

# TestBeam for Tracker

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What we did w/ beam  
case of LCTPC

What R&D are head of us  
Beam?

where ? when?

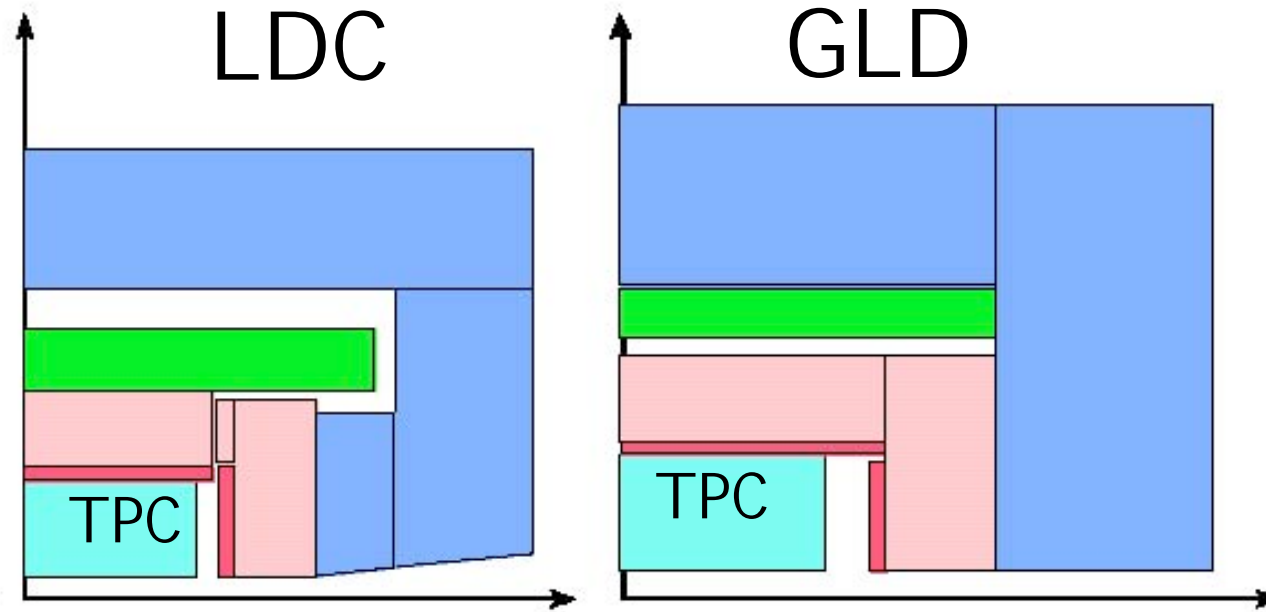
facilities at beam

International collaboration

# Case of TPC

TPC is a only candidate  
of main Tracker  
for LDC and GLD

same goal (performances)



good  $P_t$  resolution

good 2track separation

good tracking efficiency

$$\frac{\delta p_t}{p_t} \sim 5 \times 10^{-5} p_t \quad \text{with inner tracker and VTX}$$

R&D groups in the world are working together as LCTPC collab.

North America : Victoria, Carlton, LBL, Cornel, Purdue,,

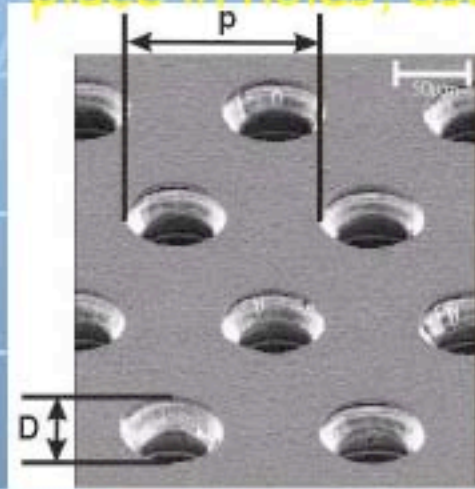
Europa : Saclay, Orsay, DESY, Aachen, MPI ,,,

Asia : CDC(Mindanao,KEK, Tsukuba,TUAT,Kogakuin,Kinki,Hiroshima, Saga)

