INTRODUCTION: FROM EURODAFNE TO EURIDICE*

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EURIDICE has been the third in a series of EU funded networks which explored and exploited the physics potential of DAFNE, the electron–positron ϕ-factory, built in Frascati in the 1990s. While studying physics at DAFNE, we encountered unexpected objectives and goals, and these Proceedings bear witness to the vast field of research covered by the network activity.

Before describing our activities and how we came to this place and to this Final Meeting, I would like to briefly mention the starting point of electron-positron physics. Bruno Touschek, the Austrian born physicist, recollects that the first suggestion of such collisions came to him through Rolf Wideröe, the Norwegian physicist who befriended Touschek during the latter's imprisonment in Germany in the last years of World War II. The actual possibility of an electron–positron collider was then put forward by Touschek, living and working in Italy since 1952, during a seminar by the Stanford physicist Pief Panofsky, held in Rome in late 1959 or early 1960. Instead of the electron–electron machines being planned at the time both in the USA and in the then Soviet Union, Touschek suggested to build an electron–positron accelerator and, in the following months, in February and March 1960, prepared the actual proposal for a storage ring to be built in Frascati, and to be called AdA, Anello di Accumulazione. Touschek's proposal was accepted by the Laboratory and within one year AdA was built. The next step towards a successful exploitation of Touschek's idea goes through AdA's travelling to France to increase the luminosity thanks to the more powerful injector provided by the Linear Accelerator in Orsay.

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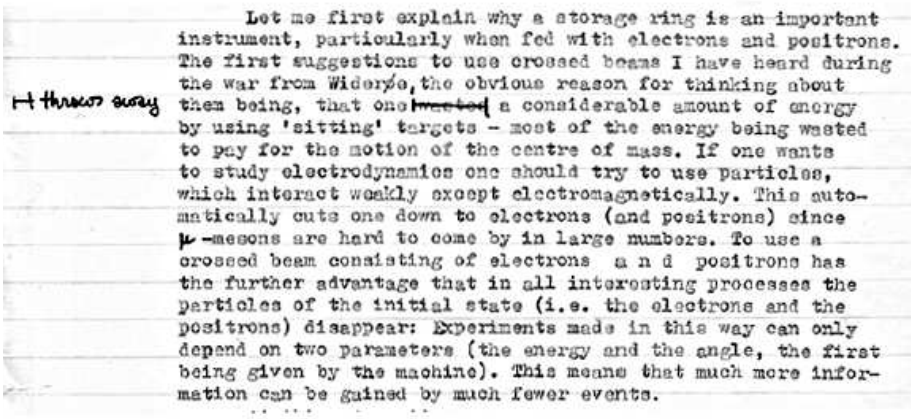
Let me first explain why a storage ring is an important instrument, particularly when fed with electrons and positrons. The first suggestions to use crossed beams I have heard during the war from Wideröe, the obvious reason for thinking about them being, that one ~~wasted~~ a considerable amount of energy by using 'sitting' targets - most of the energy being wasted to pay for the motion of the centre of mass. If one wants to study electrodynamics one should try to use particles, which interact weakly except electromagnetically. This automatically cuts one down to electrons (and positrons) since μ-mesons are hard to come by in large numbers. To use a crossed beam consisting of electrons a n d positrons has the further advantage that in all interesting processes the particles of the initial state (i.e. the electrons and the positrons) disappear: Experiments made in this way can only depend on two parameters (the energy and the angle, the first being given by the machine). This means that much more information can be gained by much fewer events.

Fig. 1. From Bruno Touschek's notebook about the birth of AdA.

Afterwards, in Orsay, Frascati, Stanford and Novosibirsk, bigger and more energetic electron–positron colliders were designed and finally built, in a crescendo which culminated in 1974 in the discovery of the J/Ψ by SPEAR at SLAC (jointly with BNL) and its confirmation with ADONE.

I think it will be interesting for all of us to recollect how we have arrived to this Final EURIDICE Meeting in Kazimierz. In the history of our series of networks, this is the first time we have held a Final Meeting, and the location has been chosen to recognize the contribution of our Polish friends to the network activities. I am also personally very fond of the town of Kazimierz, where I had started coming in the 1980s to participate in the Kazimierz Symposium on Particle Physics organized by the University of Warsaw. At the time, things were quite different from now, although the warmth of our hosts was always as wonderful. In Kazimierz at the time there were no restaurants in the main square: if we wanted to have a beer we had to walk along the Vistula for quite a long time to reach a cool resort along the river where we would be able to obtain three beers for 6 people! I will also confess to a little bit of illegal money changing under the porticos in the main square, to purchase some beautiful handmade tapestry, which still hangs in my home in Italy. Other fond memories concern a special tradition, during the Symposium, of an evening *closed door meeting*, where our Polish hosts would tell ... political jokes (what-else?) and the guests would pull from their bags smuggled and otherwise forbidden Italian or Swiss or French salamis and some whiskey or grappa or cognac to share with our hosts.

