



Theoretical Division, NPAC

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LANL Hosts the 2012 National Nuclear Physics School



Since 1988 the National Nuclear Physics Summer School (NNPSS) has brought together talented graduate students, postdoctoral researchers, and prominent lecturers to discuss the exciting recent developments and future directions in nuclear science. The 2012 NNPSS was organized by the Los Alamos National Laboratory and was held July 9 - July 20, 2012 at St. John's College in Santa Fe, New Mexico. Students and postdocs within a few years of their PhD were invited to take advantage of this opportunity to network and learn about the future directions of nuclear physics. LANL also organized the 2002 NNPSS.

The 2012 NNPSS covered a broad range of topics, including QCD and heavy ion physics, hadron structure and spin physics, nuclear structure and reactions, nuclear astrophysics, fundamental symmetries and neutrinos, lattice QCD, cold atoms, NIF physics, and medical applications of nuclear science. Lecturers from the leading centers for nuclear physics in the U.S. and more than 50 students from the U.S. and abroad contributed to the success of the summer school and enjoyed the cultural and outdoor activities that Santa Fe, Los Alamos and Northern New Mexico provide.

The 2012 NNPSS was sponsored by the National Science Foundation, the U.S. Department of Energy's Institute for Nuclear Theory, and the Los Alamos National Laboratory. Local organizing committee included Joe Carlson, Vincenzo Cirigliano and Ivan Vitev (chair).

Lecturers and lecture topics

QCD and Heavy Ion Physics:

Lecturer 1: *Tom Hemmick*, 3 lectures on heavy-ion physics and QCD at extreme temperatures and densities. Recent results from the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC): [Lecture1](#) | [Lecture2](#) | [Lecture3](#)

Lecturer 2: *Berndt Mueller*, 2 lectures on theoretical methods for heavy-ion physics, jet quenching and jet tomography, relativistic hydrodynamics and the AdS/CFT correspondence: [Lecture1](#) | [Lecture2](#)

Hadron Structure and Spin physics:

Lecturer 1: *Zein-Eddine Meziani*, 3 lectures on spin physics and the structure of the nucleon. Recent results from the spin physics programs at the Thomas Jefferson National Accelerator Facility (JLab) and RHIC: [Lecture1](#) | [Lecture2](#) | [Lecture3](#)

Lecturer 2: *Jamal Jalilian-Marian*, 2 lectures on QCD matter at high gluon densities, initial-state effects and the future Electron-Ion Collider (EIC): [Lecture1](#) | [Lecture2](#)

Nuclear Structure and Reactions:

Lecturer 1: *Hendrick Schatz*, 3 lectures on experimental nuclear physics. The Facility for Rare Isotope Beams (FRIB) [Lecture1](#) | [Lecture2](#) | [Lecture3](#)

Lecturer 2: *Dick Furnstahl*, 2 lectures on new theoretical methods for nuclear structure, nuclear matter and cold atoms: [Lecture](#)

Nuclear Astrophysics:

Lecturer 1: *Chuck Horowitz*, 3 lectures on the neutron star crust, supernovae, nucleosynthesis and the r-process: [Lecture1](#) | [Lecture2](#) | [Lecture3](#)

Lecturer 2: *Tod Strohmayer*, 2 lectures on observational methods, nuclear astrophysics and recent results: [Lecture1](#) | [Lecture2](#)

Fundamental Symmetries and Neutrinos:

Lecturer 1: *George Fuller*, 3 lectures on neutrinos and the new standard model. Neutrino masses and oscillations. The neutrino physics program of the Deep Underground Science Laboratory (DUSEL): [Lecture1](#) | [Lecture2](#) | [Lecture3](#) | [Slides](#)
Lecturer 2: *Barry Holstein*, 2 lectures on fundamental symmetry tests with π nuclei, neutrons and neutrinos. Connections to the physics beyond the Standard π Model, electric dipole moment, double beta decay: [Lecture1](#) | [Lecture2](#) | [Lecture3](#)

Seminars:

1. *Speaker: Peter Petreczky*, Lattice gauge theory methods for π nuclear physics [\[pdf\]](#)
2. *Speaker: Silas Beane*, Lattice gauge theory methods for nuclear π physics [\[pdf\]](#)
3. *Speaker: Anna Hayes*, The national ignition facility [\[pdf\]](#) π
4. *Speaker: Suzanne Lapi*, Medical applications of nuclear physics [\[pdf\]](#)
5. *Speaker: Martin Zwierlein*, Cold atom experiments [\[pdf\]](#)
6. *Speaker: Sanjay Reddy*, Unravelling the neutron star interior: π prospects and challenges [\[pdf\]](#)

Description of the format of the school

For each of the five broad areas listed (1.QCD and Heavy Ion Physics; 2.Hadron Structure and Spin Physics; 3.Nuclear Structure and Reactions; 4 Nuclear Astrophysics; 5.Fundamental Symmetries and Neutrinos) we had two main lecturers who gave 3 and 2 lectures, respectively. This structure allowed for in-depth expert coverage of several topics in each area. It also provided more possibilities for one-on-one interactions between the students and the lecturers and diversified the break-out sessions dedicated to problem solving and discussion of more advanced topics. Specialized topics and applications of nuclear physics, for example lattice QCD and medical applications, were presented in 6 seminars. Last but not least, we will organized sessions where the students present briefly their own research. The student talks were 10 min each and the quality of the presentations was excellent. This structure of the summer school conveyed the excitement from the cutting edge research in nuclear physics, the unique ways in which our field interfaces with other disciplines and the many important applications of nuclear science. The NNPS helped form long lasting collaborations between the participants.

