Fyzikální ústav
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Supervisor's report on the doctoral thesis of Mgr. Matěj Kudrna

In his PhD project Matěj has focused on numerical open string field theory with the goal to unravel the space of possible consistent conformal boundary conditions in 2D conformal field theories (called D-branes), which represent consistent open string backgrounds in string theory.

He is an author of three published papers and three additional preprints which should be published in the near future too. He reported his results at number of conferences, mostly in the String Field Theory and Related Aspects series. Last year, at the most prominent conference of the string theory community, Strings 2018, Ashoke Sen, one of the first recipients of the Fundamental Physics Prize have cited his results in a plenary review talk, see https://indico.oist.jp/indico/event/5/page/14.

His most significant research achievement was a development of very powerful set of versatile numerical codes in Mathematica and C++ which can run very efficiently on supercomputers with which he was able to address many outstanding issues in open string field theory (OSFT). He was the first one to discover multiple lump solutions in OSFT, first one to show the existence of positive energy solutions, and has reached the level 30 for tachyon vacuum proving Gaiotto-Rastelli conjecture. Most significantly he discovered the existence of a family of exotic solutions which became the focus for much of the follow up work by his supervisor and other students.

Matěj's expertise became obvious worldwide as he was independently invited to collaborate on two related projects with researchers from Italy and Brazil where his supervisor was not involved. I have to stress that his contributions to the field are not only through his coding and data analysis abilities but he had significant input in the theoretical development of the methods behind this success (such as implementation of the SU(1,1) singlet conditions, computation of conservation laws for the Ellwood invariants, or calculation of structure constants for the WZW models via pentagon identities which due to lack of space and time did not appear in this thesis.

Regrettably the duration of his PhD studies surpassed significantly the standard time, since in the past few years Matěj was functioning effectively as a postdoctoral researcher. There is a slight parallel to Freeman Dyson who was hired as a professor at Princeton for his groundbreaking work on quantum electrodynamics without ever earning PhD degree.

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The thesis itself contains 282 pages with at least half of it consisting of original results. Since the beginning of his studies, his writing skills improved significantly, so that the thesis now contains only about one typo or cumbersome expression per page.

In summary, I strongly recommend the thesis to be accepted for the fulfillment of the requirements for the PhD degree.

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