Center for Theoretical Underground Physics and Related Areas –
CETUP*2016 Summer Program
June 6th – July 16th, 2016
Lead/Deadwood, South Dakota

Department of Energy, Office of Science, High Energy Physics
Final Technical Report
02/15/2017

PI: Barbara Szczerbinska
Title: Professor
Email: Barbara.Szczerbinska@tamucc.edu
Phone: 361-825-3916

Organizational DUNS: 929923506
Institution: Dakota State University
Address: 812 N. Washington Ave., Madison, SD 57042

DOE Award Number: DE-SC0015840
Program Manager: Simona Rolli

Award Period: June 1, 2016 to November 30, 2016

CETUP*2016 ACCOMPLISHMANTS

Overview

The mission of the Center for Theoretical Underground Physics and Related Areas (CETUP*) is to promote organized research in physics, astrophysics, geoscience and other fields related to underground science via individual and collaborative research, in a dynamic atmosphere of intense scientific interactions. The main goal of CETUP* is to serve as a collaboration point for scientists from around the world interested in theoretical and experimental aspects of underground science and to bring together people with different expertise to address the most exciting questions in particle and nuclear physics, astrophysics and cosmology. CETUP* also encourages collaboration in science education which is essential in building a critical mass of outstanding scientists of international caliber and attracting rising young scientists to the program

For last six years CETUP* successfully provides a stimulating environment for creative thinking and open communication between researches of varying ages and nationalities in dynamic atmosphere of intense scientific interactions. Scientists invited to participate in the program not only provide theoretical support to the underground science, but they also examine core questions of the 21st century including: What is dark matter? How well do we know the neutrino parameters?, How have neutrinos shaped the evolution of the universe?, What are the fundamental underlying symmetries of the Universe? Is there a Grand Unified Theory of the Universe? How do supernovae explode?

The 2016 CETUP* summer program consisted of three sessions (June 6 – July 16, 2016) covering various aspects of theoretical and experimental neutrino physics, unification and dark matter. The two week long session on Physics and Instrumentation of the Near Detector for the Long-Baseline Neutrino Experiments (June 6 – June 16) was followed by the two week long Neutrino Physics/Unification session: “From Grand Unification to String Theory and Back” (June 20 – July 2). The program ended with two week long session on Dark Matter Physics (July 4 – July 16). This six-week long program allowed for thorough discussions and an effective and comprehensive analysis of current topics related to Dark Matter, Dark Energy, Neutrino Physics including astrophysical neutrinos, near and far detector physics, neutrino interactions, Higgs Boson, Inflation, Leptogenesis, Nucleosynthesis and many others.

Six program objectives were identified for the CETUP* 2016 summer program:

1. **Unification:** (i) Study implications of Grand Unified Theories, especially for proton decay rates; (ii) analyze the unified theories capability of relating yet to be measured neutrino parameters to those in the quark sector**.**
2. **Understanding Neutrino Sector:** (i) Assess, study and compare models to understand the measured neutrino oscillation parameters, in particular the observed large values of the neutrino mixing angles; (ii) Develop a theoretical understanding towards testing the three-neutrino oscillation paradigm by over-constraining parameters; (iii) Identify strategies to measure the remaining neutrino parameters, especially the CP-violating phase, mass hierarchy, and absolute values of neutrino masses.

3. **Neutrino Astrophysics**: (i) Identify the best path forward to integrate experimental and theoretical advances in neutrino/nuclear data into astrophysical models; (ii) Understand the origin of very high energy astrophysics neutrinos, (iii) Determine the crucial neutrino and nuclear inputs for simulations of heavy element synthesis; (iv) Quantify the impact of neutrino and nuclear data uncertainties on galactic chemical evolution predictions, (v) Understand supernova dynamics including collective neutrino oscillations.
4. **Interconnection:** (i) Analyze the connection between dark matter and particle physics models and reevaluate strategies for searches for dark matter particles; (ii) Discuss the connections among dark matter, grand unification models and recent neutrino results and predictions for future experiments; (iii) Explore the connection between particle physics and models of baryogenesis and inflation.
5. **Exchange:** Provide a stimulating venue for the exchange of scientific ideas among experts in dark matter, unification, neutrino physics, particle physics, nuclear physics and astrophysics
6. **Outreach:** Connect with venues for public education outreach to communicate the importance of dark matter, neutrino research, and the support of investment in science education.

