CURRICULUM VITÆ ET STUDIORUM

PERSONAL

Name	**Marco Poli Lener**
Place and date of birth	**Rome, 13 Gennaio 1978**
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EDUCATIONAL QUALIFICATIONS

07/04/2006	Ph.D. in Physics obtained at the "Universita' degli studi di Roma Tor Vergata". Title of the Ph.D. thesis: "Triple-GEM detectors for the innermost region of the muon apparatus at the LHCb experiment". Thesis publishing: CERN-THESIS-2006-013.
12/07/2002	Physics degree obtained at the "Universita' degli studi di Roma Tor Vergata" with a mark of 109/110. Title of the thesis: "Studio e sviluppo di un rivelatore a GEM per la zona centrale della camera a muoni di LHCb". http://www.infn.it/thesis/PDF/244-Poli%20Lener-laurea.pdf
1997/1998	High school diploma at the "Giuseppe Peano" institute of Rome.

POST-DOC CONTRACTS

27/07/2006 – 26/07/2008	Research Grant at the Laboratori Nazionali di Frascati
27/07/2008 – 30/08/2009	Research Contract (art 2222) at the Laboratori Nazionali di Frascati
1/10/2009 – in place	Fixed Term Contract at the Laboratori Nazionali di Frascati

SCIENTIFIC EXPERIENCE

01/04/2001 – 6/03/2005	Collaboration for the study and optimization of GEM detectors for the LHCb experiment.
10/02/2005 – 12/12/2008	Responsible for the construction and quality controls of GEM detectors for the LHCb experiment.

11/05/2005 – 23/07/2007	Responsible for a Monte Carlo simulation for luminosity measurements at LHCb experiment.
3/05/2006 – 2/2/2008	Collaboration for detector development in the field of medical physics based on PET and SPECT diagnostic techniques.
2/07/2006 - 1/12/2008	Responsible for the integration, installation and commissioning of GEM detectors in LHCb experiment.
15/01/2008 – 20/06/2009	Collaboration in the SIDDHARTA experiment for the optimization of the trigger system, the data analysis and eV calibration procedures of Silicon Drift Detector (SDD).
12/06/2008 – 30/09/2009	Collaboration for detector development for beam diagnostics and measurement of fast neutrons produced by thermonuclear plasma.
23/03/2008 – 30/06/2010	Collaboration in the upgrade of the VIP experiment at LNSG.
5/05/2008 – 30/06/2014	R&D responsible for a Time Projection Chamber (TPC) based on GEM for the AMADEUS experiment, a new proposal experiment at Laboratori Nazionali di Frascati.
10/04/2014 – in place	R&D responsible for a novel Micro-Pattern-Gas-Detector called μ-RWELL. Co-responsible of the detector simulation and data analysis.

COMPUTER SKILL

Good knowledge of analysis languages such as PAW, ROOT, C++ and Fortran, Monte Carlo simulation such as Pythia and Garfield. Excellent knowledge of Windows, Mac OS X and Linux operating systems; Microsoft Office, Open Office and iWork packages; Firefox, Explorer and Safari web browsers; Thunderbird, Outlook and Mail email clients; HTML Internet language.

SCIENTIFIC SKILL AND EXPERIENCE

Natural skills of dynamism and determination allow me to face and solve different problems in research projects and bring to a conclusion my work responsibility. The participation at several conferences and meetings has allowed me to acquire good communication skills with the various working groups. I gained a good capacity of synthesis thanks to workshop and meeting presentations and the drafting of several scientific articles.

RESEARCH ACTIVITY CURRICULUM

My research activity is mainly carried out in the development of Micro Pattern gas Detector for high energy physics experiments (LHCb), nuclear physics (AMADEUS), applied physics (neutron detector) and new R&D gas detector based on new amplification stage (μ-RWELL).
In the following the details of my research activity.

