HPD COURIER

NUMBER 8 | September 2026

10th anniversary of Romania becoming a CERN Member State

Electronic version
HPD Couriers can be accessed at:
http://niham.nipne.ro/HPD_Courier.html

Visionary scientists like Louis de Broglie, Niels Bohr, and Isidor Rabi have realised that in order to carry out world-class research in fundamental physics, particularly to uncover what the universe is made of and how it works, one needs particle accelerators and experimental devices, their construction and operation followed by physics studies requiring expertise and financial support beyond the capability of a single country. Therefore, only a joint effort at the international level could enable research at the forefront of human knowledge, in an environmentally responsible and sustainable way. In such a way, people from all over the world can come together to push the boundaries of science and technology, for the benefit of all. At the same time, this could be the place to train new generations of physicists, engineers and technicians, and engage all citizens in research and in the values of science and last but not least keep top European scientific minds from being forced to move to the US or the Soviet Union by that time. Over the years, many Romanian physicists, engineers, technicians were involved in CERN activities either via individual contracts or as recognised research groups in different experiments at CERN. The results obtained by them substantiated the application of Romania to become a CERN member state and consequently to be accepted.

The CERN convention was signed in 1953 by the 12 founding states Belgium, Denmark, France, the Federal Republic of Germany, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and Yugoslavia, and entered into force on 29 September 1954. Subsequently, many other countries joined CERN. In a chronological order they are: Austria (1959), Spain (1961-1969, re-joined 1983), Portugal (1985), Finland (1991), Poland (1991), Czechoslovak Republic (1992), Hungary (1992), Bulgaria (1999), Israel (2014), Romania (2016), Serbia (2019), Estonia (2024) and Slovenia (2025). The Czech Republic and Slovak Republic re-joined CERN after their mutual independence in 1993. Yugoslavia left CERN in 1961 (see Fig.1.)

Some of the members of the current Hadron Physics Department (HPD) started to work in the field of nuclear reactions in 1972 by commissioning the first experiment used in spring 1973, once the FN Tandem delivered the first proton beam. The Tandem column being destroyed by a severe earthquake in 1977, with the support of the French physics community, we proposed and performed measurements at the Saclay Tandem using the Q3D magnetic spectrometer. 1981 was the year when our collaboration with GSI-Darmstadt started. The experiments performed at UNILAC used large size spherical and cylindrical reaction chambers housing experimental configurations close to 4π geometry in the center of mass, based on large area position sensitive ionization chambers, position sensitive parallel plate avalanche counters, plastic scintillators and silicon telescopes. With such an experience, we initiated in Bucharest a rather ambitious project to build a versatile experimental setup DRACULA foreseen to be used at the Bucharest Tandem+Post Accelerator based on room temperature resonators. Late 1990, DRACULA was transported and assembled at the 15 MV SMP Tandem of LNS Catania. Following the fruitful collaboration with GSI, in 1987 we joined the FOPI Collaboration from

Fig.1 Member states at CERN.

the very begining. Around the same time, we were invited to join the CHIMERA Collaboration at LNS. As a natural follow-up, in 1999 we became members of the ALICE Collaboration. While the main physics motivation of ALICE is the production of deconfined matter with properties supposed to be characteristic at few μsec after Big-Bang, equally interesting is to study high density baryonic matter, supposed to be characteristic for the core of neutron stars. This was the reason for joining the CBM Collaboration from the very beginning of this project. An overview on the main experiments and collaborations in which members of the Hadron Physics Department have been involved making a real contribution to all sectors can be followed in Fig.2. (Details can be found in the HPD Courier no.2 (https://niham.nipne.ro/$HPD_NR_2_Dec_$2019.pdf).

In order to have a substantial contribution to large scale experiments as ALICE and CBM, we launched in 1999 a project at the national level, which brought together our expected activities within the two Collaborations (detectors development, assembling and tests of important components of the ALICE and CBM experiments, frontend electronics, data processing, computing and last but not least data analysis focusing on specific physics topics. After a rather long process to persuade the relevant authorities at various levels that this is the only way to become visible and competitive in unavoidable large scale international collaborations, this project was approved in 2003.

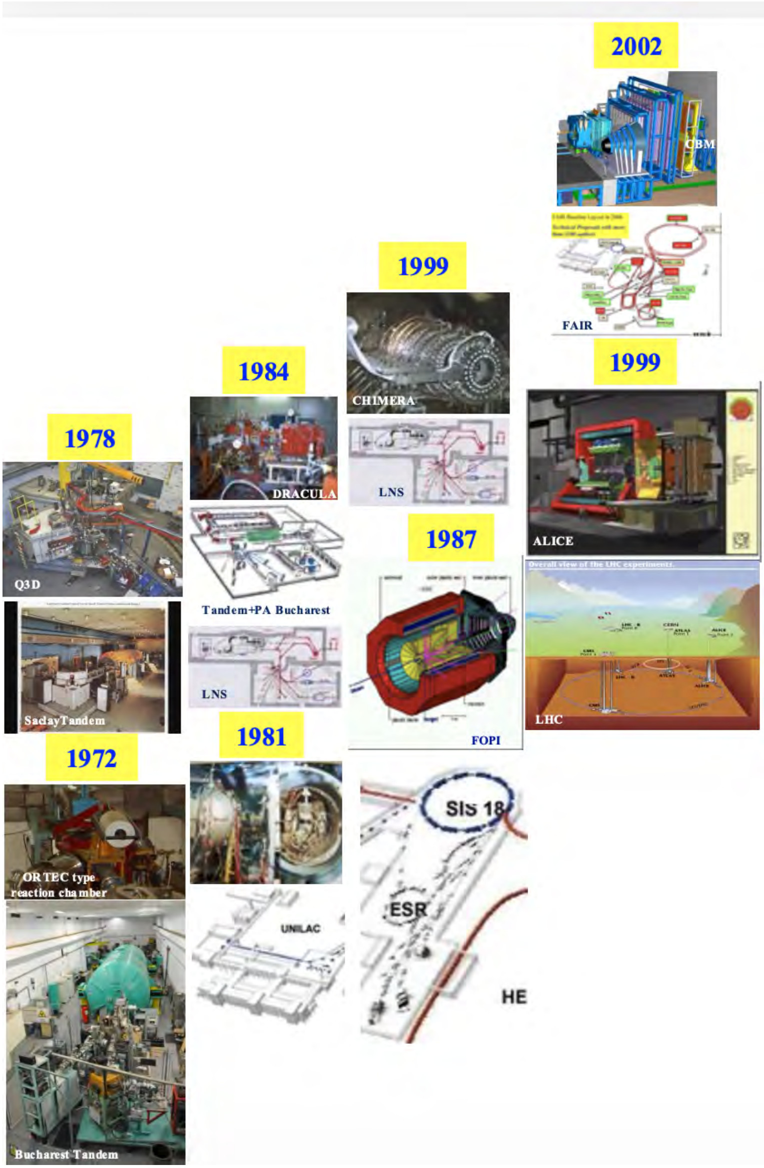

Fig.2 An overview of the experiments in which members of HPD were involved and had essential contribution.

