

# Alberto BELLONI

---

## Education & Employment

- [01/13–today] University of Maryland, Assistant Professor
- [07/07–12/12] Harvard University, Post-doctoral Fellow
- [08/02–07/07] Massachusetts Institute of Technology, Ph.D.  
Dissertation: “Observation of  $B_s^0$ –anti- $B_s^0$  oscillations and the development and application of same-side-kaon flavor tagging” [1]
- [04/02–08/02] University of Tsukuba, Research Student
- [10/97–01/02] University of Pisa *and* Scuola Normale Superiore, B.S.

## Research

- [01/12/–today] *Current Research*  
I joined the CMS Collaboration at the beginning of 2013, and I am currently involved in the upgrade of the Hadronic Calorimeter (HCAL). In particular, I am interested in the installation, integration and commissioning of the HCAL parts that will be added to the CMS experiment during the 2013-2014 shutdown, and in the development of new Front-End electronics scheduled for installation during the next shutdown (around 2020).

I am still interested in electroweak physics, and I intend to keep studying multi-boson final states, including the newly discovered Higgs boson.

- [07/07–12/12] *Post-doctoral Research and Activity*

### ***W/Z group convener***

On June 1<sup>st</sup>, 2011, I was appointed co-convener of the Standard Model  $W/Z$  subgroup. I coordinate the efforts of analysis teams dedicated to measurements with a  $W$  or  $Z$  boson, or off-peak Drell-Yan pairs in their final state. Measurements of interest are the  $W$  and  $Z$  inclusive and differential production cross sections, boson production in association with jets, production asymmetries and boson polarization. The precise measurement of these observables allows one to test the current NNLO QCD predictions, and constrain the structure functions of the proton, thus providing the crucial foundation for all searches for physics beyond the Standard Model. I am responsible of reviewing and supporting the  $W/Z$ -group requests for Monte-Carlo samples. I regularly participate in the editorial-board meetings where  $W/Z$  analysis papers are carefully reviewed before being presented to the ATLAS Collaboration. More than ten  $W/Z$  papers are expected to be completed by Summer 2012.

I participated in the measurement of the  $WW$  production cross section, presented in the EPS2011 conference [2]. In particular, I specified the selections that defined the fiducial cross-section measurement, which was measured for the first time. I continued working on an update of this analysis developing an algorithm to estimate the backgrounds from top events. This update utilizes the full 2011 data sample, about  $5 \text{ fb}^{-1}$ , and has recently been submitted for publication on PRD. The  $WW$  analysis largely overlaps with the Higgs-boson search in the  $WW \rightarrow l\nu l\nu$  channel, to which I contributed a cross-check of the top-background estimate. The  $H \rightarrow WW$  result is a part of the ATLAS report on the observation of a new particle in the search for the Higgs boson [3]. Finally, I also worked on the first ATLAS measurement of the polarization of  $W$  bosons with high transverse momentum, published on EPJC [4].

### ***W charge-asymmetry group leader***

In the fall of 2010, I started a sub-group of the  $W/Z$  group dedicated to the study of the  $W$  charge asymmetry. The results of my  $W/Z$  activities have been published in one of the first ATLAS papers

with LHC data [5]. As leader of the  $W$  charge-asymmetry group, I completed an update of this measurement with the full 2010 data samples [6]. In April 2011, I started working, as the main responsible for the ATLAS analysis, in a task force devoted to producing a combination of the  $W$  charge-asymmetry measurements performed by LHC experiments. The task force currently includes representatives from CMS, LHCb, and the CERN Theory Department. I concluded the analysis of the 2010 data sample with an updated measurement of the  $W$  cross section, submitted for publication on PRD [7].

#### **Data Quality liaison for $W/Z$ analyses**

When the LHC produced the first collision data at  $\sqrt{s} = 7$  TeV, I moved to  $pp$  data analysis within the Standard Model group. I formed and co-convened a group of data-quality experts with the mandate of overseeing the quality of the data samples used by analyses with leptonic final states in the  $W/Z$  group. My analysis interest was the measurement of the inclusive  $W \rightarrow \mu\nu$  cross section. I have been deeply involved in the preparation of results since the very first observation of  $W$  bosons in ATLAS, shown at the PLHC 2010 meeting, and provided updates for the later ICHEP2010 and HCP2010 conferences.

