Memorial Meeting for Nobel Laureate Prof Abdus Salam’s 90th Birthday

25 to 28 January 2016
Nanyang Technological University, Singapore

Prof Abdus Salam
29 January 1926 – 21 November 1996

The First Pakistani to receive a Nobel Prize (Physics) in 1979
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FOREWORD

Abdus Salam, born in 1926, was one of the most important, influential and exciting physicists of the last century. Growing up under modest conditions in what is now Pakistan, he broke all school records and went to Cambridge in England to finish his studies and to become a scientist. In 1957, he was appointed to a chair at Imperial College London, where he founded the Theoretical Physics Group and made it one of the world’s centres of excellence in particle physics. At the age of 33, he was elected a Fellow of the Royal Society.

His contributions to physics are enormous. Already in his thesis in 1951, he finalised the full proof of the renormalisability of Quantum Electrodynamics. He was one of the first to understand the importance of parity violations in the weak interactions, and was one of the key persons to realise that the weak force should be formulated as a Yang-Mills theory. This led him eventually to formulate the consistent unification of the electromagnetic and weak nuclear forces, for which he shared the 1979 Nobel Prize with Sheldon Glashow and Steven Weinberg. After the proof of the renormalisability of the Yang-Mills theories, he was, together with Pati, one of the first to attack the problem of incorporating the strong interactions into the unification scheme. At the same time he initiated a program with Strathdee to study supersymmetric quantum field theories and introduced the concepts of superfields. Abdus Salam was always in the forefront of particle physics. He would not rest until it was married with the fourth and most enigmatic force of gravity, a quest that is still at the forefront of current research.

He was very active not only in his homeland Pakistan, setting up all the government activities in science and technology in that new country, but with his boundless energy, was also an ambassador for science and education throughout the developing world. He firmly believed that every nation should be active in basic science in order to improve both its intellectual and economic standing. In 1964, he founded the International Centre for Theoretical Physics (ICTP) in Trieste, dedicated to that goal. The ICTP has served as the hub for this activity and now bears his name.

Abdus Salam was indeed a remarkable personality and the world is still missing his presence.

Prof Lars Brink (Co-Chair)  
Chalmers University of Technology

Prof Michael Duff (Co-Chair)  
Imperial College of London

Prof Kok Khoo Phua (Co-Chair)  
Institute of Advanced Studies  
Nanyang Technological University
## ORGANISING COMMITTEE

### Co-Chairs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Lars Brink</td>
<td>Chalmers University of Technology</td>
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<tr>
<td>Michael Duff</td>
<td>Imperial College London</td>
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<tr>
<td>Kok Khoo Phua</td>
<td>Institute of Advanced Studies, NTU</td>
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### Local Organising Committee

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<thead>
<tr>
<th>Name</th>
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<tr>
<td>Belal Baaquie</td>
<td>National University of Singapore</td>
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<tr>
<td>Lock-Yue Chew</td>
<td>School of Physical and Mathematical Sciences, NTU</td>
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<tr>
<td>Leong Chuan Kwek</td>
<td>Institute of Advanced Studies, NTU</td>
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<td>Hwee Boon Low</td>
<td>Institute of Advanced Studies, NTU</td>
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<td>Mirza Mohammed Ali Namazie</td>
<td>National University of Singapore</td>
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<td>Choo Hiap Oh</td>
<td>National University of Singapore</td>
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<tr>
<td>Shuyan Xu</td>
<td>National Institute of Education, NTU</td>
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Day 1: Monday, 25 January 2016

8:15 am       Registration

9:00 am - 9:15 am  Welcome & Opening Ceremony
Welcome address by
Kok Khoo PHUA (Director of IAS, NTU)
Opening address by
Bertil Andersson (NTU President)

Session Chair: Kok Khoo PHUA (Institute of Advanced Studies, NTU)

9:15 am - 10:00 am  Gerard ‘t Hooft (Universiteit Utrecht)
Imagining the Future: How the Standard Model may survive the attacks

10:00 am - 10:45 am  Carlo Rubbia (CERN)
An Alternative Proposal of a Muon Cooled Higgs Factory

10:45 am - 11:15 am  Group Photo and Coffee Break

Session Chair: Peter Jenni (CERN)

11:15 am - 12:00 pm  Michael Duff (Imperial College London)
Abdus Salam at Imperial College

12:00 pm - 12:45 pm  Lu Yu (Institute of Physics, CAS)
Salam’s Dream and Dynamic Changes in Chinese Condensed Matter Physics – A Personal Perspective

