Search for High-Mass Resonances in di-electron channel

In 2008-2009 I have performed feasibility studies for Heavy Neutral Gauge Boson search in di-electron channel at CMS. That study predicts that if such a particle exists it can be discovered with 200 pb-1 of data collected at 7 TeV in the mass range of 0.9 – 1.2 TeV, not yet excluded at that moment.

With arrival of first 7 TeV data in spring 2010 I have concentrated on validation of electron object in new data. Extensive comparisons of electron parameters have been made, with particular interest to the values that enter final electron identification for Z' analysis (so called HEEP ID). That required continuous analysis of arriving data and frequent reports to Exotica Electron group. This activity continued throughout the year of data taking. It permitted me to be among the first people to identify problem with Ecal Endcap misalignment which showed itself as a big discrepancy between data and MC prediction in distance between SC position in ECAL and track propagated from the tracker. As well as first indications of ECAL energy scale shift were observed in this prompt data analysis, with particular concentration on ECAL performance.

Based on the studies that I have performed for HEEP group as well as studies performed within ECAL DPG the effect of ECAL energy scale offset in end cap due to ECAL crystal transparency loss was accounted for by adding an average energy scale correction to SC energies associated with electrons.

Towards the end of data-taking my major activity became development and validation of methods and applications for statistical analysis of accumulated data. I have provided all the signal and background parametrization for the limit extraction procedures as well as acceptance and efficiency studies. In addition I have investigated di-electron mass resolution parametrization for Z' signal and performed appropriate Data/MC correction at Z peak. As we haven't observed any major excess in di-electron mass spectrum with respect to MC predictions, I have studies a number of methods for setting an exclusion limit on the mass of Z', such as CLsb, Feldman-Cousins, MCMC and counting experiment.

Based on the full 2010 data set corresponding to 35 pb-1 of integrated luminosity we exclude at 95 % CL Z'ssm and Z'psi with mass less then 958 and 731 GeV respectively.

AN-10-318
“Search for High-Mass Resonances Decaying to Electron Pairs in the CMS Experiment”
http://cms.cern.ch/iCMS/jsp/openfile.jsp?tp=draft&files=AN2010_318_v7.pdf

AN-10-312
“Statistical Analysis of a Resonant Signal Search in Multiple Final State Modes”
http://cms.cern.ch/iCMS/jsp/openfile.jsp?tp=draft&files=AN2010_312_v12.pdf

CMS PAPAER EXO-10-013
“Search for Resonances in the Dilepton Mass Distribution in pp Collisions at sqrt(s) = 7 TeV”
http://cms.cern.ch/iCMS/analysisadmin/paperversions?analysis=EXO-10-013
http://cdsweb.cern.ch/record/1333970
http://arxiv.org/abs/1103.0981

ECAL DPG Z->ee studies

With arrival of first significant (few pb-1) data set, Z->ee peak was used to study ECAL energy scale.

Using CB(x)BW fit to estimate peak position a comparison between data and MC was made in order to estimate energy scale offset in data with respect to MC. I have performed independent studies using VBTF95 selection which confirmed the results observed by other group. In addition I have performed systematic studies arising from peak extraction procedure. This activity continued throughout the period of several reprocessing of final 2010 data set which took place in fall 2010 – winter 2011.

The method used for peak position extraction, i.e. unbinned likelihood fit to CB(x)BW distribution, can be used to estimate effects coming from detector effects, notably ECAL energy resolution. I have performed first study of this method with respect to the Z peak width extraction within ECAL DPG, including systematic effects arising from this procedure, this method is promising and by far the most understood approach. A similar study I've performed for Z'->ee mass resolution parametrization, only then with no reference to ECAL energy resolution.

