

Preface

Correlations among several many-body systems manifest themselves at various scales especially under extreme conditions. In collecting invited contributions for this special volume, we especially had in mind many-electron systems both in solids and in molecules or clusters, under high pressure or low temperature, and especially in solids or molecular systems with reduced dimensionality.

These in fact embrace the main research interests of Prof. Renato Pucci, whose 70th birthday we would hereby like to celebrate. Professor Pucci started his career immediately after he graduated in physics from the University of Catania (Italy) in 1968, where he eventually became full professor of structure of matter (condensed matter theory) in 1990. During his long and fruitful career, he enjoyed a constant collaboration with Prof. Norman H. March (Oxford University, UK), with regular visits of Prof. Pucci to Oxford first and of Prof. March to Catania later. Professor Pucci also collaborated with several other distinguished scientists, including Profs. R.G. Parr (North Carolina University, USA), F. Flores (Universidad Autónoma de Madrid, Spain), and L.S. Brizhik (Ukrainian Academy of Science, Kiev, Ukraine). He is the author of more than 150 papers on several peer-reviewed international journals and serves as referee for numerous national and international journals, such as the *Physical Review* and the *Physical Review Letters*, and the *Journal of Chemical Physics*.

Professor Pucci is quite well known within the high-pressure scientific community. After organizing two Archimedes Workshops on high-pressure science, he chaired the European High Pressure Research Group (EHPRG) meeting in 1998 and the Joint International Conference of the International Association for the Advancement of High Pressure Science and Technology (AIRAPT) and of the EHPRG in 2007. He was also scientific secretary of the national congress of the Italian Physical Society (SIF) in the International Year of Physics 2005. For both the EHPRG and the AIRAPT, he has been the member of the respective scientific committees for several terms.

At the University of Catania, Prof. Pucci served as head of the undergraduate program in physics, head of the Department of Physics (later: and Astronomy), dean of the Faculty of Sciences (for two terms), and member of the Board of Administration of the university.

His research interests are quite broad and span from chemistry to physics, especially in the solid state. These are reflected, to some extent, in the topics covered by the present volume, which includes invited contributions from collaborators, colleagues, and friends of Renato's.¹ In particular, Prof. Pucci has given contributions to the fields of positron annihilation, to the many-body theory of surfaces (see Chap. 2 by Flores and Goldberg), to nonlinear effects in electronic transport in low-dimensional systems (see Chap. 15 by Brizhik and Chap. 10 by Deretzis et al.), including polyacetylene (see Chap. 11 by Baldo).

Professor Pucci and his group devoted much attention to superconductivity in novel compounds, such as the high- T_c superconductors (see Chap. 3 by Angilella), especially under high pressure (see Chap. 4 by Schilling), or the ruthenocuprates (see also Chap. 5 by Citro).

Within the field of high-pressure physics, Prof. Pucci and his group predicted that the light alkali metals should become insulating (and then possibly reenter a metallic phase) with increasing pressure (see the reprinted article by Siringo et al. on Chap. 18). This has stimulated much research, both experimental and theoretical, with the eventual identification of insulating phases occurring indeed in lithium and sodium under pressure (see Chap. 3 by Angilella for a review). These findings may also be relevant for the pressurized electronic phases of several electrides (see Chap. 6 by Dong and Oganov).

In chemical and molecular physics, Prof. Pucci is probably best known for the so-called Yang–Parr–Pucci formulae (see Chap. 19 by Echeagaray et al.), which are the key working equations for most practical applications of the Fukui functions—a reliable descriptor of molecular electronic structure and chemical reactivity. Together with N.H. March, Prof. Pucci has given contributions in the general area of density functional theory (see the reprint in Chap. 21 by Pucci, for a review).

More recently, Prof. Pucci's group has given contributions to the study of the effect of strain on several transport (both electrical and optical) properties of graphene (see Chap. 3, and especially Sect. 3.4, by Angilella, for a review, Chap. 12 by Pellegrino, Chap. 13 by Deretzis and La Magna, and Chap. 14 by Pidatella and Mazzarello).

Part IV contains some reprints or translations (and one original contribution by Ruggieri, Chap. 24) of several papers by Prof. Pucci et al. on the philosophy and the history of science and on the 'correlations' thereof with another deeply rooted aspect of man's endeavor toward knowledge, with its own peculiar 'language,' *viz.* theology—a subject under 'extreme conditions' in its own respect!

¹Some of these were delivered at a workshop which took place in Catania, on September 23, 2016.

This volume is meant to be a testimony to Prof. Pucci's scientific achievements during his career thus far, a small token of our gratitude toward his efforts as a group leader, and of course a hopeful encouragement for future successes!

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birthday

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