# ALICE

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## Introduction

The main focus of our group in 2016 will be on

1. Thedata analysis of *√s­*­NN=2.76 TeV *Pb+Pb, √s=0.9, 2.76, 7 and 8 TeV*  *p+p and √s­*­NN=5.02 TeV *p+Pb* data samples collected in ALICE run-1.
2. Preparation of T0 and EMCal L0 trigger hardware for run-2.
3. Participation in upgrade activities:
   1. ALICE TPC GEM readout chambers upgrade
   2. Production and commissioning of the new Trigger Region Units (fast L0 single photon trigger electronic) for the four new super-modules of ALICE EMCal.
   3. Participation in the R&D activities related to the Fast Interaction Trigger (FIT) which is upgrade of T0 and V0 detectors planned for LS2.
   4. Participation in the forward physics activities (Risto Orava). One of the reason to hire Beomkyu Kim.

## Data analysis.

The first flow harmonic correlation paper was accepted in Physics Review Letter ([Phys. Rev. Lett.](http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.117.182301) **[117](http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.117.182301)**[, 182301 (2016)](http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.117.182301)). Two related papers are being prepared and to be finalized for submitting to journals to be shown in Quark Matter 2017 conference (Feb. 2017). Two ongoing projects are close to be completed: (i) Study of the initial state soft QCD radiation using the analysis of the dijet pair momentum distributions in *p+p* and p*+Pb* data. This is a subject of Beomsu Chang PhD thesis (should be defended in June 2017). (ii) Study of the final state soft QCD radiation utilizing the dihadron correlations. Topic of Jussi Viinikainen PhD thesis. The preliminary results are approved and shown in Hard Probe 2016 conference. The corresponding paper will be published in June 2017, thesis defense in 2017. New soft-hard interaction analysis will begin around June 2017 where we need to combine our main analysis topics together, jet and flow. This analysis will try to address how the fast moving jet traveling trough the medium created in Pb+Pb collisions will leave energy and momentum to the medium.

In addition we need to strengthen our role in the analysis of ALICE Electro-Magnetic Calorimeter (EMCAL) data. The main purpose is to utilize clean sample of high-pT neutral pions, direct photons and jets as a trigger particles and study their associated yields. These measurements are important for understanding of the parton interaction with exited nuclear medium (see e.g. *Phys. Rev. Lett.,* **2010***, 105*, 142301, *Phys. Rev. D,* **2010***, 82*, 072001). Topics for Tomas Snellman and Marton Vargyas analyses.

## Preparation for upcoming ALICE run-2

Jyväskylä group has been always actively participating in data taking. Many of us has served as a shift leader as an on-call expert for the T0 and EMCAL detector systems. ALICE is almost back in the fully operational mode. We have to (i) to train new shifters from our group and (ii) to modify TRU and EMCAL trigger systems to adapt the improvements of the ALICE data taking system during the long shutdown.

## L0 single photon trigger electronics

Because of our interest in high-pT physics, Jyvaskyla group took a responsibility in design/development and commissioning of Trigger Region Units (RTU) electronics. TRU electronics is a FPGA based system performing a fast (<600 ns) on-line analysis of EMCAL data and searches for high-energy single photon hits to generate level-0 trigger. EMCAL consists of 12 super-modules and every super-module is equipped by 3 TRU boards. TRU modules have been produced by Jyväskylä team and J. Kral implemented the L0 trigger decision logic into a FPGA firmware. The whole EMCAL trigger system developed in our group was fully operational since 2010 and gave us an opportunity to study the fully reconstructed jets in ALICE. Jiri Kral has defended his PhD and he is moving probably to USA (he got two offers, one for the CERN fellowship, and one from USA for the tenure track position ORNL.) Jussi Viinikainen is taking the major responsibility for this project.

