No-nonsense Physicist

An overview of Gabriele Giuliani's work and life

edited by
Marco Polini, Giovanni Vignale,
Vittorio Pellegrini and Jainendra K. Jain

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Figure 1. Gabriele (left) and Giovanni Vignale (right) promoting the sales of their newly published book at the Cambridge University Press boot at the 2005 American Physical Society March Meeting in Los Angeles (USA).

Figure 2. Gabriele with a big smile on his face at the Montreal "Grand Prix du Canada" in 2010.

Figure 3. Gabriele (left) and Giovanni Vignale (right) at the 1988 American Physical Society March Meeting in New Orleans (USA).

Figure 4. Gabriele was a passionate supported of F.C. internazionale, one of the two soccer teams based in the city of Milano (Italy). The picture was taken in the summer of 2009.

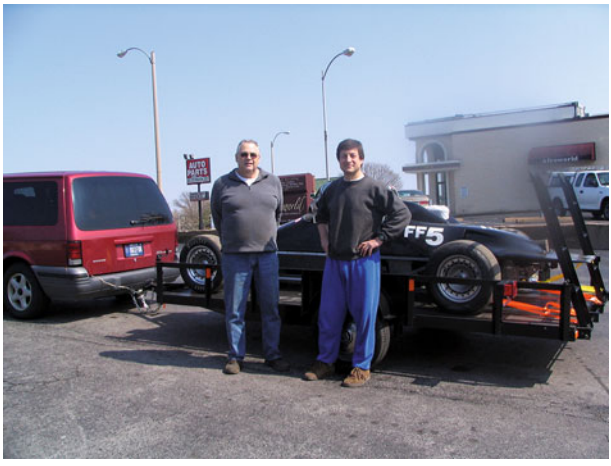

Figure 5. Gabriele (right) with his (in)famous red minivan and his Formula Ford car, which he used to call "his black girlfriend" (circa 2010).

Contents

Preface

Gabriele Francesco Giuliani, Professor of Physics at Purdue University (West Lafayette, Indiana, USA), died on November 22, 2012 (Thanksgiving Day) after a 12-year-long battle with a rare, slow-growing, relentless form of cancer. His passion for life, his taste for simple and earthy pleasures, and his no-nonsense attitude in science as in all other aspects of life, remained with him until the last minute. This volume is as much an attempt to pay tribute to his scientific contributions as to record the many facets of his personality: scientist, educator, author, sportsman, coach, polemist, family man, and provocateur. The gallery of photographs collected in the following pages will give an idea of the range of his interests. The volume opens with a series of personal recollections of Gabriele by his immediate family and friends. This is followed by a set of scientific papers by former colleagues, collaborators and students of Gabriele. These papers, especially written for this volume, report original research on topics to which Gabriele made important contributions, and often are inspired precisely by those contributions. A selection of reprints of Gabriele's most important scientific papers concludes the volume.

Born in Ascoli Piceno, Italy, on April 13, 1953, Giuliani was educated at the University of Pisa where he graduated cum laude in 1976 under the guidance of Professor Mario Tosi. He continued his studies at the Scuola Normale Superiore in Pisa and was a researcher in Rome and in Trieste, where he worked with Professor Erio Tosatti. In 1979 he met Professor Albert Overhauser, who was to be the decisive influence in his career. Fascinated by the physics of broken symmetry phases in simple metals, he joined Overhauser at Purdue University in the study of collective modes of charge-density waves, the so-called "phasons" and "amplitons". He eventually became a member of the physics faculty at Purdue in 1984 –but not before completing an extremely fruitful postdoctoral experience at Brown University with Professor John Quinn. It was during this period that some of his best known contributions sprang to life, such

as the calculation of plasmon dispersions in semiconductor superlattices, the discovery of the singular behavior of the quasiparticle linewidth as a function of temperature in a two-dimensional electron gas, and the prediction of a ferromagnetic phase transition in the two-dimensional electron gas in the quantum Hall regime (now experimentally observed).