12:45 pm - 1:45 pm  Lunch

Note - All indicated times include 10 minutes for discussion.
### Session Chair: Lu Yu (Institute of Physics, CAS)

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<tr>
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<tbody>
<tr>
<td>1:45 pm - 2:30 pm</td>
<td>Chris Hull (Imperial College London)</td>
<td><em>Symmetry and Geometry in String Theory</em></td>
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<tr>
<td>2:30 pm - 3:15 pm</td>
<td>Kazuo Fujikawa (RIKEN)</td>
<td><em>CPT Symmetry in an Extension of the Standard Model</em></td>
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<tr>
<td>3:15 pm - 4:00 pm</td>
<td>Peter West (King’s College London)</td>
<td><em>E11 must be a Symmetry of Strings and Branes</em></td>
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<tr>
<td>4:00 pm - 4:30 pm</td>
<td>Coffee Break</td>
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### Session Chair: Tejinder Virdee (Imperial College London)

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<td>4:30 pm - 5:15 pm</td>
<td>Tasneem Zehra Husain (Theoretical physicist and writer)</td>
<td><em>What Remains Invariant: Life Lessons from Abdus Salam</em></td>
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<tr>
<td>5:15 pm - 6:00 pm</td>
<td>Qaisar Shafi (University of Delaware)</td>
<td><em>Abdus Salam: Science and Leadership</em></td>
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<td>The Long Journey to the Higgs boson and Beyond at CERN's Large Hadron Collider (LHC) - Part I</td>
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<td>The Long Journey to the Higgs boson and Beyond at CERN's Large Hadron Collider (LHC) - Part II</td>
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<tr>
<td>10:30 am - 10:50 am</td>
<td>Coffee Break</td>
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<td>10:50 am - 11:35 am</td>
<td>David Gross (University of California, Santa Barbara)</td>
<td>QCD - Then and Now</td>
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<td>11:35 am - 12:20 pm</td>
<td>Jogesh Pati (SLAC, Stanford University)</td>
<td>Unity With SU(4)-Color: With Neutrino Oscillations Seen Proton Decay Is The Missing Piece</td>
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<tr>
<td>12:20 pm - 1:05 pm</td>
<td>Hirotaka Sugawara (Okinawa Institute of Science and Technology)</td>
<td>Past, Present and Future of High Energy Physics</td>
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<tr>
<td>1:05 pm - 2:00 pm</td>
<td>Lunch</td>
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Session Chair: Jean Tran Thanh Van (Rencontres de Moriond)

2:00 pm - 2:45 pm  
**Anthony Leggett** (University of Illinois at Urbana-Champaign)  
*Majorana Fermions in Condensed Matter Physics*

2:45 pm - 3:30 pm  
**Eliezer Rabinovici** (The Hebrew University of Jerusalem)  
*SESAME Opens - A Realization of an Abdus Salam Vision of Science for Peace*

3:30 pm - 3:50 pm  
**Coffee Break**

Session Chair: Lars Brink (Chalmers Institute of Technology)

3:50 pm - 4:35 pm  
**Fernando Quevedo** (ICTP)  
*ICTP: 50+ Years of Science for the Future*

4:35 pm - 6:00 pm  
**Panel Discussion on “The Future of Fundamental Physics”**  
Panel speakers:  
- **Pisin Chen** (National Taiwan University)  
- **David Gross** (University of California, Santa Barbara)  
- **Peter Jenni** (CERN)  
- **Carlo Rubbia** (CERN)  
- **Hirotaka Sugawara** (Okinawa Institute of Science and Technology)  
- **Gerard ’t Hooft** (Universiteit Utrecht)  
- **Tejinder Virdee** (Imperial College London)

6:15 pm  
**Depart for Banquet (by invitation only)**  
Two-way transport will be provided. Please gather at the NEC Guest Wing Lobby (Level 1) by 6:15 pm.

