Worldwide Study of
the Physics and Detectors
for Future Linear
e+ e- Colliders

# TPC R&D for an ILC Detector

The groups as of June 2007:

*AMERICAS*

| | |
|---|---|
| *Canada:* | Carleton U & TRIUMF, U Montreal, U Victoria & TRIUMF |
| *United States:* | Cornell U, Indiana U, LBNL, Louisiana Tech U |

*ASIA*

| | |
|---|---|
| *China:* | Tsinghua U |
| *Japan:* | Hiroshima U, KEK Tsukuba, Kinki U, Kogakuin U Tokyo, Saga U, Tokyo UAT, U Tokyo, U Tsukuba |
| *Philippines:* | Minadano SU-IIT |

*EUROPE*

| | |
|---|---|
| *France:* | LAL Orsay, IPN Orsay, CEA Saclay |
| *Germany:* | RWTH Aachen, U Bonn, DESY/U Hamburg, U Freiburg, MPI-Munich, U Karlsruhe, U Rostock, U Siegen |
| *Netherlands:* | NIKHEF |
| *Russian Federation:* | BINP Novosibirsk, PNPI St.Petersburg |
| *Sweden:* | U Lund |
| *Switzerland:* | CERN |

*Groups with Oberserver status:*

S Biagi, Iowa State U, Purdue U, MIT,
Yale U, TU Munich, UMM Kraków, NIP-NE Bucharest

# R&D Planning

- 1) Demonstration phase
  - Continue work with small prototypes on mapping out parameter space, understanding resolution, etc, to prove feasibility of an MPGD TPC. For CMOS-based pixel TPC ideas this will include proof-of-principle tests.
- 2) Consolidation phase
  - Build and operate the Large Prototype (LP), Ø ~ 90cm, drift ~ 60cm, with EUDET infrastructure as basis, to test manufacturing techniques for MPGD endplates, fieldcage and electronics. LP design is starting → building and testing will take another ~ 3-4 years.
- 3) Design phase
  - During phase 2, the decision as to which endplate technology to use for the LC TPC would be taken and final design started.

# TPC R&D summary to date

- Now > 4 years of MPGD experience gathered
- Gas properties rather well understood
- Limit of resolution understood
- Resistive foil charge-spreading demonstrated
- CMOS RO demonstrated
- Work starting for the Large Prototype

## 1.2 Next R&D Steps, the LP and SPs

Table 1 gives the general features for the present planning. The LP is under way, and the groups agree that over the next three years there will be an evolution of endplates towards a true prototype for the LCTPC. These stages are sympolized by LP1, LP1.5, LP2 in the table. Supplemental testing with the small prototypes (SP) which have been used extensively to date will continue, since there are still several issues to be explored which can be performed more efficiently using small, specialized set-ups. The small-prototype work is driven to a large extent by the needs of the individual labs, whereby certain issues are and will be looked at on request of the collaboration (the examples in Table 1).

Table 1: LCTPC R&D Scenarios for Large Prototype and Small Prototypes.

| Testbeam Options | | |
|---|---|---|
| Lab | Beams | Availability |
| CERN SPS | 10-400GeV $e, h, \mu$ | LHC absolute priority |
| DESY | 1-6.5GeV $e$ | $>$ 3 months per year |
| Fermilab | 1-120GeV $e, h, \mu$ | Continuous (5%), except shutdown |
| IHEP Protvino | 1-45GeV $e, h, \mu$ | One month, twice per year |
| KEK Fuji | 0.5-3.4GeV $e$ | From fall 2007, 240 days per year |
| SLAC | 28.5GeV $e$ (primary) | Parasitic to PepII, |
| | 1-20GeV $e, h$ (secondary) | non-concurrent with LCLS |

