

**Physics in the Sixties: from Rome to
Florence and back.**

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Summary

- 1) Learning physics at La Sapienza.
- 2) Gatto's school at Florence.
- 3) With Cabibbo at Rome.
- 4) GIM at Harvard.
- 5) INFN, CERN and CNR

Our studies in Rome

We had good teachers:

Edoardo Amaldi : Classical Physics Gaetano Fichera : Mathematics

Carlo Cattaneo : Mechanics Marcello Cini : Relativity and Quantum Mechanics

Enrico Persico : Advanced Quantum Mechanics up to Pauli matrices for spin

Bruno Touschek : Statistical Mechanics.

Two exams prepared together with Luciano:

Mathematical tools for Physics : Wolf Gross

Spectroscopy (together with Massimo Cerdonio) : Carlo Bernardini

This interesting course was particularly successful, since we even completed an argument on magnetic resonances and, after passing the exam, explained our progress to the teacher.

Amilcare Bietti spread the legend that our lecturers were afraid of us

Why we went to Florence.

Luciano Paoluzi, who was my cousin, asked Gatto, who was leading the theory group in Frascati, to propose to me an argument for the thesis, which was:

"Radiative corrections to $e^- e^+$ diffusion"

Luckily Guido Altarelli joined and the disaster of my belief that I should study radioactive corrections turned into the triumph on Landau book.

Well impressed by our performance, Gatto invited us to come to Florence. First Giovanni Gallavotti and then Luciano after his experimental thesis on positronium came also.

The first positive effect of Luciano's arrival has been our transfer from our living in a place for old people chosen by our mothers in the cheaper and more attractive place, full of young people held by Marchesa Pepi.

SU(3) and the schools at Varenna and Erice in 1964

It was Ezio Ferrari, invited by Gatto to give a seminar on the peripheral model, to let us know the experimental discovery of Ω^- and induce the study of Lie algebras, helped by two elder colleagues, Gianni De Franceschi and Enrico Giusti, very gifted mathematically.

In summer I went with Luciano to the Varenna School, where we knew Glashow, who gave very brilliant lectures on SU(3) and met Emilio Del Giudice, Carlo Becchi and Roberto Iengo, and with Guido to Erice with Feynman speaking on SU(6), Cabibbo on CP violation and Gatto on the theorem discovered with Ademollo.

Next year Luciano came a little later to Florence, since he had to complete the paper on Fortschritt fur Physik with De Franceschi on symmetries, and he was very brave to collaborate with Preparata, a brilliant scientist and a good person, but with the enthusiasm of thinking physics 25 hours on 24 and a volcano of ideas, not always necessarily right, that only a person with good physical intuition and a very solid nervous system could resist.

In fact it was a very efficient collaboration.

Gatto's school and our american trip

When we went to Florence, there was a robust theoretical group lead by Prof. Gatto, consisting of physicists elder than us,

Marco Ademollo, Claudio Chiuderi and Giorgio Chiuderi

and of our age,

Enrico Giusti (from Rome), Enrico Celeghini and Giovanni Licheri (from Cagliari) and Emilio Borchi, Giovanni Martucci and Mario Poli

finally Gabriele Veneziano was taking the degree on the S-matrix approach to strong interactions.

In summer 1965 three of us went to Brandeis together with De Franceschi and met there Cabibbo, who gave beautiful lectures on weak interactions, and Gianni Jona, working with Nambu on spontaneous symmetry breaking, who, seeing us, made the ironic statement : "Italian physics is rich again."

We met also Sam Ting, who was in the week-ends our guest in New York, where he went to check his experimental apparatus. I was strongly impressed by his statement that since many years he never was in holiday.

After the school Giuliano and Luciano made a tour in the most prestigious american institutes, which they would visit some years after.

