August 31/64

Dear Feza,

I hope you had a good crossing &
enjoyed some rest after the rush & the
hectic activity of the last month.

I am sorry I am not able to report any
substantial progress since you left. I did a
few odd things but somehow I was too lazy
to work hard. I will start again this
week after finishing writing a few pages for
Luke Yuan on the super high energy machine.
I couldn't resist the pressure & I agreed
to give a seminar on October 1. It will
be a rather general seminar & I do not
plan to go too deep into the theory.

It would be nice however if I could say a few words about two problems

1. The generation of rotationless field by means of a local gauge transformation. This is a necessary preliminary step for the construction of the constants of the motion which generate spin transformation; in our notation they are related to the rotationless axial vector current through the equation:

$$a_k^A = \int d^3x \, a_k^A$$

where $\partial_\mu A_{\nu}^A - \partial_\nu A_{\mu}^A = 0$

The construction of the axial vector field interacting with A_μ^A is an important generalization of Utiyama's paper which is at the basis of our whole problem.

I will think about this problem & I would

be very gratefull if you would let me
know your point of view.

2. The exact definition of the little groups
for the three point function. I will do
some preliminary reading about this point
& I will let you know my views as soon
as I have any.

Have a good time in Geneva & give my
regards to T.D. & the other people there.

Greetings to Suha & Luzut.

Yours ever

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, Inc.
UPTON, L. I., N. Y.
TEL. YAPHANK 4-6262

DEPARTMENT OF
PHYSICS

Letter # 2

September 4, 1960

Dear Feza,

I am sorry to bombard you with my letters but I believe you will like to see the enclosed copy of a letter by Michel even if it is rather pessimistic on the meaning of our work. I should add however that Gian Carlo had a letter from Wigner where he says that he likes our work _very much_!

To be frank in my present pessimistic mood I'm rather inclined to side with Michel's critical attitude. Indeed in the last few days I have been worrying about a number of points which I would like to discuss with you.

1. Rotationless axial vector current.

The axial vector current for a spin 1/2

, $\bar{\psi} \gamma_5 \gamma_\mu \psi$, is _not_ rotationless. The

theory has therefore no meaning for

a free spinor. I do not yet know what

is the 'minimal theory' for which a

rotationless axial current exists. Clearly

this is a drastic departure from conventional

theories where the fields are enough to

construct the generators of transformations.

2. Generators of 'Spin' Rotations.

Consider the simple case of SU_2. The

following quantities are constant of the motion

$$B = -i \int d^3x \; V_4 (x)$$

$$T_a = -i \int d^3x \; V_4^a (x)$$

$$C_k = \int d^3x \; a_k (x) \qquad\qquad (1)$$

$$C_k^a = \int d^3x \; a_k^a (x)$$

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, Inc.
UPTON, L. I., N. Y.
TEL. YAPHANK 4-6262

DEPARTMENT OF
PHYSICS

where: $\partial_\mu V_\mu = 0$; $\partial_\mu V_\mu^a = 0$ $a = 1, 2, 3$

$\partial_\mu A_\nu - \partial_\nu A_\mu = 0$; $\partial_\mu A_\nu^a - \partial_\nu A_\mu^a = 0$

T_a, C_k, C_k^a are the generators of SU_4

It is clear that T_a commutes with
the generators of the Lorentz Group: C_k and
C_k^a however do not commute. Let $J_{\mu\nu}$ be
the generators of $L.T.$ [homogeneous] I would be inclined
to put $C_k = \varepsilon_{ijk} J_{ij}$ because this is
the expression I get if I insert for A_k in
eq (61) its expression for spin $\frac{1}{2}$

$A_k = \bar\psi \, \delta_5 \delta_k \, \psi \sim \psi^\dagger \, \sigma_k \, \psi$; $\int d^3x \, \psi^\dagger \sigma_k \psi \sim S_k$

(Notice however that when L constructs the [on] generators
for the L.G. one never asks that they should
come from a rotationless current)

But even if $C_k \neq \varepsilon_{ijk} J_{ij}$ it clearly obeys
the same commutation rules and actually does

induces the same transformations since we sa
always said that

$$C_3 \,|\, J J_3 \rangle = J_3 \,|\, J J_3 \rangle \qquad etc. \qquad (*)$$

Unless we can find the other generators
isomorphic to J_{iq} and we actually construct
the group $\mathcal{G}_4$, our theory remains a non
<u>relativistic</u> approximation completely equivalent
to Wigner's supermultiplet theory.

$(*)$ $\quad C_3, C_1, C_2 \quad$ do not ~~there~~ commute with

the other generators J_{iq}

I don't think I want to discuss other points today.
The first question we must answer before we proceed
further is, in my opinion, the following:
    ⓐ Which are the generators of $\mathcal{G}_4$ & what
     are their commutation rules with $B_{\mu\nu}$ & $J_{\mu\nu}$.
In particular are the quantities defined in (1)
part of
& the generators of $\mathcal{G}_4$? is it true that $C_4 = \delta_{ig} J_{ig}$?

I hope you had a good trip & are now settled
in Ankara. Regards to Suha & thanks for her letter
            Yours

Sept 30, 1964

Dear Feza,

I write only a few lines because I have to go to Patchogue. Luke Yuan asked me to remind you that the deadline for your paper about high energy physics is not too far ahead: Oct 30. He would very much like to have your contribution and has already included your name in the preliminary list of authors.

I haven't yet received the letter you promised in your telegram from CERN but I suppose this is due to the many things you have to do these days.

From my last I haven't made any
progress towards the proof of the relativistic
invariance of our theory & I strongly ⊛
suspect such a proof may not exist: but
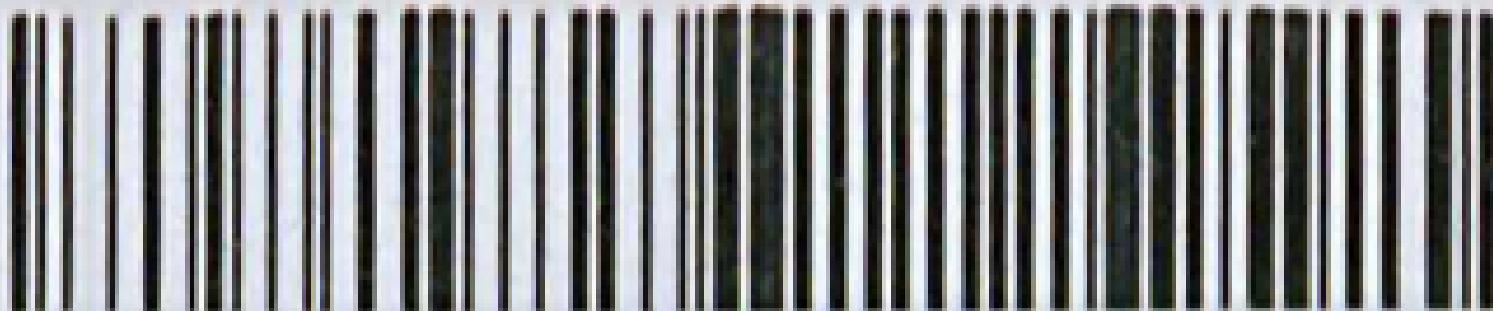maybe I am pessimistic.

Regards to Suha & love to Yusuf from
the children

Yours ever

Abdus

⊛ as I told you in my last letter

Feza Gürsey Arşivi

FGASCI0202004