

**ADDENDUM-02**

**For the years  
2011-2015**

**to**

**THE MEMORANDUM OF UNDERSTANDING FOR A  
MULTILATERAL COLLABORATION**

**between**

**THE INSTITUTIONS AND FUNDING AGENCIES OF  
THE CTF3 COLLABORATION**

**concerning**

**THE CONTRIBUTION OF  
THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS  
THE UNIVERSITY OF PATRAS  
THE DEMOCRITUS UNIVERSITY OF THRACE  
TO THE CTF3 COLLABORATION**

## **CONSIDERING:**

The Memorandum of Understanding ("the MoU") defining the framework applicable to the construction of a 3<sup>rd</sup> generation Compact Linear Collider Test Facility (CTF3) and the performance of Experiments to demonstrate the feasibility of key issues of the CLIC scheme;

That Article 1.2 of the MoU envisages the conclusion of Addenda defining each contribution pledged to the CTF3 Collaboration,

**THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS ("NTU-Athens"),**  
Prof. Evangelos Gazis, School of Applied Mathematics & Physics Sciences (SAMPS), Department of Particle Physics  
Prof. Theodoros Alexopoulos, School of Applied Mathematics & Physics Sciences (SAMPS), Department of Particle Physics  
Prof. Yorgos Tsiopolitis, School of Applied Mathematics & Physics Sciences (SAMPS), Department of Particle Physics  
Prof. Stavros Kourkoulis, School of Applied Mathematics & Physics Sciences (SAMPS), Department of Mechanics  
Prof. Evangelos Chinis, School of Mechanical Engineering (SAME)

**THE UNIVERSITY OF PATRAS ("UoPatras"),**  
Prof. Vassilios Kostopoulos, Department of Mechanical & Aeronautics Engineering

**THE DEMOCRITUS UNIVERSITY OF THRACE ("UoThrace"),**  
Prof. Ioannis Andreadis, Department of Electrical & Computing Engineering

In associated cooperation with the Universities, Research Organizations, Firms:

**THE ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS (AUEB)**  
Prof. Theodoros Apostolopoulos, Department of Informatics

**THE NCSR "DEMOKRITOS"**  
Prof. Sotirios Harissopoulos, Institute of Nuclear Physics

**THE KAVALA INSTITUTE OF TECHNOLOGY**  
Prof. Lycourgos Magafas, Department of Electrical Engineering

**THE PRISMA ELECTRONICS, S.A.**  
Mr. Petros Soukoulis, MSc Informatics, President of the Scientific Board

in their capacity as Members of the CTF3 Collaboration and represented by Professor Evangelos Gazis,

**HEREWITH AGREE** to make the following contributions in addition to those parts agreed on the previous addendum and have not yet been delivered:

1. **NEUTRON AND CHARGED IONS IRRADIATION TO THE MATERIALS FOR THE CLIC-MODULE STUDIES (NTU-ATHENS, APPLIED PHYSICS DEPARTMENT: Professor Evangelos Gazis, NCSR "DEMOKRITOS", NUCLEAR PHYSICS INSTITUTE: Professor Sotiris Harissopulos)**

Neutron and charge ions (protons, carbon-12, oxygen-16, etc.) irradiation tests will be realized at the NCSR "Demokritos" Tandem accelerator laboratory to various samples of the materials for the CLIC module studies and detector prototypes, at large range of incident energies of neutron and charged particle beams.

The ageing effects of the materials will be studied before and after the irradiation procedure with fatigue and stretch tests and measurements at the Department of Mechanics of the Applied Sciences Faculty at NTUA (see #2).

The HEP-NTUA team has a great experience on neutron irradiation techniques applied to the particle detectors studies (ATLAS-MDT, ATLAS-TGC, ATLAS-CSC and Micro-megas), to various high-tech materials (super-/semi-conductor i.e. YBCO, Si, GaAs, Silicon-Carbide, etc).

More technical details of the neutron irradiations can be downloaded from the HEP-Tech TTN link: <http://ttn.extra.cea.fr/Phoceia/Page/index.php?id=10>

The Greek participation shall contribute to the CLIC Module studies for the CTF3 and the sequent projects. (**Germana Riddone** BE-RF-SR).

**DELIVERABLES:** Neutron and charged ion beam irradiation to materials for test measurements. Conference papers

**TIME SCHEDULE:** Five years

**RESOURCES:** Two senior physicists, one doctoral student of engineering, two students.

2. **FATIGUE/STRETCH TESTS AND MONITORING MEASUREMENTS OF VARIOUS MATERIALS TO BE USED FOR THE CLIC MODULE STUDIES (NTU-ATHENS, APPLIED PHYSICS DEPARTMENT: Professor Evangelos Gazis AND DEPARTMENT OF MECHANICS: Professor Stavros Kourkoulis)**

The NTUA Department of Mechanics (DoM) team has a great and many years experience on the experimental measurements of the materials tests (Fatigue, Fracture, Tensile, etc.). The experimental infrastructure of the DoM laboratories involves all the large facilities for material tests and measurement, being one of the widely most well equipped places in Europe.

