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**Project No:** 318922

**Project Acronym:** EENP2

**Project Full Name:** EUROPE EGYPT NETWORK FOR PARTICLE  
PHYSICS

## Marie Curie Actions

## Mid-term Report

**Period covered:** from 01/01/2013 to 31/12/2013

**Period number:** 1st

**Start date of project:** 01/01/2013

**Project coordinator name:**  
Prof. Giuseppe Iaselli

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POLITECNICO DI BARI

# Mid-term Report

## PROJECT MID-TERM REPORT

<b>Grant Agreement number:</b>	318922
<b>Project acronym:</b>	EENP2
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# 1. GENERAL PROGRESS OF THE PROJECT

The project has achieved most of its objectives and technical goals for the mid-term period with relatively minor deviations;

## Description of the modifications:

Most of the expected technical and scientific goals for the midterm period have been successfully achieved. A general description of the scientific outcomes will be extensively given in section "Project Achievements". The original secondment Gantt chart was however rescheduled by moving some visits to 2014 to cope with the initial difficulties connected to well know political instability that Egypt has faced in 2013. This rescheduling of the secondments has not affected the project overall running thanks to proper use of remote virtual meeting capabilities that has allowed frequent contacts both in the contest of the EENP2 work packages activities and in the larger CMS collaboration contest in which the project is embedded.

## Qualitative indicators of progress and success in line with workplan and milestones (description of progress towards milestones and deliverables)

The EENP2 INDICO web site (<http://www.ba.infn.it/INDICO/EENP2>) contains an exhaustive documentation of all talks given at the various meetings. This collection surely proves the progress and the active involvement of the researchers in the ongoing activities. The frequent call for remote virtual meetings and presentation of status reports, has prompted the young researches involved in each WP to plan coherently the work and has offered opportunities to widely discuss the results. With the proper use of these resources, effective and efficient activity was carried on by the seconded ESRs/ERs also after their return to Egypt. In addition, they could also discuss their work once approved in the EENP2 contest, in larger audiences of the CMS experiment, offering an unique opportunity for their career profile enhancement.

Some of the seconded ERSs had the opportunity to travel to the European Organization for Nuclear Research (CERN) either to join collaboration meetings or to spent a longer visiting period, thanks to the support of the Italian INFN and French CNRS-IN2P3 funding agency for particle physics. This was particularly beneficial for the WP2 EENP2 activity on detector development that could be integrated in the high level expertise and laboratory infrastructure available within the CMS collaboration.

As far as the single WPs are concerned, impressive progress have been made in the new particles search analysis, in the preparation of instruments for the detector laboratory and in the training of experts for GRID computer centre management and operation. In this contest, an important donation of servers and other hardware has been recently done from CERN to the Academia of Scientific Research and Technology (ASRT) toward the development of an Egyptian GRID node. The presence of local experts formed at the European POLIBA and ECOLE sites through the EENP2 project has been one of the promoting factors for such positive attitude of the European laboratory. As planned in the EENP2 "Annex I-Description of Work" document, the first consolidation meeting foreseen at month 12, has successfully taken place on January 2014 in Cairo. The double purpose of this meeting was to overview the different WPs activities (with emphasis on presentations from the young researchers involved) and monitor the network effectiveness during the first year. Finally the organization of the High Energy Physics School in Egypt is quite advanced. The school has been planned for end April 2014, quite in line with the expected schedule at the month 16 of the project milestone chart. A draft poster announcing the school is available at the EENP2 web page (<http://www.ba.infn.it/EENP2>).

## 2. PROJECT ACHIEVEMENTS

### Scientific highlights and research achievements:

#### Achievement on WP1

The objective of WP1 “New particles search” is the reconstruction, analysis and simulation of collision events produced in CMS, for the search of the Standard Model Higgs and new massive boson predicted in Beyond Standard Model theories. The studies were performed both at POLIBA and ECOLE. The activity at POLIBA was more focused on the standard model Higgs discovery and the performance of the muon system, while ECOLE was more involved on Beyond Standard Model new particles search and the performance of the Electromagnetic calorimeter.

