APPLICATION NO:_____
(for URA use only):

COVER SHEET URA VISITING SCHOLARS PROGRAM APPLICATION

All parts of this form MUST be filled out

APPLICANT INFORMATION
Name (*Last,First, MI*):____Bose, Suvadeep_____
Title/Status:_____PostDoctoral Research Associate _____

Home Institution:__University of Nebraska Lincoln_____ Department:_Dept of Physics and Astronomy_____
Address:____855 N. 16th Street_____ Tel. No.____402 482 2783_____
_____Lincoln, NE 68588 _____ Email:____sbose@fnal.gov_____
_____

CO-APPLICANTS
Name:_____Prof. Daniel Claes_ _____ Name:_____
Title/Status: Professor of Physics and Department Chair Title/Status:_____
Home Institution: University of Nebraska Home Institution_____
Email: dclaes@unlhep.unl.edu Email:_____

TITLE OF PROPOSED ACTIVITY *(brief description)*
First QCD Physics Measurements and Pixel-Detector Research at the CMS Experiment
I shall work on the measurement of the dijet angular distributions in proton-proton collisions at a center-of-mass energy of 7 TeV using the CMS detector at the LHC. This is a critical analysis for testing perturbative QCD and probing new physics (such as quark compositeness models) and the results are expected to be ready for publication in early 2011. I shall also work on two detector studies – charge calibration for the pixel detector and measurement of track reconstruction efficiency using only the pixel detector. I plan to take part in the test beam activity to test the performance of various radiation hard sensors for the SLHC program at the Fermilab MTest facility.

NAME OF FERMILAB SPONSOR:___ Kevin Burkett_____
Fermilab Division: CMS Center (LPC) Email: burkett@fnal.gov

SOURCES OF SUPPORT

Amount Requested: $38000_____ Duration *(months)*: _12 months _____ Requested Start Date:_01/01/2011____

Other sources of support for proposed work:_University of Nebraska College of Arts and Sciences _____
_____

Prior URA Visiting Scholar Award, if any *(month & year)*:__None_____
Sponsor:_____

GRANTS OR SPONSORED RESEARCH OFFICER *(in applicant's home institution)*:

Name: Jeanne Wicks Tel. No. 402-472-1825
Address: 312 N. 14 Street, Alexander West Email: jwicks2@unl.edu
University of Nebraska
Lincoln, NE 68588-0430
_____

Signature: Suvadeep Bose **Date:** _____**08/16/2010**_____

Project proposal of Suvadeep Bose

Overview of the proposal:

In this URA Visiting Fellowship proposal, I request support for my stay at the Fermilab LHC Physics Center (LPC) for 12 months starting January, 2011, working on the CMS experiment under the direct supervision of Daniel R. Claes of University of Nebraska Lincon (UNL). Significant support for my stay at Fermilab LPC is already being provided by University of Nebraska Lincoln (salary support). The fellowship is requested for a part of the salary and two trips between Lincoln and Fermilab.

In the interest of building UNL's permanent presence at the Fermilab LPC, and contributing to the effort to establish a US center of expertise here, I have been posted to the LPC. Full-time residence at Fermilab will enable my interaction with detector and software experts and increased participation in LPC and CMS activities. I have been already working closely with Kevin Burkett of Fermilab and Nikos Varelas (Univ. of Illinois), a visiting professor at Fermilab. Letters of support from Daniel R. Claes and Kevin Burkett are attached to this application.

The fellowship is important for me in many critical areas. First, it will allow me to engage fully in the current analysis of the QCD Dijet Angular study with the upcoming LHC data as recorded with the CMS detector. The LPC has a big and dynamic QCD group and my work will be greatly benefited by close interactions with them. Second, it will allow me to work with my collaborators in the LPC in the Tracking Data Performance Group, in which I shall continue to work on the track reconstruction and charge calibration for the pixel detectors. These studies are important for understanding the CMS tracker and are closely connected to Nebraska's established pixel effort. Third, there are pixel R&D work going on at the Silicon lab at Fermilab for the LHC upgrade program in which I will participate. Moreover, during my stay at Fermilab, I shall be able to take Remote Offline Data Quality Monitoring (DQM) shifts from the FNAL Remote Operation Center (ROC). Finally, given limited NSF funding, many Nebraska students may have limited opportunity to travel to CERN and will work primarily through the LPC. I shall help supervise all Nebraska students during their LPC visits and consult with them regularly on all CMS software issues whether here at the LPC or at home in Nebraska.

