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Experimental Particle Physics Group

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Research Activities

This group has been conducting the experimental investigations on the elementary particles using electronic counting detectors. Originally, this group started from the bubble chamber physics group formed in 1971. Most of experiments were carried out by using large accelerator and non-accelerator facilities in Japan and oversea. The data are being analyzed at Tohoku University using the computer facility at the bubble chamber physics laboratory.

This group consists of staff members from the bubble chamber physics laboratory and the particle-nuclear physics groups. The experiments are performed by jointly forming subgroups from both groups.

The following are the major subjects being carried out in 1993.

I. Stanford Large Detector (SLD) group (H.Yuta, K.Abe, F.Suekane, T.Nagamine, Y.Hasegawa, Y.Iwasaki, M.Kuriki, H.Araki)

The experimental run using SLD has been carried from 1990 with 50 GeV polarized electrons colliding onto 50 GeV positron beam at Stanford Linear Collider (SLC) facility. This experiment aims to study the properties of the neutral weak boson Z^0 and to examine the standard model of elementary particle physics. We have accumulated 60,000 Z^0 events in upto 1993 run. The data analysis is being carried at both SLAC and Tohoku. The first result on the left-right cross section asymmetry was published in Jan. 1993 [1-3]. The experimental run will be continued until 1997.

In addition, the polarized electron-nucleon experiment at the End Station A(E143) was carried out and the data are being analyzed.

II. Deep Underwater Muon and Neutrino Detector (DUMAND) group (A.Yamaguchi, T.Hayashino, T.Matsumoto, S.Narita, A.Iwasaki)

The project is to observe high energy neutrinos from universe for the study of the origin of universe. The detector is a water Cherenkov counter in a deep ocean which consists of 9 strings with 24 of 15 "photo multiplier tubes in octal array. This detector will be deployed into the deep ocean, 4800 meters under sea level and 30 km west off the coast of Hawaii Island.

We have constructed 70 optical modules (JOM) for first three strings. One string was deployed in Dec. 1993, but failed due to a water leak during the data-taking. The data have been analyzing to examine the performance of JOM etc [4-11]. Three string deployment will be tried again in 1994-1995.

III. Kamiokande Group (A.Suzuki, T.Hasegawa, K.Fujita)

The data analysis on proton decays, solar neutrinos, supernova neutrinos, atmospheric neutrinos, and high energy neutrinos from active extraterrestrial objects has been going on using the Kamiokande 3,000 ton water Cherenkov detector. To examine the response of a water Cherenkov detector to charged particles (e , μ , π) a 1000 ton water Cherenkov detector was constructed at KEK. The beam exposure was started in March, 1994 with the beam momenta (0.2-1.0 GeV/c) of e^- , μ^- , π^- . In November, 1993, the performance of newly developed 20-inch photomultipliers was obtained by using a small water tank and π^- beam from 12-GeV KEK-PS [12-19].

This group has also been taking part in the construction of SuperKamiokande (50,000 ton water Cherenkov detector), and preparing double beta-decays and solar neutrino detections by developing a large volume (>10 ton) liquid scintillation detector.

IV. KEK B group (H.Yuta, A.Yamaguchi, K Abe, T.Nagamine, O.Watanabe)

In order to understand how the Universe evolved from the matter-antimatter symmetric world at Big Bang to the matter world at present, the study of CP violation is very important. For this study the B factory project at KEK has been approved in Japan, and the B factory experiment in colliding 8GeV electrons on 3.5GeV positrons is scheduled to start from 1998.

The goal of this experiment is to study the CP violation in B meson decays, and then to define the origin of CP violating asymmetry. The research and development for a resistive plate counter as a detector of K_L^0 and muon in the B decay products is being carried out at Tohoku University.

The data for the KEK VENUS experiment and bubble chamber experiment have been analyzed and some results were published [20-24].

V. SDC group (H.Yuta, K.Abe, F.Suekane, T.Nagamine, K.Neichi, H.Kawasaki, S.Hatakeyama, J.Yashima, M.Onoda)

Tohoku group had been joined to the muon group of the SDC detector for the SSC since 1992. Our major responsibility was to build 4000 muon drift tubes and the first level trigger using FPGA. In 1993, we have carried two beam test experiments at KEK to examine the performance of the drift tube. The data are being analyzed.

In addition, a series of R&D studies has been performed for the warm liquid calorimeters. The results for the studies are being published [25-28].

Publications

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Doctor Thesis

- D3) Kenji Sakai, "Study on Parity non-conservation by neutron -nucleus interactions"
- D3) Kazushi Neichi, "R&D study on warm liquid calorimeters"

Master Thesis

- M2) Shinya Narita, "Characteristics of the optical modules for DUMAND"
- M2) Hiroyuki Kawasaki, "Study on performance of SDC muon detector"
- M2) Syuichiro Hatakeyama, "Study on performance of SDC muon detector by simulation"