SYMPOSIUM ON PARTICLES AND FIELDS

December 30, 1970 — January 4, 1971

DEPARTMENT OF THEORETICAL PHYSICS
UNIVERSITY OF MADRAS

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DEPARTMENT OF THEORETICAL PHYSICS

SYMPOSIUM ON PARTICLES AND FIELDS

Programme

Wednesday, December 30, 1970

Inauguration (~~Around~~ 6 p.m. ~~Time to be finalised~~)

Thursday, Dec. 31, 1970

Session A1. 9.00 - 11.00 A.M.

P. M. Mathews*	(29)
N. Mukunda	(34)
P. Ghose	(18)
A. Maheswari	(25)

Session A2. 11.30 AM-1.00 A.M.

~~M. G. K. Menon~~ *	~~(31)~~
T. Das*	(11)

LUNCH BREAK

Session A3. 2.15-3.50 P.M.

V. Singh*	(61)
G. Rajasekharan	(46)
R. Choudhury	(10)

Session A4. 4.20- 5.00 P.M.

G. Ramachandran	(47)
R. Rajaraman	(45)

Friday, January 1, 1971.

Session B.1 9.00 - 10-45 A.M.

N. Panchapakesan*	(37)
J. Maharana	(24)
P. Das Gupta	(12)
P. Mahanta	(23)

Session B2. 11.15 A.M. 1.00 P.M.

A. P. Balachandran*	(2)
B. B. Deo	(14)
N. Panchapakesan	(38)
T. S. Santhanam	(52)

LUNCH BREAK

Session B.3 2.15 - 3.40 p.m.

R. Rajaraman* (44)
K. V. L. Sarma (53)
C. P. Singh (56)

Session B.4 4.10-4.50 P.M.

P. Achuthan (1)
K. C. Garg (17)

Saturday January 2, 1971.

Session

Session C.1 9.00 - 11.05 A.M.

Alladi Ramakrishnan* (48)
I. V. V. Raghavacharyulu (43)
K. H. Mariwalla (28)
S. Dutta Majumdar (13)
B. K. Basu (3)

Session C.2 11.35AM - 1.00 PM.

S. N. Biswas* (5)
M. Seetharaman (55)
J. Jayaraman (20)

LUNCH BREAK

Session C.3 2.15-3.40

E. C. G. Sudarshan* (58)
P. M. Mathews (29)
J. N. Passi (40)

Session C.4 4.10-5.10

A. C. Rae (42)
S. Mukharjee (33)
C. V. A. V. B. Chandra Raju (6)

Sunday January 3, 1971.

Session D.1 9.00-10.45 A.M.

R. Ramanna* (49)
D. Chattarji (9)
V. Devanathan (15)
P. G. Takwale (59)

Session D.2 11.15AM - 12.45 P.M.

G. Bhamathi (4)
K. Prema (41)
A. K. Rej (51)
K. Srinivasa Rao (57)

LUNCH BREAK

Session D.3 2.00 - 3.35 P.M.

P.P.Divakaran (16)

A.V.Khare (21)

S.Pakvasa (36)

A.Maheshwari (25)

Session D.4 4.05-5.00 P.M.

Tulsi Das (60)

Chhajlany (7,8)

Monday January 4, 1971.

Session E.1 9.00 - 10.00 A.M.

L.K.Pande (39)

K.H.Mariwalla (28)

Naresh Chandra (35)

Hari Prakash (19)

Kumar Eswaran (22)

Session E.2 11.00- 1.00

Ramesh Chand (50)

S.P.Misra (32)

C.V.Sastry (54)

Concluding Summary.

The talks marked by asterisks(*) are of 45 minutes duration. Time available for other talks (Papers) is 20 minutes each.

The numbers in parenthesis in the programme refer to the serial numbers of the papers in the list given below.

LIST OF PAPERS

	Title	To be presented by
1.	Low energy parameters in πN scattering	P.Achuthan
2.	Crossing and positivity properties in partial wave amplitudes	A.P.Balachandran
3.	On the group SU(3).	B.K.Basu
4.	Λ-N interactions.	G.Bhamathi
5.	Relativistic two body problem.	S.N.Biswas
6.	Negative metric and modified Lee Model with two baryons.	Chandra Raju

7.	The axial vector $K_{\ell 4}$ decay form factor based on current algebra	S. C. Chhajlany
8.	Leptonic K-decay with broken SU(3)xSU(3) and SU(3) violation of μ-e Universality.	S. C. Chhajlany
9.	K^- absorption in $^{157}_{64}Gd$	D. Chatterji
10.	Inelastic $e^- - p$ scattering.	S. R. Choudry
11.	Report on Kiev Conference (1970)	T. Das
12.	Veneziano parametrisation of strip model input.	P. Dasgupta
13.	Finite transformations and C. G. coefficients of SU(3).	Datta Mujumdar
14.	Envelope factor for high energy scattering	B. B. Deo
15.	Muon capture in Nuclei.	V. Devanathan
16.	Current density algebras	P. P. Divakaran
17.	Analysis of π-N scattering in S_{11} and P_{11} partial waves.	R. C. Garg
18.	On massive non - abelian gauge theories	P. Ghose
19.	Density operator of unpolarised radiation	Hari Prakash
20.	Invariant scalar product in the theory of arbitrary spin particles.	J. Jayaraman
21.	Lagrangian model of pion source algebra.	A. V. Khare
22.	Generalised Phase Operators	Kumar Eswaran
23.	$\pi\pi$ Cross duality amplitude	P. Mahanta
24.	Charge and hypercharge exchange processes in the Veneziano model.	J. Maharana
25.	Weak interaction as an S-matrix	Maheswari
26.	Quantisation of non abelian gauge fields	Maheswari
27.	possible modes of existance of tachyons.	K. H. Mariwalla
28.	Global coordinate transformation groups, gravitation and elementary particles.	K. H. Mariwalla
29.	i) Relativistic Particle Wave Equations.	P. M. Mathews
30.	ii) Wightman Functions, Spectral representations, and the spin statistics theorem	P. M. Mathews
31.	(To be announced)	M. G. K. Menon
32.	A Relativistic Quark model.	S. P. Misra
33.	Scale and conformal currents in re-normalisable field theories.	S. Mukherjee
34.	Photons and tachyons with continuous spin	N. Mukunda
35.	Anticorrelation of Photons.	Naresh Chandra
36.	Strong and Weak decays of baryons.	S. Pakvasa