During six week long program over 70 national and international scientists from over 48 different universities and laboratories were accommodated by CETUP*. Scientists represented United States, Australia, Georgia, Germany, India, Japan, South Korea and Slovenia. US based researchers came from Arizona, California, Florida, Hawaii, Illinois, Indiana, Kansas, Louisiana, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Utah, Virginia – see below for details.

During CETUP* Dark Matter session thirty-seven scientific talks and extended discussions were presented and lead by experts in the Dark Matter field. During the Neutrino Physics sessions, twenty-nine talks and discussions were conducted by international Neutrino Physics experts. The power point presentations for the talks and discussions can be found on the CETUP* website: http://research.dsu.edu/cetup/agenda.aspx. In depth collaborations lead to 10 new scientific publications with assigned preprint number and many more in progress. The program proceedings to be published by American Institute of Physics are in preparation.

Organization

Time and location:

Six week long CETUP*2016 summer program took place on June 6 – July 16, 2016 in Lead/Deadwood, SD. The two week long session on Near Detector for the Long-Baseline Neutrino Experiments (June 6 – June 16) was followed by the two week long Neutrino Physics/Unification session: “From Grand Unification to String Theory and Back” with two week long Dark Matter Physics session (July 4 – July 16) ending the program.

The CETUP* attendees were provided by Deadwood-Lead Middle School with a specious office space, access to the meeting rooms, break room, fax and copy machine, as well as high speed wireless internet connection.

Speakers/Talks:

CETUP*'s scientific program involved 3 to 4 one hour-long talks a day on the current status of dark matter and neutrino theory and experiments. The talks were followed by questions and discussion sessions. The format of this program accommodated separate discussion sessions where the outstanding issues of the disciplines were explored. The selected speakers were very active senior and junior members of the community in order to make the discussions informative and productive. During the PPC conference experts from theory and experiment community gathered together to cover topics related to Dark Matter, Direct and Indirect Detection, Dark Energy, Neutrino Masses and Oscillations, Near Detector and Far Detector Physics, Inflation, Baryogenesis, Large Scale Structure, Higgs Boson Physics, Collider Physics, and many others. Both theoretical and experimental aspects were incorporated into the sessions. The list of speakers and talks given during CETUP*2016 is available at https://research.dsu.edu/cetup/index.aspx. CETUP* 2016 brought together 17 graduate students, 16 postdocs and 39 senior scientists to work together on cutting edge scientific subjects related to neutrino physics and dark matter.

CETUP* 2016 Organizing Committee:

Baha Balantekin – University of Wisconsin, Madison, WI
Babu Kaladi – Oklahoma University, Stillwater, OK
Jason Kumar – University of Hawaii, Honolulu, HI
Sanjib Mishra – University of South Carolina, Columbia, SC
Stuart Raby – The Ohio State University, Columbus, OH
Pearl Sandick – University of Utah, Salt Lake City, UT
Louie Strigari – Texas A&M University, College Station, TX
Barbara Szczerbinska – Dakota State University, Madison, SD/Texas A&M University – Corpus Christi, Corpus Christi, TX

Financial support:

Supporting organizations:

- City of Deadwood
- Dakota Sciences
- Dakota State University
- Department of Energy
- Fermi National laboratory
- John T. Vucurevich Foundation
- Lead-Deadwood School District
- Lodge of Deadwood
- National Science Foundation
- South Dakota Science and Technology Authority

The support provided by DOE was used to provide a travel support for graduate students and postdocs: Patrick Stengel (graduate student, University of Hawaii), Hongyue Duyang (postdoc, University of South Carolina), Brianna Hackett (graduate student, University of Hawaii at Manoa),

Hasan Serce (graduate student, University of Oklahoma), Tathagata Ghosh (graduate student, Texas A&M University).