Within this project we received the financial support from the Ministry for Education, Research and Youth which gave us the possibility to organise a Detector Laboratory with proper clean rooms and infrastructure. An overview of the Laboratory with the main activities taking place in different areas can be followed in Fig.3.

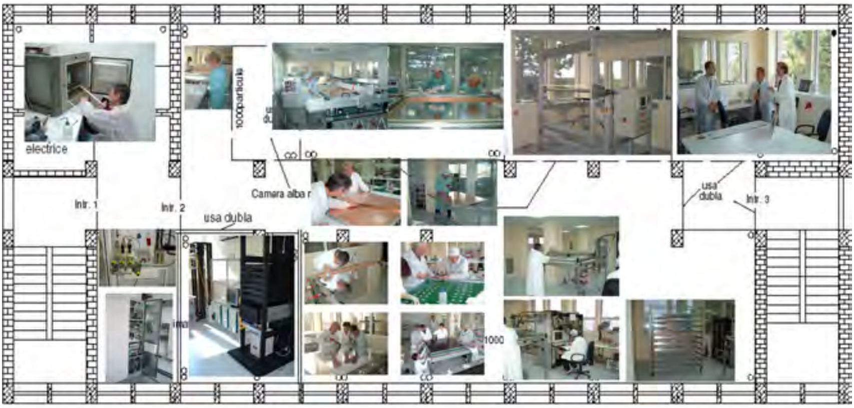

Fig.3 An overview of the Laboratory with the main activities taking place in different areas.

The Detector Laboratory was inaugurated on 25 October 2004. The DetLab, organised in an existing building, was intensively used for assembly and testing of 130 TRD chambers, i.e. 24% of the ALICE-TRD detector (https://inspirehep.net/files/a956a092946a6e4aeb6496becdbb7b43).
Details on the assembly and testing procedures can be found in Courier no.6 of HPD *https://niham.nipne.ro/hpd_courier_no6.pdf*.
In Fig.4 is represented the region of the ALICE-TRD covered by the 130 chambers assembled and tested in HPD. We also had an essential contribution in designing a dedicated 16 channels charge sensitive preamplifier (PASA) CHIP as frontend electronics for ALICE-TRD.

In 1999 at CERN were initiated activities for developing large-scale distributed computing and storage infrastructures, called GRID, to be used by the four large experiments at LHC, i.e. ALICE, ATLAS, CMS and LHCb. Similar activities have been also undertaken in our group having in mind the ambitious target to become in time a significant member of the ALICE-GRID.

In 2002, a local distributed computing system was connected to the ALICE-GRID and became the first international GRID application in Romania. By following a coherent strategy and utilising funding from a number of projects we set up the Data Centre NIHAM, one of the most efficient Tier2 components of the ALICE-GRID and a local Data Centre, NAF, used by HPD members for large scale model calculations and development and tests of different analyses software before being

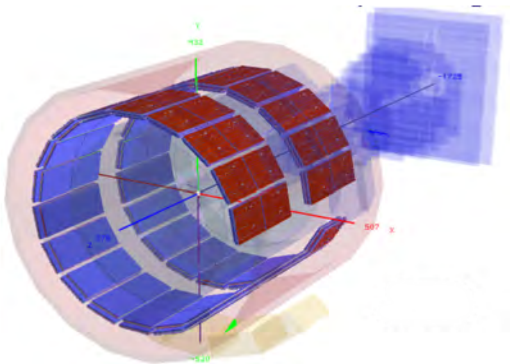

Fig.4 What would the TRD sub-detector have looked like if it had been fitted only with TRD chambers assembled and tested in Hadron Physics Department.

launched on ALICE-GRID. Fig. 5 shows what a section of the NIHAM Data Centre looks like.

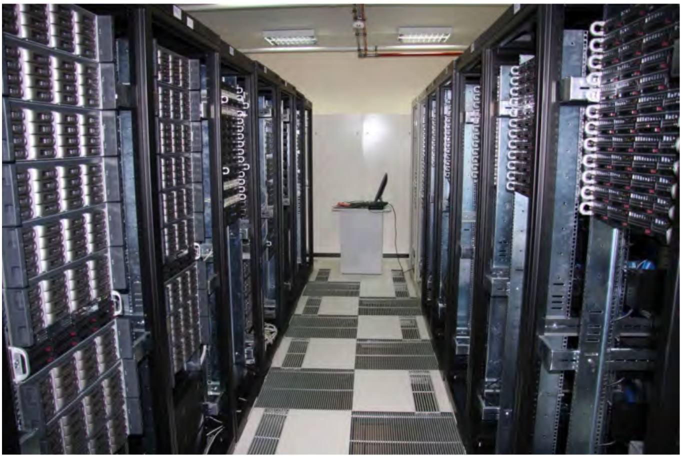

Fig.5 NIHAM Data Center.

A snapshot of the traffic between NIHAM and other centres of the ALICE-GRID can be followed in Fig.6.

The contribution of NIHAM to the ALICE computing GRID in terms of done jobs (58.8 Mjobs, 6.7% of all Tier2 centres of ALICE-GRID) and CPU time (283.6 Mhours, 7.4% of all Tier2 centres of ALICE-GRID) in the last 15 years is presented by histograms and pie charts in Fig.7 and Fig.8, respectively.

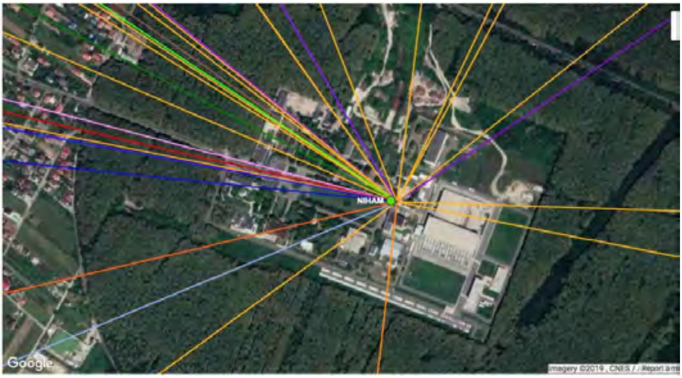

Fig.6 A snapshot of the traffic between NIHAM and other centres of the ALICE-GRID.

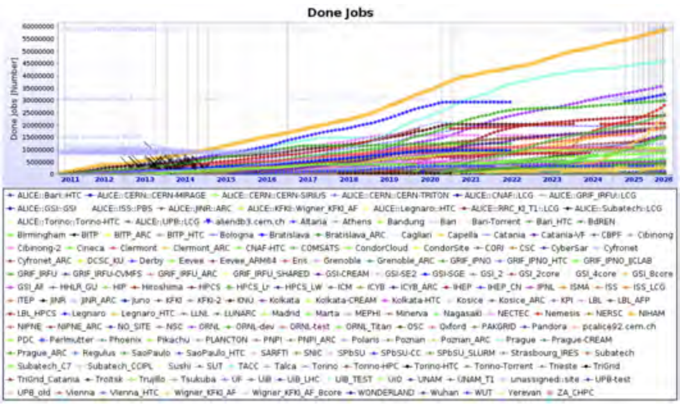

Fig.7 Jobs processed by the ALICE Tier2 centers, per year, since 2011.

