GLC calorimeter subgroup activities in JFY2003 and plans in JFY2004 and after

KEK, Kobe, Konan, Niigata, Shinshu and Tsukuba

Summary

Mainly worked on testbeam programs for these years.

Expanded international collaboration.

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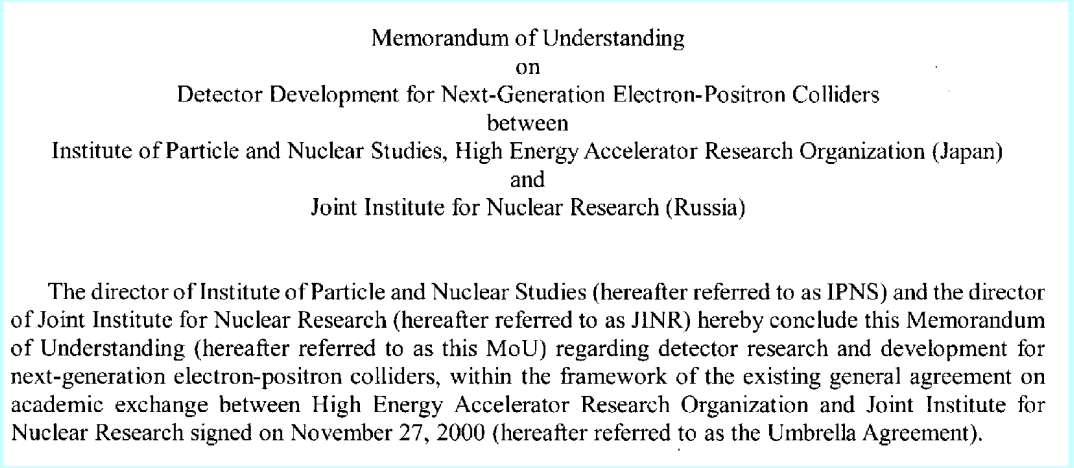
1. International Collaborations
2. Test Beam Programs
3. Data Analysis
4. Photo-detector R&D
5. Simulations
6. Future Plans

1. International Collaborations

Three programs are in progress.

a. JINR/DLNP

- KEK/IPNS and JINR have concluded an MoU on linear collider detector R&Ds in July 2003.
- Based on this MoU, fabrication of test modules are in progress. These will be tested at KEK in March 2004.



Memorandum of Understanding
on
Detector Development for Next-Generation Electron-Positron Colliders
between
Institute of Particle and Nuclear Studies, High Energy Accelerator Research Organization (Japan)
and
Joint Institute for Nuclear Research (Russia)

The director of Institute of Particle and Nuclear Studies (hereafter referred to as IPNS) and the director of Joint Institute for Nuclear Research (hereafter referred to as JINR) hereby conclude this Memorandum of Understanding (hereafter referred to as this MoU) regarding detector research and development for next-generation electron-positron colliders, within the framework of the existing general agreement on academic exchange between High Energy Accelerator Research Organization and Joint Institute for Nuclear Research signed on November 27, 2000 (hereafter referred to as the Umbrella Agreement).

b. DESY

- Co-works with DESY-HCAL group are in progress on photon detector R&D and on beam test programs.
- Our shower position detectors were tested at DESY in collaboration with DESY-HCAL group in Sep.2003.
- They will paritipate in our beam test at KEK in March 2004, with their photo-detectors.

c. U.S.

