Annexure- III

UNIVERSITY GRANTS COMMISSION

BAHADUR SHAH ZAFAR MARG

NEW DELHI- 110002

Annual/Final Report of the work done on the Major/ Minor Research Project.

1. Project report No. : Final report
2. UGC Reference No.: F.42-790/2013(SR) dated March 22, 2013
3. Period of report : 5th June 2013 to 31st March 2017
4. Title of research project : "**Study on neutrino masses and mixings in the context of recent neutrino oscillation data**".
5. (a) Name of the Principal Investigator : Dr. Mrinal Kumar Das
   (b) Dept. and University/ College where work has progressed:
   Department of Physics, Tezpur University.
6. Effecting date of starting of the project : 05-06-2013
7. Grants approved and expenditure incurred during the period of the report:
   (a) Total amount approved : Rs. 10,50,800/-
   (b) Total grant received: Rs. 9,47,280/-
   (c) Interest Earned: Rs.11,410/-
   (d) Total Expenditure : Rs. 8,80,487/-
   (e) Unspent Balance : Rs. 78,203/-
   (f) Report of the work done : Separate sheets attached as Annexure IV
8. (a) Brief objective of the project:
   The primary objectives of the project are:
   - Theoretical prediction of texture of neutrino mass matrices from SO(10) GUT with or without supersymmetry.
   - Study of prediction of neutrino masses and mixing from framework of seesaw types (I,II,III) and their combinations and discrimination of neutrino masses-normal vs inverted hierarchical.
   - Studies on neutrino mass matrices which lead to deviation from tri-bimaximal mixings and their origins from the general structure of gauge symmetry.
   - Study of non-zero texture of the right-handed Majorana mass matrices M_R which can be useful to explore baryogeneiss through leptogenesis provided.

(b) Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication):

(i) "***Radiative generation of non-zero θ_{13} in MSSM with broken A_4 flavor symmetry***" *by M. K. Borah, D. Borah and M. K. Das,* ***Nucl. Phys. B885, 76-96(2014)***

(ii) "***Perturbations to the μ-τ symmetry, leptogenesis and lepton flavor violation with the type II seesaw mechanism***" *by M. K. Borah, D. Borah, M. K. Das and Sudhanwa Patra,* ***Phy. Rev. D 095020 (2014)***

(iii) "***Corrections to scaling Neutrino Mixing: non-zero Θ_{13}, δ CP and Baryon Asymmetry***" *by Rupam Kalita, Debasish Borah, Mrinal Kumar Das,* ***Nucl. Phys. B 894, 307-327 (2015)***

(iv) "***Discriminating Majorana Neutrino Textures in the light of Baryon Asymmetry***" *by M. K. Borah, D. Borah and M. K. Das,* ***Phy. Rev. D 91, 113008 (2015)***

(v) "***Neutrino Phenomenology and scalar dark Matter with A_4 flavour symmetry in Inverse and type II seesaw***", *by A. Mukherjee and M. K. Das,* ***Nucl. Phys. B913, 643-663(2016)***

(vi) "***Common origin of nonzero Θ_{13} and Dark Matter in an S_4 flavor symmetric model with Inverse seesaw***" *A. Mukherjee, D. Borah and M. K. Das, accepted for publication in* ***Phy. Rev. D***

(c) Has the progress been according to the original plan of work and towards achieving the objective, if not, state reason: Yes

(d) Please indicate the difficulties, if any, experienced in implementing the project: Due to non-receiving the 2nd installment, it was difficult to maintain the progress of the project as fellowship of the project fellow was dis-continued from January 2015.

(e) If project has not been completed, please indicate the time by which it is likely to be completed. A summary of the work done for the period (Annual basis) may please be sent to the Commission on a separate sheet: N/A

(f) If the project has been completed, please enclose a summary of the findings of the study. Two bound copies of the final report of the work done may also be sent to the Commission on a separate sheet.

(g) Any other information, which would help in evaluation of work done on the project. At the completion of the project, the first reports should indicate the outputs such as (a) Manpower trained (b) Ph.D awarded (c) Publication of results (d) other impact, if any: Project fellow Mr. Manikanta Borah has been awarded Ph.D degree on the work associated with the findings of the project.

PRINCIPAL INVESTIGATOR
Date: 3/1/18

Principal Investigator
Title "Study on Neutrino ..... Oscillation data"
Department of Physics
TEZPUR UNIVERSITY

REGISTRAR, Tezpur University
Date:

Registrar
Tezpur University

Annexure – IV

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

Utilization Certificate (2016 – 17)

Certified that Grant-in-aid of Rs. **2,60,480/-**(Rupees Two Lakhs Sixty Thousand Four Hundred Eighty only) was sanctioned by the University Grants Commission as 2nd installment under the scheme of support for Major Research Project entitled "**Study on neutrino masses and mixing in context of recent neutrino oscillation data**" vide UGC letter No. **F.No. 42 – 790/2013(SR)** dated March 22, 2013 and an unspent amount of Rs. **13,243/-**(Rupees Thirteen Thousand Two Hundred Forty Three only) from the previous year (first installment) have been remained. Amount of Interest earned is of Rs. **11,410/-** (Rupees Eleven Thousand Four Hundred and Ten only). Out of which an amount of Rs. **2,06,930/-** (Rupees Two Lakh, Six Thousand, Nine Hundred Thirty only) has been utilized for the purpose which it was sanctioned and an unutilized balance of Rs.**78,203/-** (Fifty Three Thousand, Five Hundred Fifty only) have been remained, which is to be returned to UGC. Kindly let us know the bank account number associated with University Grants Commission to which we can send the total unspent balance mentioned above.

31/3/18

PRINCIPAL INVESTIGATOR
Date:

Principal Investigator
Title "Studies on neutrino ..... data"
Department of Physics
TEZPUR UNIVERSITY

FINANCE OFFICER
Tezpur University
Date:

Finance Officer
Tezpur University

REGISTRAR
Tezpur University
Date:

Registrar
Tezpur University

For SURAJIT CHAKRABORTY & CO.
CHARTERED ACCOUNTANTS

03.05.2018

CA. SURAJIT CHAKRABORTY
(Proprietor)
Membership No.- 305054

Annexure – XI

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

Final Report Assessment / Evaluation Certificate
(Two Members Expert Committee Not Belonging to the Institute of Principal Investigator)
(to be submitted with the final report)

It is certified that the final report of Major Research Project entitled **"Study on neutrino masses and mixing in context of recent neutrino oscillation data"** by Dr. Mrinal Kumar Das, Dept. of Physics, Tezpur University has been assessed by the committee consisting of the following members for final submission of the report to the UGC, New Delhi under the scheme of Major Research Project.

Comments/Suggestions of the Expert Committee:-

The committee has examined the final report on the project refereed above entitled "**Study on neutrino masses and mixing in context of recent neutrino oscillation data**". The work completed under the project has satisfied all the objectives mentioned in the project proposal. Three papers based on the work done during the project have been published in reputed international journal. This work will be definitely a good contribution to the field of neutrino physics.

Name & Signatures of Experts with Date:-

	Name of Expert	University/College name	Signature with Date
1.	Prof. Kalyan Bhuyan	Dibrugarh University	
2.	Prof. D. Sarkar	Gauhati University	

It is certified that the final report has been uploaded on UGC-MRP portal on ..... .

It is also certified that final report, Executive summary of the report, Research documents, monograph academic papers provided under Major Research Project have been posted on the website of the University/College.

(Registrar)
Seal