7:15 pm  
**Banquet at Pan Pacific Hotel (by invitation only)**

*Note - All indicated times include 10 minutes for discussion.*
### Day 3: Wednesday, 27 January 2016

#### Session Chair: Robert Delbourgo (University of Tasmania)

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<tr>
<th>Time</th>
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<tr>
<td>9:00 am - 9:45 am</td>
<td>Eric Bergshoeff (University of Groningen)</td>
<td><em>A New Look at Newton-Cartan Gravity</em></td>
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<tr>
<td>9:45 am - 10:30 am</td>
<td>Sergio Ferrara (CERN)</td>
<td><em>Cosmology in Supergravity</em></td>
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<tr>
<td>10:30 am - 10:50 am</td>
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<td><em>Coffee Break</em></td>
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#### Session Chair: Kellogg Stelle (Imperial College London)

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<td>10:50 am - 11:35 am</td>
<td>Robert Delbourgo (University of Tasmania)</td>
<td><em>The Force and Gravity of Events</em></td>
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<td>Jordan Nash (Imperial College London)</td>
<td><em>Looking at Ultra-rare Standard Model Processes to Search for New Physics with COMET</em></td>
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<tr>
<td>12:20 pm - 1:05 pm</td>
<td>Ali Chamseddine (American University of Beirut)</td>
<td><em>Quanta of Geometry and Unification</em></td>
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<tr>
<td>1:05 pm - 2:00 pm</td>
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<td><em>Lunch</em></td>
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*Note - All indicated times include 10 minutes for discussion.*
Session Chair: Jordan Nash (Imperial College London)

2:00 pm - 2:45 pm   **Kellogg Stelle** (Imperial College London)
*Classical Solutions to Quantum Corrected Gravity*

2:45 pm - 3:30 pm   **Goran Senjanovic** (ICTP)
*To be announced*

3:30 pm - 4:15 pm   **Spenta Wadia** (Tata Institute of Fundamental Research)
*The S-matrix of Chern-Simons Plus Matter Theories and Fermi-Bose Duality in 2+1 dims*

4:15 pm - 4:35 pm   **Coffee Break**

Session Chair: Spenta Wadia (Tata Institute of Fundamental Research)

4:35 pm - 5:20 pm   **Francis Allotey** (African Institute for Mathematical Sciences)
*Professor Abdus Salam, my Teacher and Mentor: The Role of ICTP in Africa*

5:20 pm - 6:05 pm   **Christian Fronsdal** (University of California, Los Angeles)
*Action Principles for hydro- and thermo-dynamics*

6:30 pm   **BBQ at Campus Clubhouse**

*Note - All indicated times include 10 minutes for discussion.*
Day 4: Thursday, 28 January 2016

Session Chair: George Thompson (ICTP)

9:00 am - 9:45 am  
**Miguel Virasoro** (National University of General Sarmiento)  
*Abdus Salam: The Passionate, Compassionate Man and his Masterpiece, the ICTP*

9:45 am - 10:30 am  
**Ahmed Ali** (DESY)  
*Precision Tests of the Standard Model in Rare B-Meson Decays*

10:30 am - 10:50 am  
**Coffee Break**

Session Chair: Harald Fritzsch (Ludwig Maximilians University)

10:50 am - 11:35 am  
**George Thompson** (ICTP)  
*Chern-Simons Theory with Complex Gauge Group*

11:35 am - 12:20 pm  
**Madumbai Narasimhan** (Indian Institute of Science)  
*Moduli of flat bundles on Riemann surfaces*

12:20 pm - 1:05 pm  
**Stefano Ruffo** (SISSA)  
*Long-range Interacting Systems*

1:05 pm - 2:00 pm  
**Lunch**

**Note** - All indicated times include 10 minutes for discussion.
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Session Chair: Madumbai Narasimhan (Indian Institute of Science)

2:00 pm - 2:15 pm  Arnulfo Zepeda (Mesoamerican Centre for Theoretical Physics)
The Mesoamerican Centre for Theoretical Physics

2:15 pm - 2:30 pm  Muneer Rashid (National University of Science and Technology)
Spinor Representations of Finite Rotations of SO(4)

2:30 pm - 3:15 pm  Harald Fritzsch (Ludwig Maximilians University)
Neutrino Oscillations and Neutrino Masses

3:15 pm - 3:30 pm  Closing Remarks by Lars Brink (Chalmers Institute of Technology)

3:30 pm - 4:00 pm  Coffee Break

Note - All indicated times include 10 minutes for discussion except for talks indicated with *.
**SPEAKERS’ ABSTRACTS**

**Author(s):** Ahmed ALI  
**Affiliation(s):** DESY  
**Email of Presenter(s):** ahmed.ali@desy.de  
**Title:** Precision Tests of the Standard Model in Rare B-Meson Decays  

**Abstract:**
After some brief personal recollections of my mentor Prof Abdus Salam, I would like to review the current status of the standard model in flavour physics. Foremost on this frontier are rare B-meson decays, measured at the B factories and the LHC. Precise calculations carried out in the standard model for some benchmark processes will be confronted with experiment, and some of the current anomalies in this field will be discussed.