#### **Deputy Muon DAQ coordinator**

Once I joined the ATLAS Collaboration in 2007, as a post-doctoral fellow in the Harvard University, I immediately started working on the commissioning of the muon chambers for precision tracking, the Monitored Drift Tubes (MDT). My responsibility included the installation and testing of chamber services, for the chambers of the forward region of the ATLAS detector, particularly the power supplies and the readout electronics. Upon completion of the installation phase, I worked on the development and maintenance of the muon data acquisition software. I was appointed deputy Muon DAQ coordinator. In the course of my first year at CERN I had the opportunity to mentor many students, from the Harvard group and other institutions, at the graduate and under-graduate level. Students obtained first-hand experience in the assembly and commissioning of one of the largest detectors ever built. I trained graduate students to become on-call experts for the MDT DAQ shift crew. I coordinated the preparation of documentation for the MDT control-room shifters, and prepared the DAQ training meetings, available in video format.

At the end of the commissioning era, I moved to studying the performance of the ATLAS muon detectors with cosmic data. I started studying the performance of the optical alignment system, in particular pioneering the study of chamber misalignments in the end-cap muon chamber. The Harvard group also studied the performance of muon reconstruction, measuring reconstruction efficiency and resolution, and defining data-driven procedures that were later on applied to the first analyses with collision data.

- [02/03–07/07] *Ph.D. Research*

#### **$B_s$ mixing observation**

Upon completion of coursework in Boston, I moved to Fermilab to work on various projects with the final prospect of observing  $B_s$  mixing and eventually measuring the mixing frequency. At first, I worked on the measurement of  $B.R.(B_s \rightarrow D_s\pi)/B.R.(B_d \rightarrow D\pi)$ , preparing and validating all the Monte-Carlo samples needed to evaluate the reconstruction, trigger and selection efficiencies. In 2004, my interest moved to  $B_d$  mixing. I worked on the reconstruction of multiple decay modes of the  $B_d$  and  $B_u$  mesons and performed the fits for the mixing frequency and the properties of flavor taggers. The measurement of the  $B_d$  mixing frequency, an observable which is very precisely measured by  $B$  factories, allowed for a check of the fitting framework and the calibration of flavor taggers. These are important inputs to the  $B_s$  mixing analyses. The first  $B_d$  mixing analysis was presented in March 2005. Later in the same year I worked on the upgrade of the  $B_d$  mixing analysis to include more decay channels ( $B_{u,d} \rightarrow D3\pi$ ), and improving the  $B_s$  mixing analysis by adding two new  $B_s$  decay modes. Finally, in 2006 I worked on the inclusion of the new same-side-kaon tagger in the  $B_s$  analysis and produced the amplitude scan which was presented at FPCP2006, in Vancouver, with the first measurement of  $B_s$  mixing [8]. In the summer of 2006 I worked on the improvement of the same-side-kaon tagger, preparing a Neural-Network-based algorithm to be used for the following round of  $B_s$  mixing analyses, which led to the observation of  $B_s$  mixing [9]. As a member of the M.I.T group, I have been responsible for the set-up of the

framework for the preparation of Monte Carlo samples and the production of the fully hadronic samples used by all analyses since 2004.

### L3 Expert

As a requirement for the entrance in the CDF collaboration I took a three-month shift as member of the Control Room operation crew. Since then, I joined the Event Builder and Level 3 Trigger hardware support group as an on-call expert.

- [11/02] *Diploma di licenza*  
I concluded my studies at Scuola Normale Superiore presenting an update of the studies described in my B.S. thesis. Using  $11 \text{ pb}^{-1}$  of CDF-II data collected up to June 2002,  $33 \pm 9 B \rightarrow h^+ h^-$  ( $h = K, \pi$ ) candidates were reconstructed.
- [01/02] *B.S. thesis*  
Under the supervision of Prof. Giovanni Punzi I worked on the reconstruction of hadronic, charmless decays of  $B$  mesons. Assuming that the U-spin symmetry is perfect (the exchange between  $s$  and  $d$  quarks), it is possible to measure  $\sin 2\gamma$ , one of the angles of the Unitarity Triangle, using the four branching ratios  $B_d \rightarrow K\pi, \pi\pi$  and  $B_s \rightarrow KK, K\pi$ . This measure is competitive also in the case of a 10% level of inaccuracy for the supposed symmetry. The work is based on the first  $14 \text{ nb}^{-1}$  of data collected by the CDF II experiment during the October 2001 Commissioning Run. The size of the data sample allowed only for a study of the expected background to the observation of  $B$  candidates.
- [03/00] *Supervised Physics Colloquia at Scuola Normale Superiore*  
Under the supervision of Dr. Luca Ciotti (now Professor at the University of Bologna) and Prof. Giuseppe Bertin I wrote a C program to numerically solve the set of differential equations which govern the motion of a star inside a galaxy. The galaxy was described in terms of a statistical ensemble. The purpose of the study was the characterization of the regions of phase space for the initial conditions of the motion of the star and the shape of the galaxy which produce the final separation of the star from the galaxy (“evaporation” of the galaxy). A substantial evolution of this study is reported in [10].

