Memorandum of Agreement
on the Formation of the LCTPC Collaboration

October 2007 / July 2008

1 Introduction

1.1 Preamble

Several detector concepts for the linear collider 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 linear collider framework have been described many times, most recently in LC Note LC-DET-2007-005 at http://flcweb01.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 goals of the LCTPC collaboration, specifically the development, prototyping and design of a TPC for an experiment at the linear collider. This MOA describes the strategy to achieve those goals and the structure of the LCTPC Collaboration, including the collaboration board, technical board and regional coordinators. The MOA enters into effect upon signature by a majority of partners; it can be terminated with the formation of the linear-collider-detector collaboration or with dissolvement by its members. Any member institution, upon one-year-advance written notice to the other member institutions, may withdraw from the LCTPC collaboration.

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, publications and legalities are covered in Sections 2.3, 2.4, 2.5, 2.6, 2.7 and 2.8. 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" (ϕ ~30cm) 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 linear collider 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 ~1m 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 sytem 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. LCTPC may not impose financial obligations on members without such members' consent.

2.5 Publications

All results, relevant to the goals of the LCTPC collaboration, obtained from the work by the members of the LCTPC collaboration will be openly available to all members. Data obtained using jointly constructed prototypes shall be the property of the LCTPC collaboration. The groups agree that they will not publish or make otherwise public any information belonging to LCTPC without obtaining prior agreement of the collaboration. However, prior agreement of the collaboration shall not be imposed on the filing of any student thesis or dissertation. 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.

Data obtained using prototypes or equipment owned and operated by individual member institutions or smaller groups of institutions, which has not become part of the jointly constructed prototype, shall remain the property of those institutions. This applies to data obtained both before and after this MOA is effective. While such data shall be available to all LCTPC members, such data shall not be released outside of the collaboration without the prior approval of the institution(s) owning that data.

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.

2.7 Warranty

No warranties, express or implied, are conveyed as to any matter whatsoever, including, without limitation, the project or any inventions or results whether tangible or intangible, conceived, discovered, or developed under this agreement or the ownership, merchantability, or fitness for a particular purpose of the project or any such invention or results. Members shall not be liable for any direct, consequential, or other damages suffered by any licensee or any others resulting from the use of the project or any such invention or results.

2.8 Liability

Each party hereby assumes any and all risks of personal injury and property damage attributable to the negligent acts or omissions of that party and the officers, employees, and agents thereof.

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.&Sience, 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
Minadanao 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