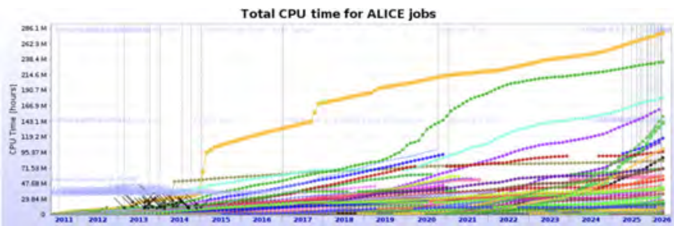

Fig.8 CPU time used by the ALICE Tier2 centers, per year, since 2011.

Building on these achievements, which have been recognized by the ALICE Collaboration, we organized several workshops. The first, focusing on the ALICE and CBM sub-detectors, took place at Cheile Grădiştei. After realising the first GRID application in Romania, in 2006 we organised in collaboration with particle physics department, computing department, theory department of IFIN-HH and Technical University of Bucharest a dedicated International GRID Workshop at Sinaia. Before starting the experiments at LHC, we organised in Sibiu an ALICE Workshop focused on the TRD sub-detector, off-line software, GRID activities and physics. The posters and group photos of these events can be followed in the following pictures:

Fig.9

As it was already mentioned, all these efforts and results paved the way to access the experimental data for analysis, primarily directed toward aspects of physics that we have studied at lower energies, i.e. collective type phenomena. Having in mind the Gribov prediction supported by the results obtained at DESY in e-p collisions concerning the partonic cascades density at low values of Bjorken x and Q^2 we initiated an analysis of charged particles and identified charged particles as a function of charged particle multiplicity and event shape in pp collisions at LHC energies once the data at 7 TeV became available.

The first signatures for similarities between Pb-Pb and pp collisions at LHC energies in terms of collective expansion at high charged particle multiplicity and close to azimuthal isotropy (ALICE Week, PWG2-Soft Physics, 9.11.2010) were obtained at the same time as the identification of near-side long range correlations in pp collisions at large charged particle multiplicity by the CMS Collaboration.
Being aware that at LHC energies the spectra at larger values of transverse momentum (p_T) are contaminated by jet contributions, we used the boosted Tsallis expression for a simultaneous fit of the pions, kaons and protons spectra obtained in the above mentioned conditions. A large transverse expansion was observed at large multiplicity and close to azimuthal isotropic events relative to the case of low multiplicity and jetty-like events. Such rather unexpected phenomena in pp collisions came as a surprize and took quite a number of iterations and time to be scrutinised within the ALICE Collaboration. Once the p-Pb data became available and similar trends were identified, the message was clear and at Quark Matter 2014 details on such similarities were presented (Nucl.Phys. A931(2014)888).
A simultaneous fit of the p_T spectra for pions, kaons and protons using this time a Boltzmann Gibs Blast Wave (BGBW) expression was performed and the average transverse expansion velocity ($\langle\beta_T\rangle$), kinetic freeze-out temperature (T^{fo}_{kin}) and flow profile (n) fit parameters and their correlations as a function of charged particle multiplicity or centrality for pp, p-Pb and Pb-Pb are presented in Fig.10 and Fig.11. A clear similarity between pp, p-Pb and Pb-Pb collisions can be observed.

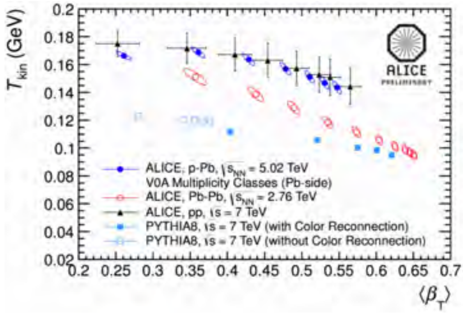

Fig.10.

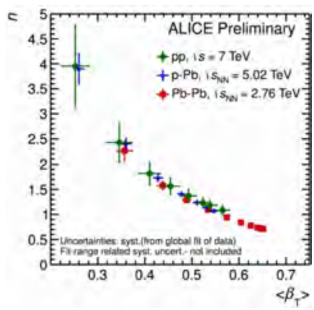

Fig.11

In order to have a detailed understanding of the underlying physics behind these similarities in terms of different trends observed in pp and Pb-Pb collisions at LHC energies, a multi-differential analysis is mandatory. This and many other type of physics analyses addressed within the ALICE Collaboration and other experiments at LHC required higher luminosities and thus higher collision rates. This was the reason for the ALICE Collaboration to embark on an upgrade program of some of the detectors, electronics and data processing strategy.
In Run1 and Run2 campaigns, the read-out chambers of the TPC were based on multi-wire chambers. The positive ions back flow, in high counting rate operation,

builds up large positive space charge with direct impact on the performance of the detector. In order to minimise such an effect, a decision was taken to replace the TPC read-out chambers by new ones based on GEM technology (ALICE-TPC upgrade TDR, https://inspirehep.net/files/11c10c25be338dc1fc068fb853a51210).

Argued by the results summarised above and many others, not directly related to the ALICE Collaboration, we managed to obtain funding from the Ministry of Research for another essential project within the national IMPACT Program to expand our infrastructure. A snapshot during the construction phase and the present configuration of the Hadron Physics Department building can be followed in Fig.12 and Fig.13, respectively.

Fig.12.

Fig.13.

In the new building, we organised offices for permanent staff, for diploma, master and PhD students, meeting rooms, 3 detector test laboratories, a control room, 2 electronic laboratories, a bonding laboratory and 2 laboratories for thin layer

Fig.14 Conference Hall.

deposition for applied research. For seminars, workshops, conferences, etc. with larger audience, a Conference Hall with 160 seats was set-up (Fig.14).
All meeting rooms, seminar room and Conference Hall are equipped with an integrated audio-video system for zoom connections.

Based on our previous experience in developing new types of detectors for the experiments we were involved in, assembling and testing various detector prototypes, assembling and testing 130 TRD chambers for the ALICE experiment and the new infrastructure organised in the meantime, brefly summarised above. (Details can be found in https://niham.nipne.ro/*hpd_courier_no*6.*pdf* and https://niham.nipne.ro/*hpd_courier_no*7_*August*_2024.*pdf*), we joined the ALICE Collaboration effort to upgrade the Time Projection Chamber (TPC) based on GEM technology. The commitment was to assemble and test 50% of the upgraded TPC outer read-out chambers (OROCs). A general view of of the partition on the assembling and testing areas is presented in Fig.15. The main steps in the assembling and testing process of the OROCs can be followed in Fig.16.

