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Ref: Report on the habilitation thesis “Invariants in Relativity and Gauge Theory” by Igor Khavkine

Steinfurt, April 13, 2019

Dr. Khavkine’s scientific interests center around mathematical physics questions dealing with classical and quantum gauge field theories and with general relativity.

The first paper of the thesis, “Local and gauge invariant observables in gravity” proposes a definition for gauge invariant local functionals in gravitational theories by using differential invariants. The reference list of the paper is eclectic: it ranges from classical papers about observables in general relativity and recent work on perturbative quantum field theory to mathematical references on differential invariants. This work has attracted a fair number of citations by authors from different domains, including for instance Don Marolf and Klaus Fredenhagen.

The second and last paper, “Calabi complex and Killing sheaf cohomology” and “Compatibility complexes of overdetermined PDEs of finite type, with applications to the Killing equation” deal with compatibility complexes of linearized gauge or gravitational theories around a background solution. They have been prominently cited in a recent Physical Review Letters paper on gauge invariants of perturbations of the Kerr spacetime.

Two related papers deal with an intrinsic characterization of cosmological and higher dimensional black hole spacetimes, while a paper on cohomologies with causally restricted support, motivated by questions on quantum field theory in curved backgrounds, completes the thesis.

The habilitation thesis underlines the strengths of Dr. Khavkine as a researcher: he knows what questions are interesting from his understanding of modern theoretical physics, and what mathematical tools, not commonly known to most theoretical physicists, to use in order to make original contributions.

The broad interests as well as the scientific independence demonstrated by Dr. Khavkine come at a prize. Because of the high degree of specialization, even within the sub-domain of mathematical physics, it takes time to produce work that makes a serious impact, and more time for such work to be recognized.

In my opinion, Dr. Khavkine has demonstrated through this thesis that he can make serious and original contributions to the field. As consequence, I would recommend that the habilitation thesis be accepted and the promotion granted.

Sincerely,

Glenn Barnich
Professor
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