The team will provide all the necessary test measurements before and after the

samples neutron/charged particle irradiation, covering adequately the requirements of the project, including:

- Standard tests foreseen by the Fracture Mechanics to the planar samples with central or edge notch to define the Fracture Toughness factor,  $K_{IC}$  and quantified to be compared with the  $K_I$  (Stress Intensity Factor, SIF).
- Study of the support bench materials with a scanning electronic microscope (SEM)
- The SEM tests will give information on the material tolerance under static or loading conditions.

The Greek participation shall contribute to the CLIC Module studies for the CTF3 and the sequent projects. (**Germana Riddone** BE-RF-SR).

**DELIVERABLES:** Fatigue materials studies and SEM tests for those components to be used before and after the irradiation of the materials. Conference paper.

**TIME SCHEDULE:** Five years

**RESOURCES:** One senior physicist one senior engineer, one doctoral student of engineering, two students.

3. OPTIMIZATION STUDIES OF THE MECHANICAL PROPERTIES AND TOLERANCES OF THE CLIC MODULE SUPPORTING SYSTEM UNDER HIGH-LEVEL RADIATION BACKGROUND (NTU-ATHENS, APPLIED PHYSICS DEPARTMENT: **Professor Evangelos Gazis**, NTU-ATHENS, MECHANICAL ENGINEERING SCHOOL, NUCLEAR ENGINEERING DEPARTMENT: **Professor Evangelos Chinis**)

The wide properties studies of the CLIC Module, mechanical support design, taking into account the specifications and the reasonable cost to similar constructions; based into the radiation hardness of the various materials will be optimized and realized at the NCRS "Demokritos" with neutron and charged particle beams plus their mechanical properties investigation.

The Greek participation shall contribute to the CLIC Module studies for the CTF3 and the sequent projects. (**Germana Riddone** BE-RF-SR).

**DELIVERABLES:** Optimization studies of the mechanical properties of the components to be used for the CLIC module support before and after the irradiation of the materials. A PhD-thesis. Conference paper.

**TIME SCHEDULE:** Five years

**RESOURCES:** One senior physicist one senior engineer, one doctoral student of engineering, two students.

4. MECHANICAL STUDIES & CONSTRUCTION (UoPATRAS, MECHANICAL ENGINEERING DEPARTMENT: **Professor Vassilios Kostopoulos**)

The CLIC RF accelerating structures have to be pre-aligned at few micrometers with respect to the beam axis. A very sophisticated pre-alignment system is needed to fulfill the technical specification. This implies the development of positioning and measuring devices to be validated in prototype modules, being the elementary object of the CLIC main linac. Several configurations have to be studied and fabricated. They will be installed in the prototype modules and intensively tested under different operating conditions.

The Greek participation shall contribute to the CLIC Module studies for the CTF3 and the sequent projects. (**Germana Riddone** BE-RF-SR).

**DELIVERABLES:** Theoretical simulations, mechanical designs and test measurements for CLIC prototypes

**TIME SCHEDULE:** Five years

**RESOURCES:** Two senior engineers, two students

The following project is, still, under discussion and further definition:

5. CONTROL SYSTEMS-INFORMATICS APPLICATIONS (NTU-Athens, Department of High Energy Physics: Professor Theodoros Alexopoulos, AUEB, Department of Informatics: Professor Theodoros Apostolopoulos, Kavala Institute of Technology, Department of Electrical Engineering: Professor Lycourgos Magafas), PRISMA Electronics, SA: Mr. Petros Soukoulias)

A global study for the high gradient controls shall be initiated for the control of the magnets (current) and the High and Low Power supplies (voltage, current) plus the monitoring of different sensors (gas, temperature, B-field) under the frame of the SCADA system PVSS-II, providing alarms and interlock conditions for the magnets operation, beam losses and beam protection monitoring (**Hermann Schmickler**).

In addition, a database of the monitoring parameters shall be designed for the archiving and off-line analysis of the data.

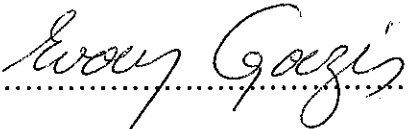
**DELIVERABLES:** Implementation for monitoring and control parts via the PVSS-II of the CTF3 machine and test measurements

**TIME SCHEDULE:** Two years

**RESOURCES:** One senior physicist one senior engineer, two students

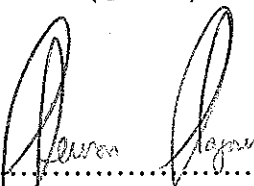
Signed at CERN, on 04 March 2011

**For the National Technical University of Athens,  
the University of Patras,  
the Democritus University of Thrace,**



Professor Evangelos GAZIS

**For the European Organization for Nuclear Research  
(CERN)**



1.12.2011

Professor Steinar Stapnes  
CERN Linear Collider Study Leader