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**Author(s):** Francis ALLOTEY  
**Affiliation(s):** African Institute for Mathematical Sciences  
**Email of Presenter(s):** fkallotey@gmail.com, fka@nexteinstein.org  
**Title:** Professor Abdus Salam, my Teacher and Mentor: The Role of ICTP in Africa  

**Abstract:**
The presentation deals with my personal recollections of the late Professor Abdus Salam from 1958 to 1996, first as my teacher at Imperial College of Science and Technology and Medicine, London and later at the International Centre for Theoretical Physics (ICTP), Trieste Italy. It also discusses his strong advocacy for the development of Science and Technology in the developing world, particularly in Africa, and his role in the establishment of the African Academy of Sciences, the African Physical Society and ICTP Affiliated Centres in Africa.

The talk gives a brief account of my position as his campaign manager for African votes when he attempted to vie for the position of the Director-General of UNESCO in 1987. Despite massive support from the developing countries, particularly African governments, his attempt did not materialise because the government of his country, Pakistan, did not endorse his candidature. He was very religious and a devout Muslim but did not discuss his religious beliefs with his students and collaborators.
**Author(s):** Eric BERGSHOEFF  

**Affiliation(s):** Van Swinderen Institute, University of Groningen  

**Email of Presenter(s):** E.A.Bergshoeff@rug.nl  

**Title:** A New Look at Newton-Cartan Gravity  

**Abstract:**  
In this talk I will discuss the return of Newton-Cartan gravity to the research agenda. In particular, I will discuss its minimal conformal extension and the relation with Horava-Lifshitz gravity.

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**Author(s):** Ali CHAMSEDDINE  

**Affiliation(s):** American University of Beirut  

**Email of Presenter(s):** chams@aub.edu.lb  

**Title:** Quanta of Geometry and Unification  

**Abstract:**  
Volume quantization of a four dimensional spin Riemannian manifold leads to the geometry of a noncommutative space unifying all fundamental interactions. The resulting symmetry is Pati-Salam including the Standard model as a special case.

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**Author(s):** Robert DELBOURGO  

**Affiliation(s):** University of Tasmania  

**Email of Presenter(s):** bob.delbourgo@utas.edu.au  

**Title:** The Force and Gravity of Events  

**Abstract:**  
Local events are characterized by “where”, “when” and “what”. Just as (bosonic) spacetime forms the backdrop for location and time, (fermionic) property space can serve as the backdrop for the attributes of a system. With such a scenario I shall describe a scheme that is capable of unifying gravitation and the other forces of nature. The generalized metric contains the curvature of spacetime and property separately, with the gauge fields linking the bosonic and fermionic arenas. The super-Ricci scalar then can automatically yield the spacetime Lagrangian of gravitation and the standard model (plus a cosmological constant) upon integration over property coordinates.
Author(s): Michael DUFF
Affiliation(s): Imperial College London
Email of Presenter(s): m.duff@imperial.ac.uk
Title: Abdus Salam at Imperial College

Abstract:
The Theoretical Physics group at Imperial College was founded in 1957 by Abdus Salam shortly after the head of physics, Lord Patrick Blackett, persuaded him to move there from Cambridge. He remained as Professor of Theoretical Physics until his death in 1996. I describe Salam’s legacy at Imperial.

Author(s): Sergio FERRARA
Affiliation(s): CERN
Email of Presenter(s): Sergio.ferrara@cern.ch
Title: Cosmology in Supergravity

Abstract:
We discuss models for inflation in the framework of supergravity. The embedding of the Starobingsky model and the relevance of non-linear representations of Supersymmetry to describe de Sitter phases in cosmology are presented.

