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Nuclear Physics B 901 (2015) 249–251

NUCLEAR PHYSICS B

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Obituary

Guido Altarelli (1941–2015)

Guido Altarelli was one of a small group of physicists who shaped our current theory of the fundamental interactions: the so-called Standard Model.

Guido was born in Rome in the midst of World War II, and in Rome he spent his early years. His hometown was very present in his words and memories, and he never lost contact with Rome during his scientific career: he never sold the apartment in which he grew up (he actually lived in it after the death of his parents), and after so many years spent abroad, he never lost his beautiful Roman accent — we always had the feeling that he did it on purpose.

He graduated in 1964 at University of Roma La Sapienza, one out of an outstanding group of young physicists who later played an essential role in the foundation and development of modern fundamental physics. Right after graduation he followed Raoul Gatto in Florence, where this promising group of scientists grew up and became mature researchers. In the following years (1968–1970) he was in the United States, were the quantum field theory of the fundamental interactions was being developed at the time; at the Rockefeller University in 1969 he overlapped with another young physicist he had already met at La Sapienza, Giorgio Parisi. In 1970 he obtained a position at his Alma Mater, where he became a full professor in 1980. In that period he visited Ecole Normale Supérieure in Paris (1976–1977, when Giorgio Parisi was in Paris too, and again in 1981), and Boston University (1985–1986).

In 1987 he became a staff member at CERN, where he was head of the Theory Division from 2000 to 2004. While at CERN, Guido never left his position in Rome. In 1992, he moved to the newly established Università di Roma Tre, where (together with Mario Greco and others) he played an essential role in establishing its Physics Department, and in particular a theoretical physics group. He used all of his scientific influence and human capabilities in attracting good young physicists at Roma Tre, and creating a vibrant and exciting atmosphere, as one of us experienced personally. During these years Guido always managed to hold a dual part-time appointment at Rome and CERN, spending half of his time at each institution and dutifully fulfilling teaching and administrative university obligations — one of us used to joke that it was easier for students to find him in his office than some of his full-time colleagues. Guido retired from CERN in 2006 and in 2011 from the university, where he was at the time head of the graduate school — a request for a two-year extension of retirement age, strongly supported by the university, was turned down on bureaucratic grounds, and Guido did not bother to appeal — he said that he'd take it as a sign of destiny. Guido used to say that "retirement" meant that at CERN he had to move from an office with two windows to one with a single window. Indeed,

http://dx.doi.org/10.1016/j.nuclphysb.2015.10.021
0550-3213/2015 Published by Elsevier B.V.

Guido never stopped working: one of us received comments from Guido on a recent paper on September 18, 2015.

Guido's contributions span all the aspects of contemporary theoretical particle physics, including seminal contributions to precision tests of the electroweak interactions, the now standard way of parametrizing potential deviations from the Standard Model, grand unification and experimental limits on it, models of neutrino mixing, and the road that led to Higgs discovery. However, his most celebrated work is in the theory of strong interactions, where he has opened ways which have been widely traveled for many years and are now important directions of development, such as strong corrections to weak processes, higher order QCD corrections to collider processes (jets, Drell–Yan, heavy quarks), and resummation, with more recent work concentrating on polarized processes, and small-x resummation.

His most important result, which is at the basis of any subsequent application of quantum chromodynamics to high energy physics, is contained in an article, written in 1977 in collaboration with Giorgio Parisi when they were both in Paris, and published in Nuclear Physics B. The title of that paper is "Asymptotic freedom in parton language": a title which reveals Guido's way of attacking physics problems. The paper essentially shows how asymptotic freedom, i.e. the possibility of performing perturbative calculations of observables involving quarks and gluons, can be used in connection with the familiar framework of the parton model beyond the leading approximation. In the words of Giorgio Parisi, "his most celebrated work [...] stemmed from one of his ideas. He liked clear, precise formulations which could be understood by all."

The original Altarelli–Parisi paper is both exemplary and extraordinary in many respects. It contains an outstanding result, which makes sense of an entire field by relating and making sense of something which was confusely present in the literature in various forms. It is completely exhaustive (for example, the case of spin states of hadron is discussed in full detail). It presents the results in such a perfect way that essentially all subsequent textbooks reproduce the original argument with no changes. It uses an ideal choice of notation and language ("splitting functions"). And it is completely free of errors. As Guido commented once to a collaborator, once the repeated failure of numerical check was found to be due to a subtle theoretical issue, rather than to a trivial error, "we never make computational errors, we only make conceptual mistakes" — and we can imagine his broad grin and self-deprecating manner in saying so.

However impressive, the list of Altarelli's scientific achievements does not fully convey his influence on the world of high energy physics. His opinion, expressed in simple words and short sentences, during CERN theory division seminars, or international conferences, was always taken very seriously: for many it would clarify the crux of a previously obscure argument, and often it simply defined the opinion of the community on an important point, such as for instance the correct interpretation of an experimental result.

Guido never sought leadership duties, but he always accepted to fulfill them when he was asked to: among many others, he was editor of Nuclear Physics B, and, besides leading the CERN theory division, he was director of the Rome laboratory ("Sezione") of INFN, from 1985 to 1987. And he was very good at them: with his absolute honesty, lack of self-interest, clear thinking, and common sense. Similarly, Guido accepted as much as possible the numerous requests he received to give opening or summary talks, invited lectures, and courses at summer schools: the only reason for him to decline was when he thought that someone else could do a better job, especially if it was a younger physicist. This led Guido to travel a lot, something he enjoyed very much. He accepted with pride prizes and awards: for instance, we remember his happiness in receiving the Sakurai prize of the American Physical Society on the year of his seventieth birthday.

Guido had a very strong influence on the many who came in contact with him. His students include famous theorists such as Keith Ellis, but his influence on younger collaborators was such that many of them (including us) consider themselves Guido's students even though he was never their formal advisor. A characteristic of Guido, which for many was at first hard to believe and understand, was that he always said what he believed to be true, and always spoke his mind. If he thought that an idea was great, or silly, he would just say so: never with malevolence, and often with a smile, or a joke.

So far we have mostly talked about Guido as a prominent public figure in the scientific community. We would like to add some personal recollections. However, we are unable to make a choice among many that come to mind. What we do want to say is that Guido was at once very deep and incredibly fun to be with: any instant of time we spent with him is for us a most cherished recollection. We never remember Guido angry: nor does anyone else whom we asked. What we, and all, remember of Guido is his broad grin. Many have experienced it, and no-one will forget it.

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29 October 2015

Available online 4 November 2015