## Conferences and public talks

- [02/12/12] Aspen 2012 - The Hunt for New Particles  
“Electroweak Physics Results from the LHC”
- [04/04/11] Working Group on Electroweak precision measurements at the LHC  
“W/Z and DY production, pt spectra, asymmetries: ATLAS”
- [03/11/11] MIT LNS Special Seminar  
“W Physics with the ATLAS Detector. Recent Results and Prospects”
- [03/07/11] PDF4LHC Meeting  
“W Asymmetry and prospects for PDF studies with ATLAS data”
- [11/18/10] ANL ASC US ATLAS Analysis Jamboree  
“Inclusive production of W- and Z-bosons. W charge asymmetry”
- [08/23/10] SUSY 2010, Bonn  
“ATLAS Recent Results”, plenary session
- [04/01/09] LBNL Atlas Analysis Jamboree  
“Cosmic Lessons for the Muon Spectrometer”
- [08/30/08] ICHEP 2008, Philadelphia  
“Integration and Commissioning of the ATLAS Muon Spectrometer”
- [09/24/06] September 2006 Beauty 2006  
“ $B_s$  Mixing at CDF”
- [06/08/06] Joint Physics Meeting, Fermilab  
“Measurement of the  $B_s^0 - \bar{B}_s^0$  Oscillation Frequency”, paper seminar, CDF Note No. 8252

- [05/31/06] Fermilab Users' Meeting  
“ $B_s$  Mixing at CDF”, poster session
- [05/19/06] SUSY Workshop, Fermilab  
“ $B_s$  Mixing Report from CDF”
- [04/17/05] APS meeting in Tampa  
“ $B_d$  Mixing and Flavor Taggers in Exclusive  $B$  Decays at CDF”

## Short Bibliography

- [1] A. Belloni, “Observation of  $B_s^0$  - anti- $B_s^0$  oscillations and the development and application of same-side-kaon flavor tagging,” FERMILAB-THESIS-2007-36 (2007).
- [2] [ATLAS Collaboration], “Measurement of the WW cross section in  $\sqrt{s} = 7$  TeV pp collisions with the ATLAS detector and limits on anomalous gauge couplings,” Phys. Lett. B **712**, 289 (2012) [arXiv:1203.6232 [hep-ex]].
- [3] [ATLAS Collaboration], “Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC,” [arXiv:1207.7214 [hep-ex]].
- [4] [ATLAS Collaboration], “Measurement of the polarisation of W bosons produced with large transverse momentum in pp collisions at  $\sqrt{s} = 7$  TeV with the ATLAS experiment,” Eur. Phys. J. C **72**, 2001 (2012) [arXiv:1203.2165 [hep-ex]].
- [5] [ATLAS Collaboration], “Measurement of the  $W \rightarrow l\nu$  and  $Z/\gamma^* \rightarrow ll$  production cross sections in proton-proton collisions at  $\sqrt{s} = 7$  TeV with the ATLAS detector,” JHEP **1012**, 060 (2010). [arXiv:1010.2130 [hep-ex]].
- [6] [ATLAS Collaboration], “Measurement of the Muon Charge Asymmetry from W Bosons Produced in pp Collisions at  $\sqrt{s} = 7$  TeV with the ATLAS detector,” Phys. Lett. B **701**, 31-49 (2011) [arXiv:1103.2929 [hep-ex]].
- [7] [ATLAS Collaboration], “Measurement of the inclusive  $W^{+-}$  and  $Z/\gamma$  cross sections in the electron and muon decay channels in pp collisions at  $\sqrt{s} = 7$  TeV with the ATLAS detector,” Phys. Rev. D **85**, 072004 (2012) [arXiv:1109.5141 [hep-ex]].
- [8] A. Abulencia *et al.* [CDF Collaboration], “Measurement of the  $B_s^0 - \bar{B}_s^0$  Oscillation Frequency,” Phys. Rev. Lett. **97**, 062003 (2006) [arXiv:0606027 [hep-ex]].
- [9] A. Abulencia *et al.* [CDF Collaboration], “Observation of  $B^0(s)$  - anti- $B^0(s)$  Oscillations,” Phys. Rev. Lett. **97**, 242003 (2006) [arXiv:0609040 [hep-ex]].
- [10] V. Muccione, L. Ciotti, “Collisionless evaporation from cluster elliptical galaxies: A Contributor to the intracluster stellar population,” Astron. Astrophys. **421**, 583-593 (2004). [arXiv:0404259 [astro-ph]].