Author(s): Harald FRITZSCH
Affiliation(s): Ludwig Maximilians University
Email of Presenter(s): fritzsch@mpp.mpg.de
Title: Neutrino Oscillations and Neutrino Masses

Abstract:
The neutrino oscillations give information about the mass differences of the neutrinos. Using the texture zero mass matrices, I calculate the absolute masses of the neutrinos, which are less than 0.1 eV. If the neutrino masses are Majorana masses, the present limit on the effective neutrino mass, relevant for double beta decay, must be improved by a factor 20 in order to see an effect.
Author(s): Christian FRONSDAL
Affiliation(s): University of California, Los Angeles
Email of Presenter(s): fronsdal@physics.ucla.edu
Title: Action Principles for hydro- and thermo-dynamics

Abstract:
B. The first action for hydrodynamics, with 2 field degrees of freedom Action for hydrodynamics with 4 degree of freedom
D. Applications: Couette flow, Astrophysics/ E&M/ More applications: General Relativity, Electrodynamics Thermodynamics: Variables/ Entropy/ Sound/ Atmospheres

Author(s): Kazuo FUJIKAWA
Affiliation(s): RIKEN
Email of Presenter(s): k-fujikawa@riken.jp
Title: CPT Symmetry in an Extension of the Standard Model

Abstract:
A concrete example of the Lorentz invariant non-local scheme of CPT breaking, which gives rise to different masses for the positive and negative energy solutions, is discussed. To quantize the non-local theory, we use a path integral on the basis of Schwinger’s action principle. It is illustrated that non-locality with the Planck length scale can give rise to the mass splitting of the neutrino and anti-neutrino which is about the same magnitude as the observed neutrino masses in an extension of the Standard Model.

References:
Author(s):        David GROSS

Affiliation(s):   University of California, Santa Barbara

Email of Presenter(s):   gross@kitp.ucsb.edu

Title:           QCD - Then and Now

Abstract:
To be announced.

Author(s):        Chris HULL

Affiliation(s):   Imperial College London

Email of Presenter(s):   c.hull@imperial.ac.uk

Title:           Symmetry and Geometry in String Theory

Abstract:
To be announced.
Author(s): Tasneem Zehra HUSAIN
Email of Presenter(s): tasneem.zehra@gmail.com
Title: What Remains Invariant: Life Lessons from Abdus Salam

Abstract:
Abdus Salam was a multi-dimensional man. He straddled research and institution-building with enviable flair; he was both religious and iconoclastic, a true citizen of the world yet deeply nationalistic, a scientist and a lover of literature, a villager and a cosmopolitan. While the specific details of his life belong to the man alone, Salam’s rich experiences exemplify certain values, attitudes and lessons that are universal.

In this talk, we attempt to draw out those truths, by looking at Salam’s life through the lens of physics. Our analysis of Salam’s personal journey mirrors the search for the invariants of a physical system in that we look beyond the particularities of his unique set of circumstances, to the essence that both categorizes, and transcends, explicit events.

Thus we move through Salam’s life, collecting “invariants” that apply as much to us today as they did to him several decades ago. Together, these constitute an enduring wisdom that can prove invaluable to young scientists - especially those from developing countries - as they move between different cultures, navigate diverse loyalties, and balance the lure of research with the demands of service.
The Long Journey to the Higgs boson and Beyond at CERN’s Large Hadron Collider (LHC)

Abstract:
Since 2010, the experiments at the Large Hadron Collider (LHC) have been studying particle physics at the highest collision energies ever achieved in a laboratory. A rich harvest of physics has resulted, including measurements of countless processes of the Standard Model, and in July 2012, the ground-breaking discovery of the long-awaited Higgs boson by the ATLAS and CMS experiments. This new, heavy particle is the keystone of the SM and is fundamental to the understanding of Nature. All the subsequent data point strongly to its properties as those expected for the boson associated with the Brout-Englert-Higgs mechanism postulated to explain the spontaneous symmetry breaking in the electro-weak sector, and thereby explaining how elementary particles acquire mass. Although the discovery of the Higgs boson completes the particle content of the SM, it is considered to be a low energy manifestation of a more complete theory – physics beyond the SM is therefore widely anticipated.

Building up the experimental programme, with the unique high-energy collider, the associated sophisticated experiments, the 3000-strong collaborations, and operating and exploiting these instruments has been an incredible scientific and human adventure, that already spans three decades – and this marks only the beginning of the journey into unchartered physics territory.

In the summer of 2015, the LHC restarted operation at even higher collision energy, with the exciting prospects of discovering physics beyond the SM, including that of the elucidation of the mystery of Dark Matter in the Universe, which could be related to a theoretically proposed overarching symmetry in particle physics, called Supersymmetry (SUSY).