[illegible]	Veneziano Models	N. Panchapakesan
38.	Dual resonant amplitudes for many pions.	
39.	The implications of tachyon-like matter for super dense stars	L. K. Pande
40.	Compositeness criterion for unstable particles.	J. N. Passi
41.	Double hypernuclei and Λ-Λ interaction.	K. Prema
42.	Consequences of Renormalisability.	Anil C. Rae
43.	Polynomial Algebras.	I. V. V. Raghavacharyulu
44.	Phenomenology of very high energy scattering,	R. Rajaraman
45.	Three body forces in Nuclei	
46.	Poles and sum rules for deep inelastic scattering.	G. Rajasekharan
47.	Elastic e-d scattering and violation of T. reversal invariance.	G. Ramachandran
48.	L-matrix and its application to elementary particles	Alladi Ramakrishnan
49.	Unified Theory of Nuclei and Atoms.	R. Ramanna
50.	SU(3) Quark model for High Energy particle Reactions.	Ramesh Chand
51.	Inelastic production on Nuclei and determination of I_o/c	A. K. Rej
52.	A remarkable Connection between the multi-Veneziano integrand and the character of special unitary groups.	T. S. Santhanam
53.	Electromagnetic correction to forward K_L-K_S regeneration amplitude.	K. V. L. Sarma
54.	Photo production processes in Quark Model.	C. V. Sastry
55.	Role of invariance conditions in the determination of arbitrary spin wave wave equations	M. Seetharaman
56.	Role of box diagram in N^* production processes.	C. P. Singh
57.	Charged pion photoproduction processes from O^{16} and C^{12}.	S. K. Srinivasa Rao
58.	Analiti/in Field theory.	E. C. G. Sudarshan
59.	Polarisation effects in ν-induced reaction.	Takwale
60.	Proken SU(3) x SU(3) and Cabibbo angle	Tulsi Dass
61.	Exact asymptotic results for scattering amplitudes.	Virendra Singh

PROGRAMME

Thursday, December 31, 1970

Session A1 9.00–11.00

P. M. Mathews
N. Mukunda
P. Ghose
A. Maheswari

Session A2 11.30-1.00

T. Das
(To be announced)

LUNCH BREAK

Session A3 2.15–3.50

V. Singh
G. Rajasekharan
R. Choudhury

Session A4 4.20-5.00

G. Ramachandran
R. Rajaraman

Friday, January 1, 1971

Session B1 9.00–10.45

N. Panchapakesan
J. Maharana
P. Das Gupta
P. Mahanta

Session B2 11.15–1.00

A. P. Balachandran
B. B. Deo
N. Panchapakesan
T. S. Santhanam

LUNCH BREAK

Session B3 2.15–3.40

R. Rajaraman
K. V. L. Sarma
C. P. Singh

Session B4 4.10–4.50

P. Achuthan
R. C. Garg

Saturday, January 2, 1971

Session C1 9.00–11.05

Alladi Ramakrishnan
I. V. V. Raghavacharyulu
K. H. Mariwalla
S. Dutta Majumdar
B. K. Basu

Session C2 11.35-1.00

S. N. Biswas
M. Seetharaman
J. Jayaraman

LUNCH BREAK

Session C3 2.15-3.40

E. C. G. Sudarshan
P. M. Mathews
J. N. Passi

Session C4 4.10-5.10

A. C. Rae
S. Mukharjee
C.V.A.V.B. ChandraRaju

Sunday, January 3, 1971

Session D1 9.00-10.45

R. Ramanna
D. Chattarji
V. Devanathan
B. G. Takwale

Session D2 11.15-12.45

G. Bhamathi
K. Prema
A. K. Rej
K. Srinivasa Rao

LUNCH BREAK

Session D3 2.00–3.35

P. P. Divakaran
A. V. Khare
S. Pakvasa
A. Maheswari

Session D4 4.05-5.00

Tulsi Das
Chhajlany

Monday, January 4, 1971

Session E1 9.00–10.40

L. K. Pande
K. H. Mariwalla
Naresh Chandra
Hari Prakash
Kumar Eswaran

Session E2 11.00-1.00

Ramesh Chand
S. P. Misra
C. V. Sastry

Concluding Summary

UNIVERSITY OF MADRAS

DEPARTMENT OF THEORETICAL PHYSICS

SYMPOSIUM ON PARTICLES AND FIELDS

(December 30th 1970 to January 4th 1971)

ABSTRACTS OF PAPERS

1. Low-energy parameters in pion-nucleon scattering

P.Achuthan

It is important for various reasons and purposes to arrive at a better understanding of the low-energy parameters such as effective ranges and scattering lengths for hadronic interactions. In this paper, we have studied the problem of theeffective range parameter in pion-nucleon scattering using the dispersion theoretic techniques. The results achieved are compared with those of other calculations and discussed.