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Important papers on current algebra

The success of the Adler and Weissberger relation, a sum rule for the square of the ratio $\frac{G_A}{G_V}$ in terms of the pion-nucleon cross-sections inspired an important paper of Gatto, Maiani and Preparata with the prediction:

$$\frac{G_A^2}{G_V} = \frac{D + F}{3(D - F)} \quad (1)$$

in good agreement with experiment, followed by other successful papers related to the interpretation of their result by Cabibbo and Ruegg in terms of mixing of representation of the $SU(3) \times SU(3)$ chiral algebra, the one at the basis of the AW formula.

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Two important papers on radiative corrections to weak interactions

Back in Rome, together with Cabibbo, Giuliano e Luciano wrote two important papers on radiative corrections to weak decays.

It was particularly wise in that time, in presence of the dominating paradigma of S-matrix theory, to work in quantum field theory and expecially to face the evaluation of higher order contribution for weak interactions, at that time described by a phenomenological non-renormalizable Lagrangian.

This was particularly positive for their following studies in the States, where Giuliano, one of the few phenomenologists at that time expert in QFT, related, together with Richard Brandt, deep inelastic phenomena to light-cone singularities, and Luciano during his stay in Harvard discovered GIM mechanism together with Sheldon Glashow and John Iliopoulos.

The golden period

The prediction of the existence of charm particle and of its coupling to s and d quarks is a very good example of the efficiency of the phenomenological approach to induce progress in elementary particles.

In fact the discovery arose from the necessity to reconcile the experimental knowledge on K_L-K_S mass difference as well as the branching ratio of K_L into two muons with the prediction, within the quark model, of higher order weak interactions.

The discovery of J/ψ by Sam Ting, our Brandeis friend, played a fundamental role in establishing the standard model, by supporting at the same time GIM mechanism and the asymptotic freedom of strong interactions.

Back in Europe in Rome and Paris

By extending the 2×2 Cabibbo, GIM matrix to 3×3 , Luciano found the interpretation of CP violation independently, but unfortunately subsequently to Kobayashi and Maskawa. Otherwise CKM matrix should be called CM matrix and Cabibbo should not be the victim of a great injustice.

Together with Cabibbo in Paris he wrote pioneer papers on non-leptonic charm decays and back in Rome he began to think to my future, by involving me and my friends Alessandra Pugliese and Maurizio Lusignoli in the only paper written together with me on parity violation in nuclei with also the project to make easier my coming back to Florence, where he believed I might create a favourable scientific atmosphere.

Project Florence, result Naples

Having got the chair in 1976, Luciano was in the committee for the next competition in 1980 with two "gattini" competing, Altarelli and myself. But while Guido due to DGLAP equations was a certain winner, despite the important paper on QED and another one on the transformation from constituent to current quarks, without Luciano's strong personality and the patience to explain to the other members of the committee the relevance of the second one (that he knew very well, because it was the continuation of his papers with Gatto and Giuliano mentioned before), I strongly doubt I should be a winner too.

However his project to send me to Florence was lost in a forest (Bosco in Italian) and instead the beauty of the Rome-Florence school was exported to Naples.

One may say that Luciano predicted the direction of my displacement, was wrong by 20% for the modulus, but the sign was wrong.

Leading important scientific institutions

At a certain moment of his life, as it happened to Cabibbo, Luciano was involved in high level responsibilities for important research institutes.

He began with INFN with his direction related to the project of DAΦNE (he took care also in the preparation of the handbook),

then CERN and the ν_μ oscillations into ν_τ , which reminds us of his engagement to send to GRAN SASSO a neutrino beam produced at the European accelerator,

and finally CNR.

The qualities to do this job are different from the ones needed to be a brilliant scientist and one has to admire the courage to face different challenges.

Anyway he found the time also for interesting research, as the one where, together with Piccinini, Polosa and Riquer, he was able to see in the DAΦNE data the well hidden strangeness in the scalar mesons with isospin 0 and 1 around 1 GeV with the consequent interpretation as a tetraquark for the lightest scalar nonet.

Conclusion

In conclusion for the wisdom, which allowed him to take advantage from his high level intellectual ingenuity, he will be remembered as an important physicist of the past century and will be honoured, as we are doing now.

Good Birthday, Luciano.