Rome, 12 November 2010

Recollections about Nicola

Guido Altarelli

At the beginning of my scientific life I had two great "Maestri":

Raoul Gatto and Nicola Cabibbo

When I graduated in '63 Nicola was not in Rome.

Gatto was my thesis advisor and in '64 I followed him in Florence (with Buccella, Maiani, Preparata)

I met Nicola for the first time at the Erice School in ‘64

Then also in ‘65, ‘66, ‘67

At times I even drafted part of his Proceedings!

Erice ‘65

BROKEN SYMMETRIES AND SUM RULES

N. Cabibbo,
CERN, Geneva.

INTRODUCTION

In the last few years there has been an increasing interest in the attribution of approximate symmetries to the world of strongly interacting particles, with respect to both their strong interactions and their weak and electromagnetic ones. The oldest example is that of the SU(2) invariance implied by I-spin conservation. This symmetry is not exact, due to the electromagnetic interactions which break it. Such breaking, however, is, in general, "under control" owing to the smallness of the fine structure constant, and in most cases we can put safe limits on the possible deviations from the exact symmetry.

A different situation occurs in the (broken) SU(3) symmetry, where the origin of the breaking is not yet properly identified, and the breaking itself can be large enough to play an essential role. In fact, predictions based on the SU(3) symmetry seem to be in fair agreement sometimes, while at other times in wild disagreement (especially in processes involving four or more particles) with experimental results.

Still a different situation occurs in dealing with SU(6) and the other proposed symmetries which connect space-time and internal variables. In fact, it has been conclusively shown (McGlinn, O'Raifeartaigh, Coleman) that such symmetries cannot be exact without conflicting with our most fundamental ideal on the structure of the

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Notes for first three lectures taken by G. Cicogna and E. Remiddi.
Notes for fourth and fifth lectures taken by G. Altarelli.

The Erice School in those years was really great

The leaders of the field all went there

Two weeks, lectures at the blackboard, discussions, students taking notes

Everybody was very young:

In ‘64 I was 23, Nicola 29, Gell-Mann 35, Feynman 46

Nicola was already a star but he was very accessible and friendly with the students. Fortunately, I was able to make a good impression on him, so that I established with him an important contact for my future

Soon Nicola settled back in Rome

When Gatto moved to Padua in ‘67 the romans went back to Rome, some of us via the US

In my case it was Nicola who directly contacted Zumino to arrange that I go to New York University in ‘68

When back in ‘70 it was Nicola who invited me to apply for a tenured position of Assistant Professor in Rome which I got.

Thus in the ‘70’s a group started to form around Nicola with myself and Maiani and then with K. Ellis, Petronzio, Parisi, Testa, Martinelli...

We were studying the SM, charm, QCD, the parton model.... before all these fields were widely accepted by the community

A list of papers that Nicola signed with me (and Maiani)

The sigma term and low-energy pi-n scattering.
Guido Altarelli, N. Cabibbo (Rome U.), L. Maiani (Rome, ISS).
Published in **Nucl.Phys. B34 (1971) 621-631**

Magnitude of the sigma-term, chiral symmetry and scale invariance.
Guido Altarelli, N. Cabibbo (Rome U.), L. Maiani (Rome, ISS).
Published in **Phys.Lett. B35 (1971) 415-418**

The Drell-Hearn sum rule and the lepton magnetic moment in the Weinberg model of weak and electromagnetic interactions.
Guido Altarelli (Rome U.), N. Cabibbo (Rome U. & INFN, Rome), L. Maiani (Rome, ISS & INFN, Rome).
Published in **Phys.Lett. B40 (1972) 41**

The Nucleon as a bound state of three quarks and deep inelastic phenomena.
Guido Altarelli (Rome U.), N. Cabibbo (CERN & Rome U. & INFN, Rome), L. Maiani (Rome, ISS & INFN, Rome), R. Petronzio (Rome U.).
Published in **Nucl.Phys. B69 (1974) 531-536**

Enhancement of Nonleptonic Decays of Charmed Particles.
Guido Altarelli (Ecole Normale Superieure & Rome U.), N. Cabibbo (Rome U. & CERN), L. Maiani (Ecole Normale Superieure & Rome, ISS).
Published in **Nucl.Phys. B88 (1975) 285-288**

Is the 3104-MeV Vector Meson the psi - Charm or the W0?.
Guido Altarelli, N. Cabibbo, R. Petronzio (Rome U. & INFN, Rome), L. Maiani (Rome, ISS & INFN, Rome), G. Parisi (Frascati). INFN-ROME-592. Nov 1974.

