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P46 Add.5

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COMMON ADDENDUM TO PROPOSALS CERN/SPSC75-71/P53

and CERN/SPSC/75-27/P46

EXTENSION OF THE NARROW BAND BEAM EXPERIMENT WITH GARGAMELLE TO ANTINEUTRINO RUNNING AT HIGH ENERGY WITH THE USE OF A TRIGGER

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Abstract:

The aim of the extension proposed here is a bubble chamber study of antineutrino interactions in an energy region in which recently observed phenomena (increase of $\sigma_{\bar{\nu}}/\sigma_{\nu}$ ratio, y distribution anomalies, dilepton events production) have not been accounted for by a simple and unique interpretation. The use of visual techniques is of great interest in particular if such effects are due to the production of new particles. It is proposed to use the electronic equipment surrounding Gargamelle to trigger the flashes, thus to concentrate the data on a restricted number of photographs.

The aim of this addendum is to propose an extension of the experiments P53 and P46 to a systematic study of antineutrinos at energies greater than 30 GeV. Those antineutrino data will complement the neutrino data requested in Proposals P46 and P53.

Indeed, since the presentation of proposals P53 and P46, new experimental facts observed in antineutrino reactions have increased the number of questions still not answered in the energy domain above 30 GeV. Also new facilities will be available right at the beginning of the running SPS period of Gargamelle. The possibility of using the veto counter, the picket fence and the calorimeter lead to reconsider the exploration of the antineutrino reactions in this energy range with larger statistics.

PHYSICS AIM:

Beside the production of dimuons and the anomalies in the elasticity y distribution, recent results obtained in the experiment HPWF at FNAL tend to indicate a large increase of the ratio of the charged current of antineutrino to neutrino (total cross section) $\sigma_{\bar{\nu}}/\sigma_{\nu}$ from the value ~ 0.3 at low energy up to the value ~ 0.6 at high energy (Ref.1.). However, it should be pointed out that the magnitude of the anomalies (Ref. 2) as well as the increase of the $\sigma_{\bar{\nu}}/\sigma_{\nu}$ are still controversed (Ref.2).

If this effect is verified, this would indicate a strong violation of scaling. This is to be brought into contrast with what is observed at lower energies in electro-production and neutrino-production where scaling was very well checked.

There have been many speculations about the origin of these observations. A first interpretation is a charm production which is likely to be responsible for the ν induced dimuon events (Ref. 3) a process which seems constant at a rate of 1% within statistical error over the energy range from 50 GeV to 150 GeV as well as for the recently observed events $\mu^- e^+ V^o$ in bubble chambers (Ref. 4). This interpretation

is also supported by the narrow resonances in $K\pi$'s or $\Lambda\pi$'s observed at SLAC and FNAL. Nevertheless, the phenomena observed in HPWF experiments are difficult to interpret quantitatively by charm only since they would require a large increase of the sea quark.

Another possible interpretation of the observations is the existence of particles coupled with new currents with still another quantum number beyond charm. Many theoretical suggestions were made in this direction before and after the FNAL results (Ref. 5).

Apart from the interest of checking these results with techniques distinct from those already used, it will be necessary to study these events in a detailed manner with a detector such as Gargamelle in order to understand better their origin. The bubble chamber has proved to be of great interest in the search for new phenomena, because the details of the interactions are completely identified.

EXPERIMENTAL CONDITIONS:

The event rate in the antineutrino narrow band beam is small. Nevertheless, it is possible to take advantage from two conditions which are quite essential to undertake such an analysis:

a) the narrow band beam is expected to run already for the two counter experiments and we propose to use the $\bar{\nu}$ running time already foreseen for these experiments.

b) it is possible to take only a small amount of photographs with a high integrated flux, providing we use the whole assembly of counters placed around Gargamelle i.e. the vetocounter, the picket fence, the calorimeter and the EMI.

During the running time foreseen for the counter experiments, it would be possible to collect on a restricted number of photographs a

sample of events corresponding to 1.10^{16} bursts with an intensity of 10^{13} p.p.p. This will give 3800 events and we should expect in addition the same number of events of an entirely new type (if the increase of $\sigma_{\bar{\nu}}$ is verified).

We hope to concentrate the useful events on about 100,000 px and to obtain in addition an exposure without trigger of about 200,000 px in order to test any trigger bias.

The characteristics features of the events can be easily separated. As usual, the dimuon events are identified in the two-planes-EMI with high efficiency and low background. For example the EMI, veto and picket fence will be used for the separation of events according to the number of muons produced. A systematic study of the events can be made in the region where anomalies have been evidenced. These events have high y values and can be separated in particular using the calorimeter together with the EMI. It is important to understand the nature of these events, especially by searching for associated strange particles.

EXPERIMENTAL SET UP:

Beam: The beam is the narrow band beam N3. It can be used at 275 GeV/c and/or at 200 GeV/c for the parents as well. A lower energy has the advantage of providing a twofold increase of the number of events. The 200 GeV/c beam would give $\bar{\nu}_{\pi}$ and $\bar{\nu}_{K}$ of respectively 60 and 170 GeV, with the $\bar{\nu}_{\pi}$ being well above the threshold of the possible new effects studied.

The chamber will be filled with a mixture of propane C_3H_8 and light freon C_2F_5Cl of 70 cm radiation length, which has the advantage of maximizing the density for the fixed radiation length.

Run: We propose to begin the exposure for this experiment in a non-triggered-mode to be able to choose an efficient trigger as soon as N3 is ready for running in antineutrino in the region 200-275 GeV/c parent.

The best spill is 0.5-1 ms whereas it is possible to run in the range 20 μs-2ms. Thanks to the use of the electronic equipment with GGM, we will be able to run the experiment with a minimum expense for the fil.

CONCLUSION:

The proposed experiment seems to have unique features to explore this new domain with a reasonable statistics and all the information available in bubble chamber pictures. Such a kind of information has proved to be essential in the interpretation of the nature of the produced particles, and consequently in the identification of the nature of the production reactions.

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