

Research Proposal – 18 Month – João Pela

The current knowledge in the field of particle physics is summarized in the Standard Model (SM). It is known that this model is incomplete without the inclusion of a spontaneous symmetry breaking mechanism that would explain the observation that the electroweak bosons (the W and Z particles) have mass. The easiest way to introduce such a mechanism is with the Higgs Mechanism, which suggests the presence of a new, yet to be observed particle, the Higgs Boson.

The main purpose of the Large Hadron Collider (LHC) and the Compact Muon Solenoid (CMS) experiment and also the main motivation of my PhD research, is to investigate the reasons for the spontaneous symmetry breaking.

I have worked until recently on:

- **Higgs to gamma-gamma analysis**, which was one of the leading analysis on the discovery of the Higgs boson. Here I participated on the spin measurement.

Currently I am working on:

- **Vector Boson Fusion (VBF) produced Higgs decaying invisibly analysis** which is to search for the Higgs invisible decay, and therefore more the invisible branching ratio of this new boson. This branching ratio if higher than predicted can be evidence of new physics.

For *VBF Higgs to invisible*, I will use 2012 “parked” data which is now reconstructed and available for analysis.

My work will be mainly on 3 fronts:

- **Analysis work**
 - It will include detailed analysis of the collected data and any limits or discovery/properties measurement made as well.
- **Service Work**
 - Actual work necessary to keep the experiment running such as doing shifts or supporting roles for the data acquisition like providing on-call support.
- **Trigger Performance and upgrades**
 - Improvements to the Data Quality Monitoring (DQM) of the CMS Level 1 Trigger which will allow better monitoring to the operation of the trigger as well as ability to certify the quality of the data taken.
 - Performance monitoring of the trigger system.
 - In 2013-2014 technical stop as well as in other future stops the trigger system will be upgraded and I will participate in studies to ensure the proper operation of the new system.

I started my PhD on January 2012, and have not been on LTA at the detector site in Geneva for 1 year. I have currently access to all data necessary for my thesis and will be working from now on its analysis. Assuming my PhD takes the normal 3-3.5 years this leaves me 1.5-2 years to do analysis and write my theses, which should be more than enough. Still, if more time is needed my grant cover 4 years of funding.

During all the stages of my work I will be writing up my work and presenting it internally at CMS and Imperial College Physics meetings as well as externally at conferences.