

# Memorandum of Agreement

## on the Formation of the LCTPC Collaboration

October 2007

### 1 Introduction

#### 1.1 Preamble

Several detector concepts for the International Linear Collider (ILC) foresee a time projection chamber (TPC) as the central tracker in a tracking system of high precision and fine granularity combined with a calorimeter system of very fine granularity. The detector is being designed for precision measurements in the electroweak sector and of new HEP-phenomena which might be discovered. One aspect of precision experiments requires the measurement of charged tracks with an order of magnitude better accuracy than at previously built collider-detectors. Another aspect requires the detector to be optimized for the reconstruction of multi-jet final states. The jet energy resolution using the particle-flow technique is best when the reconstruction of individual particles in jets is as complete as possible, meaning efficiency in reconstructing charged tracks is more important than momentum precision. A TPC central tracker is being developed to meet these requirements in concert with the other subdetectors. The issues for the TPC performance within the ILC framework have been described many times, most recently in LC Note LC-DET-2007-005 at <http://fcweb01.desy.de/lcnotes/>. The formation of an R&D collaboration to address these issues is the purpose of this document.

#### 1.2 Scope of the Collaboration

The groups signing this Memorandum of Agreement (MOA) express their interest to contribute to the development, prototyping and design of a TPC for an experiment at the ILC. This MOA describes the main goals and the structure of the LCTPC Collaboration. The MOA enters into effect upon signature by a majority of partners; it can be terminated with the formation of the ILC detector collaboration or with dissolution by its members.

An overview of R&D strategy is given in Section 2.1, the structure of the LCTPC collaboration is explained in Section 2.2. General policies on new groups, finances and publications are covered in Sections 2.3, 2.4 and 2.5. The groups and the signatories of this MOA are listed in Section 3. The names of the responsible persons in the collaboration and a more detailed description of the R&D program are provided in an *Addendum* which will be updated regularly as the collaboration and tasks evolve.

## 2 The LCTPC collaboration

### 2.1 R&D Strategy

The R&D work is proceeding in three phases:

- (1) Demonstration Phase: Finish the on-going exploratory work using “small” ( $\phi \sim 30\text{cm}$ ) prototypes (SP), built and tested by several of the LCTPC groups. This work provided a basic evaluation of the properties of a TPC with Micropattern Gas Detector (MPGD) gas amplification, demonstrating that the requirements for the ILC can be met.
  
- (2) Consolidation Phase: Design, build and operate a “Large Prototype” (LP) at the Eudet facility using low-energy (Desy) and high-energy (Cern, Fermilab) beams. By “Large” is meant  $\sim 1\text{m}$  diameter, so that: first iterations of TPC-design details for the LCTPC can be tested, larger area readout systems can be operated and tracks with a large number of measured points are available for analysis and correction procedures. The tasks have been divided into workpackages listed in Section 2.2.
  
- (3) Design Phase: Start work on an engineering design for the final detector. This work in part will overlap with the R&D for the LP, and the final design will start after the LP/SP results allow decisions on technical options.

### 2.2 Organizational Structure

The LCTPC structure consists of management and workpackage bodies.

The main governing body of the collaboration is the collaboration board (CB) in which each member institution is represented by one person and one vote. All major decisions are taken by the CB which meets at least twice per year. A quorum for a CB meeting exists if at least 50% of its members are present, and decisions are taken by simple majority. In urgent cases, the CB can take decisions also by phone/video conference or by e-mail vote. The CB can delegate decision power on certain issues to other boards. In particular to the Regional Coordinators, described next, will be charged with the day-to-day management of the collaboration.

Three regional coordinators (RC), one each from the Americas, Asia and Europe, are elected for two-year periods by the CB members of the corresponding region. The R&D planning and the collaboration meetings are organized by the RCs. They are responsible for tracking the progress of the collaboration, preparing decisions and reporting regularly to the CB. To expedite their work, the three RCs will choose one of their members to be the LCTPC Spokesperson who will organize/summarize workpackage meetings and chair the collaboration meetings.

For day-to-day running, the RCs will work closely with the technical board (TB). The TB consists of the leaders of the different workpackages defined below. They are charged with coordinating within their respective workpackages, and report on this regularly to the RC and the CB. At the time of writing this MOA the following workpackages were set up, and changes to the structure of the work packages can be decided by the CB at any time:

Workpackage (0) TPC R&D Program
Workpackage (1) Mechanics
a) LP endplate structure with panels
b) Fieldcage
c) GEM panels
d) Micromegas panels
e) Pixel panels
f) Panels with charge-dispersion-anode
Workpackage (2) Electronics
a) Standard RO/DAQ system for LP
b) CMOS RO electronics
c) Electronics for LCTPC
Workpackage (3) Software
a) LP software +simul./reconstr.framework
b) LCTPC simulation/perf./backgrounds
c) Full detector simulation/performance
Workpackage (4) Calibration
a) Field map for the LP
b) Alignment
c) Distortion correction
d) Radiation hardness of materials
e) Gas/HV/Infrastructure for the LP

### 2.3 New Groups

The LCTPC collaboration is open to new members. A new group should apply for membership to the CB and will be accepted into the collaboration by a vote of the CB.