Education and Outreach

Attendees of CETUP* participated in educational outreach programs conducted during the six week time period:

- On June 15th the participants of the Near Detector for the Long-Baseline Neutrino Experiments session met with students participating in Davis-Bahcall summer program (high school graduates and college freshmen). The students discussed both experimental and theoretical aspects of Neutrino Physics, different career paths available for students interested in science and mathematics. The scientists shared their personal stories on selecting physics as a career path as well as provided students with multiple advises on how to be successful in college.
- On June 28th scientists attending the Neutrino Physics and Unification session met with the students and teachers attending QuarkNet program at Black Hills State University for Q&A session on neutrino and dark matter physics.
- On June 21th five participants of Dark Matter session met with 32 Native American students participating in the summer program organized by the Indian University of North America at Crazy Horse Monument in Black Hills, SD. The talk given by Brooks Thomas from Lafayette College and Keith Dienes from University of Arizona on Dark Matter and Dark Matter detection was followed by extended Q&A session with few other scientists. Students were able to learn about cutting edge dark matter and neutrino experiments conducted at Sanford Underground Research facility and other laboratories around the world. Informal discussions on what it takes to be a scientist, different STEM carrier paths, how to balance personal and work life ended our annual meeting with Indian University of North America students.
- Neutrino Day – July 9th – scientists attending Dark matter session participated in different activities, talks and interacted with general public attending the Neutrino day event at Sanford Lab

Summary

2016 CETUP* summer program was attended by over 70 national and international scientists (including 17 graduate students, 16 postdocs and 39 senior scientists) from over 48 different universities and laboratories. Scientists represented United States, Australia, Georgia, Germany, India, Japan, South Korea and Slovenia. US based researchers came from Arizona, California, Florida, Hawaii, Illinois, Indiana, Kansas, Louisiana, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Utah, Virginia – see below for details.
95% of participants came from outside of South Dakota
23% of participants came from outside of United States
24% of participants were female (United States, Australia and Germany)

During Dark Matter session thirty-seven scientific talks and extended discussions were presented. Twenty-nine talks and discussions were conducted during the Neutrino Physics sessions by

international Neutrino Physics experts. The power point presentations for the talks and discussions can be found on the CETUP* website: http://research.dsu.edu/cetup/agenda.aspx.

Based on the collaborations established during CETUP* (June 06, 2016 – January 31, 2017) ten preprints are already published – see below for the list of authors and titles. More detailed information can be found on the CETUP* website which is accessible by the scientists year around: https://research.dsu.edu/cetup/preprints.aspx?cetupYear=2016.

The proceedings from CETUP*2016 are in preparation to be published by American Institute of Physics in summer 2017.

CETUP*2016 PRODUCTS:

CETUP* 2016 – list of preprints submitted (June 06, 2016 – January 31, 2017)

- Title: Non-standard interactions and the resolution of ordering of neutrino masses at DUNE and other long baseline experiments
  - Abstract: In the era of precision neutrino physics, we study the influence of matter NSI on the question of neutrino mass ordering and its resolution. At long baseline experiments, since matter effects play a crucial role in addressing this very important question, it is timely to investigate how sub-leading effects due to NSI may affect and drastically alter inferences pertaining to this question. We demonstrate that the sensitivity to mass ordering gets significantly impacted due to NSI effects for various long baseline experiments including the upcoming long baseline experiment, Deep Underground Neutrino Experiment (DUNE). Finally we draw a comparison of DUNE with the sensitivities offered by two of the current neutrino beam experiments NOvA and T2K.?
  - Contributors: M. Masud and P. Mehta
  - Preprint Number: CETUP2016-001

- Title: Limiting Equivalence Principle Violation and Long-Range Baryonic Force from Neutron-Antineutron Oscillation
  - Abstract: We point out that if the baryon number violating neutron-antineutron oscillation is discovered, it would impose strong limits on the departure from Einstein's equivalence principle at a level of one part in 10^{19}. If this departure owes its origin to the existence of long-range forces coupled to baryon number B (or B-L), it would imply very stringent constraints on the strength of gauge bosons coupling to baryon number current. For instance, if the force mediating baryon number has strength α_B and its range is larger than a megaparsec, we find the limit to be $\alpha_B \leq 2\times 10^{-57}$, which is much stronger than all other existing bounds. For smaller range for the force, we get slightly weaker, but still stringent bounds by considering the potential of the Earth and the Sun.
  - Contributors: K.S. Babu and Rabindara N. Mohapatra
  - Preprint Number: CETUP2016-002