The presentations will be given in two parts, by T. Virdee and P. Jenni, and will trace the history of the LHC Project, the accelerator and the associated general-purpose experiments, the discovery of the Higgs boson and the outlook, including the High Luminosity LHC (HL-LHC) programme.
Author(s): Anthony LEGGETT
Affiliation(s): University of Illinois at Urbana-Champaign
Email of Presenter(s): aleggett@illinois.edu
Title: Majorana Fermions in Condensed Matter Physics

Abstract:
Originally conjectured in a particle-physics setting, the idea of a “Majorana fermion” – a fermionic particle which is its own antiparticle – has in recent years played an important role in condensed matter physics, in particular in the context of attempts to design a topologically protected quantum computer. In this talk I sketch how Majorana fermions may arise in one important kind of condensed-matter system, a so-called “p+ip” Fermi superfluid, and how it is proposed to exploit their properties for topological quantum computing. However, there are important differences between the particle-physics and condensed matter contexts, and I emphasize that neglect of these differences may risk physically incorrect predictions in the latter case.

Author(s): Madumbai NARASIMHAN
Affiliation(s): Indian Institute of Science and Tata Institute of Fundamental Research
Email of Presenter(s): narasim@math.tifrbng.res.in
Title: Moduli of flat bundles on Riemann surfaces

Abstract:
Moduli spaces of (projectively) flat bundles play an important role in Yang-Mills theory on compact Riemann surfaces and are deeply related to concepts from Algebraic Geometry, like stable vector bundles. Moduli spaces of vector bundles are also relevant in Number Theory, for example in (geometric) Langlands correspondence.

I will begin my talk with an overview of the topic and then present a recent result showing that the derived category of the Riemann surface is embedded in that of the moduli space of (projectively) flat bundles of rank 2.
Author(s): Jordan NASH
Affiliation(s): Imperial College London
Email of Presenter(s): j.nash@imperial.ac.uk
Title: Looking at Ultra-rare Standard Model Processes to Search for New Physics with COMET

Abstract:
The COMET (Coherent Muon to Electron Transition) experiment is currently being constructed for operation at the J-PARC proton accelerator in Japan. The experiment has been designed to look for Charged Lepton Flavour Violation in the reaction $\mu N \rightarrow e N$. The Standard Model prediction for this reaction has a rate of around $10^{-54}$, whereas models with new physics can have substantially higher rates. The COMET experiment will operate in two phases, the first phase achieving a sensitivity of around $3 \times 10^{-15}$ is expected to enter commissioning in 2016, while the second phase aims to achieve a sensitivity of around $3 \times 10^{-17}$ which is a factor of 10000 better than current limits.

The experiment uses a novel production method for its high intensity muon beam which will be described as well as the tracking and calorimetry detectors.

Author(s): Jogesh PATI
Affiliation(s): SLAC, Stanford University
Email of Presenter(s): pati@slac.stanford.edu
Title: Unity With SU(4)-Color: With Neutrino Oscillations Seen Proton Decay Is The Missing Piece

Abstract:
Beginning with brief remarks on my association with Salam, the origin and the current status of the idea of a unification possessing the symmetry SU(4)-color will be presented. In particular, its implications for neutrinos having mass-scales as observed, and also for generating matter-antimatter asymmetry through leptogenesis, utilizing the existence of superheavy right-handed neutrinos (a crucial feature of SU(4)-color), will be noted. With neutrino oscillations observed, with mass-scales as anticipated, proton decay remains the missing piece. It will be argued that with the inclusion of GUT-scale threshold corrections within a class of minimal supersymmetric grand unification models, one obtains theoretical upper limits on the inverse decay rates of $d=6$ ($p \rightarrow e^+ \pi^0$) and $d=5$ ($p \rightarrow \bar{\nu} K^+$) modes, for any given supersymmetric spectrum. Assuming reasonable naturalness in the choice of the SUSY spectrum, the upper limits on the inverse decay rates of the two modes are found to be within a factor of ten of the current empirical lower limits on the same. It will thus be noted that the prospects for major discoveries in the next-generation detectors pertaining to a) proton decay, b) neutrino CP violation and c) study of core-collapse supernova neutrinos are high.
Author(s): Fernando QUEVEDO

Affiliation(s): ICTP

Email of Presenter(s): fquevedo@ictp.it

Title: ICTP: 50+ Years of Science for the Future

Abstract:
A brief outline is presented of the current status of the Abdus Salam International Centre for Theoretical Physics (ICTP), its programmes and vision for the future.

_________________________

Author(s): Eliezer RABINOVICI

Affiliation(s): The Hebrew University of Jerusalem

Email of Presenter(s): eliezer@vms.huji.ac.il

Title: SESAME Opens - A Realization of an Abdus Salam Vision of Science for Peace

Abstract:
I will invite you to a tour of a real parallel universe in which scientists from the middle east work for a common cause for over twenty years.