R&D are based on MPGD + TPC scheme

# Gas-Amplification Systems: Wires & MPGDs →

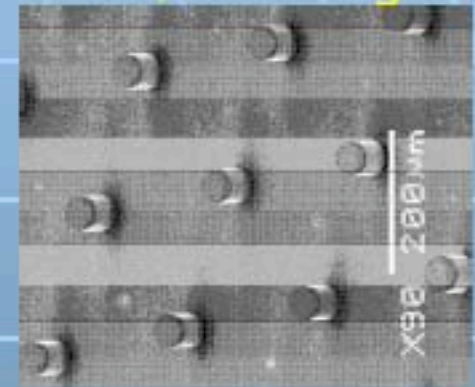
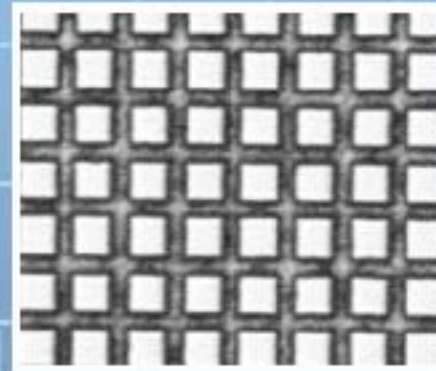
**GEM:** Two copper foils separated by kapton, multiplication takes place in holes, uses 2 or 3 stages



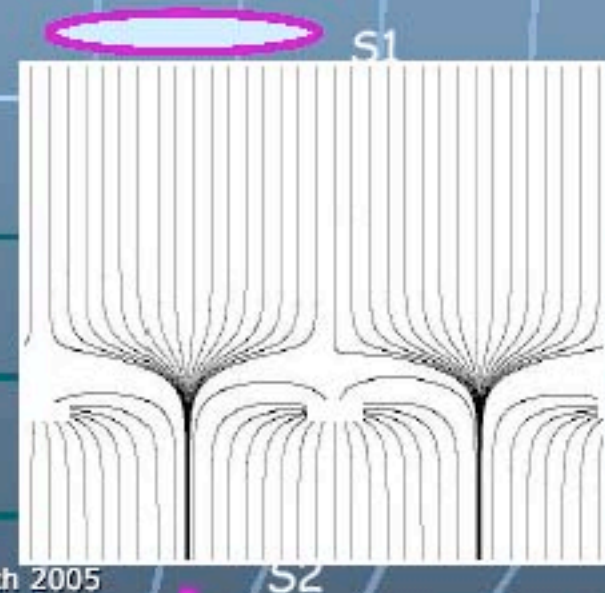
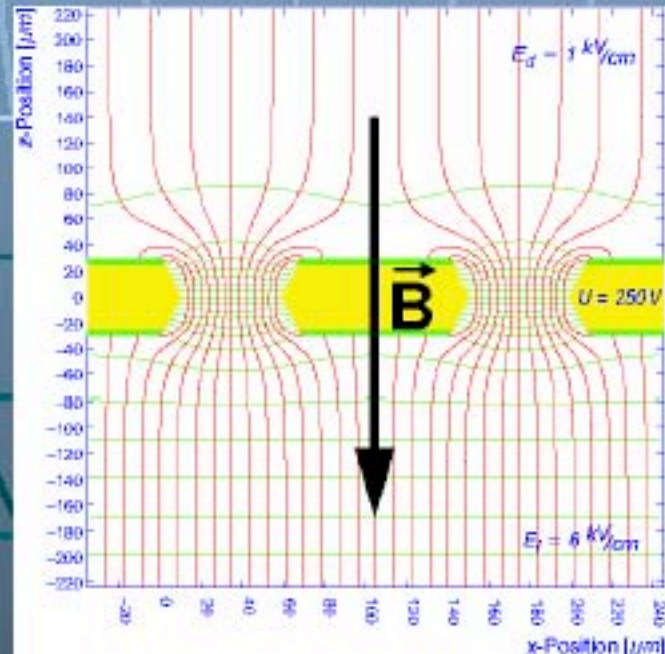
$P \sim 140 \mu\text{m}$