My memories of Kazimierz are of many kinds, including misadventures like breaking a bone, some 15 years ago, by skidding on the floor at the beginning of a first day afternoon session. Another time, perhaps the first

time I came to Kazimierz, the bus which was to take us back to Warsaw broke down along the way, but, from the photograph I have, I see no terrible anxiety on people's faces, as you might expect today at the prospect of missing a flight, it was more like a country picnic attitude. The food in the Dom Architekta was, and still is, just wonderful, cooked slowly on the enormous wood stoves. At night, after walks and physics discussions along the river (and lots of gigantic mosquito bites), we would sneak into the kitchen for a glass of tea, from the still warm tea kettles on the stove corners. I could go on for more, but perhaps this is enough to explain why I was very happy that we could hold our final meeting here, to conclude a number of years of physics activity and celebrate a friendship with Maria Krawczyk which has been lasting for more than 20 years now.

The contributions in this volume reflect our history. Many of the authors came together fifteen year ago, when Luciano Maiani started the DAFNE Theory group, between Rome and Frascati. There is a photograph of the group which came together to write the DAFNE Physics Handbook, reproduced here. Actually, when the time came to publish the book, I found

Fig. 2. The DAFNE Theory group in 1992, in Frascati. From left, in the back row: Mario Greco, Nello Paver, Stefano Bellucci, Rinaldo Baldini, Alberto Bramon, Johann Bijnens, Gerhard Ecker, Frank Close, Gilberto Colangelo, Juerg Gasser, Roberto Petronzio, Eugenji Shabalin, Alessandra Pugliese, Michael Pennington, Victor Demidov, Luciano Maiani, Enzo Iarocci; standing in the middle: Adriano Zallo, Juliet Lee-Franzini, Agnes Grau, Elisabella Pallante; in the front row: Paolo Gensini, Paolo Franzini, G.P., Giancarlo D'Ambrosio, Pietro Santorelli, Gino Isidori, Francesco Sannino.

that not all the authors were present in the photograph, and went around searching for the missing ones, namely Frank Close and Mike Pennington. I wrote to Mike about this, and he wrote to his wife and she wrote back to me, sending a small photograph of Mike' s, saying "my husband tells me you want a picture of him ...". In those days (1992) digital photography was not yet mainstream, so we had to do a complicate job of cut and paste, and the result is rather rough, as you can see.

After the first Handbook, we started the first network, it was actually Mike Pennington's idea, and it was Mike who proposed the name, EURODAPHNE, while it was Gerhard Ecker who suggested that I start writing the proposal. We succeeded, and decided we should also start another Handbook. Actually I do not really remember why we decided to write a Second Handbook, probably because there were new interesting items, like the emphasis on $\pi\pi$ scattering, which deserved an entire chapter all by itself, the development of a proposal for measuring $\gamma\gamma \to$ hadrons, prepared together with a group from University of Tel Aviv, and new emphasis on precise radiative corrections and Bhabha scattering. It is during this period, that we held a Collaboration Meeting in Durham, in December 1994. Going North, it was a great experience for many of us southerners. The wind at Newcastle airport was so strong that we could hardly reach the little bus sent by Mike to pick us up at the airport. But, then, the sunsets we saw from the bridge across the river Wear with the castle and the cathedral cancelled all the discomfort some of us had felt while the air-plane has tried to land amid gusts of wind from the North Sea.

And all the while we were writing the Second Handbook. So, when we finished it and put it on the web, which was something quite new in April 1995, we felt ready to start a new network and confident of success. We applied, but, to our great surprise, were rejected! The argument was that there was not enough focus, that the various issues seemed unconnected, that there was not much new physics. And here comes another pivotal time for our network story, because Juerg Gasser suggested that we go to Brussels and find out what we had done wrong and how could we do it better. It was a one day trip, in a city still very different from today's capital of 27 European nations. For me it was to be the first of many future trips to Brussels. Juerg and I were very kindly received by the EC officer, who encouraged us very strongly to apply again, and gave us some suggestions, which I have forgotten now, but which must have been quite useful, since the application was successful. The proposal was prepared more carefully, mostly without assuming that we deserved success. Gasser spent an entire week in Frascati, in January 1996, working on the proposal, which was then sent to Frank Close for a final reading. And it worked! For that call and all successive calls, the success rate had diminished and since many very

good groups in Europe did not pass, everybody (including ourselves) was very surprised that our network had been approved. But we had on our side many positive points, among them a specific subject on which to focus, a dedicated group of world class physicists, well interconnected, used to relate to each other, and in a friendly way.