2001-2008 LHCb Experiment

The first project concerned the study, development and construction of a gas detector called Gas Electron Multiplier (GEM) for the LHCb Experiment at CERN.
When I started my thesis at the Laboratori Nazionali di Frascati, the GEM detectors had just been invented (F.Sauli et al., A NIM A386 (1997) 531) and the first experiment to use them as a trackers was COMPASS in 2001 (B.Ketzer et al., NIM A535 (2004) 314).
In the same year, the group of the Laboratori Nazionali di Frascati was the first group in Italy and internationally to study and develop the GEM detector as triggering detector for the LHCb experiment, the first experiment to use GEM in the LHC era .
In fact in 2001, no detector had yet been proposed to operate in the region around the beam-pipe of the first station of the LHCb Muon Apparatus and able to provide the required time performance.
It should be emphasized that during the last decade, the knowledge progress on the GEM operation, the development in the production of large area (~1 m^2) and the good results obtained with the GEM in the first run of data LHCb convinced the scientific community to adopt this technology in the upgrade of CMS (Muon Apparatus) and ALICE (TPC).

In the following I will report the different responsibilities and tasks which I covered during this project.
In the summer of 2001 a first full simulation of a GEM detector using simulation programs such as Maxwell, Garfield and Spice was performed. The results were extremely useful in the final choice of the gas mixture and electric fields configuration. This simulation study, in which I was the co-author, was presented at several conferences and published in a journal [2].
From the fall of 2001, several prototypes were built and tested with particle beams at CERN and at the Paul Sherrer Institute (PSI). The use of a gas mixture containing CF4, as foreseen by the simulation, has allowed to decrease by a factor of 2 the time resolution (<4 ns) with respect to the measurements published in literature.
In December 2001 I presented the first experimental results at the LHCb collaboration [b], which were published in journals ([1], [5]).
Starting in the spring of 2002, I performed an analytical modelling of detector parameters such as the single GEM gain and the transparency of the GEM to ions and electrons. This study was then published in a journal [3]. In the summer of 2002 I was responsible for the data acquisition and the data analysis of the laboratory measurements and in a test beam for the study of the discharge probability of GEM detectors. For the first time, it was measured the positive effect of the electron spread to reduce the discharge probability. Exploiting this effect, different prototypes were exposed to a high intensity hadrons beam without losses in the time performance.
In addition, the discharge mechanism was studied in detail with an α source as a function of the detector geometry, gas mixture and GEM polarizations. I presented these results in a conference [I] and they were published in a journal [5]. In the summer of 2003 I was responsible for the data acquisition of an aging test performed at ENEA Casaccia, where three prototypes were exposed to a radiation dose greater than that foreseen in 10 years of operation in the LHCb experiment. Detectors were shown to be able to tolerate such radiation dose without damage or performance loss. The results were presented at several conferences and published in journals ([6], [7]). In

February 2004 the GEM detector technology was officially chosen by the collaboration to equip the innermost region of the first Muon Station of the Apparatus. I was one of the authors of the Addendum of the Muon System Technical Design Report [a].
In 2006 the project was involved in the construction of all detectors. In addition to the construction, I was responsible for activities related to quality controls of all delivered detectors. The results were presented at several conferences ([II] and [III]) and published in journals ([8], [xiv]).
From 2006 to 2008 I was the responsible of the GEM detectors integration and commissioning in the Muon Apparatus at CERN.

Within the experiment collaboration I actively participated to a Monte Carlo simulation for the absolute measurement of the integrated luminosity at LHCb during data taking. This simulation has focused on the study of processes such as $Z \rightarrow \mu\mu$ and $W \rightarrow \mu\nu$. Despite the limited geometrical acceptance of the experiment and the optimization of the experiment on the B physics, these simulations have demonstrated the ability to perform an absolute luminosity measurement at LHCb with an accuracy better then the theoretical uncertainty in the production cross section of Z and W bosons. Currently, this uncertainty is estimated to be of the order of 4% .
This work allowed to join in the working group at CERN, "Production and Decay Model Working Group." The details of this analysis were published in an internal note of the experiment [c].