$D \sim 60 \mu\text{m}$

**Micromegas:** micromesh sustained by  $50 \mu\text{m}$  pillars, multiplication between anode and mesh, one stage



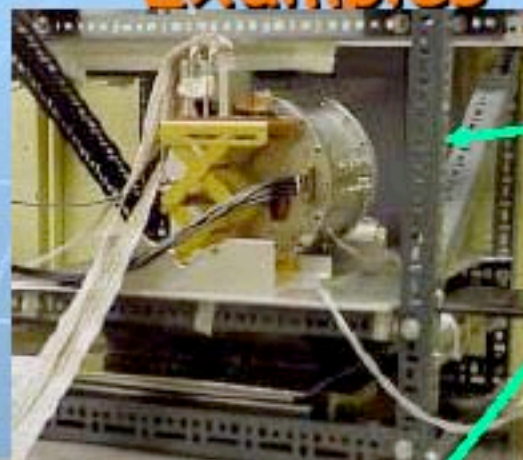
$S1/S2 \sim E_{\text{amplif}} / E_{\text{drift}}$





R&D groups have own prototype chamber

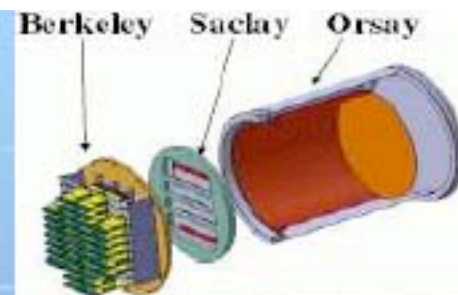
## Examples of Prototype TPCs



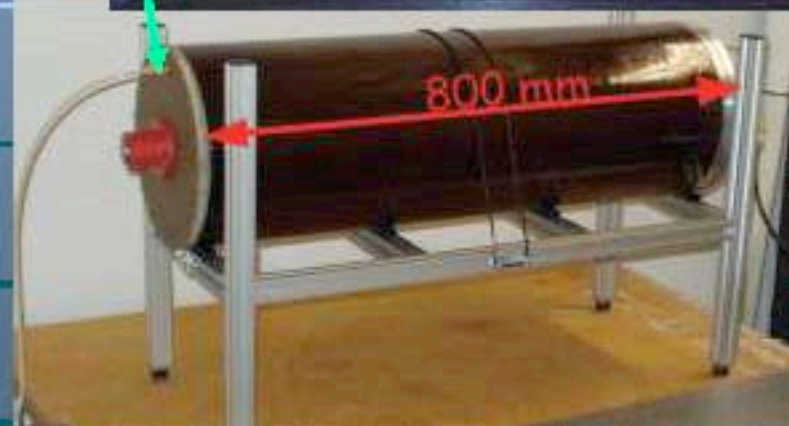
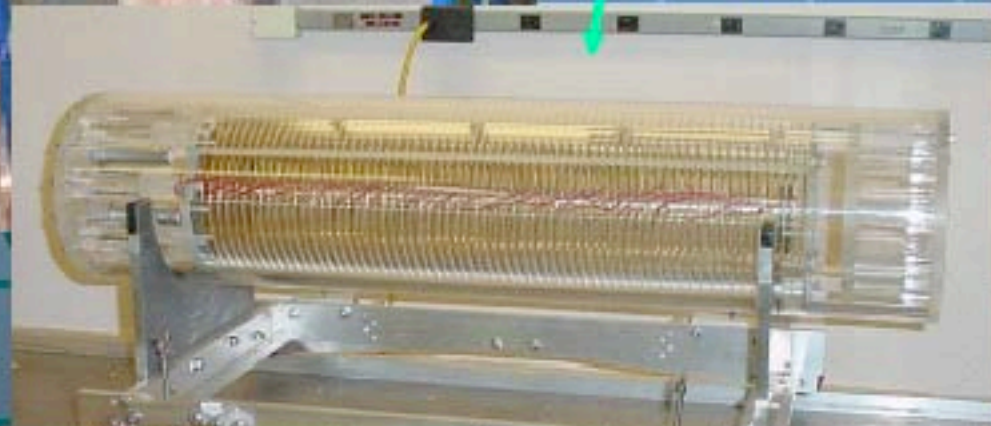
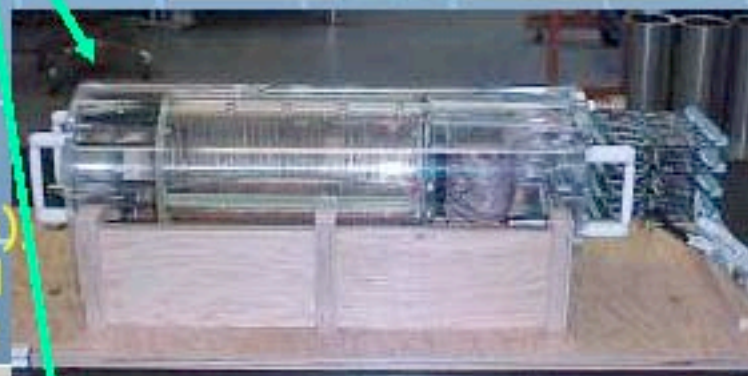
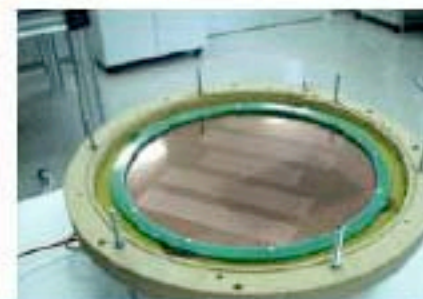
Carleton, Aachen,  
Cornell/Purdue, Desy(not  
shown) for B=0 studies

