

Master Your Physics 2022

Master Your Physics

**A conference by master's
for master's students**

Report of Contributions

Contribution ID: 1

Type: **not specified**

String Theory and Early Universe Cosmology

Wednesday, 8 June 2022 15:00 (2 hours)

I will argue that we need to go beyond an effective field theory description of physics if we want to understand the evolution of the very early universe. Superstring theory is the prime candidate for a fundamental theory of all forces. I will show how to obtain emergent metric space-time from matrix theory, a suggested non-perturbative definition of string theory. Thermal fluctuations in this matrix model yield cosmological perturbations in the resulting early universe scenario which leave specific imprints in cosmological observables.

Presenter: ROBERT BRANDENBERGER (McGill University)

Contribution ID: 2

Type: **not specified**

Road to Reality: Quantum Mechanics without Complex Numbers

Wednesday, 8 June 2022 13:00 (2 hours)

Since Schrödinger we know that the fundamental equation of quantum mechanics contains the imaginary number i , the square root of minus one. This seems unavoidable, but in recent years we have discovered a class of materials that are described by a real wave equation. The materials are called topological superconductors and the particles that they host are called Majorana fermions. This topic is of fundamental interest, but it may also find applications in the context of quantum computers.

Presenter: BEENAKKER, Carlo (Instituut-Lorentz, Leiden University)

Contribution ID: 3

Type: **not specified**

A Brief Introduction to the use of Group Equivariant Non-expansive Operators for Topological Data Analysis and Geometric Deep Learning

Tuesday, 7 June 2022 10:00 (2 hours)

Group equivariant non-expansive operators (GENEOs) have been recently introduced as mathematical tools for approximating data observers, when data are represented by real-valued or vector-valued functions. The use of these operators is based on the assumption that the interpretation of data depends on the geometric properties of the observers. In this talk we will illustrate some recent results in the theory of GENEOs, showing how these operators could be used for topological data analysis and geometric deep learning.

Presenter: PATRIZIO FROSINI (University of Bologna)

Contribution ID: 4

Type: **not specified**

Equity, Diversity and Inclusion Efforts in Dutch Astronomy

Tuesday, 7 June 2022 15:00 (2 hours)

Social justice issues, such as race relations, gender equality and disability rights, are often seen as irrelevant to us as scientists in the research community. The global pandemic and the groundswell of reaction after the murder of George Floyd has brought these issues to our doorstep in way that leaves unable to ignore them any longer. In this talk, I will discuss my new role as equity and inclusion officer for Dutch astronomy. I will share updates on efforts to promote equity, inclusion and diversity in astronomy. I will discuss current activity, implications and connections for Dutch astronomy and physics, and how to become involved or partner with these efforts.

Presenter: TANA JOSEPH (University of Amsterdam)

Contribution ID: 5

Type: **not specified**

Dualities between Physics and Philosophy

Tuesday, 7 June 2022 13:30 (1h 30m)

While dualities are part of physicists' toolboxes to construct theories, they have only relatively recently received the attention of philosophers. After giving several examples of dualities, I will discuss whether and if so how dualities bear on old philosophical issues: in particular, on the questions of theoretical equivalence, under-determination, and scientific realism.

Presenter: SEBASTIAN DE HARO (University of Amsterdam)

Contribution ID: 6

Type: **not specified**

ITER – The Way to New Energy

Friday, 10 June 2022 10:00 (2 hours)

Fusion is the energy that powers the sun and the stars. Imagine we manage to harness this energy down here on earth – for the benefit of mankind? Especially in an era when mankind’s energy consumption is affecting the climate and can spell doom for future generations, fusion might represent a hope, a light at the end of a tunnel, a new way out. 35 nations have already joined their forces to form the world’s largest International scientific collaboration in the ITER project. It’s goal: to prove that fusion energy is feasible, that we have the knowledge, the technologies and the materials to deliver fusion energy to the grid.

Presenter: WILLIAM GARCIAS (ITER)

Contribution ID: 7

Type: **not specified**

T.B.A

Wednesday, 8 June 2022 17:00 (2 hours)

Presenter: ERIK VERLINDE (University of Amsterdam)

Contribution ID: 8

Type: **not specified**

Gravitational Lensing of Gravitational Waves

Thursday, 9 June 2022 10:00 (2 hours)

Gravitational bending of light was the first observational test that heralded the remarkable success of Einstein's general theory of relativity. In the last few decades, gravitational lensing of light has emerged as a powerful tool for astronomy. Gravitational waves (GWs) are also expected to be lensed similar to light. Around hundred GW signals from coalescing compact binaries have been observed by LIGO and Virgo so far. In the next few years, thousands of such observations are expected. Some of these GWs will be lensed by intervening objects such as galaxies and compact objects. This talk will summarise the prospects of detecting lensing signatures in GWs and will discuss some of the potential new probes such observations will enable.

Presenter: PARAMESHWARAN AJITH (International Center for Theoretical Sciences)

Contribution ID: 9

Type: **not specified**

Application of Algebraic Geometry for Feynman Integral Computations

Thursday, 9 June 2022 13:00 (2 hours)

In this talk, I introduce the application of algebraic geometry for the computations of Feynman integral computations. Nowadays, Feynman integrals are the key objects for the LHC precision physics, the precise gravitational wave computation and the deep structures in formal theories. Some computational algebraic geometry ideas, like the Groebner basis, syzygies, module operations have interesting applications on Feynman integrals. I will present some neat examples in that direction.

Presenter: YANG ZHANG (University of Science and Technology of China)

Contribution ID: 10

Type: **not specified**

Particle Physics : Journey from the very small to very large!

Thursday, 9 June 2022 15:00 (2 hours)

In this talk I want to summarise the current status of the subject of particle physics. Beginning from the discovery of the electron, the physicists have relentlessly pursued the journey towards understanding what lies at the heart of matter. They have through the centuries probed constituents of matter at smaller and smaller distance scales and how they are held together. This journey came to a spectacular stop in the discovery of the Higgs at the large hadron collider. It seems that the next steps in this journey need to be taken by exploring physics of the very small and the very large scales. I want to give a flavour of the current engagement of particle physicists in this effort.

Presenter: ROHINI GODBOLE (Indian Institute of Science)

Contribution ID: 11

Type: **not specified**

Networks powered by Quantum Entanglement: from a Loophole-free Bell Test to a Quantum Internet

Friday, 10 June 2022 13:00 (2 hours)

Entanglement – the property that particles can share a single quantum state - is arguably the most counterintuitive yet potentially most powerful element in quantum theory. The non-local features of quantum theory are highlighted by the conflict between entanglement and local causality discovered by John Bell. Decades of Bell inequality tests, culminating in a series of loophole-free tests in 2015, have confirmed the non-locality of nature.

Future quantum networks may harness these unique features of entanglement in a range of exciting applications, such as blind quantum computation, secure communication, enhanced metrology for astronomy and time-keeping as well as fundamental investigations. To fulfill these promises, a strong worldwide effort is ongoing to gain precise control over the full quantum dynamics of multi-particle nodes and to wire them up using quantum-photon channels.

Here I will briefly introduce the field of quantum networks. I will then discuss our most recent work, demonstrating the realization of the first multi-node network wired by quantum entanglement, based on optically connected solid-state chips, including first primitive network protocols, and provide an outlook towards the coming years.

Presenter: RONALD HANSON (Delft University of Technology & QuTech)

Contribution ID: 12

Type: **not specified**

The Conformal Bootstrap and Dispersive Sum Rules

Tuesday, 7 June 2022 17:00 (2 hours)

Presenter: DAVID SIMMONS-DUFFIN (California Institute of Technology)