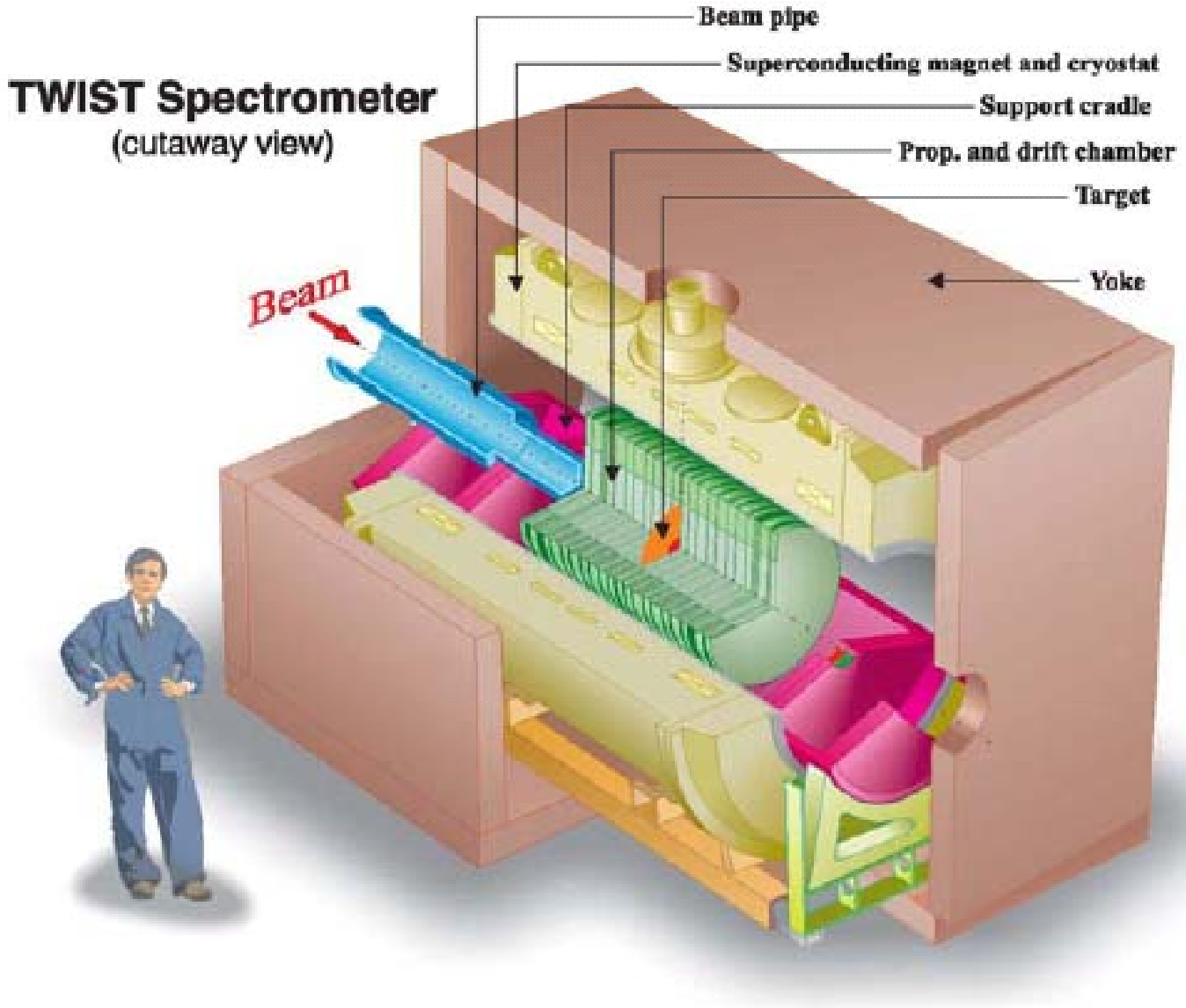
Large Prototype R&D

| Device | Lab(years) | Configuration |
|---|---|---|
| LP1 | Desy/Eudet(2007-2009) | Fieldcage⊕2 endplates: GEM+pixel, Micromegas+pixel |
| *Purpose: Test construction techniques using 10000 Alice/Eudet channels, demonstrate measurement of 6GeV beam momentum over 70cm tracklength, including development of corrections procedures* | | |
| LP1.5 | Fermilab/Eudet(2010) | Fieldcage⊕2 endplates: GEM+pixel, Micromegas+pixel |
| *Purpose: Continue tests using 10000 Alice/Eudet channels to demonstrate measurement of 100GeV beam momentum over 70cm tracklength, in a jet environment, including use of corrections procedures developed for LP1* | | |
| LP2 | Fermilab/Eudet(2011) | Fieldcage⊕endplate: GEM, Micromegas, or pixel |
| *Purpose: Prototype for LCTPC including gating and other options, demonstrate measurement of 100GeV beam momentum over 70cm tracklength, and in jet evironment, test prototype LCTPC electronics* | | |

| Small Prototype R&D | | |
|---|---|---|
| Device | Lab(years) | Test |
| SP1 | KEK(2007-2008) | Gas tests, gating configurations |
| SP2,SP3 | Fermilab(2008-2009) | Performance in jet environment |
| SPn | LCTPC groups(2007-2009) | Performance, gas tests, dE/dx measurements, continuation of measurements in progress by groups with small prototypes |

