he suggested an extension of the validity domain of Bell's theorem, showing that Bell's inequality is satisfied also by the best known nonlocal theories, like Newtonian dynamics and de Broglie's and Bohm's hidden variables theories; he has found some proofs of the EPR paradox and Bell's theorem based only on the principle of local reality, with no need of hidden variables; he criticized Clauser and Horn's probabilistic proof of Bell's theorem. In further works, some of which in cooperation with Franco Selleri, he has shown how a probabilistic proof of Bell's theorem may be given without recourse to the factorizability hypothesis, thus avoiding Clauser and

Horne's (and many other authors') unjustified identification between statistical independence and the physical notion of separability. As it was stressed by Karl Popper in 1985:

F. Selleri and G. Tarozzi found a model that satisfies Bell's definition of locality but not the Clauser-Horne definition of locality (also known as the 'factorizability condition'); this seems to show again that Clauser and Horne have not established the Universality Claim.

In order to do so, he defined physical reality without using the notion of predictability with certainty, thus providing a probabilistic generalization of EPR's criterion. The value of these contribution was stated by Max Jammer, one of the greatest historians of science of last century, in his opening speech of the 1991 conference in memory of John Bell:

Other current developments concerning Bell's inequalities, which promise further to clarify their significance, contains certain elaboration of ideas which had been mentioned already in 1980 by A. Garuccio and F. Selleri and in 1981 by F. Selleri and G. Tarozzi in their attempts at systematically derivating all Belltype inequalities, but only recently explored as to their experimental consequences.

Of the measurement problem he mainly discussed some epistemological aspects, with particular regard to the mind-body problem, negative result measurements, and the implications of macrorealistic theories, showing that even a satisfactory physicomathematical account of the reduction process would still leave unsolved the more serious problem of the entangled superposition states. He also studied the epistemological and methodological aspects of measuring and experimental instruments in the history of classical mechanics and electromagnetism.

These foundational researches are based on his reformulation of the demarcation criterion, allowing for philosophical sentences that are meaningful, but non-falsifiable. Cases in point are

- the realistic hypothesis of Lewis "If all minds disappear from the universe, stars still go on on their courses", analyzed in "Testability and Meaning" by Carnap, who highlighted how this was a statement satisfying the most stringent requirements of factual significance since it is testable, albeit incompletely;

- the EPR principle of physical reality, indirectly veriafiable, according to the definition given by Alfred Ayer, who remarked in a letter to Tarozzi of 1981:

I agree you have shown the possibility to obtain non trivial empirical consequences from what you choose to call a realist philosophical hypothesis, but I am non persuaded that your result could be interpreted by an instrumentalist accordig to his own fashion.

- the probabilistic generalizations of the EPR principle.

In a similar way Tarozzi has shown that there are at least four formulations of the principle of causality endowed with empirical meaning and contradicting the orthodox interpretation of quantum theory: Laplace' determinism, causality as lawfulness according

to Kant's second analogy of experience, Mill's principle of the uniformity of nature, and Hume's causality as ordered connection which excludes any reversal of the temporal order. Moreover, he analyzed the mind-body problem with respect to von Neumann's and Wigner's subjectivistic interpretation, pointing out the paradoxical consequences of orthodox quantum mechanics and the need of alternative theories.
Such a possibility of reformulations endowed with empirical meaning of metaphysical principles has been furtherly extended to holism, strongly supported by quantum mechanical description based on entangled states and even to the archimetaphysical concept of nothing, stressing how the reality of nothing, implied by a new quantum paradox, represents an argument against the idea that (only) macroscopical properties are real.

ACADEMIC EXPERIENCE

Permanent member of Accademia nazionale di scienze, lettere e arti di Modena
Class of Physical Sciences
November 2016 – present

Head of Department of Pure and Applied Sciences at Urbino University
November 2015 – present

Vice-président de l'Académie Internationale de Philosophie des Sciences (AIPS)
September 2015 – present

Coordinator of the international network "Archimedes in the Renaissance: The Origins of Modernity" Max-Planck-Institut für Wissenschaftsgeschichte of Berlin, Centro Internazionale di Studi "Urbino e la Prospettiva", Department of History and Philosophy of Science of the Indiana University,
Dornsife College of Letters, Arts, and Sciences of the University of Southern California
September 2012 – present