2. The Crossing and positivity properties of partial waves

A.P.Balachandran

Crossing symmetry of the scattering amplitude is used to derive an infinite number of sum rules each of which involves a finite number of partial waves. Such sum rules are derived for four body processes where the particles have arbitrary mass and spin and for N-body processes ($N > 5$) where the particles have arbitrary mass and no spin. These sum rules lead to an infinite number of inequalities involving the s- and p-$\pi\pi$ partial waves when certain positivity properties of the $\pi\pi$ partial waves proved by Martin are used. The generalisation of such positivity statement for certain processes which involve particles with spin and unequal mass (for example, the process $\pi N \to \pi N$) is also possible. The use of these results in the construction of theoretical models for partial waves is discussed.

3.

On the group SU(3)

B.K.Basu

In a recent paper (Majumdar and Basu - Annals of Physics 56, 464(1970)) the matrix elements of the finite transformations of the group SU(3) were determined. These matrix elements can be factorised in the form

$$\langle j\mu\delta|SU^{pq}(3)|j'\mu'\delta'\rangle = \sum_{m} e^{-i\beta Y} D^{j}_{\mu m}(\alpha_3,\alpha_2,\gamma)\langle jm\delta|e^{-i\sum\lambda N}|j'm'\delta'\rangle \times D^{j'}_{m'\mu'}(-\gamma',-\alpha_2',-\alpha_3')$$

where $N = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$, $Y = 2\delta - \frac{2}{3}(p-q)$

is the hypercharge, (p,q) the representation labelling numbers, j, μ, δ the state labelling quantum numbers and $D^{j}_{\mu m}$ are the usual rotation matrices. A method for determining the general matrix elements $\langle jm\delta|e^{-i\sum\lambda N}|j'm'\delta'\rangle$ was given in the above paper and formulae for some special cases were calculated.

These results and some other results are used to determine the C-G coefficients of SU(3) by integrating the product of three matrix elements belonging to IR's of the group. Such integrals yield the product of the C-G coefficients corresponding to the initial and final states of the matrix elements. If the direct product is not simply reducible, then the integration gives a scalar product of the C-G coefficients in the degenerate space.

Calculations have been carried out in the cases where one of the representations in the direct product is an octet or a decuplet. The tables available in the literature for these cases have been compressed into a few analytic expressions.

4. Λ-N Interactions

G.Bhamathi, K.Prema and Indumathi Seshadri

The Λ -nucleon scattering data have been analysed in conjunction with the binding energies of the light hypernuclei and the Λ -binding in nuclear matter in order to arrive at a consistent set of low energy scattering parameters. The non local separable form for the interaction was chosen. It was found that the data from the three different sources can be reconciled with each other to a reasonable degree with a simple choice for the form of the potential only if distortion of the core was allowed even for the lightest and very loosely bound hypernuclei. The dependence of the fit on the range parameter has also been studied.

5. Relativistic two body problem

S.N.Biswas

(Abstract not received)

6. Negative metric and a modified Lee Model with two baryons

C.V.A.V.B.Chandra Raju and P.K.Srivastava

In this paper a modified Lee Model with two V particles is is studied. One of them belongs to the +ve metric and the other belongs to the negative metric. Following Lee-Wick prescriptions N θ scattering amplitude is explicity calculated. It turns out to be unitary.

7. The Axial-Vector K_{14}-Decay Form-factors based on Current Algebra

S.C.Chhajlany, L.K.Pandit and G.Rajasekaran

The axial-vector K_{14}-decay form-factors given by current algebra have been reevaluated using the vector K_{13}-decay form-factors and the ratio f_K/f_π, obtained on the basis of broken

chiral $SU_3 \times SU_3$ and SU_3 symmetries. It is shown that the assumption of near constancy of these form-factors leads to good agreement with the experimental data using consistently the single Cabibbo-angle $\sin\theta_V = \sin\theta_A = 0.22$.

8. The Leptonic K-Decays with broken SU(3) x SU(3) and SU(3) and Violation of μ-e Universality

S.C.Chhajlany, L.K.Pandit and G.Rajasekaran

A phenomenological treatment of μ-e universality violation in the strangess-changing decays is proposed to account for the existing discrepancies between the form factors and other decay parameters of the leptonic K-decays determined experimentally and those predicted on the basis of the conventional Cabibbo theory with the first-order broken SU(3) x SU(3) and SU(3) symmetries.

9. K^- Absorption in $^{157}_{64}Gd$

D.Chattarji

Recently, Wiegand and Kunselman have estimated, on the basis of K^- X-ray data, that the capture rate for K^- mesons in $^{157}_{64}Gd$ is about $1.2 \times 10^6 sec^{-1}$. According to them, this result implies that the neutron density distribution extends well beyond the proton distribution. By using a K^- -nucleus optical potential proportional to the $\bar{K}N$ scattering lengths and the nuclear density, we show that agreement with experiment can be obtained without postulating different distribution parameters for the proton and neutron distributions. The fact that Gd is a strongly deformed nucleus is also considered.