- Title: Dark matter, light mediators, and the neutrino floor
  - Abstract: We analyze future direct data matter detection experiments using Effective Field Theory (EFT) operators with light, $\lesssim 100$ MeV mass mediators. We compare the

nuclear recoil energy spectra from these operators to the predicted high energy solar neutrino spectrum. A set of operators that generate spectra similar to the neutrino background is identified, however this set is distinct from those that mimic the neutrino background for heavy, $\gtrsim 100$ MeV mass mediators. We outline a general classification scheme based on momentum dependence of the dark matter-nucleus interaction to determine how strong the discovery limit for a given operator saturates in the presence of the neutrino background. Our results highlight the benefit of considering a general theoretical framework regarding dark matter, and motivate continued experimental progress towards lower nuclear recoil energy thresholds.
    - Contributors: James B. Dent, Bhaskar Dutta, Jayden L. Newstead and Louis E. Strigari
    - Preprint Number: CETUP2016-003

- Title: Directional Searches at DUNE for Sub-GeV Monoenergetic Neutrinos Arising from Dark Matter Annihilation in the Sun
    - Contributors: Carsten Rott, Seongjin In, Jason Kumar, and David Yaylali
    - Preprint Number: CETUP2016-004

- Title: One-loop pseudo-Goldstone masses in the minimal SO(10) Higgs model
    - Abstract: We calculate the prominent perturbative contributions shaping the one-loop scalar spectrum of the minimal non-supersymmetric renormalizable $SO(10)$ Higgs model whose unified gauge symmetry is spontaneously broken by an adjoint scalar. Focusing on its potentially realistic $45\oplus 126$ variant in which the rank is reduced by a VEV of the 5-index antisymmetric tensor, we provide a thorough analysis of the corresponding one-loop Coleman-Weinberg potential, paying particular attention to the masses of the potentially tachyonic pseudo-Goldstone bosons transforming as $(8,1,0)$ and $(1,3,0)$ under the Standard Model gauge group. The results confirm the existence of extended regions in the parameter space supporting a locally stable SM-like quantum vacuum inaccessible at the tree-level. The effective potential tedium is compared to that encountered in the previously studied $45\oplus 16$ $SO(10)$ Higgs model where the polynomial corrections to the relevant pseudo-Goldstone masses turn out to be easily calculable within a very simplified purely diagrammatic approach.
    - Contributors: Lukas Graf (IPNP Prague and University college of London), Michal Malinsky, Timon Mede (IPNP, Prague), Vasja Susic (IPhT CEA, Saclay and J. Stefan Institute, Ljubljana)
    - Preprint Number: CETUP2016-005

- Title: SUSY under siege from direct and indirect WIMP detection experiments
    - Abstract: We examine updated prospects for detecting WIMPs in supersymmetric models via direct and indirect dark matter search experiments. We examine several historical and also still viable scenarios: projections for well-tempered neutralinos (WTN), projections from the MasterCode (MC) collaboration, projections from the BayesFits (BF) collaboration, non-thermal wino dark matter (NThW) and finally mixed axion-higgsino dark matter from SUSY with radiatively-driven naturalness (RNS). The WTN is ruled out by recent limits from XENON and LUX collaborations.The NThW scenario, previously on tenuous ground due to gamma-line searches, appears also ruled out by recent combined Fermi-LAT/MAGIC limits combined with new HESS results from continuum gamma rays. Substantial portions of MC parameter space and 1 TeV higgsino parameter space from BF group are ruled out. The 100-200 GeV higgsino-like WIMP from RNS survives due to its possibledepleted local abundance (where the axion

may make up the bulk of dark matter). Projections from ton-scale noble liquid detectors should discover or ruleout WIMPs from the remaining parameter space of these surviving models.
    - Contributors: Howard Baer, Vernon Barger, and Hasan Serce
    - Preprint Number: CETUP2016-006

- Title: Boxes, Boosts, and Energy Duality: Understanding the Galactic-Center Gamma-Ray Excess through Dynamical Dark Matter
    - Contributors: Kim Boddy, Keith Dienes, Doojin Kim, Jason Kumar, Jong-Chul Park and Brooks Thomas
    - Preprint Number: CETUP2016-007