Neutrino processes in a compound model for the nucleon.
Guido Altarelli (CERN & Rome U.), N. Cabibbo (CERN), L. Maiani (Rome, ISS), R. Petronzio (Rome U.).
Published in **Phys.Lett. B48 (1974) 435-439**

Lepton Pair Production in Hadron-Hadron Collisions from an Explicit Parton Model.
Guido Altarelli, N. Cabibbo (Rome U. & INFN, Rome), L. Maiani (Rome, ISS), R. Petronzio (Rome U.).
Published in **Nucl.Phys. B92 (1975) 413**

Weak Nonleptonic Decays of Charmed Hadrons.
Guido Altarelli, N. Cabibbo (Rome U. & INFN, Rome), L. Maiani (Rome, ISS).
Published in **Phys.Lett. B57 (1975) 277**

Possibility that Charmed Vector Mesons are Lighter than Charmed Pseudoscalars.
G. Altarelli, N. Cabibbo (Rome U. & INFN, Rome), L. Maiani (Rome, ISS & INFN, Rome).
Published in **Phys.Rev.Lett. 35 (1975) 635-63**

Muon Number Nonconserving Processes in Gauge Theories of Weak Interactions.
Guido Altarelli, L. Baulieu (Ecole Normale Superieure), N. Cabibbo, L. Maiani, R. Petronzio (Rome U.).
Published in **Nucl.Phys. B125 (1977) 285**

Must the New Heavy Lepton Have Its Own Neutrino?.
Guido Altarelli (Ecole Normale Superieure), N. Cabibbo, L. Maiani, R. Petronzio (Rome U.). 1977.
Published in **Phys.Lett. B67 (1977) 463-466**

Leptonic Decay of Heavy Flavors: A Theoretical Update.
Guido Altarelli, N. Cabibbo, G. Corbo, L. Maiani (Rome U. & INFN, Rome), G. Martinelli (Frascati).
Published in **Nucl.Phys. B208 (1982) 365-380**

Massive States From Massless Multiplets Of The N Extended Supersymmetry.
Guido Altarelli, N. Cabibbo, L. Maiani (Rome U.).
Published in **Nucl.Phys. B206 (1982) 397-412**

Many more papers were done by the same people in different combinations

So the group was indeed very active and, even when we were not directly working with him, we always discussed with him

In those years most of our time was devoted to physics

Nicola's large office was our regular meeting point (even in his absence)

There was a very friendly and relaxed atmosphere and we all liked our work very much.
Sometimes we also met with families

We had good international relations with many visitors in Rome and we often traveled abroad (with Nicola and Luciano we went to Schools in Gif and Orsay, to the triangular meetings Rome-Paris-Utrecht etc)

In the ‘80’s we all became more important and each of us took his own way

Nicola was absorbed with APE and then with INFN

For a period we had a closer relation when
he was President of the INFN and I was Director of the Rome Section

Then I moved to CERN

But we continued to have many occasions to meet.
He appeared to appreciate the fact that I was well informed on the physics at CERN and elsewhere and he was interested to learn the developments

Nicola always made a terrific impression on me.

I consider Nicola as one of the most intelligent persons I have met in my life. He had a broad range of talents and qualities and was really a fine man in all respects

Certainly he had a very charismatic personality and everybody respected him

His approach to physics problems was remarkable. He was not fast (he could remain silent for a long while) but was extremely lucid, sharp and deep.

Economy of words and of chalk but great efficiency.

From him wrong statements were very rare.

He has achieved great things in physics but he could have done even more had he been more concentrated on physics, but he had plenty of other interests:

literature, photography, building boats, computers, telescopes.....

Some people think he was lazy: my opinion is that he only wanted to do what he liked to do.
In fact, when he was interested in something, he worked hard

CERN

All over the years Nicola had a close connection with CERN. He visited regularly, was a member of Council, of the SPC etc

His most famous ‘63 paper on the angle shows CERN as his affiliation

In 2004 he spent a year at CERN as guest professor. As we know, he did a lot of good physics with the NA48 Collaboration and brilliantly explained an intriguing feature of the data on K --> 3π.