10. Inelastic $e^- - p$ scattering

S.R.Choudry

(Abstract not received)

11. Report on Kiev Conference (1970)

T. Das

(Abstract not received)

12. Veneziano Parametrisation of Strip Model Input

P. Dasgupta

The question of using the Veneziano amplitude as the input for Strip Model calculations is considered in view of the fact that the Veneziano amplitude fails to describe accurately the low energy meson-baryon processes, where thresholds play very important role. It is concluded that while any attempt to unitarise the Veneziano amplitude as such is likely to meet insurmountable difficulties, it is advantageous and worthwhile to choose the asymptotic part as the input for the strip N/D equations. A pion-nucleon calculation has been done to illustrate the point.

13. Finite transformations and CG coefficients of the group SU(3)

S. Datta Majumdar

It is wellknown that the CG coefficients of a compact Lie group can be obtained by integrating the product of three matrix elements of finite transformations belonging to three irreducible representations (IR) of the group. The exact relation connecting the integral with the CG coefficients is

$$\int d\Omega\, D^{p_1q_1}_{\lambda i}(\alpha)\, D^{p_2q_2}_{\mu j}(\alpha)\, D^{pq\,*}_{\nu k}(\alpha) = \frac{1}{N} \sum_r \begin{bmatrix} p_1q_1 & p_2q_2 & pq_r \\ \lambda & \mu & \nu \end{bmatrix} \begin{pmatrix} p_1q_1 & p_2q_2 & pq_r \\ i & j & k \end{pmatrix}$$

where p_1q_1, p_2q_2, pq are pairs of non-negative integers characterising the IR's, T, T_z, Y - values are denoted collectively by λ, μ, ν and i, j, k, and the number of values taken by the summation index r is equal to the number of times the representation (p,q) occurs in the direct product. This formula has been

used by the author for deriving analytic expressions for the CG coefficients of SU(3). If the representations(p,q) occurs only onee in the direct product, then the general CG coefficient corresponding to the states λ, μ, ν is obtained by choosing a convenient set of initial states i, j, k for which the CG coefficient is either known or can be determined easily. On the other hand, if the representation (p,q) occurs f times in the direct product then, for getting all the CG coefficients, integrals for f sets of initial states must be evaluated. By taking appropriate linear combinations of these integrals for the same λ, μ, ν, but diferent i, j, k an orthonormal set of CG coefficients for the states λ, μ, ν can be easily obtained. If the orthogonalization is carried out by Schmidt's procedure then the coefficients of the linear combinations can also be expressed in terms of integrals of the same type. This gives a simple and convenient method of calculating the orthonormal CG coefficients of SU(3). The usefulness of the method depends entirely on the possibility of obtaining convenient representations of the finite transformations of the group. Our efforts have, therefore, been mainly directed along this line, and the expression for the matrix element derived previously (Majumdar & Basu Annals of Physics (N.Y) 56, 464 (1970)) has been further simplified and brought into a form suitable for the calculation of the CG coefficients.

14. <u>Envelope factor for high energy scattering</u>

B.B.Deo and M.K.Parida

A model of high energy scattering is developed which incorporates assumed analytic properties. The essential idea is to map the cut plane of analyticity into the interior of a parabola with cuts forming the boundary of the parabola and is normalised in such a way that the physical region extends from zero to infinity when energy is infinitely large. Scattering crossection can be

expanded in orthornormalised Lagurre Polynomials in this conformally mapped variable. The first term of such an expansion is an exponential. We find that this term, in high energy is

$$S\frac{d\sigma}{d\Omega} = Ae^{-Bk\theta(1-\frac{\theta}{\pi})}$$

where A,B are constants, k, the momentum and θ, the scattering angle in c.m. system of co-ordinates.

15. Muon capture in Nuclei

V.Devanathan

(Abstract not received)

16. Current density algebras

P.P.Divakaran

(Abstract not received)

17. Analysis of π-N scattering in S_{11} and P_{11} partial waves

R.C.Garg

(Abstract not received)

18. On Massive Non-Abelion Gauge fields

Parthasarathy Ghose and Asesh Das

It is shown that in a variant of the Stuekelberg formalism for massive non-Abelian gauge fields, which makes use of unitarity preserving, purely self-interacting auxiliary spinless fields with a negative metric, the current operator $j_u \equiv j_u^a(x)t_a$ transforms like $U(x)\, j_u(x)\, U^{\dagger}$ under local gauge transformations. Field-current identity is maintaind not as an operator identity but between matrix elements. Also, only one of the two conditions stated by Salam for renormalisability of general gauge theories of massive vector mesons turns out to be sufficient, and it shows, as is well-known, that massive non-Abelian vector gauge field theories are non-renormalisable.

19. Density operator of unpolarized radiation

Hari Prakash and Naresh Chandra

General form of the density operator for unpolarized radiation, defined as one whose nature does not change on introducing arbitrary phase change in its any polarized component, is obtained. It is shown that, if two orthogonally polarized components of unpolarized radiation are statistically independent, it is necessarily chaotic. It is also shown that the procedure currently being used for studying nonlinear interactions of unpolarized radiation is not correct and that the Stokes' parameters do not correctly specify the unpolarized state of radiation

20. Invariant scalar product in thetheory of arbitrary spin particles

P.M.Mathews, V. Jayaraman and M.Seetharaman

(Please see Page 8a)

21. Lagrangian model of pion source algebra

T.Pradhan and A.V.Khare

A Lagrangian model is constructed where pion sources (for massive pions) together with isospin generators satisfy SU(2) ⊗ SU(2) algebra and the source operators commute with the Hamiltonian in the limit of zero pion mass. In this Lagrangian model of relativistic quantum field theory an exact calculation of S-wave scattering lengths can be done in the zero pion mass limit. For massive pions, calculations can be done in a tree diagram approximation. Pion sources and axial charges (in terms of pion field) are related to each other by a transformation. The above pion source Lagrangian is unique in the sense that there is no further freedom of redefinition of pion field.