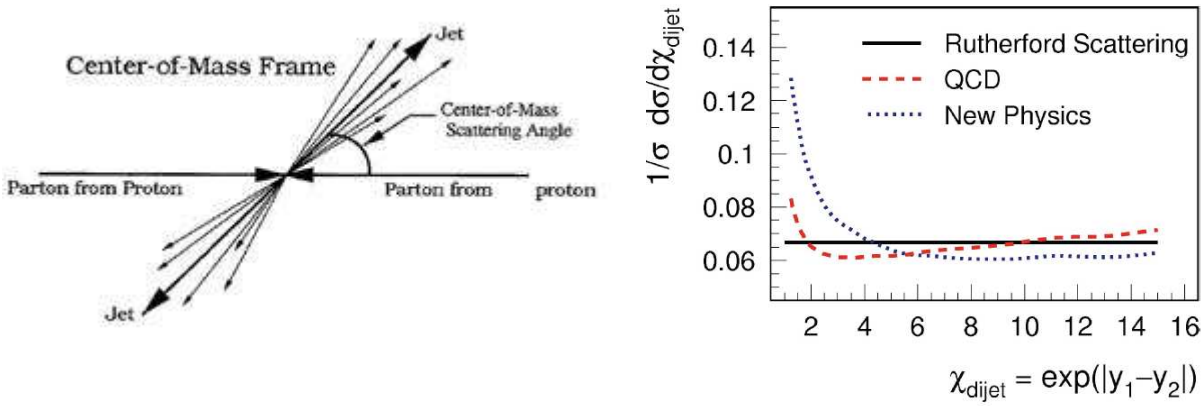
- **<u>Measurement of Dijet Angular Distributions in pp Collisions at 7 TeV</u>:**

I have been involved in the measurement of the dijet angular distributions [1] in proton-proton collisions at a center-of-mass energy of 7 TeV using the CMS detector at the LHC. This is a critical analysis for testing perturbative QCD and probing new physics (such as quark compositeness models).

Within the framework of Quantum Chromodynamics (QCD), high-energy inelastic collisions at high momentum transfers between protons are described as a point-like scattering between the proton constituents, which are collectively referred to as partons. After the collision, the outgoing partons manifest themselves, via soft quark and gluon radiation and hadronization processes, as

localized streams of particles, identified as jets (Fig. 1(a)). The production of events containing two jets with large transverse momenta (dijets) is one of the basic QCD processes occurring at hadron colliders.

The dijet angular distribution probes the properties of parton-parton scattering without strong dependence on the details of the parton distribution functions; since all three classes of scattering processes are dominated by t-channel gluon exchange, the angular dependence of the $qg \rightarrow qg$, $q\bar{q}(q') \rightarrow q\bar{q}(q')$, and $gg \rightarrow gg$ processes are similar. The dijet angular distribution is typically expressed in terms of $\chi_{dijet} = \exp(|y_1 - y_2|)$, where y_1 and y_2 are the rapidities of the two leading jets, and $y = 1/2 \ln[(E + p_z)/(E - p_z)]$, where E is the energy of the jet and p_z is the projection of the jet momentum on the beam axis. This choice of χ_{dijet} is motivated by the fact that it has a flat distribution for t-channel gluon exchange sub-processes. It also allows signatures of new physics that might have a more isotropic angular distribution than QCD (e.g., quark compositeness) to be more easily examined as they would produce an excess at low values of χ_{dijet}. (Fig. 1(b)). Measurements of dijet angular distributions have previously been reported at the Tevatron by the DØ [2, 3] and CDF [4] collaborations.



(a) (b)

Figure 1: (a) Two partons scatter at a center of mass scattering angle and create a dijet pair. (b) Normalized χ_{dijet} distribution is flat for Rutherford scattering and New Physics Signals show deviation from the flatness.