A new boson fully compatible with that expected in the Standard Model via the Higgs mechanism was discovered between 2012 and 2013 by CMS (and ATLAS) experiments. The activity of the POLIBA group, therefore, mainly concentrated on the confirmation of the discovery and the measurements of particle properties, like the mass and the spin/parity.

Dr. Reham Mohammed Aly, seconded at POLIBA, contributed to the  $H \rightarrow 4$  leptons analysis on 2011/2012 data (corresponding to an integrated luminosity of 5 fb<sup>-1</sup> at 7 TeV in 2011, and 19.8 fb<sup>-1</sup> at 8 TeV in 2012). She mostly focused on 4 muons final state and studied the strategy to suppress the background and estimate it from data by “fake rate” methods. She studied the selection strategy for observables (object selection), was able to reproduce the full analysis up to the final 4 leptons spectrum and developed the statistical analysis to quantify the significance of the excess found on data and derive exclusions limits. The study on the 4 leptons analysis is now continuing by re-interpreting the results in terms of a search of new boson in EWK-singlet theory. A note on  $H \rightarrow ZZ/ H \rightarrow WW$  is going to be released soon, followed by a paper (“high mass” paper).

Dr. Reham Mohammed Aly also contributed to muon performance studies from data and simulated Monte Carlo events, measuring the muon selection efficiency by “tag&probe” method.

Dr. Ahmed Sayed Hamed Ali, seconded at POLIBA for two months, focused his activity on muon simulation studies in the CMS detector using the “GEANT 4” software. The study had the major objective to understand the best detector muon geometry and technology to exploit the physics potentially offered in the forward region (especially in connection with multi-leptons final state decays) for the future upgrade at the high luminosity LHC. Detectors with extreme timing performance were simulated to understand the benefit introduced to background and fake muon suppression. The distribution of the time-of-flight and the dependence on the transverse momentum of the muons impacting the muon system were carefully analyzed to assess the improvement of the muon trigger capability using detector with time resolution in the range of tens of picoseconds. Effects of the final physics performance on some relevant channels were finally evaluated. As secondary objective, the training on the use of “GEANT 4” software, can build expertise in the field of complex geometry simulation for application in medical physics and medical treatment. This activity, therefore also constitute an interesting transfer knowledge for applied science.

The work at ECOLE concerned different aspects of the analysis of data recorded in the CMS experiment during years 2011-2012 and the preparation of the next data taking, with particular attention the Electromagnetic Calorimeter (ECAL) operation. Two Egyptian physicists (Dr. Sherif Elgammal and Dr. Moustafa Eshra) were seconded to ECOLE, respectively for one and three months, to continue a study they already started in Cairo, in the High Energy Electron Positron Pairs (HEEP) international team of CMS. Their work profited from many discussions and help with experts working in the French laboratory. A study was done to recover the saturated crystals in the ECAL, using the Multi Variables Applicators (MVA) technique already used by the POLIBA group for the Higgs boson discovery, and more widely in CMS. Promising results were obtained, showing a recovery of saturation at the 1.2%, better than the 5% obtained by a previous method. A CMS analysis note is in preparation. The “spikes” are background signals arising in ECAL, due to ionization by the products of neutrons interactions of the light detectors (avalanche photodiodes). In the future data taking at 14 TeV, they may be even more disturbing, both in the acquisition trigger and in the off line selection. A study was performed by simulation to understand the magnitude of this effect, especially for HEEP analysis. A tuning of the “spike killer” algorithm at the Level One was performed. An analysis note is in preparation.

The search of high energetic electron pairs can lead to the discovery of new physics beyond the Standard Model. In particular new gauge bosons ( $Z'$  and  $W'$ ) from Grand Unified Theories (GUT) or extra spatial dimensions (Kaluza-Klein excitations of the graviton). A discovery should manifest itself first as a bump in the invariant mass plot of the electron pair known from standard physics. The spin determination can then be utilized to separate the different hypotheses on the nature of this new particle. A simulation study of the angular distribution using MVA was performed for the future data taking in 2015. This work is continuing with frequent remote video meeting between ECOLE, Egyptian universities and other CMS collaborators involved in this research subject.