- Title: Probing light mediators at ultra-low threshold energies with coherent elastic neutrino-nucleus scattering
    - Abstract: Light neutral mediators, with mass . 1 GeV, are common features of extensions to the standard model (SM). Astrophysical and terrestrial experiments have constrained the model parameter space, with planed experiments around the world improve the sensitivity. In this paper we study the prospects for probing light neutral mediators using ultra-low threshold nuclear and electron recoil detectors through a combination of coherent neutrino-nucleus and electron scattering. With low threshold detectors, we show that most stringent bounds on models arise from the nuclear scattering process, improving upon previous bounds from electron scattering of solar neutrinos.
    - Contributors: James B. Dent, Bhaskar Dutta, Shu Liao, Jayden L. Newstead, Louis E. Strigari, Joel W. Walker
    - Preprint Number: CETUP2016-008

- Title: Anarchy with Hierarchy: A Probabilistic Appraisal
    - Abstract: The masses of the charged fermion and the mixing angles among quarks are observed to be strongly hierarchical, while analogous parameters in the neutrino sector appear to be structure-less or anarchical. We develop a class of unified models based on SU(5) symmetry that explains these differing features probabilistically. With the aid of three input parameters that are hierarchical, and with the assumption that all the Yukawa couplings are uncorrelated random variables described by Gaussian distributions, we show by Monte Carlo simulations that the observed features of the entire fermion spectrum can be nicely reproduced. We extend our analysis to an SU(5)-based flavor U(1) model making use of the Froggatt-Nielsen mechanism where the order one Yukawa couplings are modeled as random variables, which also shows good agreement with observations.
    - Contributors: K.S. Babu, Alexander Khanov, Shaikh Saad
    - Preprint Number: CETUP2016-009

- Title: Sommerfeld-Enhanced J-Factors For Dwarf Spheroidal Galaxies
    - Contributors: Kimberly Boddy, Louis Strigari, Mei-Yu Wang, Jason Kumar
    - Preprint Number: CETUP2016-010

CETUP*2016 conference proceedings are in preparation to be published by American Institute of Physics.

CETUP* 2016 PARTICIPANTS:

List of Participants at Physics and Instrumentation of the Near Detector for the Long-Baseline Neutrino Experiments session at CETUP* 2016 (June 6 – 18, 2016):

	First Name	Last Name	Position	Affiliation	Country
1	Tyler	Alion	Graduate Student	Fermilab	US
2	Bipul	Bhuyan	Associate Prof.	Indian Institute of Technology Guwahati	India
3	Hongyue	Duyang	Postdoc	Univ. of South Carolina	US
4	Raj	Gandhi	Professor	Harish Chandra Research Institute	India
5	Bing	Guo	Graduate Student	Univ. of South Carolina	US
6	Ashok	Kumar	Associate Prof.	Panjab university	India
7	Jonathan	Link	Professor	Virginia Tech	US
8	Steve	Manly	Professor	University of Rochester	US
9	Poonam	Mehta	Assistant Prof.	JNU	India
10	Sanjib	Mishra	Professor	Univ. of South Carolina	US
11	Mathew	Muether	Assistant Prof.	Wichita State University	US
12	Vittorio	Paolone	Professor	University of Pittsburgh	US
13	Jaewon	Park	Postdoc	Virginia Tech	US
14	Venktesh	Singh	Assistant Prof.	Banaras Hindu University	India
15	Jyotsna	Singh	Assistant Prof.	University of Lucknow	India
16	Barbara	Szczerbinska	Associate Prof.	Dakota State University	US
17	Martin	Tzanov	Assistant Prof.	Louisiana State University	US
18	Walter	Weinig	Lab director	Sanford Lab	US

List of Participants at Neutrino Physics/Unification session: "From Grand Unification to String Theory and Back" at CETUP* 2016 (June 20 – July 2, 2016):