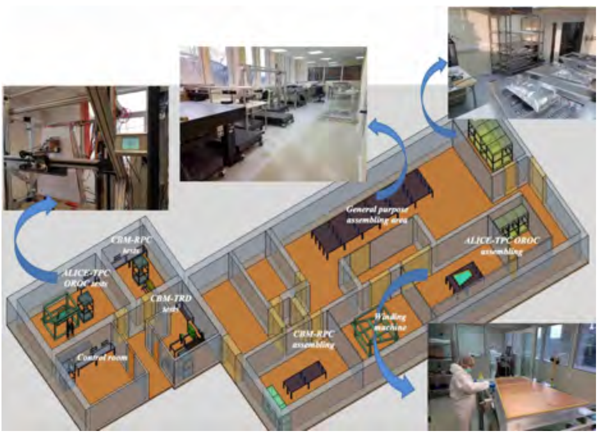

Fig.15 General view of the partition in the assembling and testing areas.

Fig.16 Snapshots of the assembling and testing process of the ALICE-TPC OROCs.

Our contribution to the ALICE TRD and TPC detectors is summarised in Fig.17 in a schematic representation.

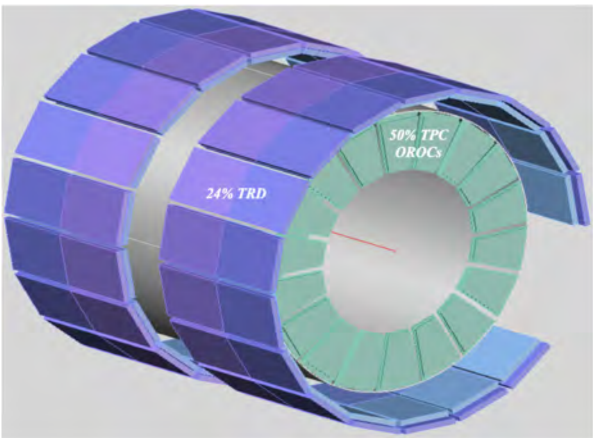

Fig.17 A view of the regions of ALICE TRD and TPC read-out chambers assembled and tested in Hadron Physics Departament.

In the meantime, the physicists from the HPD team, a member of the ALICE

Collaboration, continued their activities on all fronts, i.e. contribution to running the experiments, data analysis, the physics interpretation also based on published experimental results and last but not least in operating the NIHAM Data Center within the ALICE-GRID at maximum efficiency. A few examples of experimental results obtained from the analysis in bins of multiplicity/centrality can be followed from Fig.18 to Fig.21.

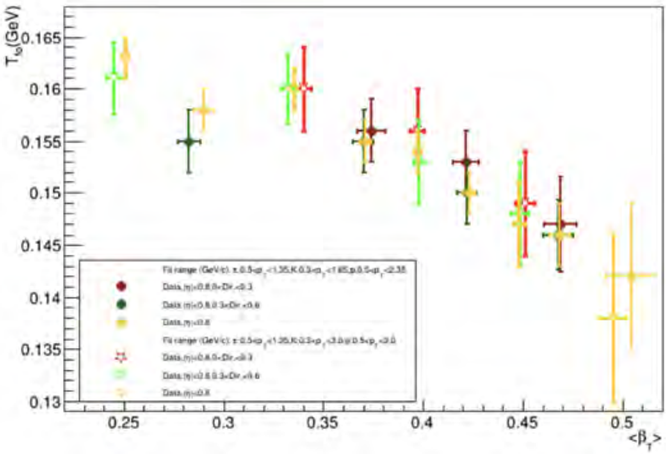

Fig.18 Kinetic freeze-out temperature versus the average transverse expansion velocity obtained using the BGBW expression for the simultaneous fitting of the π, K and p spectra over different p_T ranges and three directivity ranges, for pp collisions at $\sqrt{s}$ = 7 TeV.

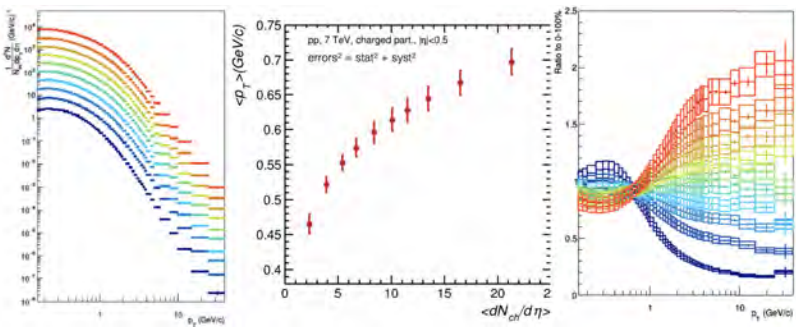

Fig.19 Charged particles p_T distributions, the corresponding average transverse momentum $< p_T >$ and the ratio of a p_T distribution for a given multiplicity to that for minimum bias (MB) in bins of charged particle multiplicity, for pp collisions at $\sqrt{s}$ = 7 TeV.

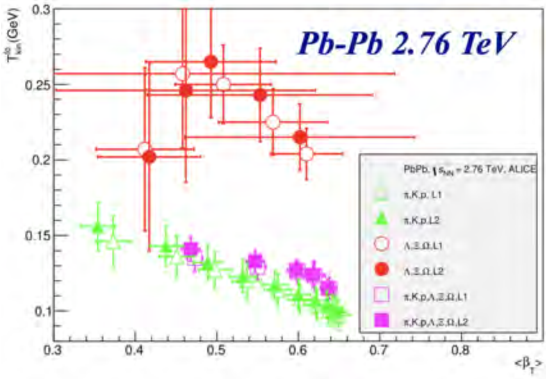

Fig.20 Kinetic freeze-out temperature versus the average transverse expansion velocity obtained using the BGBW expression for the simultaneous fitting of different species spectra over two p_T ranges, for Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV.

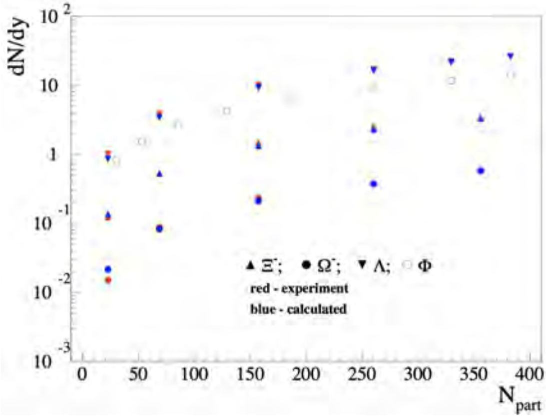

Fig.21 The Core-Corona approach is reproducing very well the dependence of strange hadrons density per unit of rapidity on the number of participating nucleons in Pb-Pb collision at $\sqrt{s_{NN}}$=2.76 TeV.