I will present from a personal point of view how a high quality regional light source is being constructed in Jordan. The trip will involve ICTP, the Sinai desert, Cern, Paris, Jerusalem and Amman.
Author(s): Muneer Ahmad RASHID, Ansaruddin SYED

Affiliation(s): National University of Science and Technology

Email of Presenter(s): muneerrshd@yahoo.com

Title: Spinor Representations of Finite Rotations of SO(4)

Abstract:
Following the work of C.B. van Wyk on Lorentz group SO(3, 1), we first express a general finite rotation of SO(4) in terms of 2 ordinary (3-dimensional) vectors \(a\) and \(b\) satisfying certain conditions, and then using the homomorphism of SU(2)xSU(2) onto SO(4), we express the same rotation in terms of a pair of 2x2 matrices, again determined by the same pair of vectors and \(b\). This is extremely useful as it allows one to convert the 4x4 matrix multiplication of elements of SO(4) into 2x2 matrix multiplication of elements of SU(2).

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Title: An Alternative Proposal of a Muon Cooled Higgs Factory

Abstract:
In analogy with the discovery of the W and Z with hadrons and the subsequent study of the Z resonance in the pure s-state with LEP, the recent discovery of the Higgs particle of 125 GeV has revived the interest in the so-called second generation Higgs factories. However, it is unlikely that LHC will reach the needed level of accuracy in model-independent Higgs coupling determinations needed. No doubt, the complete understanding of the complex Higgs mechanisms will require also the accurate observation of many additional processes with either \(e^+e^-\) or \(\mu^+\mu^-\) colliders, like for instance the double Higgs boson diagrams and W-boson fusion processes.

The option of a huge circular ring several times the radius of LEP/LHC is severely limited in the physics to \(\sqrt{s} \approx 250\) GeV. A \(e^+e^-\) Linear Collider with \(\approx 50\) km in length and \(\sqrt{s} \approx 1\) TeV is a totally novel option, with very long timescale and very high development costs.

A cooled muon collider in a \(\mu^+\mu^-\) ring represents an attractive alternative, which could be tested experimentally with an initial cooling experiment.

Once this experiment is demonstrated, muon cooling at a level suitable for single Higgs production in the s-state becomes possible within a new single and small conventional ring of \(\approx 50\) m radius (\(\approx 1.2\%\) of LHC) a collider luminosity of \(L \approx 10^{32} \text{ cm}^{-2} \text{ s}^{-1}\), and more than 10,000 \(H^0\) for each of several simultaneous detectors each year.
Author(s): Stefano RUFFO

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Title: Long-range Interacting Systems

Abstract:
Systems with long-range interactions (gravitational systems, charged and dipolar systems) can be made extensive, but are intrinsically non additive. The violation of this basic property of thermodynamics determines ensemble inequivalence, which in turn implies that specific heat can be negative in the microcanonical ensemble, temperature jumps may appear at microcanonical first order phase transitions, ergodicity is typically broken. From the dynamical point of view, long-lived quasi-stationary states appear, whose lifetime diverges with volume. Realizing that such features are present for a wide class of models has renewed in recent years the interest in long-range interactions.

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Title: To be announced

Abstract: To be announced.
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Title: Abdus Salam: Science and Leadership

Abstract:
Abdus Salam (1926-1996) holds an extraordinary place in the history of science because for him, the quest for knowledge was closely linked to education, policy making and broad-based advocacy for science. In founding the ICTP and spearheading multiple international initiatives such as BCSPIN, to give just two examples, Salam exercised global leadership well before the advent of globalization. His statement, “Scientific thought and its creation is the common and shared heritage of mankind”, seemed to have served as his guiding principle for he put it into practice through assiduous transnational institution-building that remains unparalleled.

Author(s): Kellogg STELLE
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Title: Classical Solutions to Quantum Corrected Gravity

Abstract:
Essentially all approaches to the quantization of gravity entail higher-derivative corrections to the Einstein-Hilbert action. The scales at which these might come to be important varies widely between different scenarios, but one possibility is for terms quadratic in the curvature tensor to become important for an appreciable range of scales before yet higher terms come into play. The talk will consider spherically symmetric static solutions to gravity including such quadratic curvature term in the action. The solution space includes Schwarzschild and non-Schwarzschild black holes, horizonless solutions coupling to distributional matter and also wormholes.
Abstract:
Simple historical development of fundamental constants G, h and C is presented. It is argued that these are determined in string theory once we understand the dynamics of/in moduli space is understood. Then the history of VBA since late 1900s is discussed. Comparison of SSC to CSSC and ILC to CEPC is made and some friendly advice is made.