2008-2009: SIDDHARTA Experiment

In that period I contributed to the SIDDHARTA experiment, where I was co-responsible of the trigger system. I participated in the installation of SIDDHARTA setup on DAΦNE accelerator. Furthermore I was responsible for establishing and implementing the calibration procedures at eV level for the Silicon Drift Detector (SDD) used in the experiment.
I was the responsible for the optimization of trigger procedures and the efficiency control of the data taking during the injection of beams in DAΦNE. The results were published in various journals [xix], [xxi], [xxiii].

2008-2009: Development of GEM detectors for beam diagnostic and detection of fast neutron

In the period between 2008 and 2009 I actively contributed to the development and test of GEM detectors for beam diagnostics and measurement of fast neutrons produced by thermonuclear fusions [xvii].
In this project several GEM detector prototypes were realized and tested with different purposes: as a monitor of Bremsstrahlung and luminosity at the DAΦNE accelerator at Frascati, for beam diagnostics (electrons at the BTF-Frascati , protons at SPS - CERN, heavy ion at LNS-Legnaro) and finally to detect fast neutrons produced in the Frascati Neutron Generator (FNG) facility at ENEA-Frascati.
In particular the latter application is enjoying a great interest in the physics of thermonuclear plasmas. In order to use a GEM detector as a fast neutron monitor it was necessary to simulate and optimize the thickness of a converter (polythene) and a photon absorber (aluminum) in order to maximize the conversion efficiency for neutrons of 14 MeV, i.e Deuterium-Tritium process (DT), and 2.5 MeV, i.e. Deuterium-Deuterium process (DD) respectively.
A first prototype was realized for both the reactions described above using two different thicknesses of polythene and aluminum: 2 mm of polythene and 0.5 mm of aluminum for DT and 700 μm and 5 μm for DD .
The results were encouraging and demonstrated that this detector can operate in hostile environments, up to 2.5*105 2.5 MeV n cm-2 s-1, and with a good photon rejection.

2008-2010: Upgrade of the VIP Experiment

The fourth project is related to the upgrade of the VIP experiment at the Laboratori Nazionali del Gran Sasso (VIP-2). The collaboration foreseen to increase the experiment sensitivity in order to improve of an order of magnitude the current measurement of the exclusion probability of Pauli principle [xxvii].
The upgrade foresees the use of new materials with a low background radioactivity, the application of a new veto system and the use of a new and larger detection system based on the detectors Charge Coupled Device (CCD).
My main responsibility was to study through a Monte Carlo simulation the signal to noise ratio expected in the VIP-2 and to estimate the increase in sensitivity of the upgrade with respect to the current VIP experiment.

2008- 2014: AMADEUS Experiment

From 2008 I have the responsible role for the simulation, the development and the test of a Time Projection Chamber (TPC) based on GEM detector (GEM-TPC) as internal tracking and particle identification device in the AMADEUS experiment.
The detector performances of the first GEM-TPC prototype with a drift gap up to 15 cm were successfully measured at the Frascati Beam Test Facility and at the Paul Scherrer Institute in Zurich. Detection efficiency greater then 99% and spatial resolution of about 250 μm for single track and 300-400 μm for events with two or more tracks were measured.
An energy resolution of the order of 10% was obtained which allow to identify π, K, p particles in the momentum range of 100-200 MeV/c with a high separation (> 5 σ). These experimental measurements were compatible with those simulated with Garfield and GEANT.
The results were very encouraging and they were presented at a several conferences [IV, V] and published in journals [10], [xv], [xxv].
Currently the R&D project is addressed to study a GEM-TPC as a low mass target and a particle detector at the same time. Such novel idea is motivated by the need of studying the low energy interactions of K- with nuclei in a complete way, tracking and identifying all participant particles. Even more, what makes revolutionary the proposal is the possibility of using different targets (gases of different light nuclei) without any other substantial intervention on the experimental setup, making it a flexible multipurpose device. This new detection technique applied to the nuclear physics requires the use of low-mass material and very pure gases such as Hydrogen, Deuterium, Helium-3, Helium-4, etc.
Detector gain measurements with pure gas helium have been performed in the laboratory, showing that the detector can reach gains of the order of $2x10^4$ before entering the streamer regime. The detector performance filled with pure helium have been measured at PSI obtaining efficiencies of the order of 95% and a spatial resolution of about 350 μm for single track.
The achieved results have been presented in a conference [VI] and published in a journals [11].
This R&D project , where I fulfill the role of spokeperson for the Laboratori Nazionali di Frascati in the European FP7 project "Joint-GEM".