We are expecting at least one more reprocessing of 2010 data to have final results for ECAL energy scale and estimates of ECAL effects on mass resolution. Results are being summarized in ECAL DPG performance not:

AN-10-363 (No final name is not chosen yet)

J/Psi->ee studies

In preparation for 2010 data-taking i have investigated feasibility of low mass resonance observation in early LHC data. I have developed a baseline electron ID to be efficient at low pt with respect to J/Psi->ee signal observation. This ID was first tested in 900GeV and 2.36 TeV date set collected in the end of 2009. Background rates appeared to be under control.

This study allowed me to be among the first people to observe firs significant J/Psi signal in di-electron channel. This signal gave us the first candle to validate electron object in data. I was performing this validation analyzing constantly growing data set.

Apart from early confirmations of pi0 results for ECAL energy scale, this study evolved into alternative tool to investigate ECAL energy scale at low energies. This study mostly was concentrated on low luminosity period of 2010 data-taking up to October 2010, where the rates from dedicated triggers allowed us to observe significant amounts of signal events. With several groups working on the ECAL energy scale determination with J/Psi, we summarized our study in the following note concentrating on the most efficient selection Cuts in Categories (CiC).

AN-10-443
“Calibration of the ECAL energy scale using the J/Psi resonance”

900 GeV 2.36 GeV data

Arrival of first data in 2009 allowed me to test the analysis framework for J/Psi, Z' and Z analysis on data. It resulted in first Electron ID variables validation Data with respect to MC prediction. It was the first experience of continuous data analysis and validation.

ECAL Laser monitoring

ECAL crystals can undergo transparency change under the influence of radiation coming from beam interactions in CMS. To account for this changes ECAL laser monitoring system surveys each individual crystal transparency every ~15 min. That results in a vast amount of conditions data which is changing rapidly. In order for this data to be available for offline reconstruction on time a dedicated data stream was designed. I have contributed to the design of this stream and developed an application and framework for inter database transfer so called Online to Offline (O2O) transfer. A week point at that time was the speed of accessing Online DB: it could get up to several minutes for one cycle of data transfer, getting dangerously close to ~10 min limit. I developed and implemented an optimization that resulted in reduction of this time by a factor 10-50 depending whether it is write or read access. It allowed to do this access in well under ~10 sec.

ECAL Laser monitoring system was successfully commissioned and is now an indispensable monitoring system for high luminosity data taking. Currently and already for several years I am performing Laser On-Call duties that require intervention on or tuning of the laser monitoring hardware operations.

The 17th International Conference on Computing in High Energy Physics (CHEP), March 21-27, 2009 Prague, Czech Republic.
Poster contribution: “Database usage in the CMS ECAL laser monitoring system”

Published proceedings:
Vladlen Timciuc (CMS ECAL Collaboration), Database usage in the CMS ECAL laser monitoring system, J.Phys.Conf.Ser.219:022045,2010
http://dx.doi.org/10.1088/1742-6596/219/2/022045

CMS-CR-2009-159, CERN-CMS-CR-2009-159
http://cms.cern.ch/iCMS/jsp/openfile.jsp?type=CR&year=2009&files=CR2009_159.pdf

Test Beam 2006

With first ECAL super modules coming out of assembly line the need to test them in beam test stands was paramount. I participated in a series of beam test studies which took place during my first visit to CERN in summer 2006. I was working on ECAL energy resolution measurements. This study was performed at various electron beam energies and confirmed energy resolution parametrization as a function of energy. Another study that I contributed to was ECAL energy containment parametrization. The analysis was done on the data set collected with beam being centered at various positions of surface of a crystal. From the energy contained in the adjacent crystals the position of the beam on the crystal could be obtained and the reference energy containment profile can be used in order to correct reconstructed energy for the effects of beam arriving at various positions of the surface the crystal, notable near the boundary between adjacent crystals.

2007 ECAL SM integration

With approaching data taking in 2008 ECAL supermodule integration and inspection came on the critical path, as it should go in first before tracker and pixel detector can be installed in CMS detector. I participated in ecal supermodule integration, performing installation of on-detector electronics, and validation of interconnections and electronic response to test pulses, thus contributing to ECAL being on time for the CMS schedule for completion.