I worked on producing one of the first results from LHC, the measurements of χ_{dijet} distributions in proton-proton collisions at $\sqrt{s}$=7 TeV, with a data sample of 72 nb^{-1} from the early LHC running, normalized to the total number of events, $(1/N)(dN/d\chi_{dijet})$, within several dijet mass (M_{jj}) regions, as shown in Fig. 2. As LHC is still operating at a low luminosity, the data collected so far allow us to look into the low mass regions. With more data which are foreseen to be collected by end of the year, further probes for new physics will be possible. Studies in Ref. [5] show that with a luminosity of ~ 2 pb^{-1} we expect to exclude the compositeness model with left-handed contact interference up to a scale of $\Lambda \sim 3$ TeV, starting to probe beyond the current Tevatron limit [2].

This is a mature analysis and the results with limited data have been shown in the ICHEP 2010. I plan to publish the result by next spring with more data from the LHC. A lot of close

collaborative work is needed at this crucial stage of the analysis and with the experts around at the LPC, my interaction with them will expedite the work towards an early publication.

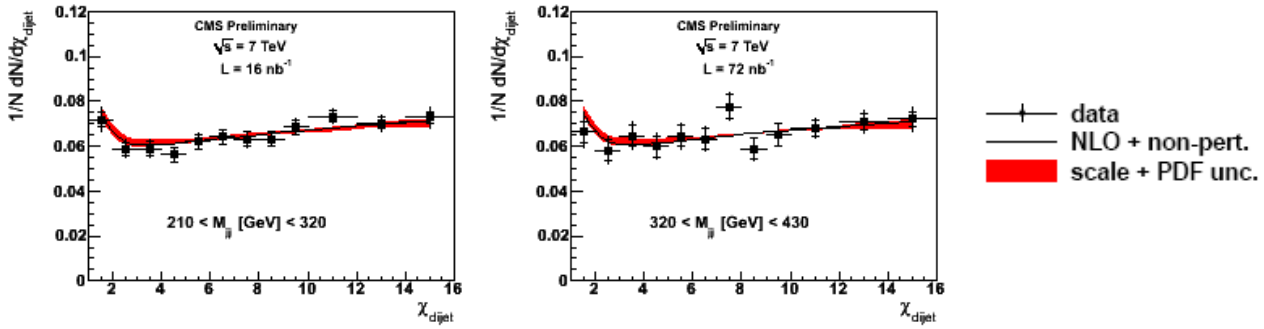


Figure 2: The first preliminary measurements of dijet angular distributions in pp collisions at √s=7 TeV are shown in two dijet invariant mass regions. The data distributions are compared to NLO QCD predictions including non-perturbative corrections. The data points include statistical (inner ticks) and systematic uncertainties. The theory band includes uncertainties from factorization and renormalization scale variations and the PDF uncertainties.

- **<u>Service works in QCD physics analysis group:</u>**

I have assumed various responsibilities within the QCD group. As a data manager for the QCD high p_T group, I am in charge of skimming the default dataset (which is big in file size) down to a smaller file size dataset (skimmed dataset) which will be useful for the analyzers in the group. I am serving as the contact person responsible for (i) keeping track of Monte Carlo samples necessary for various QCD analysis and (ii) requesting MC datasets required by the analyzers to compare with LHC data. As an additional responsibility, I am working as a member of the QCD Trigger Task Force which provides trigger efficiencies for the variables used for various high p_T QCD analyses. As the Fermilab LPC has a core group of active members working in QCD and dijets, my stay in Fermilab will benefit the working group and the students working on related analysis.