Abstract:
After the last missing piece, the Higgs particle, has probably been identified, the Standard Model of the sub-atomic particles appears to be a quite robust structure that can survive on its own for a long time to come. Most researchers expect considerable modifications and improvements to come in the near future, but it could also be that the Model will stay essentially as it is. This, however, would also require a change in our thinking, and the question remains whether and how it can be reconciled with our desire for our theories to be “natural”.
Author(s): George THOMPSON

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Title: Chern-Simons Theory with Complex Gauge Group

Abstract:
Abelianisation is used to present a complete non-perturbative evaluation of the path integral on Seifert Fibred 3-Manifolds of Chern-Simons Theory with Complex Gauge Group. In certain cases the path integral can be seen to factorize neatly into holomorphic and anti-holomorphic parts. Closed formulae of this factorization for the expectation values of Torus knots are obtained.

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Title: Abdus Salam: The Passionate, Compassionate Man and his Masterpiece, the ICTP

Abstract:
Abdus Salam was a great man in more than one dimension. I will argue, reminiscing the several stages in its creation, that the conception and building of the ICTP system required much more than the intelligence of a great scientist. I will stress his ability in the political arena, his power of persuasion and, the crucial ingredient, his capacity to bend rules without breaking them. In essence he was a short range opportunist and a long range idealist: the final ingredient of a unique genius.

I will also describe the final touches that Salam’s collaborators and successors had to add to keep it flourishing.
Author(s): Spenta WADIA
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Title: The S-matrix of Chern-Simons Plus Matter Theories and Fermi-Bose Duality in 2+1 dims

Abstract:
The 2 --> 2 S-matrix of critical bosons and fermions coupled to gauge fields of Chern-Simons theory in 2+1 dims is calculated exactly in the large N limit in the t and u channels. The answers are unitary and consistent with fermion-boson duality. We propose a formula for the s-channel S-matrix with modified crossing symmetry rules and a delta function for forward scattering that is unitary and consistent with fermion-boson duality.

Author(s): Peter WEST
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Title: E11 must be a Symmetry of Strings and Branes

Abstract:
I will review strings and branes and the role supergravity plays in the way we understand them. I will also explain why strings and branes should possess a very large Kac-Moody symmetry called E11.
Author(s): Lu YU

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Title: Salam's Dream and Dynamic Changes in Chinese Condensed Matter Physics – A Personal Perspective

Abstract:
Professor Abdus Salam deeply believed that “scientific thought is the common heritage of all mankind” and dreamed that the developing world could contribute equally to that heritage. As a humble pupil and follower, I made efforts to help materialize his teachings and witnessed the partial realization of his dream in China, in particular, in condensed matter physics. Half a century ago, modern condensed matter physics was almost non-existent in China. During the past 30 years, especially since the beginning of the 21st century, the situation has changed dramatically. A number of outstanding young physicists from China, with cutting edge research output, emerged on the world arena. How did this quantal transition occur?

From a personal perspective, I will discuss some early attempts to build-up research capacities, interruptions during the “Cultural Revolution”, survival of scientific work, opening-up to the world and revival of research. The transition from total isolation to close international exchange and collaboration is a crucial factor contributing to this success. The International Center for Theoretical Physics (ICTP), created by Professor Salam, has played a key role in this tremendous development.

Author(s): Arnulfo ZEPEDA

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Title: The Mesoamerican Centre for Theoretical Physics

Abstract:
According with the general strategy of ICTP for promoting the creation of new institutions in strategic regions around the world, with objectives similar to those of ICTP, the Autonomous University of Chiapas (Unach), Mexico, and ICTP signed at the end of 2011 an agreement to establish the Mesoamerican Institute for Science, which would seek the auspicious of UNESCO as a regional centre. In this talk I will give some details of the Mesoamerican Centre for Theoretical physics (MCTP), an institute created by Unach in order to show the feasibility of such a regional center. This step has culminated with the recent decision of UNESCO to approve the establishment in Chiapas, Mexico, of a Regional Centre for Advanced Training and Research in Physics, Mathematics, Energy and Environment: Meso-American Institute for Science (MAIS), as a category 2 centre under the auspices of UNESCO.