

**Collaboration Agreement on the transfer, use and responsibility for
the ALICE Collaboration TPC read-out electronics by the
NA61/SHINE Collaboration**

(hereinafter referred to as the “Agreement”)

between

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (hereinafter referred to as “CERN”), an Intergovernmental Organization with its seat at Geneva, Switzerland, Host laboratory of the ALICE and NA61/SHINE experiments, represented by its Director for Research and Computing, Eckhard Elsen

and

THE INSTITUTIONS OF THE ALICE COLLABORATION (hereinafter referred to as “ALICE”), represented by the Spokesperson, Federico Antinori

and

THE INSTITUTIONS OF THE NA61 COLLABORATION (hereinafter referred to as “NA61/SHINE”), represented by the Spokesperson, Marek Gazdzicki

CERN, ALICE and NA61/SHINE are hereinafter collectively referred to as the “Parties” or individually as “Party”.

TAKING INTO ACCOUNT THE FOLLOWING CONSIDERATIONS:

- The “Memorandum” dated March 15, 2016 sent by the NA61/SHINE spokesperson to the ALICE spokesperson on behalf of the Collaboration Board of NA61/SHINE;
- The reply dated May 3, 2016 sent by the ALICE spokesperson to the NA61/SHINE spokesperson;
- The status and plans of NA61/SHINE related to the Agreement as summarized in Annex I.

THE PARTIES HAVE AGREED AS FOLLOWS:

Article 1 – Scope of the Agreement

ALICE shall make available the ALICE TPC read-out electronics and the gate pulser system as listed in Annex II (hereinafter referred to as “Equipment”) for use by NA61/SHINE for the exclusive purpose of the NA61/SHINE Experiment.

As from the Equipment Transfer Dates defined in Article 2, NA61/SHINE shall be liable to ALICE and CERN as the Host Laboratory for the fulfillment of all obligations, which may exist with respect to the Equipment. This includes the Equipment removal and disposal, pursuant to the relevant Memoranda of Understanding and the current version of the General Conditions applicable to Experiments at CERN ("the General Conditions"), and shall hold ALICE and CERN free and harmless from liability relating to the Equipment. ALICE is free of any obligations to commission the equipment in NA61/SHINE.

It is understood that in case of conflict between the provisions of the relevant Memoranda of Understanding and/or the General Conditions on the one hand, and the provisions of this Agreement on the other hand, the latter shall prevail.

Article 2 – Equipment transfer

This equipment transfer shall start at the beginning of March 2019 (after the ALICE TPC is transported to the clean room in the Long Shutdown 2) and be finished within about four weeks (referred to as Equipment Transfer Dates). These dates are based on the present planning of the ALICE upgrade project and will be adjusted accordingly, in case the ALICE upgrade schedule changes. In particular, the Equipment transfer will not take place, in case the ALICE TPC upgrade plans change.

This agreement remains valid under the condition of recommendation and approval of the NA61/SHINE upgrade programme by CERN authorities, the SPSC and Research Board.

NA61/SHINE will provide necessary manpower for dismantling of the equipment as well as appropriate transport and storage.

Article 3 – Financial compensation

NA61/SHINE shall transfer 100.000 CHF (the “Amount”) to the Common Infrastructure Fund of the ALICE TPC project by the date of the start of the Equipment transfer in accordance with the payment details in Annex III.

Article 4 – Amendments, Variations or Additions

Any modifications to the terms and conditions of this Agreement can be made only by means of a written agreement signed by authorized representatives of the Parties.

Article 5 – Suspension and Termination of the Agreement

Suspension and termination procedures of this Agreement can be made only by means of a written agreement signed by authorized representatives of the Parties.

Article 6 – Annexes

The Annexes are an integral part of the Agreement:

Annex I	Status and plans of NA61/SHINE related to the Agreement
Annex II	The ALICE TPC read-out electronics and gate pulser system to be transferred to NA61/SHINE
Annex III	Payment details

In the case of conflict between any provision in the Annexes and any other provisions of this Agreement, the latter shall prevail.

On behalf of CERN

On behalf of ALICE

Eckhard Elsen

Federico Antinori

Director of Research and
Computing

ALICE Spokesperson

Date:

Date:

For NA61/SHINE

Marek Gazdzicki

NA61/SHINE Spokesperson

Date:

ANNEX I

Status and plans of NA61/SHINE related to the Agreement

NA61/SHINE at the CERN SPS is a unique experiment optimized for measurements of hadron production properties in a large acceptance with high resolution in h+p, h+A and A+A interactions from 10A to 150A (350) GeV/c. The approved programme consists of measurements for

- physics of strong interactions - study of properties of the onset of deconfinement and search for the critical point of strongly interacting matter which is pursued by investigating p+p, p+Pb and nucleus-nucleus (Be+Be, Ar+Sc, Xe+La, Pb+Pb) collisions,
- neutrino physics - precise hadron production measurements in p+A and p+(replica target) interactions for calculations of the initial neutrino beam flux in the long-baseline neutrino oscillation experiments at J-PARC and Fermilab,
- cosmic-ray physics - precise hadron production measurements h+A interaction for simulations of cosmic-ray air showers in the Pierre Auger Observatory and KASCADE experiments.

The NA61/SHINE collaboration consists of about 150 physicists from 30 institutions in 14 countries.

The data taking for the approved measurements will be finished by the Long-Shutdown 2. There are a number of important physics measurements, which can be performed at the CERN SPS after the Long-Shutdown 2 using a significantly upgraded NA61/SHINE facility.

They include measurements of:

- open charm and multi-strange hyperon production,
- high precision data for future neutrino experiments (DUNE and Hyper-Kamiokande) and cosmic-ray experiments (AMS),
- fluctuations and correlations of charged hadrons in the full acceptance,
- cumulative hadron production.

In particular, the first two measurements would require an increase of the detector event rate by a factor of 10 to about 1000 Hz. This would imply that the NA49 legacy TPC read-out electronics is replaced by a new one which satisfies the requirements of the new programme.

The planned upgrade of the TPC read-out electronics and the related software development will be conducted by NA61/SHINE groups from (main activities and currently involved manpower are listed in brackets):

- Jagiellonian University, Krakow
(DAQ, interface between the ALICE front-end-cards and the NA61/SHINE read-out chambers, 2 physicists, Ph.D. student, M.Sc. student, engineer, mechanical workshop),
- Warsaw University of Technology, Warsaw
(DAQ, DCS, physicist, two Ph.D. students)
- Goethe-University Frankfurt am Main
(interface between the ALICE front-end-cards the NA61/SHINE read-out chambers, physicists, electronic workshop)
- University of Bergen
(DAQ, DCS, two physicists)

ANNEX II

The ALICE TPC read-out electronics and gate pulser system to be transferred to NA61/SHINE

The following list of components of the ALICE TPC read-out chain components represents the result of the present studies and would be needed for the NA61/SHINE upgrade during the Long-Shutdown 2:

- 1800 Front-end cards (FEC), excluding cooling plates,
- 80 Read-out Control Units (the 2015 version with RCU2),
- 20 Read-out Receiver Cards (C-RORC).
- 2 Local Trigger Units (LTU)
- 5 optical splitter boxes for trigger and timing distribution

ANNEX III

Payment details

The financial compensation Amount will be transferred to the Common Infrastructure Fund of the ALICE TPC project following the invoice sent to NA61/SHINE from ALICE.