- **<u>Pixel works in Tracking Detector Performance Group:</u>**

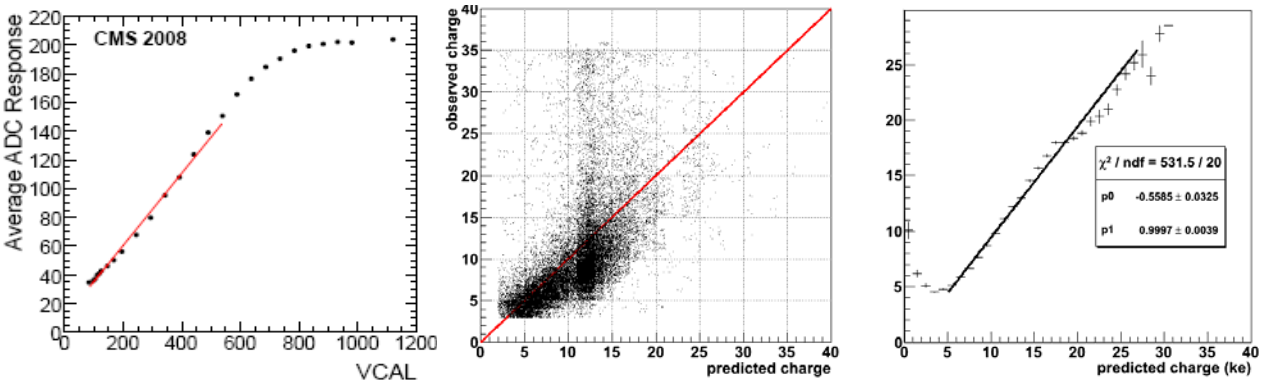
The precise and efficient determinations of charged particle momenta and primary vertex position are crucial for many physics measurements of CMS. These impact the ability to reconstruct leptons, charged hadrons, jets, and photon conversions and provide an important tool to separate the interesting hard interactions from the huge background due to long distance diffractive interactions of protons. To achieve this goal, in the innermost region, the high-precision and low-background tracking of CMS is based on a Silicon pixel detector.

The pixel analysis efforts of the UNL group are a truly joint effort, with students, postdocs, and faculty cooperating in areas of mutual interest. A team of undergraduates are performing R&D pixel work in the newly built clean-room facility at the UNL Silicon lab in collaboration with the Paul Scherrer Institute at Zurich. Their work is being supported by a multi-institutional NSF-PIRE grant. The Pixel tracking (initiated by Aaron Dominguez) and pixel triggering (conceived by Ilya Kravchenko) are already natural extensions of the pixel production and testing carried out

by UNL personnel at Fermilab's SiDet Lab. Both are areas which students have explored and contributed to and postdocs continue to develop. I plan to work on some projects related to the pixel detector, discussed in the following sections.

- **Data Based Pixel charge calibration:**

Conversion of pixel charge measurements from ADC counts to charge units requires calibration of the net response function of the pixel readout chain. This calibration is essential to achieve a precise hit position, as the cluster position is interpolated using the charge information from all pixels in the cluster. For each pixel the pulse height response in the ADC to a given amount of collected charge is measured using the charge injection feature of the Read Out Chip (ROC) [6]. For each chip, an 8-bit digital to analog converter, controls the amount of charge injection (expressed in units of VCAL) on each ROC. The chip response (in ADC counts) increases approximately linearly with the injected charge (Fig. 3(a)). The gain / pedestal calibration determines the slope and pedestal of this dependence and is used to transform the charge measured in ADC counts to electrons. This injected charge (controlled by VCAL) is not well known. For a certain value of VCAL the actual injected charge has a large spread.



(a) (b) (c)

Figure 3: (a) ADC response as a function of injected charge in VCAL units. (b) The observed vs. predicted charge correlation. (c) Fitting the correlation curve to estimate the slope and offset.

According to studies done already, this pixel to pixel charge spread leads to degradation of the pixel hit resolution of up to 20%. To improve this, it was suggested to use real data collision tracks to improve the gain/pedestal calibration. The suggestion is to gather enough data so that we have 100-1000 tracks passing through each pixel. With the data collected at the LHC already, this analysis should be possible. For each pixel one would plot the observed charge vs. the expected charge (Fig. 3(b)) using an already developed Cluster Parameter Estimator (CPE) [7]. The slope and offset of the correlation plot (Fig. 3(c)) would be the corrections to the existing calibration which would improve the pixel charge measurement. Given that we have 66 million pixels in CMS, this involves measuring the parameters of the fit (as in Fig. 3(c)) for every single pixel. The complete workflow will consist of (i) doing feasibility studies, (ii) creating the software workflow in CMSSW, (iii) writing scripts that fit 66 million histograms, (iv) obtaining new DB gain/pedestal calibration, (v) applying the new calibration using the corrected gain/pedestal, and finally (vi) studying the effects. Preliminary feasibility studies have already

been done on Monte Carlo samples. I plan to finish the work with LHC data by collaborating with Gavril Giurgiu (Johns Hopkins University) who is a postdoc stationed at Fermilab.