Desy, Victoria, Saclay  
(fit in 2-5T magnets)

Karlsruhe, MPI/Asia,  
Aachen built test TPCs  
for magnets (not shown)  
other groups built small  
special-study chambers



50  $\mu$ m pitch  
50  $\mu$ m gap



25/03/05

Ron Settles MPI-Munich/DESY  
TPC R&D Meeting @ LBNL 23 March 2005

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R&D: “proof of principle”

Scheme of MPGD + TPC

understand property (resolution, diff., ion bk-drift..)

using **small Prototype**

Beam is essential for the test

Magnet is another  
important facility

Alternative is Laser facility

ex. Victoria's laser  
@DESY

□ Approx. 2 m long to  
reach into magnet

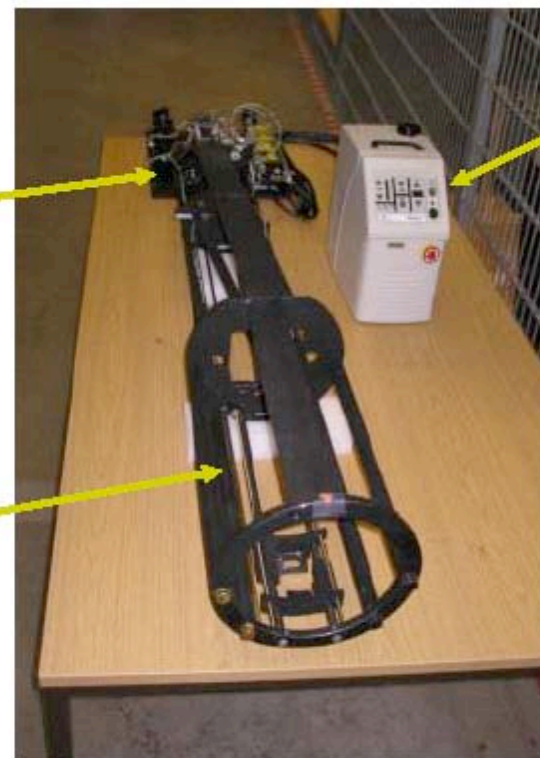
free from machine schedule  
no negotiation to other exp.