	First Name	Last Name	Position	Affiliation	Country
1	Borut	Bajc	Professor	J. Stefan Institute	Slovenia
2	Hyung Do	Kim	Professor	Seoul National University	S. Korea
3	James	Gray	Assistant Prof.	Virginia Tech	US
4	Jyotsna	Singh	Assistant Prof.	University of Lucknow	India
5	Kaladi	Babu	Professor	Oklahoma State University	US
6	Lara	Anderson	Assistant Prof.	Virginia Tech	US
7	Mathew	Muether	Assistant Prof.	Wichita State University	US
8	Nobuhiro	Maekawa	Associate Prof.	KMI, Nagoya Univ.	Japan
9	Patrick	Vaudrevange	Postdoc	TUM Exzellenzcluster Universe	Germany
10	Radovan	Dermisek	Associate Prof.	Indiana University	US
11	Raj	Gandhi	Professor	Harish Chandra Research Institute	India

12	Saki	Khan	Graduate Student	Oklahoma State University	US
13	Shaikh	Saad	Graduate Student	Oklahoma State Univ.	US
14	Stuart	Raby	Professor	The Ohio State University	US
15	Takumi	Kuwahara	Graduate Student	Nagoya university	Japan
16	Tom	Weiler	Professor	Vanderbilt University	US
17	Yoshihiro	Shigekami	Graduate Student	Nagoya Univ.	Japan
18	Zurab	Tavartkiladze	Associate Prof.	Ilia State University	Georgia
19	Walter	Weinig	Lab Director	Sanford Lab	US
20	Barbara	Szczerbinska	Associate Prof.	Dakota State University	US

List of participants at Dark Matter Session at CETUP* 2016 (July 04 – July 16, 2016):

1	Alexander	Kramer	Graduate Student	University of New Mexico	US
2	Hasan	Serce	Graduate Student	University of Oklahoma	US
3	Jong-Chul	Park	Assistant Prof.	Chungnam National Univ.	S. Korea
4	Keith	Dienes	Professor	NSF / Univ. of Arizona	US
5	Lauren	Hsu	Lab Researcher	Fermiab	US
6	Linda	Carpenter	Assistant Prof.	Ohio State University	US
7	Richard	Hill	Assistant Prof.	TRIUMF & Perimeter & U. Chicago	US
8	Walter	Weinig	Lab Director	Sanford Lab	US
9	Will	Taylor	Graduate Student	Brown University	US
10	Adrienne	Erickcek	Assistant Prof.	UNC Chapel Hill	US
11	Andrea	Albert	Postdoc	Los Alamos National Lab	US
12	Annika	Peter	Assistant Prof.	The Ohio State University	US
13	Barbara	Szczerbinska	Associate Prof.	Dakota State University	US
14	Brianne	Hackett	Graduate Student	Univ. of Hawaii at Manoa	US
15	Brooks	Thomas	Assistant Prof.	Lafayette College	US
16	Charanjit	Aulakh	Professor	IISER Mohali	India
17	Chris	Kelso	Assistant Prof.	Univ. of North Florida	US
18	Doojin	Kim	Postdoc	University of Florida	US
19	Erin	Edkins	Graduate Student	Univ. of Hawaii, Manoa	US
20	James	Dent	Assistant Prof.	U. of Louisiana Lafayette	US
21	Jason	Kumar	Associate Prof.	University of Hawaii	US
22	Jayden	Newstead	Graduate Student	Arizona State University	US
23	Jessica	Goodman	Postdoc	The Ohio State University	US
24	Jingke	Xu	Postdoc	Lawrence Livermore National Laboratory	US
25	Joel	Walker	Associate Prof.	Sam Houston State Univ.	US
26	Joseph	Bramante	Postdoc	University of Notre Dame	US
27	Kara	Keeter	Associate Prof.	Black Hills State Univ.	US
28	KC	Kong	Associate Prof.	University of Kansas	US
29	Kimberly	Boddy	Postdoc	University of Hawaii	US
30	Kuver	Sinha	Postdoc	University of Utah	US