- **Track and Vertex reconstruction using only pixels:**

I have been working on understanding the tracking and vertexing performance of the CMS pixel detector. The track reconstruction in CMS [8] can be decomposed into three main steps: seeding, pattern recognition, and track fitting. Track seeds are built from either triplets of hits in the tracker (strips and pixels) or pairs of hits with an additional constraint from the beam spot or a vertex, yielding an initial estimate of the trajectory including its uncertainty. The track seeds can also be built from triplets of pixel hits only [9] (*pixel-only tracks*) or with hits from only the strips (excluding pixel) (*pixel-less tracks*).

The Pixel detector provides high resolution, three-dimensional space points allowing for precise pattern recognition. With three pixel hits per charged particle, using only the pixel data tracks can be reconstructed and primary vertices can be found. Such *pixel-only track* reconstruction [9] is useful for track seeding, primary vertex finding and in a variety of High Level Trigger (HLT) algorithms. I am interested in pixel standalone reconstruction because it is faster than full track reconstruction and hence useful for the online HLT event selection. I shall study the efficiency and purity (as a function of η and p_T) of the *pixel-only tracks* and compare their performance with the *general tracks* which use both strip hits and pixel hits and *pixel-less tracks*.

Primary Vertex (PV) finding based on the pixel hits provides a simple and efficient method for measuring the position of the primary vertex. This measurement is subsequently used for track seeding and in many HLT analyses. Therefore, this must be sufficiently accurate and fast. Traditionally PV finding is done as a one-dimensional (1D) search along the z axis [9]. Since multiple interactions are well separated in z direction, the pattern recognition is established in just 1D using beam spot information. This collection of tracks can be used to refit the vertex in three-dimension (3D) by using appropriate vertex fitting algorithms. The 3D vertex gives better resolution than the 1D vertex [10]. I worked on developing one of the algorithm to reconstruct 3D vertices using pixel only tracks with Aaron Dominguez of Nebraska. I studied the vertex performance and timing for the pixel vertexing method [11]. I plan to continue this study to improve the performance of 3D vertexing with Kevin Burkett of Fermilab with advice from Aaron Dominguez and Ilya Kravchenko of Nebraska.

- **Tests of radiation-hard sensors for the SLHC:**

At the Super LHC (LHC upgrade scenario), after 2500 pb^{-1} of data, the expected maximum *fluence* for the pixel region (<20 cm) will be 2.5 x 10^{16} cm^{-2}. To cope with this unprecedented radiation environment, there have been quite a few collaborations being formed at CERN to find possible solutions for vertex and tracking detectors at the SLHC. A variety of solutions have been pursued. These include diamond sensors, 3D sensors, MCZ planar silicon detectors made from MCZ wafers, epitaxial, p-type silicon wafers and thin silicon detectors. In the Fermilab Meson Test Beam Facility (MTest), the performance of various sensors that are radiation hard and viable candidates for use in the innermost vertex detector for the SLHC environment, are studied. The tests are carried out as collaborative effort between Fermilab and other universities.

I participated in the Pixel Test Beam at Fermilab during December, 2009. We studied the Diamond detector as a potential sensor for the pixel upgrade plan for CMS. We used the CMS pixel-based telescope which had been commissioned and constructed for the MTest facility. The

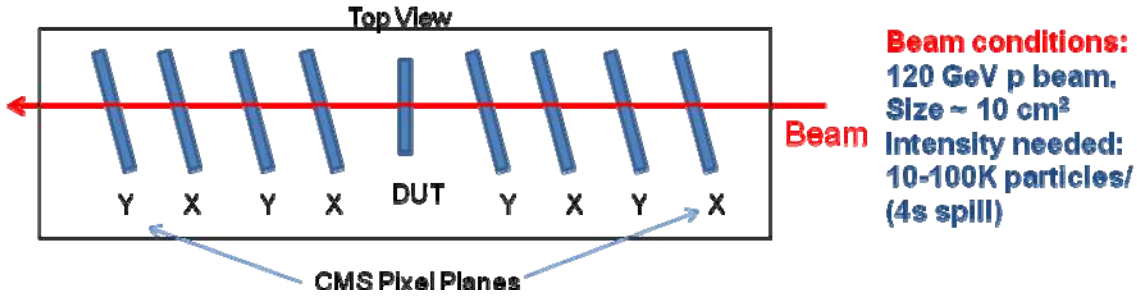


Figure 4: Set up of the test beam facility at Fermilab, showing the various parts of the Telescope of 8 pixel detectors and the device under test (DUT).