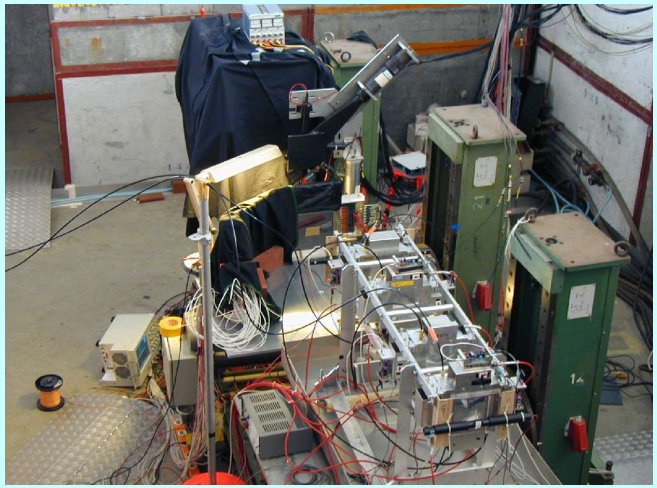
- Proposal on studies of degital hadron calorimetry with ANL LC group has been submitted to J-US program.

2. Test Beam Programs

Our major effort has been on beam test of EMcal (pi2 will be shut-down by summer 2004)

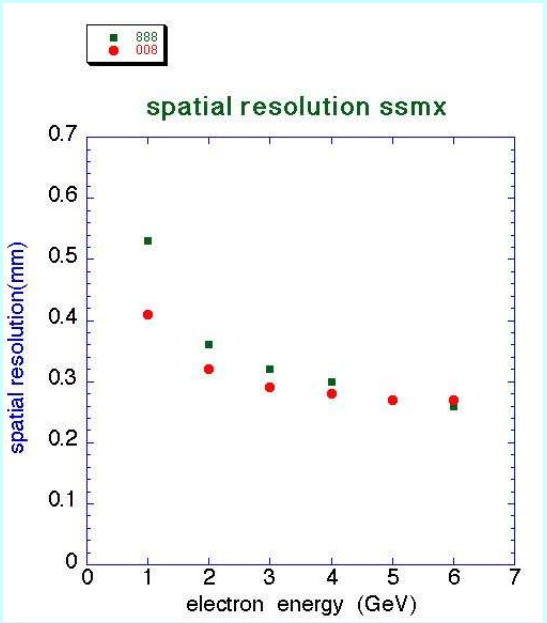
a. Shower position detectors tested at DESY-st21 in Sep.2003

- two shower position detectors were tested; conventional WLS-fiber-readout scintillator-strip array
  direct-mount ADP-readout scintillator-strip array
- electron beam of 1~6GeV with intensity of ~kHz.
- plenty of data taken. Will be reported at JPS in March.



Set up of detectors at ST21 area

direct-mount ADP-readout scintillator-strip array



Position resolution of direct-APD module

b. Integrated test at KEK-pi2 in March 2004.

- two shower position detectors with aggressive photon detectors, one of which from DESY-HCAL group.
- two EMcal test modules made by Japanese group and two EMcal test modules made by Russian group
- one test assembly using organic semi-conductor

3. Data Analysis

We did our first integrated beam test of EM modules in Nov.2002. What were tested are as follows.

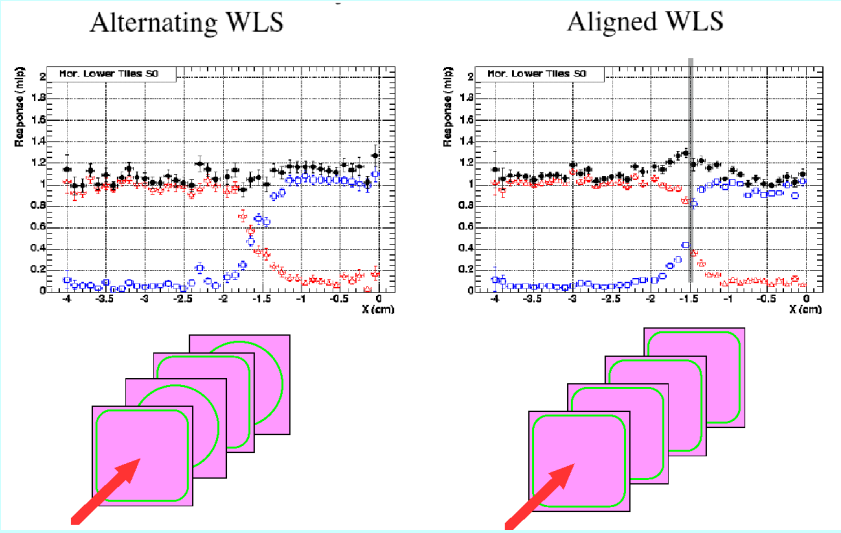
a. proof-of-principle of direct-mount ADP-readout scintillator-strip array

