The 3rd AUSTRO—UKRAINIAN SEMINAR dedicated to the 90th anniversary of the outstanding Austrian theoretician

Wolfgang KUMMER

PROGRAM & ABSTRACTS

(Kyiv Time, Vienna Time is one hour earlier)

13.30 OPENING

13.35 Hartmut ABELE (TU Wien, Austria), Stepan Moskaliuk (BITP. Ukraine) "Categorical equivalence of the effective field theories of neutron decay"

We apply renormalization method to the effective field theory (EFT) in a framework for a quantitative description of nature at certain level of resolution. Whatever physics might exist at shorter distances, unresolved length scales can be taken into account through the values of the parameters of the EFT. In the absence of further information about the microscopic physics, these parameters have to be determined by experiments. In the second half of the twentieth century, it was however developed into a full-fledged quantitative formalism with tremendous impact, from concrete physical applications to the philosophy of science. In this talk, we mostly focus on the EFTs and their categorical equivalence that are currently experiencing an intense development related to neutron decay experimental results: First, it was proposed to connect the full Standard Model to the so-called low-energy effective field theory (LEFT) below the weak scale, which coincides with the V – A theory of weak interactions augmented by complex (quaternionic, octonionic) QCD and QED. Second, it was connected the LEFT to Heavy Baryon Chiral Perturbation Theory (HBChPT), which involved non-perturbative physics. The third step, it would be matching the HBChPT onto a pionless EFT. Future Neutron β -decay experiments are discussed too.

14.15 Daniel Grumiller (TU Wien, Austria) "Wolfgang Kummer's pioneering approach to 2d dilaton gravity"

Dilaton gravity in 2d serves as a useful toy model for classical and quantum gravity, including black hole evaporation through the Hawking effect and holography. I review Wolfgang Kummer's pioneering approach to this subject and how it still influences some of the modern research developments, including the SYK/JT correspondence and Carrollian models.

15.15 (20 min) BREAK

15.35 Sergei Sharapov (BITP, Ukraine) "Harnessing the Sagnac Effect: The Efficiency of Graphene-Based Interferometers"

The Sagnac effect refers to the phase shift between two coherent waves, such as light, traveling in opposite directions within an interferometer mounted on a rotating disk. This principle forms the foundation of various modern navigation systems. Notably, laser gyroscopes based on the Sagnac effect are extensively employed in high-precision weapon. The magnitude of the phase shift is directly proportional to the area enclosed by the light rays, the frequency of the light, and the angular velocity of the interferometer's rotation.

Given that material particles also exhibit wave-like properties, the Sagnac effect has been experimentally observed in free electrons in vacuum, neutrons, and even atoms. Moreover, when the Sagnac effect is realized on electrons, the resulting phase shift in the interference pattern is roughly a million times larger than that for light. This prompted a theoretical question: how would the Sagnac effect manifest in solid-state interferometers using free electrons in monolayer graphene? Graphene is known for its zero effective carrier mass and linear electron dispersion, properties that closely resemble those of light.

We discovered that, despite these unique properties, the Sagnac effect in graphene is still governed by the mass of the free electron. As a result, the effect in graphene remains approximately a million times stronger than in light-based interferometers. The parameters of existing graphene samples make the practical realization of the Sagnac effect in graphene feasible.

A.Yu. Fesh, Yu.V. Shtanov and S.G. Sharapov, "Sagnac effect in a rotating ring with Dirac fermions," Phys. Rev. B 110, L121402 (2024); https://doi.org/10.1103/PhysRevB.110.L121402

16.25 Volodymyr Gorkavenko (KNU, Ukraine)

"Vacuum polarization effects in bosonic field theory caused by linear magnetic topological defects"

17.15 A movie about Wolfgang Kummer