arrangement of the test beam pixel telescope and the device under test (DUT) is shown in Fig. 4. We studied the charge collection efficiency of the irradiated and unirradiated devices and the spatial resolution as a function of the track incident angle. The future plan includes studying various other sensors (eg. 3D sensors) in the future test beam programs at the Fermilab facility. A stay at Fermilab will help me build a strong collaboration with the scientists and engineers involved in the test beam activities.

- **Remote Operations (shifts) and other CMS activities:**

I shall take the Data Quality Monitoring (DQM) shifts for CMS from the Remote Operation Center at Fermilab. This will help me be part of the data taking in this exciting time of LHC while it is ramping up in luminosity as well as it helps me to obtain the shift credits necessary without having to go to CERN. While at the LPC, I shall keep in touch with the Nebraska High Energy Physics group by attending weekly meetings via video conferencing. I shall attend various LPC meetings of my physics interest and give regular progress reports related to my works at the LPC.

Summary

With support from the URA Visiting Scholars program, I propose to be heavily involved in various physics programs at Fermilab's LPC. I shall serve as the full time resident UNL person at the LPC and my presence will strengthen the collaboration between UNL and Fermilab /LPC on CMS. On one hand I shall supervise the UNL students during their short visits to LPC, and I shall use my experience from my service contributions (test beam work, charge calibration of pixels, pixel-tracking/vertexing studies) to guide the UNL undergrad students performing R&D pixel work in the newly built clean-room facility at the UNL Silicon lab.

Continuing in this vein, I shall be working in LPC QCD group, specifically, the Dijet working group, which will develop the flagship analyses for first publications on searches for quark compositeness. In order to continue to play a major role in this very competitive analysis, I need the support of analysis and detector experts as well as the ability to attend meetings and collaborate in person as much as possible. As full-time residence at CERN is not feasible, the LPC at Fermilab provides a unique opportunity. I would like to take advantage of this local expertise to effectively pursue this project which will benefit the CMS physics program and help the US CMS effort to maintain a significant presence in one of the most prominent first discovery analyses at the LHC.

Regarding my involvement in the Tracking group, I shall work in the following areas – (i) carrying out the pixel charge calibration with LPC data and thereby providing better position resolution using the pixel detector to the CMS collaboration, (ii) studying the efficiency and purity of the pixel only tracking, (iii) developing fast and efficient primary vertex measurements, (iv) getting involved in the test of radiation hard sensors to be used for the LHC upgrade at the Fermilab testing facility. The proposed pixel work means direct involvement in one of Nebraska's institutional commitments. Both the test beam work and, in particularly, the data-based pixel calibration, will represent important synergy with pixel hardware work being done at UNL. The Nebarska students will benefit by regular interactions with me (through video-conferencing and face-to-face visits).

❑ References:

1) S. Bose et al, "Dijet Azimuthal Decorrelations and Angular distributions in pp Collisions at √s=7 TeV", CMS PAS **QCD-10-015**.

2) DØ Collaboration, "Measurement of Dijet Angular Distributions at √s=1.96TeV and Searches for Quark Compositeness and Extra Spatial Dimensions", Phys. Rev. Lett. **103** (2009) 191803.

3) DØ Collaboration, "High-p_T Jets in $p\bar{p}$ collisions at √s = 630 GeV and 1800 GeV", Phys. Rev. D **64** (2001) 032003.

4) CDF Collaboration, "Measurement of Dijet Angular Distributions at CDF", [Erratum-ibid 78, 4307 (1997)] Phys. Rev. Lett. **77** (1996) 5336.

5) CMS Collaboration, "The CMS physics reach for searches at 7 TeV", CMS Note **2010-008** (2010).

6) CMS Collaboration, "Commissioning and performance of the CMS pixel tracker with Cosmic ray muons", JINST **5** (2010) T03007.

