DEPARTMENT OF PHYSICS
PANJAB UNIVERSITY
CHANDIGARH
SIX-MONTHLY PROGRESS REPORT
PROFORMA FOR Ph.D. CANDIDATES

01.07.2015 to 31.12.2015
(To be submitted bi-annually by June, 30th and December, 31st)

1. Name of the candidate: Anterpreet Kaur
2. Faculty : Science
3. Department : Physics
4. Enrollment No. and Date : 13/1033 , 10-04-2013
5. Registration No. and Date : N.A.
6. Tentative/Approved Title : MEASUREMENT OF MULTIJET CROSS-SECTION RATIOS IN PROTON-PROTON COLLISIONS WITH THE CMS DETECTOR AT THE LHC (Tentative)
7. A summary of the work done during the last six months (Depending upon the stage of Ph.D. work) providing details of (i) Review of Literature (ii) Experimentation/Data Collection, Field work (iii) Data Processing (iv) Data Analysis and Interpretation and (v) Stage of thesis writing with specific reference to the goals set for the previous 6 months. (Separate sheet attached)
8. Did you complete the tasks and achieve the goals you had set for the period under report ?
   Yes/No : Yes
   If No : Difficulties, Constraints faced in achieving the objectives that had been formulated for the period under report.
9. Publications if any : N.A.

Certificate :

It is certified that the information provided above is correct to the best of my knowledge. I shall try my best to achieve the above targets during the next six months.

Name of the Candidate : Anterpreet Kaur

Signature :

Certificate:

Progress report of the candidate : Satisfactory/Unsatisfactory/Need to be improved

Supervisor Name : Prof. Manjit Kaur

Signature :

Counter –Signature of the Chairperson

PROGRESS REPORT

The jet cross-sections, differential in average transverse momentum pT are measured for inclusive two jets production as well as for inclusive three jets. Data from LHC (Large Hadron Collider) proton-proton collisions at center of mass energy of 8 TeV, corresponding to an integrated luminosity of 19.71 fb^{-1}, have been collected with the CMS (Compact Muon Solenoid) detector. Jets are reconstructed with the anti-kt clustering algorithm for a jet size parameter R = 0.7 in a phase space region ranging up to an absolute rapidity of |y| < 2.5. Appropriate selection criteria has been designed for choosing the best event.

The finite detector resolution along with the steeply falling jet pT spectrum distorts the measured cross section with respect to the particle level cross-section. To remove these detector effects from the data results, an unfolding procedure has been followed by using the results from the MadGraph+Pythia6 generator Monte Carlo samples as well as from next-to-leading order (NLO) theory predictions by using a custom Toy Monte Carlo (MC) method. The unfolded results are in agreement with the generator level MC results.

A careful examination of statistical and systematic effects has been carried out :
- Statistical uncertainties on the measured cross-sections are from < 1% to 7% for Inclusive 2-jet and from < 1% to 18% for Inclusive 3-jet events.
- Jet Energy Scale (JES) : The jet energy scale uncertainty (asymmetric) has been estimated to 3% to 9% for Inclusive 2-jet and from 1% to 15% for Inclusive 3-jet events for particle-flow jets, depending on the jet pT and η. Twenty five individual JES mutually uncorrelated uncertainty sources are considered and studied. Each of these represents a signed 1σ variation from a given systematic effect for each (pT,η) point. The sensitivity of the measurement to each JES uncertainty source was studied by changing all jets transverse momentum as: pT= pT (1 ± Uncertainty source).
- Luminosity uncertainty is ~ 2.6% for 8 TeV CMS 2012 data.

Other Activities :
- I presented the Synopsis approval talk under the title '**MEASUREMENT OF MULTIJET CROSS-SECTION RATIOS IN PROTON-PROTON COLLISIONS WITH THE CMS DETECTOR AT THE LHC**' on 12th October, 2015.
- I attended India-CMS meetings on 1-2 August 2015, 2015 at NISER, Bhubaneswar and on 21-22 November, 2015 followed by HGCAL Upgrade workshop on 23-24 November, 2015 at Tata Institute of Fundamental Research, Mumbai.

Goals for the next six months :
- To estimate the systematic uncertainties on the ratio R32, defined as the ratio of cross-sections for inclusive 3-jet events to that for inclusive 2-jet events.
- To measure the cross-sections for inclusive 4-jet events from 2012 CMS Data, MC samples and to obtain NLO theory predictions. After unfolding the data results, the aim will be to calculate ratio R43, defined as the ratio of cross-sections for inclusive 4-jet events to that for inclusive 3-jet events.
- To calculate statistical and systematic uncertainties for inclusive 4-jet events and hence for ratio R43.
- To participate in workshops, seminars and to attend academic lectures.

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