From some points of view, the second network was perhaps the most successful of all three. The second EURODAPHNE covered the period 1998–2002 when DAFNE started operating and the results from the American Muon G-2 Experiment were being confronted with Standard Model (SM) expectations. New teams had joined the original group and, with them, new expertise. Intense work by various groups covered the SM calculation of ϵ'/ϵ, KLOE started measuring the pion form factor and the theorists looked into the hadronic contributions to $(g-2)_\mu$ from the light-by-light term, where past inconsistencies were to be successively clarified through the work of various EURIDICE teams. Work was started on $\pi\pi$ scattering through a new analysis of the Roy equations, which was then exploited during EURIDICE to extract the pion scattering lengths from the KTeV measurement of K_{l4} decays. To the second EURODAPHNE network there belongs a nice example of what the networks could do in terms of training and mobility. At the time, the UK node, after having been based in Rutherford Lab during the first EURODAPHNE network, was established in Durham, with Oxford as an external participant. Richard Dalitz was on the Oxford team and it was decided to send one EC funded young researcher, Gianni Garbarino, to work on hypernuclear physics under his supervision. But Dalitz decided to do something else instead, namely study of Quantum Mechanics (QM) for the two Kaon system, something he had become interested in. After six months stay, Garbarino went to Barcelona, where he started a still active collaboration on QM with Albert Bramon, later to be joined by another EC young researcher, Beatrix Hiesmayr, trained in this subject in Vienna, by the jokingly called quantum "engineering" group, led by Reinhold Bertlemann.

And then, we decided to apply for a third time. There was no shortage of physics objectives and novel issues in which the network was already actively involved. Indeed we had been working on many projects related to DAFNE and had entered into new activities, like study of very rare Kaon decays, B-physics, *etc.*, but, at first, we were uncertain as to what should have been the focus of the new network. Having written, since 1992, that we wished to exploit the physics potential of a ϕ-factory, we could not very well repeat for the third time that this was our goal, and we had to find a new emphasis to justify financing of a third network. After a few meetings in which various suggestions did not really coalesce into a workable project, we finally saw that we were actually engaged in a precision quest for masses and couplings of the Standard Model and the EURIDICE proposal took

shape around this concept. At the same time, a new team was added to the network, the one who is hosting this meeting and whose country joined the EU as a Member State during the following year. We were successful. As a token of appreciation, Lluis Oliver made the following pen drawing of a DAPHNE physicist, the European Commission (EC) and EURIDICE.

Fig. 3. A drawing by Lluis Oliver to celebrate our third network, EURIDICE.

Most of the work done by the EURIDICE network is well represented in this volume. The major results have concerned the SM determination of V_{us} in a joint effort between theory and the KLOE experiment, the systematic analysis of rare and very rare kaon decays, the SM determination of the muon anomalous magnetic moment, which indicated an approximately 3 σ deviation between theory and experiment and gives hints to Physics beyond the Standard Model. In addition, there are important results in Meson Spectroscopy, Quantum Mechanics of the Kaon- and B-system, contributions to constraints of the Cabibbo–Kobayashi–Maskawa matrix and to the unitarity triangle and many more results, which you will find in this volume.

We have come to a partial end, with these Proceedings of The Final EURIDICE Meeting in Kazimierz, the last in a very long series. In addition to the Durham meeting, in fifteen years we have had many unforgettable Collaboration Meetings, in Vienna, Granada, Paris, Barcelona, Marseille, Frascati and Workshops in Bern, Karlsruhe, Oxford, Pisa, Valencia. But mostly, a great amount of physics was done. Our network has contributed to the saga of the muon anomalous magnetic moment like no other group in the world has done and we can read most of this story in the contributions to this volume. We are now passing the book to a younger generation, with FLAVIAnet, a fourth network, led by young physicists some of whom have been post-docs in the first or second network.

This meeting has been wonderful and its success is due to the participants, but in greatest measure to the organizers, Maria Krawczyk, Henryk Czyż and the wonderful staff of the Physics Department of University of Warsaw. On behalf of the participants to the Final EURIDICE Meeting, I wish to express our thanks and appreciation for all the efforts which have led to an unforgettable reunion.