Gabriele Giuliani's field of research was the theoretical study of the properties of low-dimensional electronic systems, particularly those that are controlled by electron-electron interactions. His enthusiasm for the theory of the interacting Electron Gas earned him the nickname of "EG" since the Trieste days. Many of his contributions are widely known and some of them are featured in textbooks. Besides the already mentioned works, these include an elegant analysis of the role of impurities in the integer quantum Hall effect, an experimentally confirmed theory of the effect of a magnetic field on the critical current of a layered superconductor, and numerous contributions to the foundations of the theory of Fermi liquids, most recently in the presence of spin-orbit interactions. Among his legacies is a monograph, co-authored with Giovanni Vignale, on the "Quantum theory of the electron liquid" (Cambridge University Press, Cambridge, 2005), which has become a standard reference for beginning students and advanced researchers.

Giuliani was known in physics circles for his flamboyant personality, his quick sense of humor, and his unremitting critical eye. Shunning the superficial and the fashionable he always strove for genuine accomplishment and complete intellectual honesty. His criticism could be abrasive, but never intentionally so. His ability to entertain and provoke with humorous word play was unmatched. He never lost the purity and the enthusiasm of his happy childhood in Ascoli Piceno. An avid soccer player and sports critic to his last days, he successfully coached soccer teams of all age groups at Purdue and in the Lafayette area. Other interests of his were Hammond-based blues, wildlife (he boasted to have once met a grizzly bear at Yellowstone), and all kinds of "italica", ranging from spaghetti alla carbonara "better than sex", to espresso brews, to Italian politics which he followed with a mixture of wit, concern, and shame. In the early 2000, after surviving against all odds a first major operation to remove a large liposarcoma, he decided to act on one of the great passions of his youth: auto racing. Equipped with an old van Diemen, which he used to call "his black girlfriend", he experienced the adrenaline rush of Formula Ford racing. During this period he also participated as a volunteer race marshal in several racing events. Above all, Gabriele Giuliani loved his family, his mentors, and his students, several of which are now professors in various countries. With his mentors he always enjoyed a relation based on admiration, respect and love, and to his students he tried

to give back what his mentors had given him. A few weeks before dying, musing on the twelve years that followed his first encounter with cancer, he told his wife: "If somebody had offered me this twelve years ago, I would've signed on the dotted line in a minute to be able to live as well as I did for these twelve years". He died as he had lived, joyously, defiantly, and deeply engaged in his own life.

This volume is dedicated to Gabriele's wife, Pamela Wilhelm-Giuliani, his children Daniela, Adriana and Giuseppe and his siblings, Alessandro and Carla Cutolo. But, more broadly, it is dedicated to the whole scientific community of which Gabriele was part, in the firm belief that the fruits of his scientific ingenuity will outlive him.

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Curriculum vitae

EDUCATION:

Undergraduate: *Laurea* in Physics, 110/110 *cum laude*),
University of Pisa, Italy, 1976;
Doctoral: *Perfezionamento*, 70/70 *cum laude*,
Scuola Normale Superiore, Pisa, Italy, 1983.

EMPLOYMENT:

1995-2012: Professor of Physics, Purdue University
1990-1995: Associate Professor of Physics, Purdue University
1984-1990: Assistant Professor, Purdue University
1983-1984: Assistant Professor (Research), Brown University
1982-1983: Postdoctoral Research Associate, Brown University
1979-1981: Postdoctoral Research Associate, Purdue University
1976-1979: *Ricercatore*, Scuola Normale Superiore, Pisa, Italy.

PROFESSIONAL ASSOCIATIONS:

Member of the American Physical Society since 1979.
Fellow of the American Physical Society since 2006.