2014- 20015: R&D on a novel Micro Pattern Gas Detector based on the "WELL" amplification concept

By combining in a unique approach the solutions and improvements realized in the last years in the Micro-pattern-gas-detector (MPGD) field, I actively collaborate to the development of a novel detector architecture called micro-Resistive-WELL (μ-RWELL).

The novel detector has been designed at the Laboratori Nazionali di Frascati and realized the first time in the 2009 by TE-MPE-EM Workshop at CERN in parallel with the CERN-GDD group. This new detector has some features (such as electric field shape and signal formation) in common with some MPGDs developed by the end of last century (C.A.T. and WELL).
The μ-RWELL is realized by merging a suitable etched GEM foil with the readout PCB plane coated with a resistive deposition. The copper on the bottom side of the foil has been patterned in order to create small metallic dots in correspondence of each WELL structure. The resistive coating has been performed by screen printing technique.
The WELL matrix geometry is realized on a 50 μm thick polyimide foil, with conical channels 70 μm (50μm) top (bottom) diameter and 140 μm pitch (of course different geometries can be considered in order to optimize the detector performance, especially in terms of gain amplitude).
A cathode electrode, defining the gas conversion/drift gap, completes the detector mechanics.
The μ-RWELL has features in common either with GEMs or Micromegas:
- from GEM it takes the peculiarity of a "well defined amplifying gap", thus ensuring very high gain uniformity. While MicroMegas, using "floating meshes", have lost this property moving to large area.
- from MicroMegas it takes the resistive readout scheme that allows a strong suppression of the amplitude of the discharges.
The assembly aspect of the μ-RWELL technology is obviously a strong point in favor of this architecture. It does not require gluing or stretching of foils or meshes: a critical and time-consuming construction step of both GEM and MicroMegas technologies.
With respect to the GEM and MicroMegas the proposed technology is extremely compact, does not require very stiff (and large) support structures, allowing large area covering based on PCB splicing with a very reduced dead space (0.2-0.3mm).
In this preliminary phase, I have performed the role of the responsible of the detector simulation: even though the amplifying element of the μ-RWELL is practically the same of the GEM, its signal formation mechanism is completely different. The signal in a GEM detector is mainly due to the electron motion, while in a μ-RWELL besides the very fast collection of the whole electron charge produced into the amplification channel (200 ps) also the ionic component contributes to the formation of the signal. In this sense the signal of a resistive-WELL is more similar to the one of a MicroMegas.
I am the responsible of the data acquisition and the data analysis collected in the laboratory with an X-rays tube: detector gain larger than 10^4 has been measured with in Ar/CO_2 che $Ar/i\text{-}C_4H_{10}$ gas mixtures. The use of thicker kapton for the realization of the amplifying component of the detector should allow to achieve gas gain larger than those obtained with the 50 μm thick amplification gap.
The introduction of a high resistivity layer between the amplification stage and the readout has been measured to reduces:
- the capability to stand very high particle fluxes. The results show that the rate capability of the detector (from 100 kHz/cm^2 to 600 kHz/cm^2 with X-rays, for a surface resistivity of about 100 MΩ/square) can be tuned with a suitable segmentation of the resistive layer.
- the discharge amplitude. It was observed at high gas gain that for the μ-RWELL the discharge amplitude is of the order of few tens of nA, while for a GEM detector is of the order of μA.
I also performed the responsible role for the data analysis of a beam test at
at the H4-SPS beam line (CERN), where for the first time a μ-RWELL prototype (with 80 MΩ/square) was equipped with a 400 μm strip pitch readout plane and with the analog APV-25 chip and in a magnetic field. The prototype performances have been very encouraging, showing a space resolution of <50 μm with a detection efficiency of the order of 98% (with 4 mm gas gap).
All the results obtained has been presented at conferences and published in several journals [13-14].