20. Invariant scalar product in the theory of particles of arbitrary spin

P.M.Mathews, J.Jayaraman and M.Seetharaman

In our theory of wave euqations for particles of arbitrary spin and mass, there exists a scalar product between any two solutions ψ_1 and ψ_2 of the Schridinger equation $i\frac{\partial \psi}{\partial t} = H\psi$ given by $\int \psi_1^\dagger(x,t)\, M\psi_2(x,t)\, d^3x$ where M is a metric operator in the space of wave functions and is to be determined in such a way that the scalar product is relativistically invariant. The actual expression for M will depend upon the expressions for the Poincare' generators and in particular on that for H. We demonstrate that with the form of M determined by translation and rotation invariance, the requirements of existence of the P-invariant metric together with the conditions of unitarity and hermiticity of the scalar product lead to consistent solutions for H's (of case (i) and case (iii) whose forms have been previously fixed with separate T, C and P invariance and specific commutation relations among these) implying relativistic invariance of the equation of motion for real mass and arbitrary spin. The parity non-invariant part of the metric is inconsistent with the relativistic invariance of the equation of motion and hence should vanish identically. For the cases (ii) and (iv) of Hamiltonians, however, inconsistencies arise unless the whole metric itself is zero. For'imaginary mass' of half integar spin the relativistically invariant Hamiltonians fall under these two cases and it is the parity non-invariant part of the metric that gives consistent solution, leading to unitarity and hermiticity of the scalar product.

22. Generalised Phase Operators

Kumar Eswaran

(Abstract not received)

23. Cross-duality amplitude

P.Mahanta

Constructions of possible $\pi\pi$ cross-duality amplitudes are given. A particular model, in which the leading cut is $\rho\rho$, is investigated, The slope of the ρ trajectory is found to be the same as in the Veneziano model and the version of the KSFR relation given by this model is very close to that of Veneziano. The daughter trajectories are, however, not physical. High-lying resonances are more weakly coupled compared with those of Veneziano.

24. Charge and hypercharge exchange reactions in the veneziano model

J.Maharana and R.Ramachandran

We have studied charge and hypercharge exchange processes in the Veneziano Model. We have calculated differential cross-secctions and polarization for $\pi^- p \to \eta n$ and $K^- N \to \pi \Lambda$. Our results are in good agreement with experimental results.

25. Weak interaction as an S-matrix

Maheswari

(Abstract not received)

26. Quantisation of non abelian gauge fields

Maheswari

(Abstract not received)

Possible modes of existence of tachyons

K.H.Mariwalla

The possible modes of existence of Tachyons are examined from the point of view of its electromagnetic interactions - if any, and the fundamental space-time Assumptions of mechanics. It is

concluded that in all probability Techyons are not charged and that they could interact only on the comsic scale in the presence of very strong gravitational fields. All attempts to detect them on the laboratory scale are therefore doomed to a failure.

28. The global coordinate transformation groups, gravitation and elementary particles

K.H.Mariwalla

It is shown that the essential condition for quantization of a given system consists in recognizing the relevant 'Global Coordinate Transformation Group'. This method is used to investigate symmetry groups associated with elementary particles and their connection with General Relativity.

29. Relativistic Particle Wave Equations

P.M.Mathews

Relativistic wave equations describing particles of arbitrary mass and spin will be reviewed.

30. Wightman functions, spectral representations, and the spin statistics theorem

P.M.Mathews

Two-point Wightman functions of arbitrary finite component relativistic fields (which may in general be reducible under the homogeneous Lorentz group) are related to those involving auxiliary fields transforming according to representations of the type $D(j,0)$, and explicit representations are obtained on the basis of the usual axioms. Our construction does not require the choice of any special kind of basis for the physical states. Using the spectral representations and the weak local commutativity condition a general proof is given for the spin-statistics connection. Special problems which arise in the case of reducible fields are discussed.

31.

M.G.K.Menon

(Abstract not received)

32. A relativistic quark model

S.P.Misra and D.Dash

We have developed a relativistic model of the hadrons based on the quark model. The wave functions of the hadrons are assumed to describe the hadrons completely. The 'wave functions' here are described in terms of the energy-momentum four vectors of the constituent quarks of the bound state with the energy component including 'the energy of interaction' of the quark. The effective mass of the bound quarks thus becomes variable. The total energy momentum of the quarks (antiquarks) is now added together to give the energy momentum of the bound state. The quark fields are taken as Dirac fields and from the rest frame, Lorentz boosting is used to describe the particles in motion. The quarks inside the hadrons are described by variable mass free field effective Lagrangians and quantisation is done accordingly. The vector and axial vector currents are also easily obtained and enable us to consider interactions with external fields or of algebra of currents of field theory. The model yields proton, neutron and lambda magnetic moments respectively as 3, -2 and -0.84 nuclear magnetons in the static approximation of the quark model. The above results seem to indicate that this may be a good approximation at low energies even when we may have not knowledge of the details of interaction or of the wave functions. The model will nontrivially depend on the explicit nature of the wave functions at higher energies.