Such results, as those summarised above and many others, obtained by Romanian research groups from IFIN-HH and other institutes involved in CERN experiments like ALICE, ATLAS, ISOLDE, LHCb, NA62, nTOF, or individuals working at CERN in permanent or temporary positions, have been the main arguments for Romania to apply to become a CERN member state. The official ceremony to raise the Romanian flag at headquarters of CERN in Geneva took place on 5 September 2016, formally marking the status of Romania as the 22nd full member state of the organisation, and was attended by the President of Romania Klaus Werner Johannis and the Director-General of CERN Fabiola Gianotti. A few snapshots of different moments of this ceremony are pesented below from Fig.22 to Fig.31.

Fig.22 The speach of Fabiola Gianotti, Director-General of CERN.

Fig.23 The Mission of CERN.

Fig.24. An overview of the history, staff, paid personnel, scientific users, Member States and other states with different status of CERN.

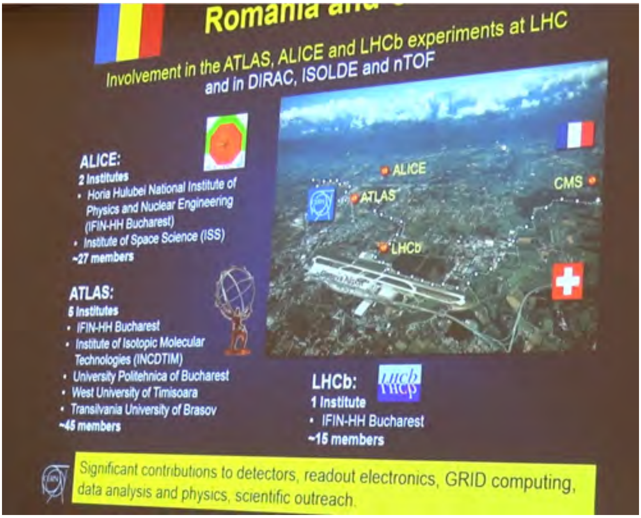

Fig.25. The previous recognised contributions of different Romanian institutes as part of various Collaborations and Experiments at CERN.

Fig.26 A summary of the main steps taken by Romania to become a Member State of CERN.

Fig.27 The speach of the President of Romania Klaus Werner Johannis.

Fig.28 The signing of the document formally admitting Romania as a CERN Member State by the President of Romania Klaus Werner Johannis, in the presence of the Director-General of CERN Fabiola Gianotti and the President of the CERN Council Sijbrand de Jong.

Fig.29 A large audience, comprising researchers involved in CERN activities, directors of different Romanian research institutes and universities, present and former ministers of research and education, foreign affairs ministers, diplomats and spokespersons of large Collaborations at CERN attended the ceremony.

Fig.30 Raising the Romanian flag at CERN.

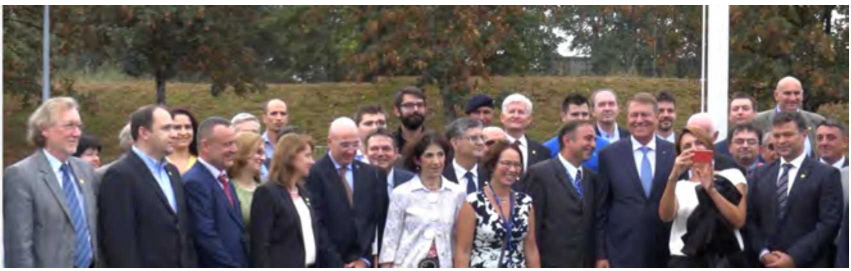

Fig.31 Group photo.

The opening session and the ceremony of raising the Romanian flag at CERN was followed by a visit of the Microcosm exhibition of CERN where Director-General Fabiola Gianotti provided explanations to the President of Romania, whilst the other members of the official Romanian delegation received explanations from the

Romanian physicists involved at CERN, regarding the experiments presented in the exhibition. During this visit the President of Romania had also discussions with many Romanian researchers involved in CERN activities (Fig.32).

Fig.32 Visit at the Microcosm exhibition.

After visiting the CERN Microcosm exhibition, a meeting of the President of Romania Klaus Werner Johannis and members of the official delegation with many Romanian researchers and directors of Institutes took place in the CERN Council Chamber. In the entrance foyer were exposed posters of different Romanian groups with the main results obtained in different Collaborations in which they were involved. The three posters exposed by the Hadron Physics Department can be followed in Fig.33.

Fig.33 The three posters, i.e. a general presentation of the activities in Hadron Physics Department - middle; the contribution in assembling and testing 24% of the ALICE-TRD sub-detector and the performance of NIHAM Tier2 center within ALICE-GRID - left; the contribution of assembling and testing 50% of ALICE-TPC OROCs - right.

During the discussions in the CERN Council Chamber, the President Klaus Werner Johannis expressed his appreciation for the results obtained in the various collaborations with CERN which paved the way for Romania to become a Member State of CERN and at the same time his hopes that the new open opportunities as a member state will be fully used by different segments, i.e. teaching, involvement of different Romanian companies in the tendering process issued by CERN for delivering or construction of different equipments, infrastructure components and use the technological transfer of different results obtained at CERN. Two photos taken during these discussions can be followed in Fig.34 and Fig.35.

Fig.34

Fig.35

He underlined the importance of creating corresponding infrastructures and strong research teams at the national level guaranteeing the visibility and competitiveness of Romania in the field. There have been also interventions of a few researchers and members of the official delegation, all of them, in a way or another, with the same message.

Worth mentioning that HPD already used some other facilities of CERN besides the involvement in the ALICE experiment either in collaboration with CERN members or within in-beam tests campaigns of CBM as a recognised experiment at CERN or for the FASP Chips developed in HPD bonding, with the support of Florentina Manolescu member of the EP-DT (Experimental Physics - Detector Technologies) department at CERN, managing the Wire Bonding Lab (Bondlab).

A photo of the experimental configuration of one of the in-beam tests carried out at SPS at CERN is presented in Fig.36.

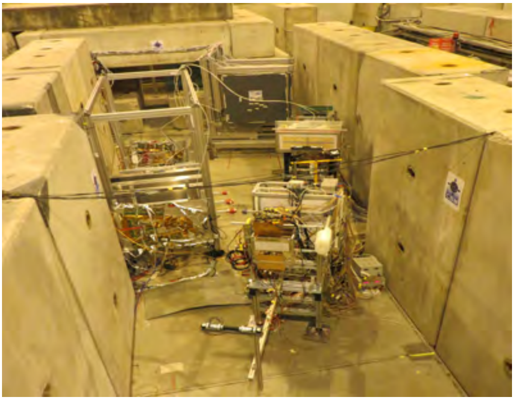

Fig.36 A photo of the experimental configuration for the in-beam tests at SPS of the new generation of high counting rate MSMGRPC (Multi-Strip Multi-Gap Resistive Plate Counters) and TRD-2D (Transition Radiation Detectors) with 2 dimension position information and associated frontend electronics developed by members of Hadron Physics Department for the CBM experiment at FAIR (Facility for Antiprotons and Ion Research), Darmstadt, Germany.

