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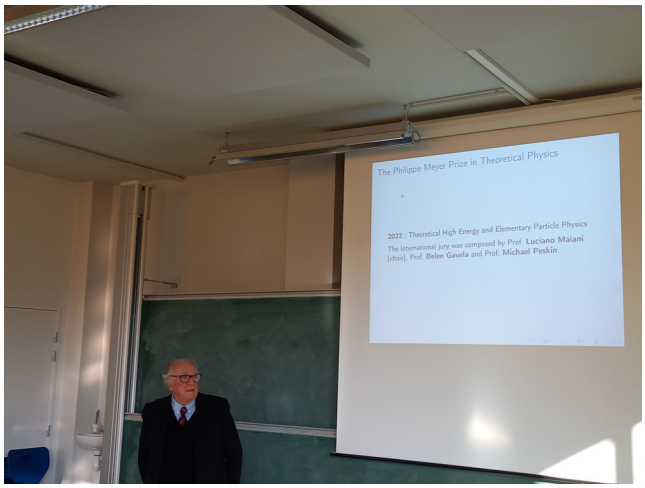
Newsletter from Philippe Meyer Institute for Theoretical Physics

December 2022

The 2022 Philippe Meyer Prize in Theoretical Physics

The 2022 Philippe Meyer Prize in Theoretical Physics was awarded to: Alexander ZHIBOEDOV.
The citation reads:
" . . . for outstanding contributions to our understanding of the operator structure of quantum field theories with conformal invariance. His foundational work has applications to the search for new non-perturbative quantum field theories and to the analysis of Quantum Chromodynamics at particle colliders."
The award ceremony took place in Paris, at the ENS, on December 12, 2022, in the presence of the Chairman of the jury, Luciano MAIANI.



Alex TUMANOV

With the recent advances in the field of collider physics and the detection of gravitational waves, it becomes increasingly important to find new and efficient ways to study the underlying scattering processes. Most of the techniques we use to study them, however, are currently limited to the narrow perturbative regime, with only a handful of mostly numerical methods available outside of it. The N=4 SYM theory, which is believed to be integrable in the planar limit, provides us with an ideal tool for getting analytical finite coupling results for various classes of important QFT observables.

In my work, I develop exact non-perturbative methods to study such objects as amplitudes, Wilson loops, form factors and correlation functions. These methods give us valuable insights into how interacting higher-dimensional gauge theories behave outside of the narrow perturbative regime. Some of these insights have potential to be useful in real world theories like QCD, where they could contribute to our understanding of crucial phenomena, such as confinement, and to the description of the inner structure of the proton.

In my most recent project, my collaborators and I have developed a novel method for calculating form factors of local operators non-perturbatively in the N=4 SYM theory. Since then, our results have been used to fully determine the simplest 3-point form factor up to an unprecedented 8-loop order. Additionally, via the maximal transcendentality principle, these results have a direct connection to the QCD experiments, in which the same exact form factor captures the leading contribution to the Higgs production via the t-quark loop.

Michele FAVA

The goal of my research is to improve the current understanding of some aspects of quantum dynamics in many-body systems, both near equilibrium, as probed by dynamical correlation functions, and far from equilibrium, as probed, e.g., by quantum quenches.

A large part of the work in my PhD focused on improving the understanding of nonlinear response functions, with the purpose of making their experimental measurement a viable tool to investigate condensed matter systems.

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