33. Scale and conformal currents in renormalizable field theories

S.Mukherjee and N.R.Ranganathan

Some general properties of the currents associated with the scale and conformal transformations in renormalizable field theories are studied. A set of equal-time commutation relations

between the generator and the components of the scale current as well as between the components themselves are evaluated. The existence of the Poincare algebra and the physical mass-spectrum are incorporated in these commutation relations. The problem of fixing the dimension of the scale current is considered Lastly, the structure of the 'σ-commutator' for these currents has also been investigated.

34. Photons and tachyons with continuous spin

N.Mukunda

Light-like and space-like representations of the Poincare group, describing photons and tachyons with continuous spin, are considered. We examine the conditions under which these representations can assume a form analogous to the Shirokov-Foldy form for the time-like representations, namely a form in which the generators of the appropriate little group show no mixing of the momentum and internal degrees of freedom. While every continuous spin light-like representations can be put into this form, only those space-like ones can, which correspond to using a continuous series representation of the little group appropriate to this case.

35. Anticorrelation of photons

Naresh Chandra and Hari Prakash

With the development of Sudarshan's (Phys.Rev.Letters 10(1963)227) phase space representation and Glauber's (Phys. Rev. 131(1963)1966) P representation of density operators of optical fields, there has been much discussion on the correspondence between the classical and quantum descriptions of coherence. Although, in one of his early papers, Glauber showed that quantum mechanically a larger variety of optical fields can exist than that allowed classically (because, for a classical field, the weight function in P representation of

density operator has to be real and non-negative, while, quantum mechanically no such condition need be satisfied), several authors have stressed the usefulnessof classical theory. One of the phenomena unexplainable classically is anticorrelation (T.F.Jordon, Phys.Letters 11(1968)289, M.M. Miller and E.A.Mishkin, Phys.Letters 24A(1967) 188, P.P.Bertrand and E.A.Mishkin, Phys.Letters 25A(1967) 204, N.Chandra and H.Prakash, Phys. Rev. A1(1970)1696) exhibited by some optical fields. Till now, the fields which have been shown to exhibit anticorrelation were ideal fields and experimentally it is difficult to get such fields. We show here that it is possible to obtain an optical field which can exhibit anticorrelation. Such fields can be obtained if one passes a laser beam through a two photon oscillator. The output fields in (a) two photon attenuator, (b) two photon (different mode) attenuator, (c) Raman type attenuator, is shown to exhibit anticorrelation. The density operator for the output field is obtained from that of input field in P representation with the help of time evolution operator, retaining only those terms which contribute appreciably to the precess under consideration. Loss mechanism has been neglected.

36. Strong and Weak Decays of Baryons

S.Pakvasa

Some regularities in the hadronic weak decays of baryons are pointed out. A possible relationship between the SU(3) structure of the weak decays and the strong decays is conjectured and tested.

37. Veneziano Models

N.Panchapakesan

(Abstract not received)

38. Dual resonant amplitudes for many pions

N.Panchapakesan

(Abstract not received)

39. The implications of tachyon-like matter for super dense stars

L.K.Pande

(Abstract not received)

40. Compositeness criterion for unstable particles

J.N.Passi

The problem of making unstable elementary particles equivalent to resonances is investigated in a soluble model field theory. It is demonstrated that the irreducible part of the scattering amplitude develops a pair of complex conjugate poles on the second sheet of the energy plane, one of them corresponding to an S-wave resonance. The poles in the vertex and inverse propagator induced by these complex poles of the irreducible part of the scattering amplitude are such that the so-called Jin-MacDowell cancellation holds good. We show that under the conditions $Z_1 = 0$ and $Z_3 = 0$, the S-wave resonance completely replaces the unstable praticle.

41. Double hypernuclei and $\Lambda\Lambda$ interaction

G.Bhamathi, K.Prema and Indumathi Seshadri

The double hypernuclei $_{\Lambda\Lambda}He^6$ and $_{\Lambda\Lambda}Be^{10}$ are analysed on the separable potential model. The value of the Λ-Λ interaction strength parameter deduced from the $_{\Lambda\Lambda}He^6$ data leads to a consistent description of the Danysz event as a $_{\Lambda\Lambda}Be^{10}$ system. On using the parameters obtained from this analysis it is found that thelightest double hypernucleus which can exist as a bound system is $_{\Lambda\Lambda}H^5$ ($_{\Lambda\Lambda}He^5$). The values of the binding energies of the plausible double hypernuclei $_{\Lambda\Lambda}C^{14}$ and $_{\Lambda\Lambda}O^{18}$ are also predicted.

42. Consequencies of renormalizability

Anil C.Rae

This is the third paper in the series under the title, "Consequences of renormalizability". This paper deals with the extension of the formalism developed in I and II, to the case of an amplitude dependent on an arbitrary number of energy-momentum invariants. It is shown that the formalism leads to an iterative solution for the high-energy behaviour of the total or differential cross-section. Some of the more important applications are pointed out. An extension to the low-energy region is given without proof.

43. Polynomial algebras

I.V.V.Raghavacharyulu and Nalini B.Menon

The present work is concerned with what are called polynomial algebras as an extension of the work of Alladi Ramakrishnan and his colleagues on matrix algebras defined by conditions like $L^m = I$ and $L^m = L^k$. We identify that some very important algebras in which physicists are interested are indeed polynomial algebras. A few general properties of these algebras are established.