The physicists from HPD, members of the ALICE Collaboration, continued the physics program on two fronts, i.e. multi-differential analysis of p_T spectra and two-particle correlations for charged particles and identified charged particles as a function of charged particle multiplicity and event shape for different regions in $\Delta\varphi$ and $\Delta\eta$ relative to the leading particle in pp collisions at LHC and different studies based on published results from AGS up to LHC energies. The explanation of the centrality dependence of the light flavour hadrons production in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV, based on the relative weight between core and corona participating nucleons were published in Phys. Rev. C 96, 014908 (2017).

Using the RHIC and LHC experimental results, the $\langle p_T \rangle$ dependence of identified light flavour charged hadrons on $\sqrt{(dNdy)/S_\perp}$, relevant scale in a gluon saturation picture, was studied from $\sqrt{s_{NN}}$ = 7.7 GeV up to 5.02 TeV. The slopes of the $\langle p_T \rangle$ - particle mass dependence and the $\langle \beta_T \rangle$ parameter from BGBW fits scale well with $\sqrt{(dNdy)/S_\perp}$. Similar trends for pp at $\sqrt{s}$ =7 TeV are in a good agreement with the ones corresponding to Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV and 5.02 TeV supporting a system size scaling (details can be found in the published paper, Phys. Rev. C 98, 024904 (2018).
Such studies extended to different masses of the colliding systems, i.e. Cu-Cu, Au-Au at top RHIC energy and Xe-Xe and Pb-Pb at LHC energies showed similar scalings (AIP Conference Proceedings 2076(2019)040001).

We also investigated the effects of strong longitudinal colour fields (SLCF) on the identified (anti)particle transverse momentum (p_T) distributions in pp collision at $\sqrt{s} = 7$ TeV within the framework of the HIJING/BBbar v2.0 model. The comparison with the experiment was done in terms of the correlation between the mean transverse momentum ($\langle p_T \rangle$) and multiplicity (N_{ch}) of charged particles at central rapidity, as well as the ratios of the p_T distributions to the one corresponding to the minimum bias (MB) pp collisions at the same energy, each of them normalised to the corresponding charged particle density, for high multiplicity (HM) and low multiplicity (LM) class of events (R_{mb}). The theoretical calculations show that an increase of the strength of colour fields (as characterised by the effective values of the string tension k), from k=2 to k=5 GeV/fm, from LM to HM class of events, respectively, led to a ratio at low and intermediate p_T (i.e., 1 GeV/c $< p_T <$ 6 GeV/c), consistent with recent data obtained at the Large Hadron Collider by the ALICE Collaboration. These results point out the necessity of introducing a multiplicity (or energy density) dependence for the effective value of the string tension. The string tension k=5 GeV/fm, describing the p_T spectra of identified particles (anti)particle in pp collisions at $\sqrt{s} = 7$ TeV for high charged particle (HM) multiplicity event classes, has the same value as the one used in describing the p_T spectra in central Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV. Therefore, one can conclude that at the LHC energies the global features of the interactions could be mostly determined by the properties of the initial chromo-electric flux tubes, while the system size may play a minor role (Phys. Rev. C 98, 064903 (2018)).

Results related to charged particle and π^0 suppression obtained at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven for Au-Au (Cu-Cu) collisions and at the Large Hadron Collider (LHC) at CERN for Pb-Pb (Xe-Xe) collisions were compiled in terms of the usual nuclear modification factors, R_{AA} and R_{CP}, and of the newly introduced R^N_{AA} and R^N_{CP} as a function of $\langle N_{part} \rangle$ and $\langle dN_{ch}/d\eta \rangle$. A clear change in the dependence of $(1 - R^{\pi^0}_{AA})/\langle dN/dy \rangle$ for the most central collisions as a function of collision energy is observed in the region of $\sqrt{s_{NN}} = 62.4$ - 130 GeV in a qualitative agreement with theoretical model results, Fig.37 left column (Phys. Rev. C 103, 034903 (2021)).

Systematic studies of the ratio between the average transverse momentum and the square root of the particle multiplicity per unit rapidity and unit transverse overlap area $\langle p_T \rangle / \sqrt{(dNdy)/S_\perp}$ as a function of collision energy for a given centrality or as a function of centrality for a given collision energy support the predictions of CGC and percolation based approaches. The dependence of the ratio of the energy density $\langle dE_T/dy \rangle / S_\perp$ to the entropy density $\langle dN/dy \rangle / S_\perp$ at different collision centralities for A-A collisions from AGS, SPS, RHIC and LHC energies was studied. The observed trend towards a plateau at the highest RHIC energies followed by a steep rise at LHC energies is in agreement with theoretical predictions made 40 years ago that indicate this behaviour as a signature of a phase transition. A similar trend was evidenced in the slopes of the $\varepsilon_{Bj} \cdot \tau$ dependence on the entropy density $\langle dN/dy \rangle / S_\perp$, as a function of the collision energy, Fig.37 middle column

(Phys. Rev. C 107, 034913 (2023)). Worth mentioning that such correlations for pp collisions at $\sqrt{s}$ =7 TeV and 13 TeV follow qualitatively the ones corresponding to Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV.

We extended such studies to strange hadrons and anti-hadrons. The correlation between the ratio of the single- and multi- strange anti-hadron yield per unit rapidity to the total particle multiplicity per unit rapidity and the entropy density as a function of the fireball size (Fig.37 right column) evidence similar trends as those observed in $\langle dE_T/dy\rangle/\langle dN/dy\rangle - \langle dN/dy\rangle/S_{\perp}$ correlations.

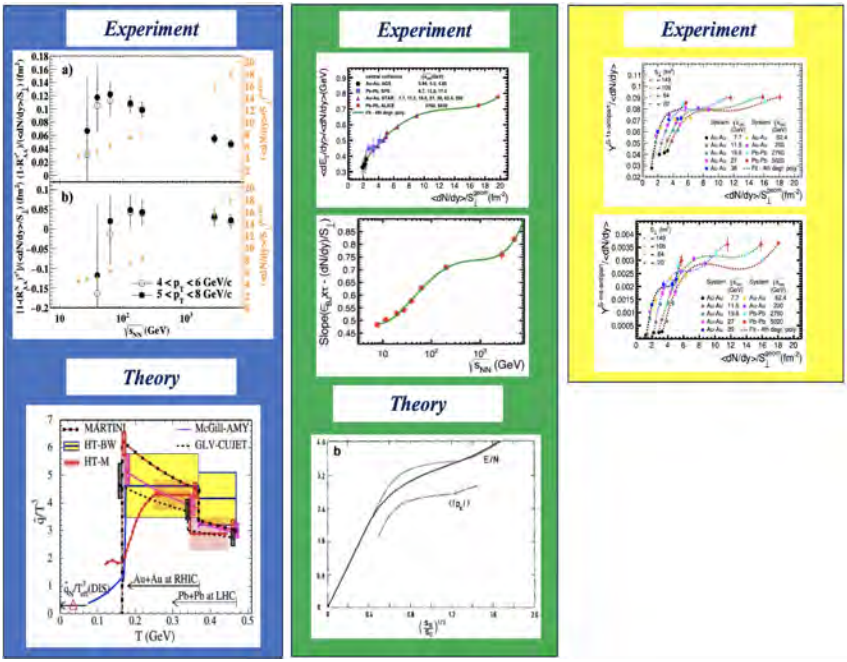

Fig.37

It was also evidenced a maximum in the strange hadron yields on particle density per unit of rapidity - entropy density correlation for combined and separate species of strange hadrons, at different centralities, in the region where a transition from the baryon-dominated matter to the meson-dominated one takes place. Within the experimental error bars, the position of this maximum does not depend on the mass of the corresponding strange hadron. Comparison with pp experimental data reveals another similarity between pp and Pb-Pb collisions at the LHC energies (Details can be found in Phys. Rev. C 111, 014908 (2025)).

