

Final Report for award DE-SC0012089

Project title: Theoretical Advanced Study Institute 2014, "Journeys through the Precision Frontier: Amplitudes for Colliders"

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Sponsoring Office: Department of Energy, Division of High Energy Physics

Name of recipient: University of Colorado

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Abstract

The Theoretical Advanced Study Institute was held at the University of Colorado, Boulder, during June 2-27, 2014. The topic was "Journeys through the Precision Frontier: Amplitudes for Colliders." The organizers were Professors Lance Dixon (SLAC) and Frank Petriello (Northwestern and Argonne). There were fifty one students. Nineteen lecturers gave sixty seventy five minute lectures. A Proceedings was published.

Summary

The Theoretical Advanced Study Institute (TASI) is a summer intensive program supported by the Department of Energy and the National Science Foundation. It has been in existence since 1984 and has been held in Boulder CO since 1989. The primary purpose of TASI is to provide a series of lectures and seminars aimed at advanced graduate students on topics of current research in theoretical elementary particle physics and on related experimental subjects. This is done to broaden their horizons beyond the thesis topics they pursue at their home institutions.

TASI is overseen by a Scientific Advisory Board, who chooses the general theme of each institute and recruits scientific directors to make up the program. The present chair of the Board is S. Dawson (Brookhaven National Laboratory). Other members of the Board during TASI-2014 were C. Johnson (USC), T. Han (Pittsburg), G. Gelmini (UCLA), T. LeCompte (Fermilab), J. Maldacena (Princeton, IAS), and T. DeGrand (Colorado).

The University of Colorado is responsible for its local infrastructure. TASI 2014 was held at the University of Colorado, Boulder, during June 2 - 27, 2014. The topic was "Journeys through the Precision Frontier: Amplitudes for Colliders." The organizers were Professors Lance Dixon (SLAC) and Frank Petriello (Northwestern and Argonne).

There were fifty one students. Nineteen lecturers gave sixty seventy five minute lectures. Each speaker gave several lectures in his/her chosen field. There were twelve discussion sessions or tutorials in modern software for phenomenology. The students organized their own series of brief talks. The atmosphere at TASI is designed to engender an intense interaction among students and lecturers, and once again it was successful in doing this.

This TASI was unique for its large emphasis on methods for calculating amplitudes. This was embedded in a program describing recent theoretical and phenomenological developments in particle physics. Topics included introductions to the Standard Model, to QCD (both in a collider context and on the lattice), effective field theories, Higgs physics, neutrino interactions, an introduction to experimental techniques, and cosmology.

A Proceedings was published by World Scientific in summer 2015 (L. Dixon and F. Petriello, "Journeys through the Precision Frontier: Amplitudes for Colliders," World Scientific (Singapore) 2015.)

TASI 2014 also had a well-attended public lecture by Chris Quigg (Fermilab), "The world according to Higgs."

Lecturers and topics:

Chris Quigg (Fermilab): Introduction to the Standard Model

Thomas Gehrmann (Zurich): Introduction to QCD

Zvi Bern (UCLA): Spinor-helicity and unitarity methods

Andrey Korytov (Florida): Experimental methods at the LHC

Iain Stewart (MIT): Effective field theories for QCD

Aida El-Khadra (Illinois): QCD on the lattice

Stefan Hoeche (SLAC): Parton showers and Monte Carlo simulations

Patrick Huber (Virginia Tech): Neutrino physics

Zoltan Ligeti (LBNL): Flavor physics

Claude Duhr (Durham): Mathematical aspects of scattering amplitudes

Marcus Spradlin (Brown): Amplitudes in N=4 super-Yang-Mills theory

Chris Herzog (Stony Brook): Applied holography

Konstantin Matchev (Florida): Physics beyond the Standard Model at colliders

Tao Han (Pittsburgh): Higgs physics and beyond

Graciela Gelmini (UCLA): The hunt for dark matter

Radja Boughezal (Argonne): Precision Higgs physics

John Joseph Carrasco (Stanford): Novel amplitude relations

Salman Habib (Argonne): Cosmology in the precision era

Aneesh Manohar (UCSD): Factorization in QCD