laser + optics

TPC holder

laser power  
supply

Engineering by  
Mark Lenkowski  
Univeristy of Victoria





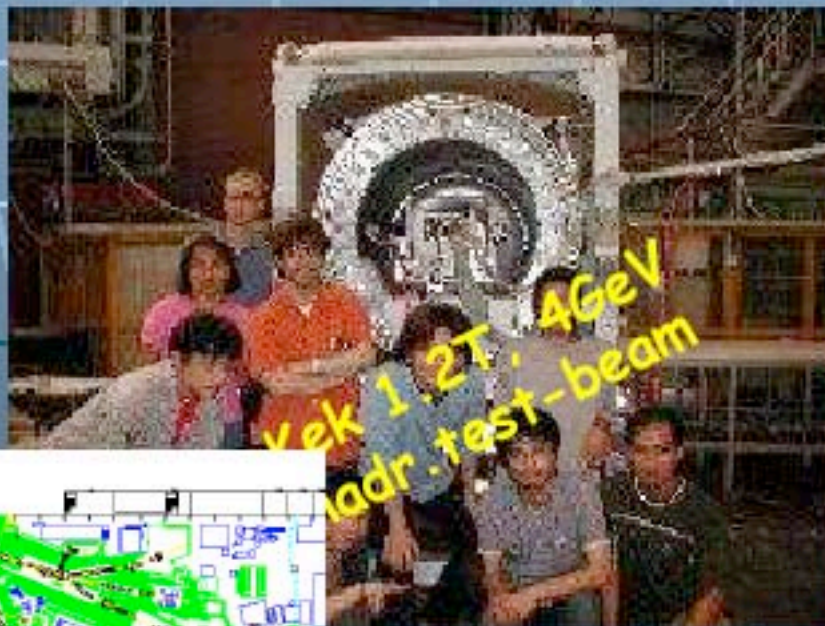
# Facilities



Desy 5T magnet,  
cosmics, laser

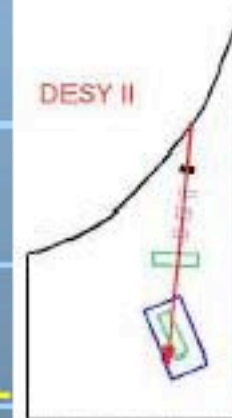


Saclay 2T magnet,  
cosmics



Cern test-  
beam (not  
shown)

1.2T, 4GeV  
test-beam



Test Beam Area 22



Desy 1T, 6GeV e-  
test-beam

Magnet



# TPC prototype beam test at KEK

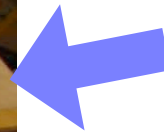
- 2004 Jun. WMPC-TPC  
MPI, DESY + CDC(Asia) group
- 2005 Apr. GEM-TPC  
MPI, DESY + CDC
- 2005 Jun. MM-TPC  
Saclay, Orsay, Carlton, MPI, CDC
- 2005 Oct. MM-TPC, GEM-TPC : Registive Foil  
Saclay, Orsay, Carlton, MPI, CDC

Now collaboration became really international.



## Setup at KEK beam

$\pi^2$  beam line  
provide 0.6~4.0 GeV/c



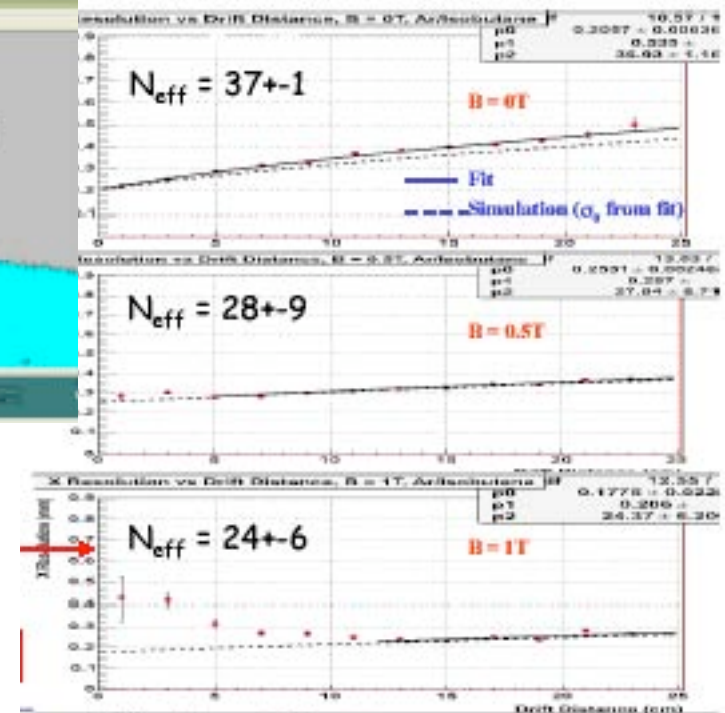
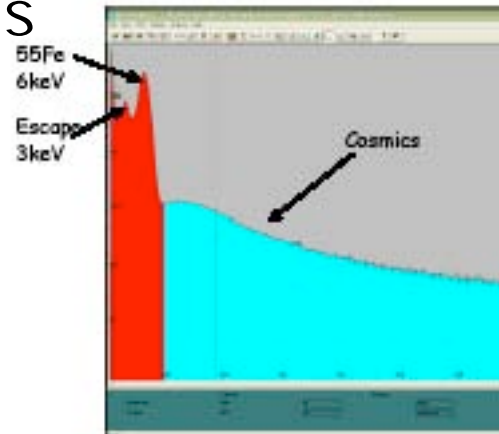
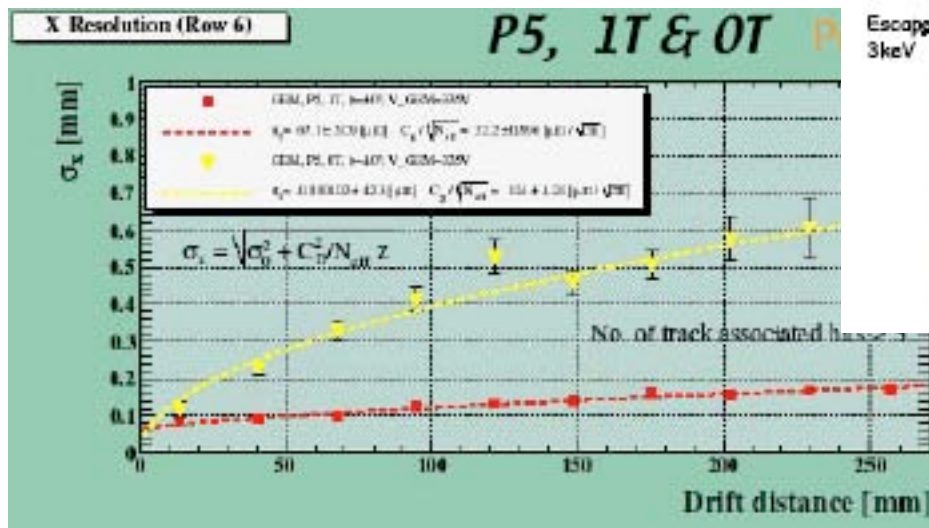
## Superconducting Solenoid Magnet(JACEE)