# Possible SC Magnets

- Triumf (Twist) Magnet (Madhu Dixit)
  - 2 T
  - 1m φ, 2.2m length
  - Available beginning 2008
- KeK (Amy) Magnet (Takeshi Matsuda)
  - 3 T
  - 2.4m φ, 1.6m length
  - Available now (in principle)


TWIST Spectrometer
(cutaway view)
Beam pipe
Superconducting magnet and cryostat
Support cradle
Prop. and drift chamber
Target
Yoke
Beam

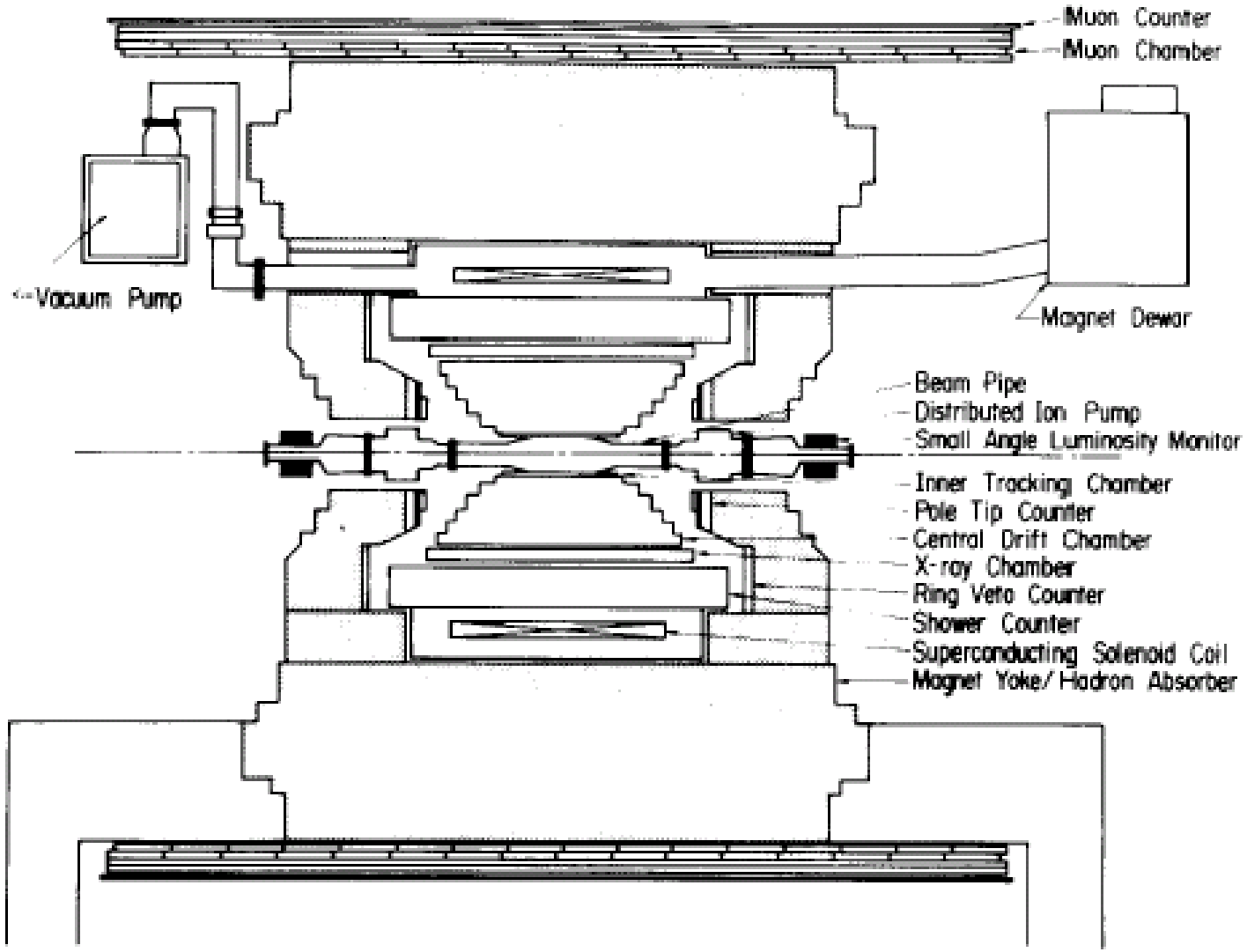



Fig. 1. A cross-sectional view of the AMY detector.