WEEK 1, July 9-13

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 - 9:30	Breakfast/Informational discussion of the topics of the day (morning session)				
9:00 - 10:15	Jalilian-Marian	Zwierlein	Meziani	Meziani	Meziani
10:15 - 10:45	coffee break	coffee break	coffee break	coffee break	coffee break
10:45 - 11:00	Horowitz	Jalilian-Marian	Horowitz	Holstein	Holstein
12:00 - 14:00	Lunch Break/Informal discussion of the afternoon session and student talks				
14:00 - 15:15	Schatz	Horowitz	Student talks	Student talks	Petraczký
15:15 - 15:45	coffee break	coffee break	coffee break	coffee break	coffee break
15:45 - 17:00	Schatz	Schatz	Student talks	Student talks	Student talks
18:00 - 20:00	Dinner / Review of 1st week topics				

WEEK 2, July 16 - 20

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 - 9:30	Breakfast/Informational discussion of the topics of the day (morning session)				
9:00 - 10:15	Mueller	Mueller	Fuller	Fuller	Fuller
10:15 - 10:45	coffee break	coffee break	coffee break	coffee break	coffee break
10:45 - 11:00	Hemmler	Hemmler	Hemmler	Strohmayr	Strohmayr
12:00 - 14:00	Lunch Break/Informal discussion of the afternoon session and student talks				
14:00 - 15:15	Furnstahl	Furnstahl	Lapi	Deane	Reddy
15:15 - 15:45	coffee break	coffee break	coffee break	coffee break	coffee break
15:45 - 17:00	Student talks	Hayes	Student talks	Student talks	Student talks
18:00 - 20:00	Dinner / Review of 2nd week topics				

List of students and their institutions*Women*

Cummings Melissa	(The College of William and Mary)
Donadelli Marisilvia	(CERN)
Ge Huijun	(Stony Brook University)
Han Sophia	(Washington Univ-St. Louis)
Mahmoodifar Simin	(Washington Univ-St. Louis)
Patton Kelly	(North Carolina State University)
Phelps Gretchen	(University of Kentucky)
Piarulli Maria	(Old Dominion University)
Sen Srimoyee	(UM-College Park)
Zhang Jie	(Arizona State University)

Men

Acharya Bijaya	(Ohio University)
Adhikari Prabal	(University of Maryland)
Bandara Nerangika	(University of Massachusetts Amherst)
Bhattarai Prabhat	(University of Texas at Austin)
Bartl Alex	(TU Darmstadt)
Carpino Fiore	(MSU)
Chen Wei-Chia	(Florida State University)
Cherry John	(UCSD)
Chowdhury Usman	(TRIUMF/University of Manitoba)
Coleman-Smith Ch.	(Duke University)
Dowd James	(The College of William and Mary)
Fickinger Michael	(University of Arizona)
Fry Jason	(Indiana University)
Gomez Jaime	(University of Maryland)
Grohs Evan	(UCSD)
He Daheng	(University of Kentucky)
Hewson Paul	(University of Manchester)
Junnarkar Parikshit	(University of New Hampshire)
Krueger Thomas	(Darmstadt)
Li Feng	(Texas A&M)
Karacoc Mesut	(Texas A&M)
Lonardonni Diego	(University of Trento)
Lynn Joel	(Arizona State University)
Mahzoon Hossein	(Washington Univ-St. Louis)
Meredith Beau	(Columbia)
Mereghetti Emanuele	(UC Berkeley, LBNL)
Misch G Wendell	(UCSD)
O'Connor Colton	(MIT)
Orazbayev Azamat	(Ohio University)
Page Brian	(Indiana University)
Qiu Zhi	(Ohio State University)
Quintero Amilkar	(Kent State)
Rislow Benjamin	(The College of William and Mary)
Rrapaj Ermal	(UW Seattle)
Schneider Andre	(Indiana University)
Shanshan Cao	(Duke University)
Shen Chun	(Ohio State University)
Simonis Johannes	(TU Darmstadt)
Subedi Adesh	(Mississippi State Univ)
Tews Ingo	(TU Darmstadt)
Ticehurst David	(University of NC at Chapel Hill)
Vlasenko Alexey	(UCSD)
Wexler Jonathan	(University of Massachusetts Amherst)
Wiranata Anton	(LBNL)
Wu Dajing	(Iowa State University)

Zhang Hong

(Stony Brook University)

Student demographics

Of the 56 students who attended the school, 22% were women and 78% men. Students ranged from 3 years before obtaining their Ph.D. degree to 2 years after obtaining their Ph.D. degree. Students covered all areas of nuclear physics. Within the U.S. students came from private and public universities and national laboratories. There was considerable international interest in the summer school with participants from abroad, 11%.

Social activities

Santa Fe and Northern New Mexico are rich in history, cultural and outdoor activities. Within the city limits, the NNPSS participants could enjoy the shows at the Lensic Performing Arts Center and visit many unique museums, such as the Palace of the Governors, the Georgia O'Keefe museum, the Museum of Indian Arts and Culture and the numerous private galleries. The summer school overlapped with the Santa Fe Opera season and Santa Fe Chamber Music Festival, which are world-class musical events. The historic Taos Pueblo, designated both a World Heritage Site by UNESCO and a National Historic Landmark, is just 70 miles north of Santa Fe.

We organized a number of social and extracurricular activities. Two conference dinners took place during the 1st and 2nd weeks of the summer school to allow students to interact with the lecturers in a completely informal setting. On the weekend we organized a hike to Wheeler Peak, the highest summit in New Mexico. We visited the cave dwellings in the Bandelier National Monument and the Los Alamos museums. We also organized a rafting trip on the Rio Grande (Racecourse) as a possibility for the more adventurous participants. Last but not least, in the free evenings the students organized sporting activities and socialized in Santa Fe.