7) M. Swartz et al., "A new technique for the reconstruction, validation and simulation of hits in the CMS Pixel Detector", CMS Note 2007-033 (2007).

8) W. Adam et al., **"**Track Reconstruction in the CMS tracker", CMS NOTE **2006-041**.

9) S. Cucciarelli et al., “Track reconstruction, primary vertex finding and seed generation with the pixel detector”, CMS Note **2006-026**.

10) A. Dominguez, “Pixel Primary Vertices”, LPC Trigger Workshop (11 July, 2007).

11) S. Bose, “3D Pixel Vertex Reconstruction”, Pixel General Meeting, (22 March, 2010).

Budget

A grant of $38,000 from the URA is sought to support a fraction of Bose’s salary + fringe support + travel between Fermilab and UNL. Nebraska has promised to match this funding to reach my full salary.

While NSF's renewal of the University of Nebrsaska's base grant provides a generous increase over the 10 years of support Claes and Snow have received, it merges several previous independent sources of support (3 startup packages, 2 CAREER awards (Bloom and Dominguez), and an NSF ARRA grant (Kravchenko) - all expiring this summer). The approved budget is significantly lower than our request and will mean the group is only able to support four postdoctoral researchers, rather than the current six. Claes' administrative appointment as department chair comes with a negotiated partial salary support ($20,000) for a postdoc (Bose). The remaining support (salary plus fringe, and some travel) is sought from this grant.

12-month salary	$43500
Fringe (28%)	$12180
Sub-Total	$55680
- College support	- $20000
Total	**$35680**
Travel to Lincoln	
Airfare (ORD-LNK)	$280
Lodging	$180
Meals	$75
Transportation to Airport	$65
Total Travel related Cost	**$600**
2 x **Travel**	**$1200**
Grand Total	**$38000**

Biographical Sketch of Suvadeep Bose

PostDoctoral Research Associate
University of Nebraska Lincoln
Dept of Physics and Astronomy
855 N. 16th Street
Lincoln, NE 68588

Telephone: (630) 840-5038
Fax: (630) 840-2194
E-mail: sbose@fnal.gov

Education:

2003 - 2009	Ph.D.	High Energy Physics	Tata Institute (TIFR), India
2001 - 2003	M.A.	Physics	University of Cambridge, UK
1998 - 2001	B.Sc.	Physics	Jadavpur University, India

Academic Appointments:

2009 -	PostDoc	University of Nebraska Lincoln, NE
2007 - 2009	Exchange Visitor	Fermilab, Batavia, IL

Awards:

2004, 2005	Kanwal Rekhi Scholarship for career development, TIFR, India.
2003	Ph.D. Research Scholarship offered by TIFR, Mumbai, India (for 6 years).
2002	St Edmund's College (UK) Commonwealth and Overseas Student award.
2001	Commonwealth Scholarship to study MA in Cambridge, U.K.

Presentations:

- APS April meeting 2009, Denver, CO, USA (May 2-5, 2009):
  QCD Multijet Studies in CMS at 10 TeV.
- US CMS JTerm-III at Fermilab (January 12 -16, 2009):
  Talk in Dijet Topology group on QCD Multijet Studies in CMS at 10 TeV.
- Fermi User's Meeting (June 3-4, 2008):
  Poster on Understanding CMS Endcap Calorimeter.
- USCMS 2008 Run Plan Workshop (May 15-16, 2008):
  User's Experience in using CRAB and the LPC CAF.

Selected Publications:

- **CMS PAS QCD-10-015:** Dijet Azimuthal Decorrelations and Angular Distributions in pp Collisions at 7 TeV (result shown in ICHEP 2010).
- **CMS AN-2010/124:** Measurement of Dijet Angular Distributions in pp Collisions at 7TeV.
- **CMS NOTE -2010/008:** The CMS Physics reach for searches at 7 TeV.
- **CMS AN-2009/073:** QCD studies in CMS with Multijets at √s=10 TeV.
- **CMS NOTE-2008/025:** Calorimetry Task Force Report.
- **CMS NOTE-2008/020:** Design, Performance, and Calibration of the CMS Hadron-Outer Calorimeter.