Recent results obtained in $^{16}O -^{16} O$ collisions at $\sqrt{s_{NN}}$=5.36 TeV confirmed the expectations based on the systematics studied by us and mentioned above in terms of charged particle density per unit of pseudorapidity as a function of $\langle N_{part} \rangle$, suppression as a function of $\langle dN_{ch}/d\eta \rangle$ and $\langle p_T \rangle$ as a function of $\sqrt{(dN/dy)/S_{\perp}^{geom}}$ for strange hadrons close to central collisions, as can be followed in Fig.38 where the Oxygen results are represented by orange symbols.

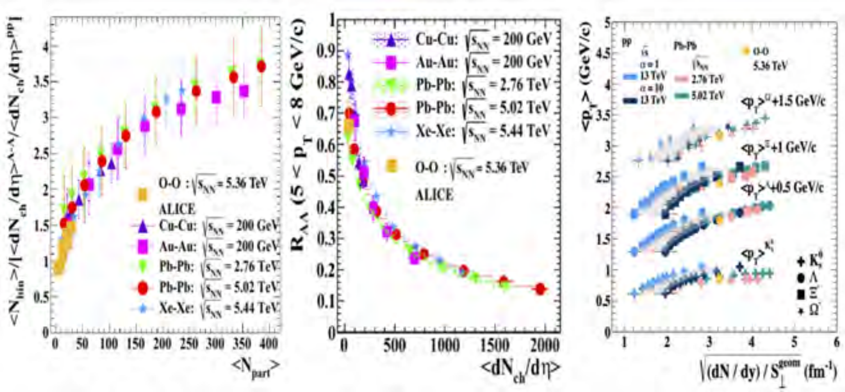

Fig.38 The charged particle density per unit of pseudorapidity as a function of the average number of participating nucleons - left, suppression as a function of the average charged particle density per unit of pseudorapidity - middle and $\langle p_T \rangle$ of strange hadrons as a function of square root of charged particle density per unit of rapidity divided by the transverse overlap area for central collisions - right. The O-O experimental results are represented by orange symbols.

One of the physics analysis recently started in HPD ALICE team is trying to evidence the alpha-like structure of Oxygen using event shape selection based on Fox-Wolfram moments.

Another important segment of our activity is to provide students with the opportunity to enhance their educational experience. Many diploma, master and PhD theses were accomplished under the coordination of members of our Department. A regular Summer Student Program organised by HPD is attended by students from Romanian and foreign universities. Lectures at the Doctoral School of Faculty of Physics, University of Bucharest, are delivered by doctoral supervisors from our Department. The participants at the Summer Student Program were asked to issue booklets or flyers with their results obtained during the two month periods spent in our Department. Examples can be seen in Fig.39. Very good participants to such programs decided to work with us and accomplish their diploma, master or PhD thesis along the topics in which they were involved during the Summer Student Programs. It is a kind of rewarding to receive messages from many of them confirming the high standards of infrastructure, scientific atmosphere and the challenge of activities in which they were involved.

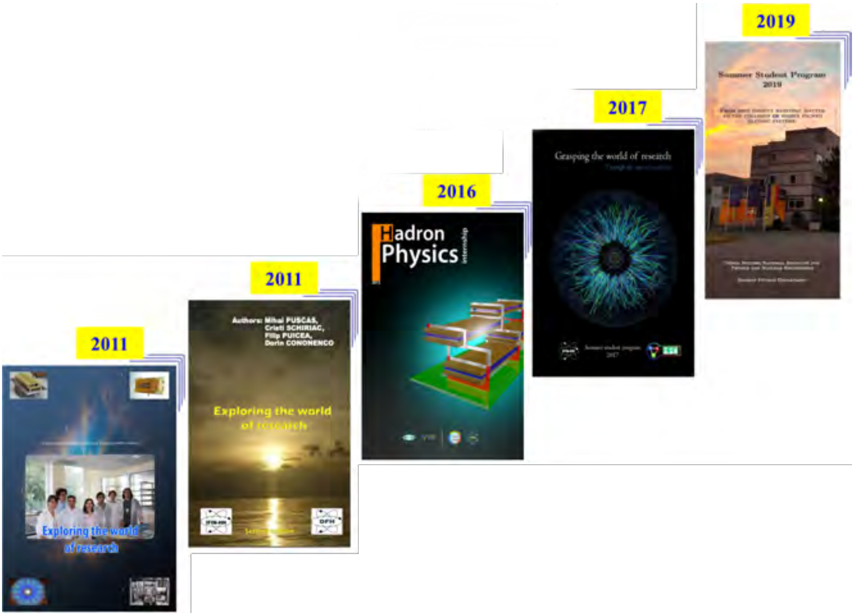

Fig.39 Examples of booklets or flyers issued by the participants to the HPD Summer Student Program.

On the occasion of the 70^{th} anniversary of the founding of CERN which took place in 2024, the ISAB (International Scientific Advisory Board) for projects within the Romania-CERN collaboration suggested organizing an exhibition in Romania dedicated to this event, for which funds were obtained from the Ministry of Research, Technology and Digitalisation. Obviously, in this exhibition the contributions of all the research groups that were involved in various collaborations at CERN had to be highlighted. For reasons of coherence, we collaborated with colleagues from ISS (Institute for Space Science), who also were ALICE members, for the arrangement of the exhibition segment dedicated to the Romanian contribution to ALICE. Together with some colleagues from HPD and students who were in HPD for diploma and master theses and in collaboration with Andrei Ţugulea, film maker, we set out to organise the segment dedicated to ALICE similar to prestigious exhibitions in the field. The Institute of Atomic Physics (IAP), coordinator of the projects within the RO-CERN National Program, decided that the exhibition would be hosted in the same building as its headquarters. Although the structure of the allocated space is not adequate for such an exhibition, we had to configure it accordingly. After several iterations between working groups formed by representatives of the various collaborations with CERN, the exhibition called DUROCERN (Discover the Universe with Romania at CERN) was configured as shown in Fig.40.