44. Phenomenology of very high energy scattering

R.Rajaraman

(Abstract not received)

45. Three body forces in Nuclei

R.Rajaraman

(Abstract not received)

46. A fixed pole in the virtual compton amplitude A_2

R.Rajaraman and G.Rajasekaran

We suggest here the presence of a $J = 0$ fixed pole in the virtual compton amplitude A_2 with a residue linear in the photon mass q^2 for all q^2. The resultant sum rule is found to be consistent with the on-mass-shell ($q^2 = 0$) data, the scale invariance requirement at $q^2 \to \infty$ as well as the electron scattering data for intermediary q^2.

Inelastic electron-proton scattering and a sum rule for the schwinger ferm

V.Gupta and G.Rajasekaran

It is shown that the form of the one-particle expectation value of the Schwinger term, in the equal time commutator of the electromagnetic current and charge densities, is determined by relativisitc covariance. This allows us to derive a sum rule for theone-proton expectation value of the Schwinger term involving the structure function W_2 measured in inelastic electron-proton scattering. From this sum rule for the Schwinger term one can obtain the sum rule

$$\frac{d}{dq^2} \int_0^\infty d\nu \; \nu W_2(q^2, \nu)/q^2 = 0$$

where q^2 is the square of the four momentum transfer and ν the energy loss of the electron in the laboratory frame. We compare this equation with the recent experimental data using 'scale invariance'. We find from this comparison that this rule is reasonably well satisfied.

47. Elastic e-d scattering and violation of time-reversal invariance

G.Ramachandran

The experimentally observed deviations in elastic magnetic e-d scattering andthe null result for the recoil deuteron vector polarization are accounted for by invoking the two

possibilities of (i) a term violating the T- invariance of the electromagnetic interaction and (ii) a relative phase between the S - and D - states of the deuteron. This model involves only a single adjustable parameter independent of the momentum transfer but provides very good fit to different experimental data.

48. L-Matrix and its application to elementary particles

Alladi Ramakrishnan

(Abstract not received)

49. Unified theory of nuclei and atoms

R.Ramanna

(Abstract not received)

50. SU(3) quark model for high energy particle reactions

Ramesh Chand

In an SU(3) quark model, high energy particle reactions are investigated in the crossed t-channel. It is assumed that the physical baryon octet contained in the direct product $\underline{3} \otimes \underline{3} \otimes \underline{3}$ is given by: $\underline{8}$ (physical) = $\underline{8}'\cos\ominus + \underline{8}\sin\ominus$, where $\underline{8}$ and $\underline{8}'$ arise from $\underline{3} \otimes \bar{\underline{3}}$ and $\underline{3} \otimes \underline{6}$ respectiely. Taking b as the SU(3) symmetry breaking parameter, strange-quark-to-nonstrange-quark coupling parameter, we find that our quark model predictions in terms of the values of $\ominus$ and b are in agreement with the available high energy data on : a) meson-baryon scattering, b) production of vector mesons in meson-nucleon collisions, c) photo production of pseudoscalar and vector mesons, d) anti-protonnucleon annihilations into i) pseudoscalar-vector mesons, and ii) baryon-antibaryon.

51. Inelastic photoproduction on nuclei and determination of I_o/C

A.K.Rej

The present prediction of I_o/C near theshold is not reliable while this quantity is of much interest in photo production of pion on free nucleons. In this note we suggest a reliable way to determine empirically this quantity from the inelastic differential cross-sections for the photoproduction of π^0 on ^7Li and ^9Be leading to their respective second excited states and further sugest a test for the quark model.

52. Remarkable connection between the multi-veneziano integrand and the character of special unitary groups

T.S.Santhanam

The remarkable connection that exists between the multi-Veneziano integrand at a fixed point of theexternal momenta and the character of special unitary groups is exhibited explicitly. Some remarks are made on such a connection for arbitrary external momenta.

53. Electromagnetic correction to eht forward $K_L - K_S$ Regeneration amplitude

K.V.L.Sarma and L.M.Sehgal

Electromagnetic correction to the amplitude of the regeneration reaction $K_L p \longrightarrow K_S p$ in the forward direction is estimated in a model in which only theelastic intermediate states are retained in the unitarity summation. Assuming Regge behaviour for the strong interaction amplitudes, it is found that the correction to $Im(f_{LS})/k$ is finite and vanishes asymptotically as $s^{-2}(\ln s)$. Correction to the $Re(f_{LS})/k$ is examined in a nonrelativistic potential model which assumes the additivity of the phase shifts.

54. Photoproduction processes in the quark model

C.V.Sastry and S.P.Misra

Many sum rules for photoproduction processes are derived starting from the vector-dominance hypothesis and treating the mesons consistently as quark-antiquark composites.

55. Role of invariance conditions in the determination of arbitrary spin wave equations

M.Seetharaman and P.M.Mathews

We show that for free particle wave equations describing arbitrary spin particles of non-zero mass, Poincare and TCP invariance lead to separate T, C and P invariance of the wave equation.

56. Role of box diagram contributions in $N^*(1236)$ and Ξ production processes

A.B.Saxena, Kunwar J.Narain, C.P.Singh and B.K.Agarwal

We have investigated the applicability of rescattering model to understand the production angular distributions and the energy dependence of the cross sections for the reactions $\pi^+ p \to \pi^0 N^{*++}$, $K^+ p \to K^0 N^{*++}$ and $K^- p \to K^+ \Xi^-$.

