Addendum No 3

to

Collaboration Agreement KN3774/EP

for the SHiP Program at CERN

Plastic-scintillator based timing detector prototype

Considering that:

The SHiP Program is governed by Collaboration Agreement KN3774/EP ("the Agreement"), including its Annexes, Addenda and Amendments, which provides the organisational, managerial and financial framework for the execution of the SHiP Program;

Articles 3.1 and 3.3 stipulate that the SHiP Program shall be organised as projects ("the SHiP Projects") and that each SHiP Project shall be defined in a dedicated Addendum to the Agreement, to be signed by CERN as the Host Laboratory and the SHiP Institutions (as defined in the Agreement) participating in the Project;

The proposal "Plastic-scintillator based timing detector prototype" includes the construction and test of a prototype array made of cast plastic scintillator bars read out by large-area silicon photomultipliers to achieve a timing resolution below 100 ps over an area of several square meters.

It is agreed as follows

Article 1: Purpose

1.1 The purpose of this Addendum is to lay down the terms of participation of SHiP Institutions in the Project, which is described in Annex 1. This Addendum is subject to the provisions of the Agreement and signature of this Addendum therefore constitutes approval of the Agreement.

1.2 The Annexes form an integral part of this Addendum.

Article 2: Parties

2.1 The Parties to this Addendum shall be the SHiP Institutions contributing to the Project and CERN as the Host Laboratory. The current list of participating SHiP Institutions is included in Annex 2.

Article 3: Duration

3.1 This Addendum shall take effect on the date of its signature. It shall remain effective until the termination of the SHiP Program, subject to

continued recommendation and approval of the SPSC and the CERN Research Board.

Article 4: The Project

4.1 The work plan consists of a number of sub-units, work packages and/or deliverables as listed in Annex 1.

4.2 The management structure of the Project is described in Annex 3.

4.3 Annex 4 sets out the deliverables, including their value, grouped by Funding Agency.

4.4 A set of Project milestones is included in Annex 5.

Article 5: Financial procedures

5.1 Pursuant to Article 9 of the Agreement, a dedicated budget code for the purposes of the SHiP Project is held and administered by CERN. Participating SHiP Institutions may financially contribute to this budget code on a voluntary basis in accordance with the estimated value of deliverables stated in Annex 4.

5.2 The aforementioned budget code is available to cover material, equipment and manpower costs connected to the SHiP Project, on condition that sufficient funds are available on the said budget code. This budget code may also be used by CERN for the execution of payments of subsistence allowance to experts of participating ShiP Institutions on behalf of such Institutions. It is understood that such payments shall be made in accordance with CERN's Rules and Regulations, including but not limited to Administrative Circular 11.

ANNEXES

Annex 1: Description of the Project

Annex 2: Participating SHiP Institutions

Annex 3: Management structure of the SHiP Program and of the Project

Annex 4: Value of deliverables grouped by Funding Agency

Annex 5: Project milestones

The European Organization for Nuclear Research (CERN)

and

The University of Geneva

declare that they agree on Addendum No 3 to Collaboration Agreement KN3774 for the SHiP Program at CERN concerning the Plastic-scintillator based timing detector prototype.

Done in Geneva

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For the European Organization for Nuclear Research (CERN), as the Host Laboratory of the SHiP Program

Eckhard Elsen
Director for Research and
Computing ……..

For the participating SHiP Institution

Institute / Funding Agency	Signatory
University of Geneva	……
Place and Date	Signature
……..	……..

The European Organization for Nuclear Research (CERN)

and

The University of Zurich

declare that they agree on Addendum No 3 to Collaboration Agreement KN3774 for the SHiP Program at CERN concerning the Plastic-scintillator based timing detector prototype.

Done in Geneva

.....

For the European Organization for Nuclear Research (CERN), as the Host Laboratory of the SHiP Program

Eckhard Elsen
Director for Research and
Computing ……..

For the participating SHiP Institution

Institute / Funding Agency	Signatory
University of Zurich	……
Place and Date	Signature
……..	……..

ANNEX 1: Description of the Project

The primary aim of this project is to build and test a prototype for a timing detector based on the concept of bulk plastic scintillator bars read out directly by large-area silicon photomultiplier (SiPM) arrays. Such a detector has applications in particle physics experiments which need to cover a large surface with a timing resolution below 100 ps even in the presence of a magnetic field, and it is proposed to play a crucial role in combinatorial background reduction in the SHiP experiment.

ANNEX 2: Participating SHiP Institutions

1. University of Geneva, Switzerland, represented by P. Mermod
2. University of Zurich, Switzerland, represented by N. Serra

ANNEX 3: Management structure of the SHiP Program and of the Project

SHiP spokesperson: **A. Golutvin**

SHiP Technical Coordinator: **R. Jacobsson**

Chairperson of the SHiP Board: **E. van Herwijnen**

Project leader for the project (U. Geneva): **P. Mermod**

Project leader for the project (U. Zurich): **N. Serra**

ANNEX 4: Value of deliverables grouped by Funding Agency

Cost estimates are provided in the table below for the baseline prototype array (24 bars of dimensions 168 cm x 6 cm x 1 cm). Expected relative contributions from the participating institutes are indicated. The costs will be shared between U. Geneva and U. Zurich, with 60% and 40% contributions, respectively.

	Cost (CHF)	U. Geneva	U. Zurich
Bars EJ-200	7.7 k	4.6 k	3.1 k
SiPMs	16.6 k	10.0 k	6.6 k
SiPM PCBs	0.5 k	0.5 k	
MUSIC FE	15.0 k	9.0 k	6.0 k
SAMPIC	5.5 k	3.3 k	2.2 k
Cables	0.9 k	0.5 k	0.4 k
Support structure	2 k	1.2 k	0.8 k
Total	**48.2 k**	**29.1 k**	**19.1 k**

ANNEX 5: Project milestones

Spring 2017: purchase of the components, tests of the electronics, construction of the bar modules, assembly of the array, tests with cosmic muons

Summer 2017: Test of the detector with beam in the SHIP muon flux measurements in the CERN SPS H4

Fall 2018: use of the prototype for PID in test-beams of atmospheric pressure TPC and high-pressure TPC.