The μ-RWELL seems to be a very promising technology showing important advantages with respect to classical MPGDs: the detector, because "thin - large - simple", is a valuable solution for large size tracking and digital calorimeters where reliability, construction simplicity and cost-effective technology are recommendable.

Presentations at International Conference

I. Novosibirsk (Russia) 2002: “8th International Conference on Istrumentation for Collading Beam Physics”, where I presented the work “Performance of a triple-GEM detector for high-rate particle triggering”, Nucl. Instrum. & Meth. A494 (2002) 156.

II. Catania (Italia) 2005: “IFAE – Incontri di Fisica delle Alte Energie”, where I presented the work “Triple-GEM detectors for the innermost region of the LHCb muon apparatus”, AIP Conference Proceedings Vol. 794 (2005) 311.

III. Honolulu (U.S.A.) 2007: “Nuclear Science Symposium and Medical Imaging Conference”, where I presented the work “The commissioning of the triple-GEM detectors for the Muon Apparatus of the LHCb experiment”, IEEE NSSMIC Vol. 6 (2007) 4671.

IV. Biodola (Italia) 2009:”Frontier Detectors for Frontier Physics” where I presented the work “Performances of a GEM-based TPC prototype for new high-rate particle experiments”, NIM A617 (2010) 183.

V. Bormio (Italia) 2013: “51th International Winter Meeting on Nuclear Physics”, where I presented the work “GEM-based TPC performances for the AMADESUS experiment” , PoS(Bormio 2013)037.

VI. Bormio (Italia) 2014: “52nd International Winter Meeting on Nuclear Physics”, where I presented the work “Active Target TPC equipped with GEM for the AMADEUS experiment”, PoS(Bormio 2014) 014.

Elenco delle più importanti pubblicazioni firmate

ARTICLES ON JOURNAL

1. ”A fast multi-GEM based detector for high rate charged particle triggering”, IEEE NSSMIC Vol. 1 (2002) 462.
2. ”A complete simulation of a triple-GEM detector”, IEEE TNS 49 (2002) 156.
3. “Measurement of GEM parameters with X-rays”, IEEE TNS 50 (2003) 1297.
4. “Triple-GEM detector operation for high rate particle triggering”, Nucl. Phys B. (Proc. Suppl.) Vol. 125 (2003) 267.
5. “Advances in fast multi-GEM detector operation for high-rate charged-particle triggering”, IEEE TNS 51 (2004) 2135.
6. “Ageing measurements on triple-GEM detectors operated with CF4-based gas mixtures”, Nucl. Phys B. Vol 150 (2006) 159.

7. “Studies of etching effects on triple-GEM detectors operated with CF4-based gas mixtures”, IEEE TNS 52 (2005) 2872.
8. “The LHCb triple-GEM detector for the inner region of the first station of the muon system: construction and Module-0 performance”, IEEE TNS 53 (2006) 322.
9. "The LHCb detector at the LHC", Journal of Instrumentation Vol. 3 (2008) S08005.
10. “A GEM-based Time Projection Chamber prototype for the AMADEUS experiment”, PoS(Bormio 2013) 037.
11. “Active Target GEM-based TPC for low energy kaon-nucleon/neclei interaction measurements”, PoS(Bormio 2014) 014.
12. “Characterization of a scintillating fibers read by MPPC detectors trigger prototype for the AMADEUS experiment”, JINST (2013) 8 T05006 (arXiv:1301.7268 [physics.ins-det]).
13. “The micro-Resistive WELL detector: a compact spark-protected single amplification”, Jinst 10 (2015) P02008.
14. “The μ-RWELL: a compact, spark protected, single amplification-stage MPGD”, PoS(Bormio 2015) 024.