CERN Bulletin

Nos 36 & 37 – 8 & 15 September 2010

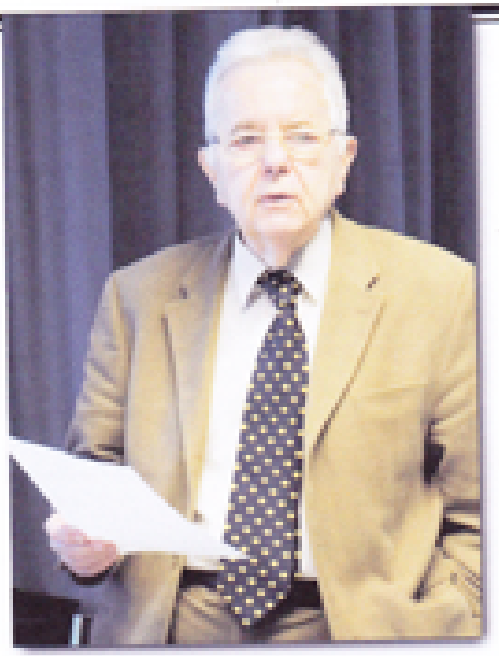
Nicola Cabibbo 1935-2010

Nicola Cabibbo, one of the most important theoretical physicists of our time, died of cancer in Rome on 16 August, 2010 at the age of 75.

Before the discovery of quarks, he gave the correct formulation of the weak current couplings that in modern terms corresponds to the phenomenon of quark mixing. His formulation, in terms of the famous Cabibbo angle, was later extended to three families of fermions (and more recently also applied to neutrino mixing), and plays an essential role in the Standard Model of fundamental interactions.

Over the years he applied his extremely lucid, deep and flexible mind to a wide range of problems, also including experiments, such as the measurement in 1963 of the electron helicity in muon decay, and the conception and design of the parallel computers APE, which he developed, starting in the early 1980s, for the simulation of the QCD theory of the strong interactions on discrete space-time.

Highly respected for his broad range of competence, international recognition, and political and managerial skills, he was appointed to important positions in Italy:



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he was President of INFN from 1983 to 1992 and President of ENEA, the Italian energy agency, from 1993 to 1998.

Since 1993 he had been President of the Pontifical Academy of Sciences. During practically all of his scientific career he was a Professor in Rome, where he was a leading actor in making the theory group one of the most reputed ones in Europe. Outstanding theorists like Parisi, Testa, Petronzio and Martinelli were among his students. Altarelli and Maiani were among his younger collaborators in the 1970s.

Throughout his life he had a continuous connection with CERN, and his most famous work, the 1963 paper on mixing, shows CERN as his affiliation. He was later a member of the SPC and of the Council and visited CERN regularly.

Recently, in 2004, he spent a year at CERN as guest professor. Free from non-scientific burdens, with youthful enthusiasm he plunged back into current research, joined the NA48 collaboration and, among other contributions, quantitatively explained an intriguing feature of the data in K-> 3pi decay in terms of the final state pi-pi interaction computable from chiral symmetry theory.

Nicola Cabibbo will be sorely missed by all those who had the chance to work with him and to appreciate directly his outstanding qualities as a person and as a physicist.

His friends and colleagues

INTERNATIONAL JOURNAL OF HIGH-ENERGY PHYSICS

CERN COURIER

VOLUME 50 NUMBER 9 NOVEMBER 2010

The Matter of Origins

in fundamental physics, Ferretti developed some more speculative ideas, such as a neutrino theory of light, and energy-dependent symmetries. He was also interested in areas other than field theory, for example in the physics of bremsstrahlung in crystals, and in some problems of statistical mechanics, particularly density fluctuations near criticality. In the field of high-energy phenomenology he worked on nuclear forces and on pion–nucleon scattering.

A taste for experimental and applied physics being one of Ferretti's special characteristics, he studied the problems posed by nuclear energy and conceived of a new type of nuclear reactor. A prototype was built near Bologna, where Ferretti also laid the foundations for the School and Laboratories for Nuclear Engineering. Nor did he stop posing and answering questions related to the teaching of physics at any level and instigated original research in science education. He remained active and enthusiastic in research until his very last years, always deeply convinced that theory should keep in touch with feasible measurements.

Ferretti was remarkable for his vast knowledge and discernment in many fields of physics, sometimes very different and widely separated. Discussions with him could last entire afternoons, and he was always well informed and rich in ideas. This was all part of a life that was totally and unconditionally devoted to physics and to the search for new insights.

