# ALICE

**Project Leader:** Jan Rak

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## Introduction

The main focus of our group in 2017 will be on

1. Thedata analysis utilizing p+p, p+Pb and Pb+Pb data collected by ALICE in   
   Run-1 and Run-2.
2. Running of the EMCal L0 trigger hardware in 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.

## Data analysis.

The first flow harmonic correlation paper was accepted in Physics Review Letter ([Phys. Rev. Lett. **117**, 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 spring 2017). (ii) Study of the final state soft QCD radiation utilizing the di-hadron correlations. The preliminary results from this analysis are approved and shown in Hard Probe 2016 conference, and the corresponding paper will be published in 2017. Jussi Viinikainen’ PhD-thesis will be build around this topic and he aims to defend his thesis in 2017.

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).

Tomas Snellman has been performing analysis on fully reconstructed jets including the EMCal cluster energies. His studies are closely connected with Jussi’s analysis but uses jets and jet constituents rather than di-hadron correlations. While Jussi and Tomas are analyzing p+p and p+Pb data, Marton Vargyas currently studies jet shapes and associated yields in Pb+Pb with di-hadron correlations.

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. We submitted a project application around these ideas to Finnish Academy in September 2016 call.

## 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 with 3 TRU boards. Jyväskylä team has produced TRU modules 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 defended his PhD-thesis in 2014 and moved to CERN beam department where he has fellowship. Jussi Viinikainen took the major responsibilities from Jiri since he left. Trigger has been running well also in Run-2 that started in 2016.

Wladyslaw Trzaska from JYFL has been the project leader in designing, building and maintaining of the T0, another important Finnish contribution. He is also currently a project leader in the new Forward Interaction Trigger (FIT) detector development that will be implemented to ALICE during the second long shutdown starting at the end of Run-2 in December 2018. We have supported this project with working time from Filip Krizek, Astrid Morreale and lately Beomkyu Kim to T0 running. As Jussi will defend his PhD-thesis in 2016, Beomkyu Kim is now learning the trigger maintenance and he will continue the work at CERN. Hence Beomkyu has become an important person we aim to hire to ALICE 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 participates, 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 Brücken to coordinate the TPC upgrade activities in HIP detector laboratory and PhD student Timo Hildén 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.

## Personnel

The personnel situation is summarized in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Family name | First name | Position | Since | Pay roll |
| 1 | Rak | Jan | Professor | 2005 | JYFL |
| 2 | Räsänen | Sami | University Researcher | 2008 | HIP |
| 3 | Kim | Dong Jo | University Researcher | 2006 | HIP |
| 4 | Brücken | Erik | Postdoc | 2013 | AKA 251737 |
| 5 | Hildén | Timo | Postdoc | 2013 | AKA 271838 |
| 6 | Beomkyu | Kim | Postdoc | 2014 | HIP (*not yet hired*) |
| 7 | Chang | Beomsu | PhD Student | 2010 | JYFL |
| 8 | Viinikainen | Jussi | PhD Student | 2010 | Foundation |
| 9 | Vargyas | Marton | PhD Student | 2013 | HIP |
| 10 | Snellman | Tomas | PhD Student | 2013 | JYFL |