#### Achievements on WP2

The consolidation of the present CMS system of Resistive Plate Chambers (RPC) and novel R&D for future detectors were the main areas of activities. In parallel, the preparation of tools and infrastructures for the Egyptian gas lab was initiated.

The CMS collaboration is upgrading the forward detector by adding a fourth station of RPCs whose finale performance test before installation is now going on at the CERN CMS-RPC gas laboratory. The POLIBA group is steering this activity in view of its high level expertise in the field. Two of the Egyptian ESRs seconded to POLIBA (dr. Shereen Aly and dr. Ahmed Ibrahim) have been integrated in the performance study group to acquire basic knowledge of the gaseous detector performance studies and operation. They are frequently visiting the CERN laboratory and are actively taking part to the efficiency studies on the new chambers with a cosmic ray telescope set up. Their training is preparatory to the development of a similar facility at the HELWAN university. The understanding of methods and procedures in the study of gaseous detectors constitutes an important scientific background to operate in future the Egyptian laboratory. Also they have recently started collaborating to a new set of measurements under gamma irradiation at the GIF CERN facility. The test is crucial to monitor the detector performance in severe background condition and study ageing effects.

CMS was originally designed for ten years operation at instantaneous luminosity of  $1034 \text{ cm}^2\text{s}^{-1}$ . In the future, however the Large Hadron Collider is supposed to deliver much higher luminosity, representing a challenge for the operation of the present detectors and forcing a general upgrade with more robust background effective detection techniques. The upgrade is now under discussion and it will be driven by the knowledge of the expected conditions at high luminosity, the availability of a detector technology capable to cope with high rate and the cost sustainability with respect to the benefits in terms of physics performance. In order to establish the physics justification for the proposed muon upgrades, the CMS collaboration started a detailed simulation program with updated geometries, detector materials and detector response to particles. Dr. Shereen Aly and dr. Ahmed Ali Abdelalim have been fruitfully integrated in the CMS group developing concepts and simulation for the future upgrade. Novel detection techniques, such as Gas Electron Amplifiers (GEM) and Glass Resistive Plate Chamber (GRPC) are being proposed for the upgrade of CMS. To this purpose, dr. Ahmed Ali Abdelalim using the full simulation and dr. Shereen Aly with the fast simulation are working in order to understand the required technical specification. The WP2 EENP2 activity has been so far focus on GEM and dr. Ahmed Ali Abdelalim is active part of the group studying the improvement of CMS physics capability by adding these detectors in the first two stations of the experiment.

The preparation of the HELWAN gas detector laboratory has a twofold approach: the HELWAN team is preparing general purpose infrastructures such as gas system and power system. Those infrastructures are now in place and the commissioning will be completed in the next months. On the other hands the WP2 ESRs seconded to POLIBA are developing and setting up, with the help and advice of the POLIBA team, a consistent test system to be exported to Egypt for the use in their laboratory. The milestone sets the hardware and the software completion by April this year. Once ready the system will be operated and certificated in Europe before the shipment to Egypt.

### Achievements on WP3

The WP3 secondments were aimed to train Egyptian experts in view of the consolidation of a GRID infrastructure in Egypt. Two ESRs joined the programme (dr. Ashraf Kasem, dr. Mohamed Elshamy) visiting both the ECOLE and POLIBA sites. They were primarily trained on basic installation, configuration and management for a typical GRID site supporting CMS Virtual Organization, including the services needed to deal with official data transfers.

Subsequently they approached the installation and configuration procedures of general-purpose monitoring systems, aiming to get all the necessary skills to monitor both the services deployed at a generic GRID site and the end-user activity. They also experienced tools for data transfer and jobs submission.

They will now apply those concepts and knowledge for establishing a GRID node in Egypt. The schedule foresees the installation of a small TIER3 center at AINSHAN in time for the event "High Energy School" on April 2014. The readiness of this computer facility will enable the school students to experiment data analysis jobs submission and CMS GRID protocol training.

