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FOREWORD to The DAΦNE Physics Handbook

The DAΦNE accelerator complex has been approved by the INFN board in june 1990. It will consist of a double ring e^+e^- collider with two intersecting regions, to be installed in the INFN Laboratories of Frascati, inside the ADONE Hall. The luminosity is optimized at the ϕ peak ($E = 1019\,MeV$), project luminosity is $\mathcal{L} \approx 10^{33}\,cm^{-2}\,s^{-1}$ (for more information, see Ref. [1]). Commissioning is foreseen for mid'95, with initial luminosity $\mathcal{L} \approx 2.5 \times 10^{32}\,cm^{-2}\,s^{-1}$.

Shortly after the ϕ-factory approval, the idea was put forward of gathering a group of theorists to write a report with an extended assessment of the DAΦNE physics potential. The idea was to have a Report in which all relevant formulae, arguments, suggestions scattered in the literature had to be rederived from scratch and put in a form comprehensible and useful for the experimental groups which will work in Frascati.

The initial nucleus of the collaboration was provided by the study group who had prepared the 1990 DAΦNE Report [2], to which several people joined, from various European Institutions and from ITEP, after the positive experience of the DAΦNE Workshop [3].

It was decided to complete the Report within one year from April 1991, a promise that we feel we have essentially kept, with this first edition of the Report. The report is issued with the ambitious title : The DAΦNE Physics Handbook. We hope that the promise was kept not only as far as timing is concerned.

The components of the DAΦNE study group in the final configuration and their scientific institutions are listed after this foreword.

Before closing this presentation, we would like to thank Enzo Iarocci and all the staff of the Laboratori Nazionali di Frascati, for their unconditioned support. The Meetings of the Working Group have been generously supported by INFN, directly and through the Commissione IV, to which we are very grateful. Finally our thanks go to all the components of the Working Group, for their passionate participation, for the amusing talks they gave during the Meetings, for very interesting discussions and, last, but not the least, for having been so timely in sending us their manuscripts.

Luciano Maiani, Giulia Pancheri, Nello Paver

Frascati, June 26, 1992

References

[1] G. Vignola in Proc. of the *Workshop on Physics and Detectors for DAΦNE*, Frascati, April 9-12, 1991.

[2] R. Barbieri et al., Laboratori Nazionali di Frascati Report n.LNF-90/041(R),1990.

[3] Proc. of the *Workshop on Physics and Detectors for DAΦNE*, Frascati, April 9-12, 1991.

FOREWORD to The Second DAΦNE Physics Handbook

After publication of The DAΦNE Physics Handbook in September 1992, we realized that there were new interesting topics which had not been fully studied and that further work was called for. Thus, the theoretical study group laid the grounds for a Second Handbook in which both new issues could be discussed fully, as well as work already published could be pushed further. The group decided to structure itself as an EEC network, financially supported under the auspices of the Human Capital and Mobility Programme, with some additional collaboration from non-european countries. Like before, INFN and the members home institutions also continued to support this initiative.

The group activity has consisted of intensive research work done in collaboration within the network, and has been based on a series of workshops (three of them in Frascati, November 1992, April 1993 and April 1994, and one in Durham, U.K., in December 1994). The workshops included general talks, presentation of results and status reports, and discussion sessions. Proceedings of these meetings, in the form of collections of the speakers transparencies, are available to all interested individuals.

The scientific programme of the collaboration included, but was not limited to, the preparation of an improved version of the Handbook, the present *Second DAΦNE Physics Handbook*. The aim of this version is to collect the research work done by the participants, and to offer a general account of all relevant research areas, including the latest developments, with introductions and detailed references, in a form which, we hope, should be suitable for consultation to all people interested in ϕ-factory physics. Only two papers are reprinted directly from the previous Handbook, all the others are either completely new or have been written as expanded and updated versions. Thus, while similar in spirit, the present Handbook in large part supersedes the previous one.

In closing this foreword, once again we express our gratitude to all the staff of the Frascati National Laboratories for their friendly, and unconditioned, support and to Enzo Iarocci, who has endorsed our efforts and enthusiastically welcome them. We gratefully acknowledge the support of the EEC, which generously supported our collaboration network. Thanks are also due to INFN, for supporting our initiative both directly and through the Commissione IV. We are grateful to all the members of the study group, for the high quality of the research work, their lively participations in the meetings and their patience with the Editors throughout these three years.

Finally, as we close in towards the commissioning of DAΦNE in late 1996, we wish to recall our dear friend and teacher Bruno Touschek, whose studies and enthusiasm were fundamental in opening the way to realize e^+e^- annihilations everywhere in the world, and to experimentally investigate these processes in the laboratory. We would like to dedicate to him our editorial efforts for this Handbook.

Luciano Maiani, Giulia Pancheri, Nello Paver

Frascati, May 26, 1995

About DAΦNE

DAΦNE will be a very powerful ϕ-factory and, through subsequent ϕ decays to (anti-symmetric) $K\bar{K}$ pairs and to $\eta\gamma$, it will represent an excellent source of monochromatic Kaons and etas.

The physics potential of such machine is appreciated in terms of the annual particle yields which determine the attainable statistical level. Throughout this Handbook a reference luminosity $\mathcal{L} = 5 \times 10^{32}\, cm^{-2}\, s^{-1}$, integrated over an effective year of $10^7\, s$, is assumed.

From the peak cross section for $e^+e^- \to \phi$

$$\sigma(\phi - peak) = \frac{12\pi}{M_\phi^2} \frac{\Gamma_e}{\Gamma}, \tag{0.1}$$

this integrated luminosity corresponds to 2.2×10^{10} yearly produced ϕ and, according to the relevant branching ratios, to the interesting particle yields reported, for convenience of the reader, in the following Table.

Mode	Br (%)	$\gamma\beta c\tau\,(cm)$	Yield	Tagged decays
K_L	34.3	344	7.5×10^9	2.0×10^9
K_S	34.3	0.59	7.5×10^9	1.6×10^9
K^+K^-	49.1	95	1.1×10^{10}	7.5×10^9 ‡; 1.5×10^9 §
$\eta\gamma$	1.28	–	2.8×10^8	

The possibility of tagging will be crucial in many cases. The efficiency depends on the average decays lengths (also reported in the Table) compared to the size of the detector, and on the efficiency of the detector itself. In the Table, the size and expected efficiencies of the detector KLOE are assumed [1]. In particular, for $K^\pm$ tagging, ‡ represents the case where all $K^\pm$ decays are used, while § corresponds to precision tags, using $K^\pm \to \pi^\pm\pi^0$ only.

[1] J. Lee-Franzini, this Handbook.

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