b. performance of conventional WLS-fiber-readout scintillator-strip array

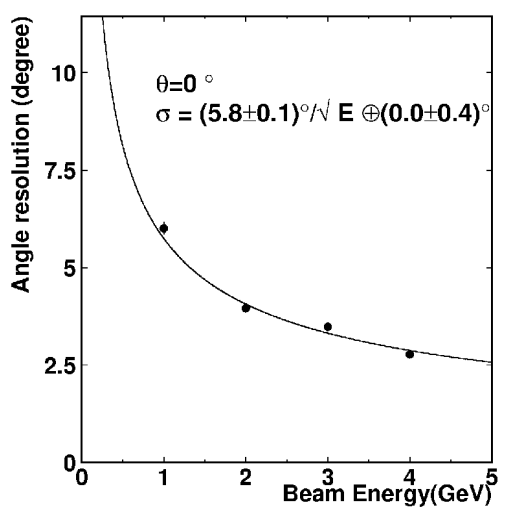
c. uniformity examination of small&thin tile/fiber EMcal

d. performance of strip-array EMcal

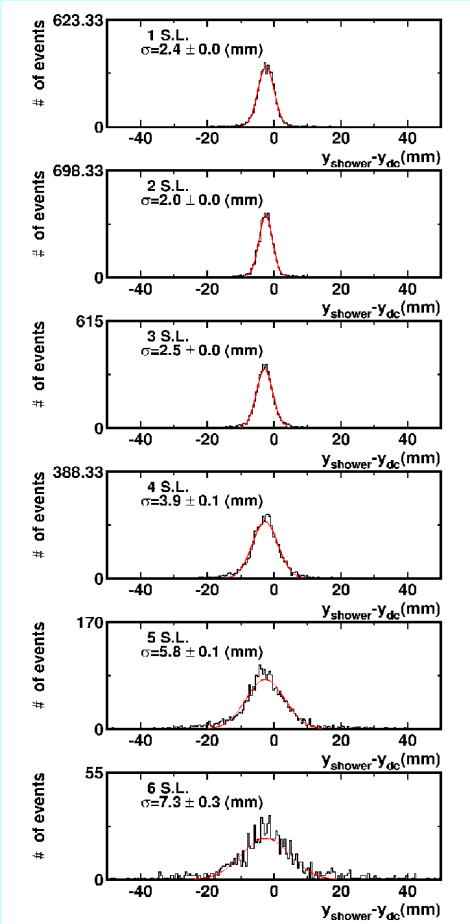
Results reported the results at JPS Spring 2003 and at JPS fall 2003.



Non-uniformity at tile boundary for tile/fiber.
Avoiding fiber line-up achieves better uniformity.



Angular resolution of shower axis
measured by scntillator-strip-array EMcal.



Position resolution for each super-layer
of scntillator-strip-array EMcal.

No beam test plans for the next few years. Data analysis and publication will be one of our major activities.