In parallel, a larger TIER2 node is under preparation at the Academia of Scientific Research and Technology (ASRT), where a consistent hardware donation from CERN is already available. The ASRT management is now finalizing the preparation of general infrastructure services (computer room, cooling system, power system). The schedule for this achievement mainly rely on local budget and manpower, but the EENP2 project will stimulate it, injecting expertise and triggering the local effort toward the success.

### **Transfer of knowledge and Training activities (workshops):**

The transfer of knowledge follows two main streams: improve the scientific and technical background of seconded ESRs/ERS; promote the active involvement of other Egyptian researchers allowing their participation to the project through remote connection meetings and discussions. The seconded personnel to Europe has primarily become familiar with the available equipments and software tools at the European sites. Indeed, it should be noticed that, most of them had already some basic knowledge so that this first phase was fast. Subsequently they were prompted, under proper supervision and encouragement, to originate some new developments in the field of their competence. All the progresses have been extensively discussed in the section dedicated to the "Project Achievements". It is important to mention that the work was monitored and reviewed through frequent open meetings where the researchers could present the improvement and get wide feedback.

On the other hand, the existing possibility to join the discussion also through remote connection, has allowed participation of other Egyptian scientists and young students triggering their interest and promoting their participation.

Besides the strict EENP2 meetings, the possibility to join from Europe other CMS meetings and the chance to visit and operate in international advanced infrastructures like the CERN CMS RPC laboratory, or the TIER GRID computer centres at POLIBA and ECOLE, is undoubtedly a formidable training.

A training milestone event will be the High Energy Physics School foreseen at the AINSHAMS university from 26 April to 2 May 2014. This event will offer to the attending students/ESRs high level lectures provided by senior physicists coming from Europe. The organization is now quite advanced and a call for application is being forwarded out. The school also foresees a poster session where the students/ESR can briefly present their research activity.

Information about the school can be accessed through the EENP2 web site where also the provisional programme can be consulted. All the lectures will be also posted on the web page to be widely available for consultation.

The school will have the twofold effect of attracting and selecting best PhD students for possible early stage academic position in local institution; selecting best ESRs for training and visiting stages to Europe.

### **Dissemination of results (conferences, publications...):**

The EENP2 project has organized the first collaboration meeting on January 2014 in Cairo to monitor the collaboration effectiveness and review the research start-up. The full documentation is

available at “<http://indico.cern.ch/conferenceDisplay.py?confId=296111>”. In this contest all the progress achieved were presented and widely discussed. The collaboration meeting was open to all the research staff and master/PhD students of the Egyptian institutions involved in the particle physics field. This event has represented a first important occasion for dissemination of results. In addition, the “XII Workshop on Resistive Plate Chamber and Related Detectors” will be held at the Beijing Tsinghua University (China) (ref: <http://hepd.ep.tsinghua.edu.cn/rpc2014/> ) on February 2014. Some of the recent achievements of the EENP2 project will be presented at this conference.

As a further step, EENP2 is promoting in collaboration with the Egyptian ASRT and the Zewail City of Science and Technology, a workshop on “Science and Industry in Egypt”. The workshop will take place at Zewail City on 3-4 May 2014 and will gather together European expert on advanced technologies (microelectronics, parallel computing, nanotechnologies, accelerator technologies for medicine) and Egyptian academic and industrial partners to discuss the perspective of possible related developments.

### 3. PROJECT MANAGEMENT

#### Overview of the activities carried out by the partnership; Identification of problems encountered and corrective action taken:

The EENP2 activity is distributed among four main work packages (WP) as described in the work document. The network has adopted a simple and effective management organization with a Supervisory Board, an Executive Board and WPs coordinators, following the mandate of the Work Document and the Partnership Agreement.

A first SB meeting has been held a month 4 to nominate the chair of the SB, in charge for a two years mandate and the WPs coordinators (also in charge for a two year mandate). The project organization chart is available for consultation on the EENP2 web site ([www.ba.infn.it/EENP2](http://www.ba.infn.it/EENP2)).

The project management has actively promoted the research program on data analysis, detector development and GRID computer technologies through the WPs coordinator and their deputies.