B field up to 1.2 Tesla

portable, standalone operation

We obtain many good results



discussing results is not a subject here

About Beamtest (personal comment)

Good thing

Direct exchange of information, technology, technique  
know-how(something hard to be described by word)

Variety of idea, opinion activate discussions

Good opportunity for grad. students

difficulties

People working around facility have to do many thing  
beam time scheduling, maintain magnet,  
maintain cosmic ray test bench

administrative work

the most important

budget



# R&D ahead of us

- 1) Demonstration phase almost finished
- 2) Consolidation phase NEXT
- 3) Design phase

Large Prototype is main R&D item for next few~ years

study model for "real TPC"  
size ~  $R \sim 0.4\text{m}$ ,  $Z \sim 1\text{m}$

just size for JACEE



TPC will cover large area

huge number of readout channels will be necessary

60k for 1mm pad, 30k for 2mm (not be read all)

$O(10\text{k})$  readout ?

large area help to accumulate cosmic ray data with high rate

beam is not so necessary. Laser is enough?

TPC + huge electronics prevent portability

large Prototype must be build near beam facility?

High rate test is unique at Beam

# R&D items with Large Prototype

## Endplate

padplane : optimal pad size and arrangement/segmentation

MPGD : GEM/Micromegas. how to hold ?. segmentation

gating : ion back-drift

structure

## Field cage

structure : field uniformity, discharge

E-field distortion due to ionization

gas container

## Electronics

mounting method, readout method

## Magnet

precise B measurement

tracking under non-uniform B field

## Gas system

## Laser calibration system



# Status

DESY plans to build a facility for Large Prototype  
based on EUDET

magnet, electronics, field cage...

specific R&D items are left for every R&D groups

electron beam is available

Asia(KEK) submit a proposal for Large Prototype, but ....

KEK PS will be shut down from the end of this year

but J-PARC testbeam will be available from 2008(?)

KEK has SC solenoid excited every day

CERN, Fermilab, SLAC,,, have beam lines

but member of LCTPC doesn't exist here

DESY will be a only place for LCTPC test?

Test beam @DESY is enough ?

Hadron beam ??

# Status of other tracker?

Sorry. I couldn't get any information.



# Summary

Test beam is very important facility for prototype study.  
good opportunity to collaborate w/ other group.  
-> good chance to form World Wide collaboration  
before I LC exp. starts

Magnet is another important facility for LC( at least TPC )

Host institute has an important role for LC(TPC) collab.

a lot of work related to facility itself must be exist

Organization under I LC is a little bit complicated.

WWS Det. R&D panel

test facility (such as EUDET)

LCTPC collab.

Concept group