Permanent member of Acadèmie Internationale de Philosophie des Sciences
September 2009 – Present

Director of Centre for Research in the Philosophy and Foundations of Physics
of the Universities of Bologna Alma Mater Studiorum, Insubria, Salento and Urbino Carlo Bo
September 2006 – Present

Corresponding member of New York Academy of Sciences
April 1997 – Present

Full professor of Logic and Philosophy of science
University of Urbino "Carlo Bo"
November 1994 - Present

Corresponding member of Accademia delle scienze dell'Istituto di Bologna
Class of Moral Sciences
July 1994 – Present

Assesseur at Acadèmie Internationale de Philosophie des Sciences
April 2011 – September 2015

Head of Department of Philosophy
May 2009 - December 2010

Dean of Faculty of Literature and Philosophy
November 2005 - May 2009

Chairman of Faculty Board (M.A. program) in Theories of Knowledge, Morals and Communication
October 2004 - October 2005

Coordinator of Dottorato di Ricerca (Ph.D. program) in Philosophical Anthropology and Foundations of Sciences
April 2001 - October 2005

Head of Institute of Philosophy “Arturo Massolo”
November 1998 - October 2004

Vice president of Italian Society for Logic and Philosophy of Science (SILFS)
April 1999 - May 2002

Director of School of Advanced Studies in The Foundations and Philosophy of Physics
September 1998 - September 2000

Director of Centre for Research in the Philosophy and Foundations of Physics
Universities of Bologna and Urbino
April 1995 - September 2000

President of Italian Society for Logic and Philosophy of Science (SILFS)
February 1996 - March 1999

Head of local operative unit C.N.R. research project
of the Universities of Bologna, Florence, Urbino
February 1995 - May 1998

Chairman of Faculty Board (B.A. program) in Philosophy
February 1995 - February 1998

National coordinator of joint research project of the Universities of Bologna, Chieti and Urbino
January 1994 - November 1997

Corresponding member of Accademia nazionale di scienze, lettere e arti di Modena
Class of Physical Sciences
February 1989 – November 2016

Associate professor of Philosophy of science
Faculty of Literature and Philosophy, University of Urbino
June 1988 - November 1994

Researcher at Istituto per i Beni Culturali, Regione Emilia Romagna
June 1978 - June 1988
Lecturer of History of philosophy

Faculty of Education , University of Urbino
November 1985 - June 1987

Lecturer of Contemporary philosophy
Faculty of Literature and Philosophy, University of Perugia
November 1977 - June 1981

LIST OF PUBLICATIONS

Logic and Philosophy of Science (M-FIL/02)

"Realistic Interpretation of Physical Theories", Mem. Acc. Naz. Sci. Lett. Arti Modena XX , 49-61 (1978)
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"Realism as a Meaningful Philosophical Hypothesis", Mem. Acc. Sci. Bologna VII, XIII, 89-98 (1980)
"On the Relevance of the Realist Assumption in the Proof of Bell's Inequality", Mem. Acc. Naz. Sci.
Lett. Arti Modena XXII-XXIII, 81-86 (1980-1981)
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"Critica alle interpretazioni del teorema di Bell", in Logica e Filosofia della scienza oggi , ed. by E. Agazzi, M. Mondadori, S. Tugnoli Pattaro CLUEB, Bologna (1986), vol. II, pp. 331-335.
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"Pre-measurement vs. Measurement. A Basic Form of Complementarity", with G. Auletta, in The Foundations of Quantum Mechanics, ed. by C. Garola et al., World Scientific, Singapore 2006; pp. 40-47
"Can Nothing Cause Nonlocal Quantum Jumps?", with A. Afriat, in Quantum Mechanics. Are There Quantum Jumps? ed. by A. Bassi et al., American Institute of Physics, Melville, New York (2006); pp. 3-7
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“Parthood and Composition in Quantum Mechanics”, with C. Calosi, in Mereology and the Sciences, ed. by C. Calosi and P. Graziani, Berlin: Springer: 53-84 (2014)
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Leopoldo Nobili e la cultura scientifica del suo tempo , ed. by, Nuova Alfa, Bologna (1985); therein pp. 137-169
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