Each WP has autonomously progressed in the activity, however updating constantly the SB, the EB and the full community of the achievement in their respective fields.

It should be noted that the WP1 and WP2 activity have developed faster, having already some original seeds in Egypt, while the WP3 activity on GRID computing technologies, being definitely a new field, has required a more laborious start up phase (as certified by the lower number of meetings registered in INDICO). The seconded WP3 ESRs, after the 2013 training at POLIBA and ECOLE, are now attracting more people to constitute a basic team for the GRID development in Egypt. The EENP2 management is urging the ASRT to make available resources and stable manpower for the launch of the TIER2. Also, to overtake the obvious inertia for such a large infrastructure, we have decided to proceed with the preparation of a smaller TIER3 in AINSHAMS university which appears to be possible within the EENP2 resources. In the next months, the European expert will join the effort in Egypt to ensure that the AINSHAMS node will be ready by middle 2014.

We have registered some initial difficulties to start the secondments, partially connected to known turbulence in Egypt, but also due to the important teaching load that the academic personnel has to face, resulting in a reduced availability for possible visits to Europe. We succeeded however to start the secondment program, and a rescheduling was applied between the year 2013-2014 to account for these circumstances.

The SB members have been constantly in contact beyond the formal occasions by organizing with short notice VIDYO or SKYPE discussion whenever this was necessary. Often the WPs coordinators were also included in the meetings. This approach has helped to establish friendly and cooperative management style by also offering quick and effective reaction to unforeseen problems.

The SB and EC members have been very proactive in the last months toward Egyptian academic authorities to emphasize the role of the EENP2 project as a boosting factor for the development of the particle physics and related technologies in the country. They are also activating management contact with European funding agencies (the Italian INFN funding agency, the French CNRS-IN2P3 funding agency) and other relevant European projects (ReCaS) to ensure future long term collaboration.

## 4. ADDITIONAL INFORMATION

### Additional information, which may be considered useful to assess the work done during the reporting period:

During the first year of activity some well known socio-political perturbations and instabilities in Egypt has somehow decreased the potentiality of the project toward the fully exploitation in the country of the possibilities offered by the exchange programme. Nevertheless, the secondment programme has started and the use of virtual rooms offered by the CERN VIDYO system has allowed constant and frequent meetings on the different work packages. This is a quite relevant aspect, because some logistic difficulties affecting the normal daily research activity in Egypt (heavy teaching load on ESRs, long daily time trip to reach the institutes from home places, and the previously mentioned political instabilities) can impacting negatively on the research capability. The possibility of remotely steer the activity, together with the frequent monitoring of the progress, has significantly compensated for these negative factors.

Although all the Egyptian institutions are under the umbrella of the Academia of Scientific Research and Technology (ASRT) and the Egyptian Network for High Energy Physics (ENHEP), the inter-institution collaboration needs to be reinforced, also in view of the fact that the average size of the research groups is below critical mass. Again, the call for frequent virtual meetings has favorably boosted the attitude toward a more fruitful local collaboration.

The preparation of local Egyptian infrastructures for a data analysis center, a computer center and a detector laboratory is one of the main scopes of the project. While the initial effort for these achievements will be mainly based on European expertise and successful training of local researchers, the final delivery of such infrastructures will be mostly due to Egyptian funding capabilities for instrumentation and stable manpower. Milestone for delivering such infrastructures are further ahead in the project schedule. However it is predictable that the difficult economic situation in Egypt could somehow affect the completion. In this respect the EENP2 project has urged the ASRT and ENHEP managements to activate all possible funding mechanism which could synergistically contribute to the establishment and the long term running of such strategies scientific infrastructures. Also the EENP2 project is promoting collaboration agreements between the Italian INFN funding agency, the French CNRS-IN2P3 funding agency and the Italian ReCaS project (whose scope is the creation of GRID computing infrastructures in south Italy) to further deploy all possible additional resources that could be made available.

**Attachments**

school poster 2014.pdf, Managment chart.pptx,  
Slides 22-23 January 2014.pdf

Date:

Person in charge of the project for the beneficiary(ies):