## ALICE TPC upgrade

The central parts of the ALICE detector are the Time-Projection Chamber (TPC) and the Inner Tracking System (ITS). TPC is the main tracking detector of the central barrel (|η|<1.5) and is optimized to provide charged-particle momentum measurements down to ~50 MeV/c with excellent two-track separation, particle identification (d*E*/d*x*), and vertex determination. With the current design and readout configuration the maximum data acquisition rate in Pb–Pb collisions is about 500 Hz. The main limitation of the existing design comes from the TPC gating grid, which is needed to prevent the ion flow back to the drift volume, and can be operated with the maximum rate about 3.5 kHz. In order to optimize the ALICE performance after the second long LHC shutdown in 2018 the ALICE collaboration decided to upgrade TPC to be able to record Pb–Pb collisions at a rate of 50 kHz. This requires replacing all the multi-wire proportional readout chambers with the Gas Electron Multiplier (GEM) technology, which allows preserving the same tracking performance (momentum resolution and dE/dx resolution) as with the current readout chambers.

There is a need to produce 32 m2 of triple-GEM ROC’s, which corresponds to a total area of 96 m2 of GEM foils. Helsinki Institute of Physics has agreed to contribute to the TPC upgrade by providing a suitable infrastructure (100 m2 clean room of class 1000) and expertise in the GEM technology area. The ALICE/Finland team will participate, in collaboration with the GEM expert team of the HIP detector laboratory, in the triple-GEM ROC R&D (first phase) and in the GEM production and quality assurance tests. In the later stage we are also committed to participate in the ROC assembly and commissioning. A part of the ALICE TPC upgrade project includes a strong synergy and connection with the FAIR Super FRagment Separator beam-tracker project carried out in collaboration with the Center of Excellence on Nuclear and Accelerator based Physics at the University of Jyväskylä.

At the end of 2013 we hired a postdoc, Erik Brucken to coordinate the TPC upgrade activities in HIP detector laboratory and and PhD student Timo Hilden as a GEM expert. The R&D activities at CERN and GSI are still ongoing but we expect that in the second half of 2015 the mass production of 100 m2 GEM foils and the optical scan in HIP clean room should start.

## Fast Interaction Trigger

Wladek Trzaska as a project leader of the T0 detector is leading the design effort of the Fast Interaction Trigger upgrade. During the LS1 and LS2 upgrade periods, the LHC luminosity will be improved beyond the original design specifications. This increase in performance requires the modernization of several key detectors of ALICE, particularly the trigger. At the same time, addition of new detector subsystems will reduce the space available for the existing T0 subsystem. To cope with these challenges, a comprehensive detector design must be developed. Although the funding of this upgrade project is at this moment unclear, there seems to be a good motivation to support our involvement in this project.

## Central Exclusive Production proposal

Risto Orava of HIP joind ALICE in 2014 with the Central Exclusive Production project.

We would like to hire Beomkyu Kim, an expert in the diffraction physics field, to join this project.

## Personnel

The personnel situation is summarized in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | last name | first name | Status | Since | payroll |
| 1 | Rak | Jan | Prof. | 2005 | JYFL |
| 2 | Orava | Risto | Prof. | 2014 | HIP |
| 3 | Trzaska | Wladyslaw Henryk | Uni Researcher | 1998 | JYFL |
| 4 | Rasanen | Sami Sakari | Uni Researcher | 2008 | HIP |
| 5 | Kim | Dong Jo | Uni Researcher | 2006 | HIP |
| 6 | Brucken | Erick | postdoc | 2013 | AKA 251737 |
| 7 | *Beomkyu* | *Kim* | *postdoc* | *2014* | *HIP not yet hired* |
| 1 | Chang | Beomsu | PhD Student | 2010 | JYFL |
| 2 | Viinikainen | Jussi | PhD Student | 2010 | Nyyssonen foundation |
| 3 | Vargyas | Marton | PhD Student | 2013 | HIP |
| 4 | Snellman | Tomas | PhD Student | 2013 | JYFL |
| 5 | Hilden | Timo | PhD Student | 2013 | AKA 271838 |
| 6 | Mieskolainen | Matti Mikael | PhD Student | 2014 | HIP Orava |
| 7 | Slupecki | Maciej | PhD Student | 2013 | JYFL T0 |