Other CMS Publications:

- CMS Collaboration, "Measurement of the charge ratio of atmospheric muons with the CMS detector", Phys. Lett. B **692** (2010) 83-104.
- CMS Collaboration, "Transverse-Momentum and Pseudorapidity Distributions of Charged Hadrons in *pp* Collisions at √s=7 TeV", Phys. Rev. Lett. **105** (2010) , 022002.
- CMS Collaboration, "First Measurement of Bose-Einstein Correlations in proton-proton Collisions at √s =0.9 and 2.36 TeV at the LHC", Phys. Rev. Lett. **105** (2010) 032001.
- CMS Collaboration, "Transverse momentum and pseudorapidity distributions of charged hadrons in pp collisions at √s=0.9 and 2.36 TeV", J. High Energy Phys. **02** (2010) 041.

Synergic activities:

I have been involved in the physics activities at Fermilab LPC. I am a member of the LPC Physics Forum and also a newly formed journal club which reads and discusses newly published papers every week. I have been an active participant in the JTerms and E-JTerms held at the Fermilab LPC. I also present posters showcasing my works in the Fermilab Users' meetings.

Academic References:

- Daniel R. Claes, Professor and supervisor, University of Nebraska Lincoln.
- Nikos Varelas, Professor, University of Illinois Chicago.
- Kevin Burkett, Scientist, Fermilab.
- Danek Kotlinski, Scientist, PSI, Switzerland.
- Klaus Rabbertz, Professor, Karlsruhe Institute of Technology (KIT), Germany.

UNIVERSITY OF Nebraska Lincoln

COLLEGE OF ARTS AND SCIENCES
Department of Physics and Astronomy

To: University Research Association
From: Professor Daniel Claes, University of Nebraska-Lincoln
Re: Application of Suvadeep Bose to URA Visiting Scholars Program

In the interests of building a permanent presence at Fermilab's LHC Physics Center, and contributing to the effort to establish a U.S. center of expertise there, we hired TIFR graduate and CMS student Suvadeep Bose to serve as our UNL postdoc. We have been very impressed by how rapidly he has taken on service work, identified and self-started what is destined to be one of CMS' earliest publications, and embraced institutional responsibilities of the University of Nebraska. Suvadeep was hired just last September, immediately engaging in the October Exercise to test data handling, and serving December Pixel Test Beam shifts. Two internal CMS notes have been completed for his measurement of dijet angular distributions (**CMS AN-2010/124** and **CMS Physics Analysis Summary QCD-10-015**), approved for ICHEP presentation, and targeted spring publication with additional data. Having chaired the Editorial Board that reviewed that same analysis for DØ (12 years ago) I have been excited by the rapid results.

Our group's NSF renewal includes a substantial bump reflecting our increased size, yet still won't replace the additional funding sources (startup, Career awards and soon-to-expire one-time grants) supporting the group through now. We will be stretched to support just 4 of our current 6 postdocs. My own administrative appointment as department chair comes with a negotiated partial salary support ($20,000) for a postdoc (Suvadeep). This requests enough to complement the full salary.

My current graduate student, Jason Keller, works through the LPC. Our funding will likely limit time at CERN for most of our students, making the success of the LPC critical to our own students' success. We expect Suvadeep to assume the role of a resident QCD and pixel-tracking expert for US-CMS as well as serve as consultant, advisor, and on-site supervisor to our own students.

Notice that his service contributions (test beam work, a proposed data-based calibration of pixels, and pixel-only tracking/vertexing studies for CMS' high level trigger) all build upon Nebraska's established pixel effort. Suvadeep's interactions with the UNL undergrad students performing R&D pixel work in our new clean room facility and collaborating colleagues at the Paul Scherre Institute (a project funded through an NSF-PIRE grant) will benefit all involved enormously.

I am sure Suvadeep's already demonstrated potential merit your consideration as a URA Visiting Scholar who will prove an asset to establishing the LPC as the U.S. center of expertise on CMS. Please feel free to contact me if you have any questions at all.

Daniel R. Claes

Daniel Claes
Professor and Chair
Department of Physics and Astronomy

208 Theodore Jorgensen Hall / P.O. Box 880299 / Lincoln, NE 68588-0299 / (402) 472-2770 / FAX (402) 472-6148 / www.physics.unl.edu