31	Louis	Strigari	Assistant Prof.	Texas A&M	US
32	Patrick	Stengel	Graduate Student	University of Hawaii	US
33	Pearl	Sandick	Assistant Prof.	University of Utah	US
34	Ranjan	Laha	Postdoc	KIPAC, Stanford Univ.	US
35	Rebecca	Leane	Graduate Student	University of Melbourne	Australia
36	Regina	Caputo	Postdoc	UC Santa Cruz	US
37	Rouzbeh	Allahverdi	Associate Prof.	University of New Mexico	US
38	Seodong	Shin	Postdoc	Indiana University	US
39	Susanne	Westhoff	Assistant Prof.	University of Heidelberg	Germany
40	Takahiro	Yamamoto	Graduate Student	University of Utah	US
41	Tathagata	Ghosh	Graduate Student	Texas A&M University	US
42	Thomas	Thorpe	Graduate Student	Univ. of Hawaii - Manoa	US
43	Tim	Linden	Postdoc	The Ohio State University	US
44	Yu	Gao	Postdoc	Texas A&M	US

CETUP*2016 SCIENTIFIC AGENDAS:

Physics and Instrumentation of the Near Detector for the Long-Baseline Neutrino Experiments Session Agenda:

6/June/16, Monday
10:00 —11:59 AM
Welcome — Barbara Szczerbinska
Challenges for the Near Detector — Sanjib R. Mishra
2:00 — 5:30 PM
NOvA Near Detector Physics — Mathew Muether

7/June/16, Tuesday
10:00 —11:59 AM
FGT Simulation — Tyler Alion
R&D Effort for the FGT — Ashok Kumar
2:30 — 5:30 PM
Neutrino Production of Resonance Interactions — Hongyue Duyang

8/June/16, Wednesday
Working Day

9/June/16, Thursday
10:00 —11:59 AM
Working Morning
2:30 — 5:30 PM
High Resolution Measurements & in situ Constraints on Nuclear Effects — Sanjib R. Mishra
Nuclear Effects — All

10/June/16, Friday

Working Day

11/June/16, Saturday
10:00 —11:59 AM
Working Morning
2:30 — 5:30 PM
To be announced — Martin Tzanov

13/June/16, Monday
10:00 —11:59 AM
Working Morning
2:30 — 5:30 PM
High Resolution Fine-Grained Tracker (FGT), DUNE's Ref. Detector — Bipul Bhuyan
Neutron Detection — Jonathan Link / Jaewon Park
New Physics and CP-Violation in the Neutrino Sector — Poonam Mehta

14/June/16, Tuesday
10:00 —11:59 AM
Working Morning
2:30 — 5:30 PM
MINERvA Physics — Steve Manly

15/June/16, Wednesday
10:00 —11:59 AM
Working Morning
2:30 — 4:00 PM
Meeting with high-school students — All

16/June/16, Thursday
10:00 —11:59 AM
Working Morning
17/June/16, Friday
Working Day

Neutrino Physics/Unification session: "From Grand Unification to String Theory and Back" session agenda:

Week 1			
20-Jun Monday	**9:30 - 10:15**	Tom Weiler	Interpreting present IceCube data
	11:30 - 12:15	Sanjib Mshra	Near Detector Physics and Status
21-Jun Tuesday	**9:30 - 10:15**	Walter Weinig	Sanford Underground Research Facility Overview
	11:00 - 11:45	Radovan Dermisek	Loop suppressed electroweak symmetry breaking and naturally heavy superpartners
22-Jun Wednesday	**9:30 - 10:15**	Saki Khan	Radiative Electroweak symmetry breaking in SM Extensions SM Extensions
	11:00 - 11:45	Borut Bajc	Residual symmetries of SO(10) GUT
23-Jun Thursday	**9:30 - 10:15**	Shaikh Saad	New Class of SO(10) models for Flavor
	11:00 - 11:45	Zurab Tavartkiladze	Leptonic CP Violation and Leptogenesis
24-Jun Friday	**9:30 - 10:15**	Nobuhiro Maekawa	Neutrino masses and mixings as an evidence of GUT, and the impact to (flavor changing) nucleon decay
	11:00 - 11:45	Hyung Do Kim	Nnaturalness
Week 2			
27-Jun Monday	**9:30 - 10:15**	Yoshihiro Shigekami	D-term contributions and CEDM constraints in E_6*SU(2)_F*U(1)_A SUSY GUT model
	11:00 - 11:45	Kaladi Babu	Trinification and LHC physics
28-Jun Tuesday	**9:30 - 10:15**	Takumi Kuwahara	Threshold Corrections to the Dimension-six Proton Decay Operators in SUSY SU(5)
	11:00 - 11:45		Q&A with undergrad and grad students
29-Jun Wednesday	**10:00 - 4:30**	SURF - underground tour	
30-Jun Thursday	**9:30 - 10:15**	Lara Anderson	Standard Models and more in smooth heterotic compactifications
	11:00 - 11:45	Stuart Raby	Leptogenesis in a PS theory of inflation
1-Jul Friday	**9:30 - 10:15**	James Gray	Yukawa Unification in Heterotic Calabi-Yau Models
	11:00 - 11:45	Patrick Vaudrevange	Grand Unification without Proton Decay