### 2.4 Finances

The work of the LCTPC collaboration is funded through the individual budgets of its members. Items of common expense will be shared between the collaborators based on a case-by-case agreement. Collaborators agree to provide financial information to the RCs. The information will be treated confidentially if so requested.

### 2.5 Publications

All results obtained from the work within the LCTPC collaboration will be openly available to all members, and data obtained using common prototypes or common equipment will belong to all collaborators. The groups agree that they will not publish or make otherwise public any information belonging to LCTPC without obtaining prior agreement of the collaboration. Results from the collaboration will be published under the name “LCTPC Collaboration”. The CB will install a proper editorial process before releasing material to the public. In case of a conflict the collaborators agree to accept the decision of the CB as final.

## 2.6 Ownership of Equipment

All equipment purchased or fabricated using funds of a member institution remains the property of that member institution and shall be subject to the property management system of that institution. It is the intent of the members that all equipment purchased or fabricated by a member institution and incorporated into the LCTPC prototype or a test facility would remain with the prototype effort or test facility until it is determined by the LCTPC collaboration that such equipment is no longer needed. At that time the property would be returned to that member institution at its expense.

## 3 Institutes

Groups in the three regions which have signaled interest in participating in the LCTPC R&D are listed here. The signatories of the MOA are compiled in Section 4.

### *Americas*

Carleton Univ & TRIUMF, Ottawa, ON K1S 5B6, Canada  
Univ. de Montreal, Montreal, PQ H3C 3J7, Canada  
Univ. of Victoria & TRIUMF, Victoria, BC V8W 3P6, Canada  
Brookhaven National Laboratory, Upton, NY 11973-5000, USA  
Cornell Univ., Ithaca, NY 14853-5002, USA  
Indiana Univ., Bloomington, IN 47405, USA  
Lawrence Berkeley National Lab., Berkeley, CA 94720-8153, USA  
Louisiana Tech Univ., College of Eng.&Science, Ruston, LA 71272, USA

### *Asia*

Tsinghua Univ., Beijing 100084, China  
Hiroshima Univ., Higashi-Hiroshima, Hiroshima 739-8526, Japan  
KEK, Tsukuba, Ibaraki 305-0801, Japan  
Inst. of Space&Astron.Science, Jap.Aerosp.Expl.Ag., Kanagawa 229-8510, Japan  
Kinki Univ., Higashi-Osaka, Osaka 577-8502, Japan  
Kogakuin Univ., 1-24-2, Nishi-Shinjuku, Shinjuku, Tokyo 163-8677, Japan  
Faculty of Informatics, Nagasaki Inst. of Applied Science NiAS, Nagasaki 851-0193, Japan  
Saga Univ., Faculty of Science and Engineering, Honjo, Saga 840-8502, Japan  
Tokyo Univ. Agriculture and Technology, Koganei, Tokyo 184-8588, Japan  
Univ. of Tokyo, ICEPP, Tokyo 113-0033, Japan  
Mindanao State Univ., Iligan City 9200, Philippines

### *Europe*

IIHE (Inter-university Institute for High Energies) ULB-VUB, B-1050 Bruxelles  
LAL, IN2P3 and Univ. de Paris-Sud, F-91898 Orsay, France  
IPN, IN2P3 and Univ. de Paris-Sud, F-91405 Orsay, France  
CEA Saclay, Irfu, F-91191 Gif-sur-Yvette, France  
RWTH Aachen, D-52056 Aachen, Germany  
Univ. Bonn, D-53115 Bonn, Germany  
DESY Hamburg, Notkestrasse 85, D-22603 Hamburg, Germany  
EUDET, D-22603 Hamburg, Germany  
Albert-Ludwigs Univ., D-79104 Freiburg, Germany  
Univ. Hamburg, Inst. für Experimentalphysik, Luruper Chausee 149, D-22761 Hamburg, Germany  
Univ. Karlsruhe, D-76128 Karlsruhe, Germany

Max-Plank-Inst. für Physik, D-80805 Munich, Germany  
Univ. Rostock, D-18051 Rostock, Germany  
Univ. Siegen, D-57068 Siegen, Germany  
NIKHEF, NL-1009 DB Amsterdam, Netherlands  
Budker Inst. of Nuclear Physics, RU-630090 Novosibirsk, Russia  
Petersburg Nuclear Physics Inst., St. Petersburg, RU-188300 Gatchina, Russia  
Lund University, Dept. of Physics, Box 118, S-221 00 Lund, Sweden  
CERN, CH-1211 Geneva 23, Switzerland

## 4 Signatories

The following page is the MOA Form to be signed by a responsible authority in each institute.  
The pages thereafter contain the compilation of those signatures.



## LCTPC Collaboration Member

Institute:

Address:

Responsible authority:

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Date and Signature