His friends and colleagues.

Nicola Cabibbo 1935–2010

Nicola Cabibbo, one of the most important theoretical physicists of our time, died in Rome on 16 August.

The son of a Sicilian lawyer, Nicola was born in Rome on 10 April 1935. He graduated in theoretical physics at the Universita' di Roma "La Sapienza" in 1958 under the supervision of Bruno Touschek, whom he always considered as his mentor.

At the beginning of the 1960s, Touschek and his collaborators were building the first e^+e^- collider at Frascati Laboratory, near Rome. Raoul Gatto was also at the laboratory at the time and played an important role in guiding the young Cabibbo towards frontier theoretical physics. Together, they wrote a number of important papers, including a pioneer study on the physics reach of e^+e^- colliders, which remained a standard reference on the subject for years to come.

Nicola then left Rome for the US and CERN. While at CERN, in 1963 he formulated what came to be known as the "Cabibbo universality" of weak currents. He showed that strangeness changing and non-changing β-decays had to be described by a single hadronic weak current, determined in terms of an unknown parameter – the Cabibbo angle, θ_C. With a value for $\sin\theta_C$ of around 0.22 and the use of unitary symmetry, Nicola was able to describe the β-decays of strange mesons and baryons, and to explain the small discrepancy between the neutron and muon Fermi-constants, the former being about 2.5% smaller than the latter.

Later, he reformulated the same concept in the context of the quark model, by stating that the weak charged current couples the u quark to an orthogonal combination of the d and s quarks that is determined by the angle θ_C. His formulation was extended to include charm (the c quark), and explain the absence of flavour-changing neutral currents, by Sheldon Glashow, John Iliopoulos and Luciano Maiani. It was later expanded to encompass three families of fermions by Makoto Kobayashi and Toshihide Maskawa, and more recently applied also to neutrino mixing. Today the Cabibbo–Kobayashi–Maskawa (CKM) matrix plays an essential role in the description of fundamental interactions.

Nicola Cabibbo. (Courtesy INFN.)

In 1967 Nicola settled back in Rome where he taught theoretical physics and created a large school with younger colleagues and brilliant students. Like all great minds, he could find simple arguments to explain the most difficult concepts. His students were fascinated by his simplicity, gentle manners and sense of humour. Inspired by Nicola's physical intuition, mathematical skill and personal charisma, the Rome school contributed significantly to establishing what is today referred to as the Standard Theory of particle physics.

We were extremely lucky to work with him at the time, and remember the long hours spent in his large office in discussions with him. Often he left us there, struggling with some problem or calculation, while he went back home for a long lunch break, which was devoted to his family and to the cultivation of numerous other interests and hobbies. When he returned in the afternoon he could often solve our problems and indicate the next step. He was known for his phlegmatic way of working. He would approach a physics problem very much as a cat approaches its prey, with great caution up to the point when he decided that the solution was within his reach. Then he suddenly became very active and enthusiastic until the work on the problem was completed.

Over the years Nicola applied his extremely lucid, deep and flexible intellect to a wide range of problems. These also included experiments, such as the measurement in 1963 of the electron helicity in muon decay, and the conception and design of the parallel computers in the APE project, which he developed with Giorgio Parisi and younger collaborators in the early 1980s, for the simulation of QCD on a discretized space–time (or lattice). In a pioneering paper he first applied lattice techniques to extract the CKM parameters from hadronic observables.

Highly respected for his range of competence, international recognition, political and managerial skills, Nicola was appointed to important positions in Italy. He was president of the INFN from 1983 to 1992, during which time the Gran Sasso Laboratory was inaugurated. He was also president of the Italian energy agency, ENEA, from 1993 to 1998, and was president of the Pontifical Academy of Sciences from 1993. He held these important positions with vision, managerial ability and universally appreciated integrity.

In 2004, Nicola spent a year at CERN as guest professor. Free from non-scientific burdens, and with youthful enthusiasm, he plunged back into current research, joined the NA48 collaboration and, among other contributions, quantitatively explained an intriguing feature of the data in $K^+ \to 3\pi$ decay in terms of the final state $\pi-\pi$ interaction computable from chiral symmetry theory.

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Guido Altarelli, Luciano Maiani and Roberto Petronzio.

I conclude my talk here
with a great sense of loss