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Strong Interaction Dynamics I: Dual Models and Theory

STRONG-INTERACTION DYNAMICS I - DUAL MODELS AND THEORY

Topic	Speaker
1. Inclusive Processes in Dual Models	M. Einhorn (NAL)
2. Currents and Off-Shell Amplitudes in Dual Models	I. Drummond (Cambridge)
3. Duality in Electroproduction	H. Rubinstein (Weizmann)
4. Recent Developments in Dual Field Theory	J. Schwarz (Princeton)
5. Clarification of the Rubber String Picture	D. Olive (CERN)
6. Where are Dual Models Going? (Short Contributed Comments)	C. Lovelace (Rutgers) Y. Nambu (Chicago) B. Sakita (CCNY) L. Susskind (Tel-Aviv)

STRONG INTERACTION DYNAMICS I - DUAL MODELS

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Motto of the Session

"Dual Theory should be presented in such a way that it becomes understandable to non-dualists. At least, as understandable as East Coast theories are for West Coast physicists and vice versa!"

from Chairman H. J. Lipkin

I. Introductory Remarks

To organize a parallel session on dual models turned out to be quite a difficult task primarily because those that have not kept up to date on this subject find the language and the formalism developed too complicated and confusing. Faced with this problem, the proposed solution, not completely satisfactory, was to divide the session into two parts: the first part was dedicated to the phenomenological applications of dual models and was to be less formal and presumably understandable to everybody. The second part, on the other hand, was dedicated to the new developments in the program to build a dual theory, where the participants had to use all the available formal apparatus. A mini-review talk by J. H. Schwarz was scheduled for the first half of this second part which served both as an introduction to the formalism as well as a summary of last year's developments in dual theory.

It is my feeling that this half solution worked quite well thanks to the collaboration of all the speakers. Of course I think we all agree that a new simpler formalism for dual models will be welcome. Perhaps at the conference we saw something like that beginning to develop in the new relativistic theory formalism. I hope that at the next conference Lipkin's expectations will be satisfied without having to resort to half solutions.

This report is organized as follows. Sections II and VI are general introductions to the two parts of the session. I have tried there to fill some gaps and to orient the reader through the mini reports that follow. Sections III, IV, and VII reproduce the written versions by Einhorn, Drummond, and Schwarz of their reports at the conference. Sections V and VIII contain the talks by H. Rubinstein and D. Olive as extracted from the tapes and notes taken during the conference. Finally Section IX contains a summary of the interesting short contributions by Lovelace, Nambu, Sakita, and Susskind on the general outlook of Duality. I have refrained myself from adding any kind of pseudo-conclusion at the end.

II. The Possible Applications of Dual Models

Our emphasis was on new and qualitative applications rather than on quantitative fits. The latter were discussed in other sessions. The "Dual Absortive Model" of Harari and collaborators was discussed in Fox's session on High Energy Collisions.

In this session we focused our attention on two areas that have been strongly pursued during the last two years. The first area consists of applications to hadronic inclusive reactions where the principal interests have been: a) to

understand the approach to scaling in terms of exoticity criteria, b) to perform numerical calculations to see how to interpolate between the different regions (fragmentation, triple Regge, and pionization) and also the study of correlations, c) to use the model as a source of suggestions for generalizations of the Finite Energy Sum Rules. M. B. Einhorn gave a review talk on the subject.

The second area discussed was the possible use of dual models for processes that involve weak or electromagnetic currents and in particular for deep electroproduction. The theoretical progress in this field has been very slow and almost painful. A somehow pessimistic attitude has evolved that believes that the dual model as it stands only describes correctly the infinitely many wee partons sector of the wave function of a hadron (see e.g., Susskind's comment after Drummond's talk). This is interesting because it leads to introducing corrections that make the parton and dual picture compatible. However, one loses in this way some other nice properties of the dual model (like the ghost killing mechanism) and therefore this attitude is not shared by everybody.

Drummond has summarized in a short review what can be done from a more optimistic point of view. My feeling is that there has been some definite progress in the construction of Green functions i.e., off-mass shell amplitudes (essentially the work of Cremmer, Neveu, and Scherk), but that these are hadrons off the mass shell rather than weak currents; the real test would be to obtain scaling and fixed poles at right signature points. For a third different approach (not discussed in this conference) to the problem of relating this to pictures see "Light Cone Physics and Duality," Del Giudice et. al., MIT preprint #271. Finally Gell-Mann in the parallel session on currents also addressed himself to this problem. We refer the reader to his talk which is reproduced in Vol. 2 of these proceedings.

As a contrast and to dramatize the need for a dual model for electroproduction, we heard H. Rubinstein presenting an impressive account on how duality manifests itself phenomenologically in this process. It is almost ironic that tests for duality are cleaner and even its definition is more unambiguous here than in hadron processes. A generalized Harari-Freund scheme seems to work quite well in this context.

The following sections contain the written version of the talks given by Einhorn, Drummond, and Rubinstein as well as the discussions that followed.