57. Phtoproduction of charged pions from ^{16}O and ^{12}C

K.Srinivasa Rao

The photoproduction of charged pions from closed shell nuclei, ^{16}O and ^{12}C, is studied by means of a transition amplitude obtained in the impluse approximation. The processes studied are:

$$\gamma + {}^{16}O(J^P=0^+;\ T=0) \to \pi^+ + {}^{16}N(J^P = 2^-, 0^-, 1^-, 3^-;\ T=1), \quad (a)$$

$$\gamma + {}^{12}C(J^P=0^+;\ T=0) \to \pi^- + {}^{12}B(J^P = 1^-, 2^+, 2^-, 1^-, 3^-;\ T=1), \quad (b)$$

and $$\gamma + {}^{12}C(J^P=0^+;\ T=0) \to \pi^- + {}^{12}N(J^P = 1^+;\ T=1).$$

Treating the ground state of ^{16}O to be spharical, we find[1], on comparison of our results with the available experimental data, that the known particle-hole wave functions for ^{16}N states yield cross sections smaller than those obtained with the Independent Particle Model (IPM), but they are still larger, by almost a factor of two, than the experimental results and we show that this discrepancy can be accounted for by invoking the surface production mechanism. However, recently, we have shown[2] that, for process (a), a better agreement between theory and experiment can be obtained without invoking the phenomenological surface production mechanism, if we explicitly take into account the two-particle-two-hole correlations in the ground state of ^{16}O.

For processes (b) and (c), we predict[3] the energy dependence of the cross sections using the IPM and the available particle-hole wave functions for the final nuclear states, in both the volume and surface production mechanisms, treating ^{12}C to be spherical. We suggest that the process (c) is ideally suited for an experimental study, since only the ground state of ^{12}N is stable against nucleon emission.

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1) V.Devanathan, M.Rho, K.Srinivasa Rao and S.C.K.Nair, Nucl. Phys. B2, 329 (1967).

2) K.Srinivasa Rao and V.Devanathan, Phys.Lettes. 32B, 578 (1970)

3) K.Srinivasa Rao, V.Devanathan and G.N.S.Prasad, to appear in Nucl. Phys (1971).

58. Analiticity in field theory

E.C.G.Sudarshan

59. Polarisation effects in high energy neutrino induced reactions

R.G.Takwale and M.T.Teli

A general expressions for the ifferential cross-section for the production of lepton and barion in the neutino-nucleon interaction are obtained in a general reference frame. Expressions are put in covariant form and contain contributions simultaneously from all the six weak form factors involved in the strong interaction current, from the polarised nucleon, lepton and barion and also from the imeginary parts of the products of any two form factors aristing from CP-noninvariance. The results are discussed in the centre of mass system. Some relations are obtained between the polarisation coefficients when the contribution due to the induced form factors or the lepton mass is neglected. The relations are a direct consequence of transfer of the same helicity state ofneutrino to the lepton whose transverse polarisation is proportional to its mass term and hence negligible at high energy.

60. Broken SU(3) X SU(3) and Cabibbo Angle

Tulsi Dass

A field theoretic model with the chiral SU(3) X SU(3) symmetry broken to U(1)(charge) level is studied with a view to relate the Cabibbo angle to strong and electromagnetic interaction parameters. A relation is obtained which reduces to the result of Gatto, Sartori and Tonin and of Cabibbo and Maiaini in the limit in which themasses of the SU(3) X SU(3) partners of the Goldstone bosons become infinite.

61. Exact asymptotic results for scattering amplitudes

Virendra Singh

(Abstract not received)

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ARRANGEMENT FOR MEALS

Bed coffee and Breakfast will be served in the hostels. Cost is included in the room charges (Rs.3.25 per day.). Lunch will not be served in the hostels. Arrangements have been made with a caterer to supply lunch in the Student Centre building(Upstairs), since there are no hotels nearby. Caterer will prepare lunch only according to the number of coupons sold. Please buy the lunch coupons for the duration of your stay immediately. If lunch is not required for any particular day, the corresponding coupon may be returned one day in advance, and refund obtained.

Dinner will be served in the hostels, but only according to the number of coupons sold one day ahead. So it is necessary to buy coupons in advance. Refund may be obtained by returning coupons one day in advance .

Note :

Those who are not staying in hostels may also buy coupons for lunch as above . (Rs. 2-75 per coupon).

Supplementary Information on the Programme

Registration :

Those who have not already sent in the registration fees may kindly pay the same at the registration desk in the A.C.College Lobby, and collect the Symposium literature.

Inauguration of Symposium :

At 6.00 p.m. on 30-12-1970 in the Student Centre (First Floor) A.C.College Campus.

Cultural Programme :

Dance - Drama ''Mahapattabhishekam'' at Kalakshetra, Adyar: at 6.15 p.m. on 1-1-1971. All delegates are invited. Transport will be provided. Anyone who will not be attending the performance, please let us know immediately.

Reception :

Tea Party on 3-1-1971 at 5.00 p.m.

Evening Lecture : at 6.15 p.m. on 3-1-1971.

'' Three - dimensional structure of macromolecules''

by Dr.Gopinath Kartha (Centre for Crystallographic Research, Roswell Park Division of Health Research Inc., Buffalo, N.Y.,(USA).