CONFERENCE PROCEEDINGS

i. ”A fast multi-GEM based detector for high rate charged particle triggering”, NIM A478 (2002) 245.
ii. “Performance of a triple-GEM detector for high rate charged particle triggering”, NIM A494 (2002) 156.
iii. ”A Comparison between GEM-based detector simulation and experimental measurements”, NIM A494 (2002) 233.
iv. "Results from the measurement of GEM-based detector parameters performed with X-rays", IEEE NSSMIC Vol. 1 (2002) 595.
v. ”Advances in triple GEM detectors operation for high rate particle triggering”, NIM A513 (2003) 264.
vi. “Operation of triple-GEM detector with fast gas mixtures”, World Scientific.
vii. “High-rate particle triggering with triple-GEM detector”, NIM A518 (2004) 106.
viii. “A triple-GEM detector for high rate particle triggering”, NIM A525 (2004) 17.
ix. “Fast triggering of high rate charged particles with triple-GEM detector”, NIM A535 (2004) 319.
x. “Triple-GEM detectors for the innermost region of the LHCb muon apparatus”, AIP Conference Proceedings Vol. 794 (2005) 311.
xi. “The triple-GEM detector for the M1R1 muon station at LHCb”, IEEE NSSMIC Vol. 2 (2005) 811
xii. “Production and performances of the LHCb triple-GEM detectors equipped with the dedicated CARDIAC-GEM front-end electronic”, NIM A572 (2007) 12.
xiii. “Status of the triple GEM Muon chambers for the LHCb experiment”, NIM A581 (2007) 283.
xiv. “The commissioning of the GEM detector for the Muon Apparatus of the LHCb experiment”, IEEE NSSMIC Vol. 6 (2007) 4671.
xv. “GEM detectors activity at the Laboratori Nazionali di Frascati of INFN”, World Scientific Volume 4 (2008) 3.
xvi. “Performances of a GEM-based TPC prototype for high-rate particle experiments”, NIM A617 (2010) 183.
xvii. “Applications in beam diagnostics with triple GEM detectors”, NIM A617 (2010) 237.
xviii. “Measurement of $\sigma(pp \to b \bar{b} X)$ at $\sqrt{s}=7$ TeV in the forward region”, Phys.Lett.B694:209-216, 2010.
xix. “Kaonic atoms at DAFNE”, published PoS FACESQCD:047, 2010.

xx. “Prompt K_short production in pp collisions at sqrt(s)=0.9 TeV”, Phys.Lett.B693:69-80, 2010.
xxi. “Low energy kaon nuclei interaction studies at DAFNE”, EPJ Web Conf.3:03021, 2010.
xxii. “The AMADEUS experiment: Precision measurements of low-energy antikaon nucleus/nucleon interactions”, Nucl.Phys.A835:410-413, 2010.
xxiii. “Low-energy kaon-nucleon/nuclei interaction studies at DAFNE (SIDDHARTA and AMADEUS experiments)”, Few Body Syst.50:447-449, 2011.
xxiv. “The search for deeply bound kaonic nuclear states at J-PARC”, Int.J.Mod.Phys.A26:561-563, 2011.
xxv. “Unlocking the secrets of the kaon-nucleon/nuclei interactions at low-energies: the SIDDHARTA(-2) and the AMADEUS experiments at the DAFNE collider”, Nucl. Phys., Sec. A. (2013) 914 , 251.
xxvi. “A glimpse into the Pandora box of the quantum mechanics: The Pauli exclusion principle violation and spontaneous collapse models put at test”, AIP Conf. Proc. 1508, (2012) 136-145.

PUBLIC NOTE

a. “Second addendum to the Muon System Technical Design Report”, CERN/LHCC 2005-012.
b. “A triple-GEM detector with pad readout for the inner region of the first muon station,” LHCb-2001-051.
c. "Luminosity measurements with dimuon and single muon reconstruction of Z0 and W".

THESIS

Tesi di Laurea: “Studio e sviluppo di un rivelatore a GEM per la zona centrale delle camere a muoni di LHCb”. http://www.infn.it/thesis/PDF/244-Poli%20Lener-laurea.pdf

Tesi di Dottorato:“Triple-GEM detectors for the innermost region of the muon apparatus at the LHCb experiment”. CERN-THESIS-2006-013.