Dark Matter session – agenda:

Week 1					
	July 4	July 5	July 6	July 7	July 8
Talk 1 9:20-10:00am	----------	Jamie Dent *General analysis of direct detection and the neutrino floor*	Chris Kelso *The effects on dark matter direct detection experiments of including baryons in N-body simulations of galaxy formation*	Regina Caputo *Recent Searches for Dark Matter with the Fermi Large Area Telescope*	Takahiro Yamamoto *Charged mediators*
Talk 2 10-10:40am	----------	Jay Newstead *Estimating WIMP parameters with direct detection experiments*	Kuver Sinha *Closing in on the Thermal WIMP Miracle*	Andrea Albert *Searching for DM with Fermi and HAWC*	Rebecca Leane *Unitarity and Gauge Invariance in Dark Matter Models*
Talk 3 11:10am-12pm	----------	Brooks Thomas *Natural Realizations of Dynamical Dark Matter*	Linda Carpenter *Indirect Constraints from the Fermi Dwarf Analysis*	Tim Linden *Diffuse Emission Models of the Galactic Center and the GeV Excess*	Pat Stengel *Charged Mediators in Dark Matter Scattering*
Lunch and Free Discussion 12-4:30pm	----------				
Discussion Session 4:30-5:30pm	BBQ at the Lodge, 5pm --	Keith Dienes *Non-Minimal Dark Matter*	Kuver Sinha *Should a Thermal WIMP Still Be the Default Assumption?*	Andrea Albert, Regina Caputo, *Future of Indirect Detection*	Jamie Dent, Chris Kelso, Brooks Thomas *Undergraduates in Research*

Week 2					
	July 11	July 12	July 13	July 14	July 15
Talk 1 9:20-10:00am	Hasan Serce *Implications of Mixed Axion - WIMP Dark Matter for the DM Searches*	Adrienne Erickcek *The Early Universe's Imprint on Dark Matter*"	Erin Edkins *DarkSide*	Joel Walker *Sensitivity to Z-prime, neutrino magnetic moment, and sterile neutrino oscillation from coherent neutrino-nucleus scattering*	Ranjan Laha *Dark matter velocity spectroscopy*
Talk 2 10-10:40am	Suzanne Westhoff *Second run for Higgs-portal dark matter at the LHC*	Kim Boddy *SIDM*	Jingke Xu *The latest progress of direct search for dark matter with the LUX detector*	Richard Hill *Status and prospects for heavy WIMP direct detection*	Joseph Bramante *Cosmological Aspects of Dark Matter*
Talk 3 11:10am-12pm	Tatha Ghosh *Dark matter in the context of diphoton excess at the LHC*	Annika Peter *All Mergers Great and Small*	Will Taylor *LZ*	Doojin Kim *DDM Trilogy with the "Energy-peak" Method: MeV, GeV, and TeV*	Rouzbeh Allahverdi *Probing dark matter annihilation to right-handed neutrinos*
Lunch and Free Discussion 12-4:30pm	SURF visit 2-4:30pm		Lauren Hsu *SuperCDMS SNOlab status and prospects*		
Discussion Session 4:30-5:30pm	Tatha Ghosh, Hasan Serce *SUSY and Dark Matter*	Adrienne Erickceck, Annika Peter *What Can We Learn about Dark Matter from Astronomy?*	Brianne Hackett, Lauren Hsu, Will Taylor, Jingke Xu *The Future of Direct Detection*	Richard Hill, Jay Newstead *Dark Matter: What Do We Need From Nuclear Physics?*	Keith Dienes, Walter Weinig *The Future of Large Physics Projects in the US, and the Role of Theory in the Future of US Physics*