Research Journal Publications:

PUBLICATIONS:

BOOK: **Quantum Theory of the Electron Liquid**
Gabriele F. Giuliani and Giovanni Vignale
Cambridge University Press, March 2005

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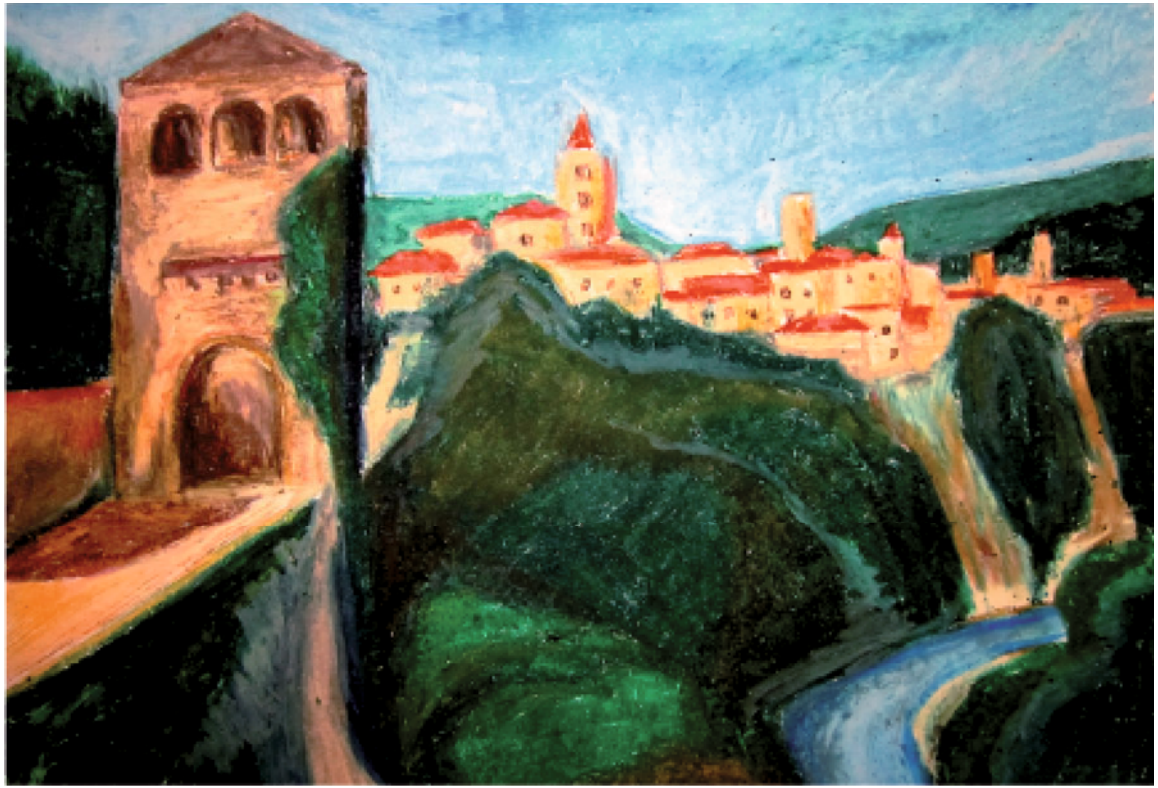
Personal recollections



Daniela Giuliani

Adriana Giuliani

My father was a bear. This aspect changed from perspective.

I saw a grizzly, bristled and growling, wild and protective. His mentor Tosatti saw a teddy bear. His students saw a majestic and noble beast.

There are lots of bears. Honey-loving Pooh bears. Lame-joke Yogi bears. Coke-drinking polar bears. Yellowstone-cabin soap bears. My father was each and all of these.

He was a bear.

It is only fitting, for he loved bears.

When we would go hiking, he would seek them out. He would stand one hill away, binoculars in hand, inching forward towards the animal he was. He would stride, camcorder in hand, towards a bear cowering on the side of the road. Park rangers yelled at him to get back. He would yell back in uncomprehending Italian.

Bears can be protective or solitary. Prone to tremendous wrath and wide smiles. Harmless unless provoked or hungry.

For a long time, I only saw one face of the bear. I knew him always and only as my father, far replaced from the cub he invariably was or the teddy bear he could seem. I never knew him as an erudite physicist nor fervent calciatore nor unabashed racer nor stimulating professor. He was my father. He was fierce, he was strong, he was unrelenting.