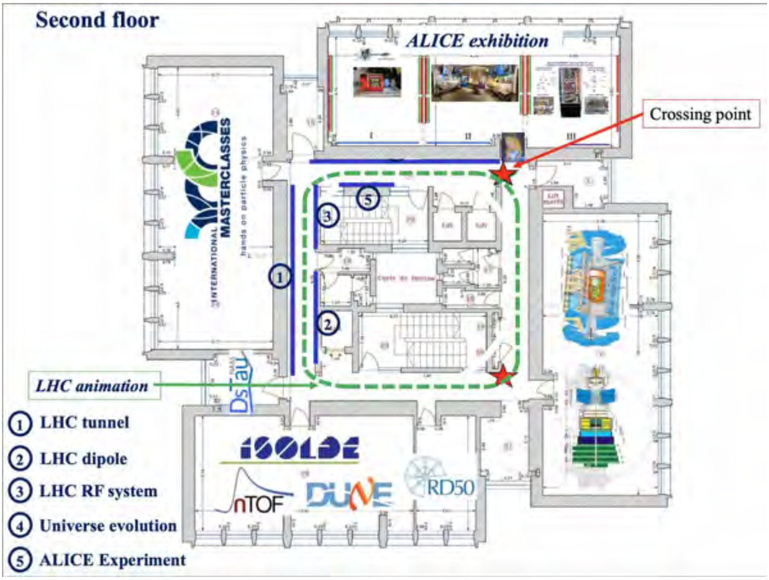

Fig.40 A schematic overview of the structure of the DUROCERN exhibition.

Taking into account that such an exhibition is addressed to a wide spectrum of visitors, the message proposed and pursued in the organisation of the entrance hall and the ALICE segment was to show how we can understand the properties of matter existing in various periods of the evolution of the universe through experiments carried out in terrestrial laboratories, how research groups within large-scale international collaborations can become visible and competitive, which were the contributions of Romanian groups in the development and realisation of some important segments of the experiments at CERN using the local infrastructure and last but not least to give visitors the opportunity to handle some experiments and detectors whose operating principles are the basis of the complex configurations used in the experiments at CERN.

As the configuration of the ALICE segment was ahead of the others, to capitalize on this, we contacted Mrs. Ioana Calen and Mr. Constantin Goagea from Modulab and the Zeppelin association and we decided together with them to organise an exhibition called QUANTA (Journey to the Beginning of Time) for which we also submitted a project to the AFCN (Administration of the National Cultural Fund) and obtained the funding. The exhibition was hosted at the Museum of Geology in Bucharest with the support of the director Ramona Bălăşcuţă. The exhibition, which lasted a month, was a great success. Some photos taken during the opening session can be followed in Fig.41.

Fig.41 Photos showing the rollup of the event, location, opening session and visitors at different segments of the exhibition.

The location being in the central area of Bucharest, the spectrum of visitors was very wide, children, students, adults of all professions and age categories and last but not least foreign visitors.

After hearing the explanations regarding the demonstrations of several principles on which the operation of some detectors is based, the contribution of HPD to the assembly and testing of parts of sub-detectors and the highlighting of some physics aspects within the ALICE experiment, a visitor asked the question: "What can we as ordinary citizens do to increase the funds allocated to such activities?" Probably ordinary citizens cannot do anything in this regard, but the competent authorities can improve the way of evaluating and financing research based on the quality of the results obtained.

At the end of the QUANTA exhibition, the exhibits were brought to the ALICE area of DUROCERN, adding to them posters and films explaining the structure and functioning of the various detectors, various detectors that can be operated by visitors, posters with suggestive presentations of the physics aspects studied by us within the ALICE Collaboration and the possibility of having live images from the HPD laboratories to arouse the curiosity of some of the visitors to visit the HPD as well. In the meantime, we have also installed on the ceiling of the hall at the entrance to the various segments of the DUROCERN exhibition a suggestive model of how the beams are transported in the LHC, their interaction and the trajectories of the particles resulting from their collision in the ALICE experiment, a portion of this being shown in Fig.42.

Fig.42 A collage of photos with the suggestive model of how the beams are transported in the LHC, their interaction and the trajectories of the particles resulting from their collisions in the ALICE experiment.

A panoramic view of a portion of the ALCE segment of DUROCERN is presented in Fig.43.

Fig.43 A panoramic view of a portion of the ALCE segment of DUROCERN.

We have also issued a guide for the ALICE exhibition that explains the structure of the exhibition and the exhibits whose cover is presented in Fig.44.

Fig.44 The cover of the guide booklet for the ALICE exhibition that explains the structure of the exhibition and the exhibits.

The DUROCERN exhibition was inaugurated on 15 November 2024. The ceremony was attended by representatives of the Romanian Government, Professor Tudor Prisecaru, State Secretary in Ministry of Research, Innovation and Digitalization and Dr. Bogdan Cristescu, State Secretary at the Ministry of Education and CERN, Dr. Malika Meddahi, Deputy Director for Accelerators and Technology, Arnaud Marsollier, Director of the Education, Communication and Promotion Department, Claire Adam-Bourdarios, President of the International Particle Physics Promotion Group (IPPOG), Dr. Kai Schweda, Vice Spokesperson of ALICE. ISAB members were also present. All visitors highly appreciated the standard of the ALICE sector of the DUROCERN exhibition. A few snapshots taken during the visit can be followed in Fig.45.

Fig.45 A few snapshots taken during the visit.

The main, present and former, contributors in different segments behind the achievements summarised above:

Anton Andronic*, Cristian Andrei, Oana Andrei, Iulian Andreicovici,
Valerica Aprodu, Dana Avramescu*, Georgiana Bagu, Daniel Bartoş*,
Ionela Berceanu^{+}, Gheorghe Caragheorgheopol*,
Vasile Cătănescu*, Mircea Ciobanu*, Gheorghe Dima, Petre Dima^{+},
Constanţa Dincă, Viorel Duţă*, Marin Duma*, Gheorghe Giolu*,
Andrei Herghelegiu, Mariana Ioniţă*, Iosif Legrand*, Amelia Lindner*,
Adrian Mare*, Gheorghe Mateescu*, Costică Măgureanu*, Nelu Mihai*,
Dorin Moisă*, Gheorghe Nagel^{+}, Mariana Petriş,
Alexandrina Petrovici, Mihai Petrovici*, Amalia Pop, Lucia Prodan*,
Andrei Radu, Laura Rădulescu, Claudiu Schiaua, Victor Simion^{+},
Gabriel Stoicea*, Mădălina Târzilă, Petre Zaharia*.
(* former members, $^{+}$ deceased)

Editors

Mihai Petrovici and Amalia Pop
Production editor: Adrian Socolov

Electronic version

HPD Couriers can be accessed at: http://niham.nipne.ro/HPD_Courier.html


ATLAS
ALICE
CMS
LHCb

Ministerul Educației
şi Cercetării

10th anniversary of Romania becoming a CERN Member State

Editors
Mihai Petrovici and Amalia Pop
Production editor: Adrian Socolov