4. Photo-detector R&D

Photo-detectors are now the most essential component of any plastic scintillator-based calorimeters. Followings are thought to be most promissing, and tested in JFY2003.

a. APD

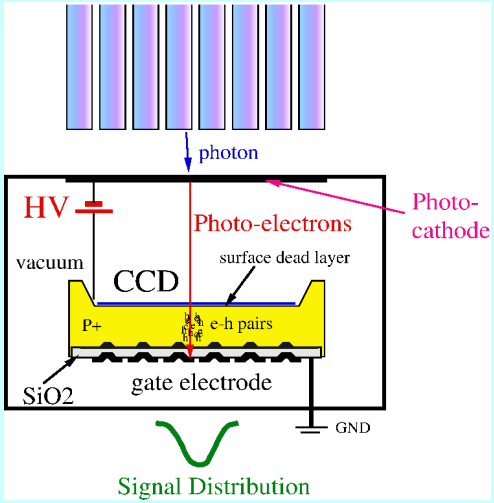
b. multi-channel HPD

c. multi-channel HAPD

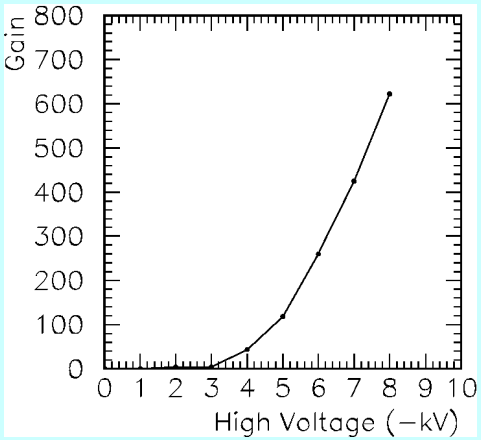
d. EBCCD

e. SiPM

HAPD (M.Suyama)



Layout of EBCCD and fibers



Gain vs HV of EBCCD

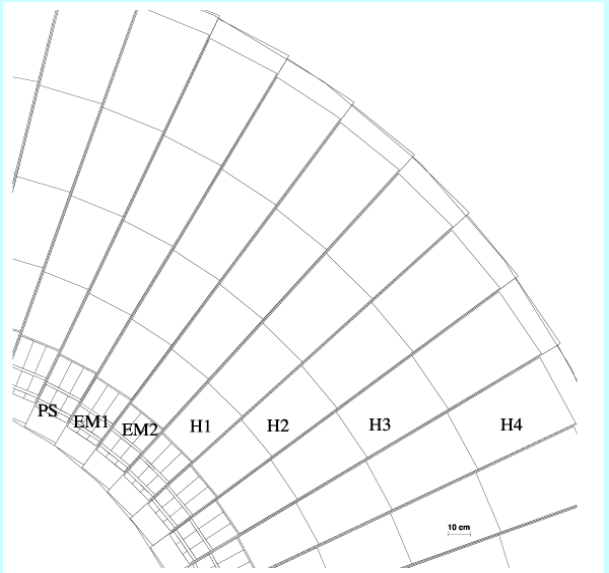
- APDs were already integrated to the direct-mount strip-array detector, and tested the with beams.
- Other four decvices have been tested at bench.

They will be integrated to the strip-array shower position detectors and tested with beams in March.

5. Simulations

- Event reconstruction at LC experiment is very challenging since we need to reconstruct every parton in the reaction.
  Therefore extensive simulation work is mandatory.
- Nevertheless simulation work has had lower priority for these years due to our hurry in testbeam programs.

- GEANT3-based full simulator has been in operation for years,
  mainly to verify calorimeter performance.
- This year, new geometry of much finer granularity (strip-array EMcal)
  has been implemented. Performance studies are being carried out.
- Transition to GEANT4-based full simulator is being discussed.



Base-line geometry in G3-based full simulator

- Physics capability studies with full-simulator and validation of fast-simulator
  using the results are highly necessary, but were not done this year.

- Simulation studies will be our major work in coming few years (no testbeam plans).
- Simulation studies on digital hadron calorimetry are about to start.

6. Future Plans

a. Fully understand and establish design and performance of tile/fiber calorimeter, based on the test module construction experience and testbeam data so far.

b. Carry out full simulation studies in detail to get optimum parameters of calorimeter (especially granularity), to proceed to the next step of engineering design.

c. Continue photon detector R&Ds, and keep up with their rapid development.

d. Keep and further extend international collaboration.