He expected and insisted upon only the best from his children, even if this expectation was limited in scope to lawyer or physician. He was smartly and often scathingly sarcastic. He stubbornly and bravely held a moral standard and true compassion which too many surrender. It was under his order that I was raised, tossed between his math lessons and his Befana masquerades. Mostly, I feared him and in that fear, I respected him.

He loved- infuriatingly, passionately, insistently- he loved. “I love you guys”, he breathed on his deathbed, “so much”.

He loved life. He loved speeding up the top of a mountain so he could look down. He loved cooking with the colors of the Italian flag. He loved swimming past the rocks, to the furthest proper boundaries and beyond. He loved Christmas ornaments that glowed and whistling the tune of "The Good, the Bad, and the Ugly". When he smiled, it was broad and wrinkled the edges of his eyes. When he laughed, it was loud and emanated from deep in the throat. His spirit burst forth and embedded itself in those moments.

He was free, unabashed, daring. He spoke with words that were only ever his own. He drove alone, pedal pushed down, speeding his racecar around the next corner. He flung curses at whoever needed them the most. He climbed onto rocks where he would fall.

When he fell, and fall he would, he always stood back up. He always defied the odds, beating them down with what only was pure will. When he died, and die he would, it was only with the consent of that same will. The odds never stood a chance against this bear of a man, with daunting blue eyes and thick mane of black hair.

I never saw a mark or wrinkle or gray hair to show what he had overcome. For my twenty long years, he was my same father. Always protective and guarded, always holding us up and telling us to be better.

He put his shoulder around me as I was shaking in an ambulance, moments from a scare with a car crash, and spoke in low tones "It's okay, baby. It's okay". He sent me a jubilant text when I completed my studies in Guatemala, calling me *gringa* and signing *el papa'* and again mentioning that I am *muy blanca*. "Adriana, Adriana mia", he called me, half-mumbling the words.

"Be good", he always managed to say to me, as I kissed a grizzled cheek and said goodbye. Eventually, the goodbyes came to an end.

It is only after his death, in my own adventures in Italy, in my moments with my Nonna, in my sifting through old letters, in my meeting older friends, that I have come to know the other faces of the bear. I learned about the cigarette burns administered by his officemate in Trieste, about his mandate on the cleanliness of his carpet in Providence, about his insistence on getting water from his mother "per bere" instead of "per piacere". More stories trickle down to me, unveiling more and more the character of a man I only knew as my father. More stories I still hold, in the recesses of my mind, of the bear I saw in my eye. This is the best proof that these memories and this spirit lives on.

A bear is a beast not to be trifled with and never to be forgotten.

February 7, 2014

Adriana Giuliani

Giuseppe Giuliani

When thoughts concerning my father come to mind, I always find myself lost. Boys look up to their fathers. I must look up to what my father was and what he stood for. Who was he? This is the hardest question which I must approach everyday. Gabriele Giuliani constantly drove himself to wrench the most out of life. He seemed to be able to accomplish anything. Starting from the day he was born on the kitchen table of his parents' home in Ascoli Piceno, he pushed himself into becoming Professor Giuliani, a great soccer player, a passionate musician, and a courageous racecar driver. Most everyone knew him from one of these very different and discrete worlds, but I knew him as the man that raised me. Gabriele was very set in his ways; he would never compromise what he truly believed in for anything. This uncompromising nature was what I thought was most unique about him. My father took many actions that were considered unusual or unaccepted because he believed whole-heartedly that what he did was right, not that he would profit from it. Many people today do not make decisions based on a moral basis but on a dormant nihilism that lies in their instinctive nature. Though simple, I always admired this in him because it made him more trustworthy in serious situations. In my eyes, this along with his intelligence, passion for knowledge and drive to push life to its limits made him who he was. I do not claim to understand the full impact my father had on the academic world, the football world and the racing world; I hope that through life and my studies I will discover more and more as to who my father was and what I have to look up to. I loved my father, and I hope that what whatever I become would have made him proud.

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Giuseppe Giuliani