Program Symposium TRENDS IN THEORY 2021
Thursday, May 20 – via ZOOM
https://zoom.us/j/94272839894?pwd=V1NoYWJQTEJyNUQ3S2gzdkZ4b3A5dz09
Meeting ID: 942 7283 9894
Passcode: HuU4sA

Session Chair: Tomislav Prokopec (UU)

13:00 – 13:10 **Opening Remarks**
Daniel Baumann (UvA, chair of governing board) and Rembert Duine (UU, director DRSTP)

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13:10 – 13:40 **Jessica Steinlechner (Maastricht University)**
Cryogenic mirrors to detect the dark side of the Universe

In 2015, gravitational waves were detected for the first time, making dark objects such as merging black holes directly measurable. Future gravitational-wave detectors are planned to have a significantly increased sensitivity to detect signals originating from more distant objects and within a much wider frequency range. Cryogenic mirrors are a key technology to realize the sensitivity increase planned for this next generation of detectors – including the Einstein Telescope, a future European detector with one of its candidate locations being in the region of Limburg in the Netherlands.
ETpathfinder is a prototype interferometer, currently under construction in Maastricht, with the goal to test technologies required to pave the way for a generation of cryogenic gravitational-wave detectors, with a focus on the highly-reflective coated detector mirrors.
In this talk. I will introduce gravitational waves and their detection, give an overview of the current status of the ETpathfinder prototype and explain some key aspects of mirror development.

13:40 – 14:10 **Andrey Bagrov (Radboud University Nijmegen)**
Neural quantum states and frustrated many-body systems

Neural-network quantum states are a novel type of variational ansatze that demonstrate very high degree of flexibility in representing diverse many-body wave functions. In my talk, I will explain in simple terms how neural networks can be used to describe complex systems, and discuss current limitations of this approach in the context of quantum spin models. Special focus will be put on connections between learning capacities of neural networks and non-trivial sign structure of ground states of frustrated many-body Hamiltonians.

14:10 – 14:40 **Kristof De Bruyn (University of Groningen)**
A Story about Penguins

The B-meson decays provide a wealth of observables to search for physics beyond the Standard Model. One prime candidate where we hope to find such evidence for new physics is the phase associated with the oscillation of a Bs meson into its anti-particle. This phase is accurately predicted by the Standard Model, and experimentally easily accessible. In fact, the experimental measurements from which this phase is derived have become so precise that we need to have a critical look at their theoretical interpretation. Next-to-leading order contributions, originating from so-called penguin topologies, can no longer be ignored. In this talk I will discuss the impact of these penguins, show how they can be controlled using the currently available data, and illustrate why this phase remains an important tool in testing the Standard Model.

14:40 – 14:55 **Coffee/tea break**

UU = Utrecht University – UvA = University of Amsterdam – UL = University Leiden

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Session Chair: Luca Giomi (UL)

14:55 – 15:55 **Students' Panel**
The second quantum revolution in the Netherlands: a perspective from the next generation of scientists

The Netherlands just decided on a €615 million public investment in quantum technologies, with the goal of training 2'000 researchers and the projection of generating 30'000 jobs. The PhD students of today, quantum experts of tomorrow, might spend most of their careers in the new academic, industrial and social-cultural environment influenced by investments like this one. Their future colleagues will be talents grown in a more quantum-aware world. The choices and actions of the quantum academic community today will define the long-term changes in these environments. In the long term, the second quantum revolution might also influence how we do theoretical physics, helping to solve problem in a range of (non directly related) fields and starting new research lines. We will discuss these topics in a panel with four PhD students working in the field.

Guest:
Freeke Heijman (director of QuantumDelta)

Student panel:
Aletta Meinsma (quantum science communication, QuTech-Delft-Leiden)
Joris Kattemölle (quantum computing, QuSoft-Amsterdam)
Dion Hartmann (spintronics theory, Utrecht)
Xavier Bonet-Monroig (quantum algorithms, aQa-Leiden)
Moderated by Stefano Polla (University Leiden)

15:55 – 16:10 **Coffee/tea break**

Session Chair: Jean-Sébastien Caux (UvA)

16:10 – 16:40 **Sara Jabbari-Farouji (Univeristy of Amsterdam)**
Collective dynamics of magnetic microswimmers in an external field

Magnetic microswimmers such as magnetotactic bacteria exhibit fascinating patterns of collective behavior in external fields. To understand the emergent pattern formation and transport of this class of microswimmers, we develop and analyze minimal kinetic theories which couple the Smoluchowski equation for active particles in an external aligning field to the mean-field flow or magnetic flux generated by the swimmers. We discuss under what conditions, the competition between long-ranged hydrodynamic or magnetic interactions and the external field leads to instability of a homogeneous polar state and what kind of instabilities in the polarization field emerge. We also investigate how the effective transport of swimmers in the field direction is affected by the instabilities.

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16:40 – 17:10 **Jordi Tura (University Leiden)**
Randomness Generation with Certification via Limited Quantum Devices

Quantum computers aim at solving specific tasks more efficiently than their classical counterparts by exploiting quantum effects that allow them to process information in a coordinated, coherent way. Although existing quantum devices remain far from perfection, recent experiments have demonstrated a fundamental separation between the power of quantum and classical devices. However, this separation has been shown on a task of no practical utility beyond proving such a separation: sampling the probability distribution that results from measuring a random quantum circuit. The success of these experiments, however, suggests that a first practical application of existing quantum computers could be that of generating random numbers in a certifiable way: ensuring that the randomness being generated could not have been produced in advance, and therefore is not accessible to any third party. I will review existing approaches to tackle this problem as well as a novel proposal that could be within reach of existing quantum technologies, which combines the theory of tensor networks and the computational hardness of many-body physics.

17:10 – 17:40 **Elisa Chisari (Utrecht University)**
Galaxy shapes as a cosmological tool

Two phenomena contribute to correlating galaxy shapes across the Universe: the deviation of photons from a straight path due to the spacetime curvature ("gravitational lensing"), and " intrinsic alignments" from physical interactions (e.g. gravitational tides). Modelling both accurately is crucial to obtaining unbiased constraints on the cosmological model, particularly in the context of elucidating the origin of accelerated expansion of the Universe. In this talk, I will cover recent advances in the modelling of galaxy shapes and discuss their role as a cosmological probe.

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17:40 – 18:10 **Free discussion, additional questions to the speakers**

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18:10 – 18:20 **Closing Remarks**
Daniel Baumann (UvA, chair of governing board) and Rembert Duine (UU, director DRSTP)