

Meson Spectroscopy: Experimental Summary^{*}

J. Napolitano¹

*Department of Physics
Rensselaer Polytechnic Institute
Troy, NY, 12180-3590 USA*

Abstract

Meson spectroscopy continues to be a useful tool for learning about the strong interaction and QCD. This conference has seen a number of new results and I will briefly review them. The contributions of the Budker Institute over the years, and in particular the experimental programs of SND and CMD-2 at VEPP-2M, are rightfully noted.

1 Introduction

The spectroscopy of mesons and their excitations continues to point the way towards new physics of the strong interactions. This laboratory has continually played an important and forefront role in this field, and it is fitting that we review some of the progress and recent results on the occasion of this 25th anniversary of the operation of VEPP-2M. Preprints were available describing in detail the most recent results from the CMD-2 [1] and SND [2] experiments at VEPP-2M today.

1.1 Old Puzzles and New Experiments

Steve Godfrey and I recently reviewed the spectroscopy of light mesons [3] and included a discussion of the many old puzzles in this field. Some of these

^{*} Invited talk at the International Workshop on e^+e^- Collisions from ϕ to J/ψ (Novosibirsk, March 1999).

¹ Research supported by the National Science Foundation.

have been discussed at this workshop. New experimental results on exotic mesons from the VES group at IHEP-Protvino were presented by Zaitsev. A new look at the so-called E/ι puzzle in the $\eta\pi^0\pi^0$ final state was discussed by Kondashov. In this talk, however, I would like to concentrate mainly on new results in the more-or-less conventional meson sector.

2 Vector Mesons

This laboratory led the way in precision measurements of the beam energy in electron storage rings. That has led to very accurate determinations of the masses and widths of vector mesons produced in e^+e^- annihilation. At this conference, new measurements of the parameters of the ω from the CMD-2 experiment were presented in a poster by Anashkin. Results for the excited isoscalar vector mesons in the reaction $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ from the SND collaboration in a talk by Srednyakov.

A new analysis, including new data, of the timelike pion form factor was presented by Logashenko. These measurements [4] refined, and made more precise, the mass and width of the ground state $\rho(770)$, as well as its decay width to e^+e^- and, through ρ/ω interference, the branching ratio for $\omega \rightarrow \pi^+\pi^-$.

Several new results on the excited ρ spectrum were presented at this conference. These included measurements of $e^+e^- \rightarrow 4\pi$ from CMD-2 [5] in a talk given by Root, and of production in $p\bar{p}$ annihilation by Doser of the Crystal Barrel collaboration.

2.1 ϕ Physics

Certainly, much of the excitement at this conference was based on new and impending measurements of CP violation from CERN, Fermilab, and DAΦNE. This is closely related to physics of the ϕ meson, especially in the case of KLOE at DAΦNE, of which there several groundbreaking results shown during the past several days.

In his introductory talk, Sidorov showed lovely data from CMD-2 on the decays $\phi \rightarrow \pi^+\pi^-$ and $\phi \rightarrow \mu^+\mu^-$. These are textbook examples of measuring small branching ratios by combining high statistics with resonance interference. The isospin violating decay $\phi \rightarrow \omega\pi^0$ was investigated by SND [6] and presented in a talk by Druzhnin. New results were also shown on $\phi \rightarrow \pi^+\pi^-\gamma$ [7] and $\phi \rightarrow \pi^+\pi^-\pi^0$ [8]

I found the new results on $\phi \rightarrow \eta'\gamma$ particularly exciting. These were presented by Purlatz for the CMD-2 experiment [9], and by Salnikov for the SND group [2]. This involves isolating a very small number of events from a large background, but represents important new information on the structure of the η' . The implications for $SU(3)$ breaking and the presence of glue were discussed in a talk by Benanyoun.

Radiative ϕ decay also sheds new light on the scalar meson sector, which we discuss next.

3 Scalar Mesons

Scalar mesons remain as somewhat of an enigma, now that the $q\bar{q}$ sector seems to be filled, as least as far as u and d quarks are concerned. [3]. There was some discussion at this conference by Takamatsu, S. Ishida, and M. Ishida [10–12] regarding the σ meson as a physical particle. Some new experimental results on scalars in $\pi^-p \rightarrow \pi^0\pi^0n$ were presented by Teige.

The peculiar light scalars $f_0(980)$ and $a_0(980)$ have been known for a long time [3] and have been suggested to be $K\bar{K}$ molecules. This notion can be tested by studying the decay $\phi \rightarrow [a_0, f_0]\gamma$ [13] which essentially measures the overlap of the scalar wave function with the mainly $s\bar{s}$ ϕ . S. Teige discussed an experiment being mounted at Jefferson Lab to study radiative decays of the ϕ as produced in photoproduction from a hydrogen target. However, new results in these decays were also presented at this workshop, based on data from VEPP-2M.

Using the decays $f_0(980) \rightarrow \pi^0\pi^0$ and $a_0(980) \rightarrow \eta\pi^0$, these experiments measure the reactions $e^+e^- \rightarrow \pi^0\pi^0\gamma$ and $e^+e^- \rightarrow \eta\pi^0\gamma$ to search for these very rare decay modes of the ϕ . It is a difficult measurement because the bachelor photon has very low energy, and there are a number of other processes which can lead to the same final state. However, the studies at VEPP-2M [1,2] are starting to uncover the contributions from the f_0 and a_0 .

Acknowledgements

Many thanks to Alex Bondar and Simon Eidelman for giving me the opportunity to review this subject for the workshop. To all the organizers and hosts, who ran an outstanding workshop, СПАСИБО!

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