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Report on habilitation thesis of Dr. Svatopluk Krýsl

This habilitation thesis deals with the scientific work of the author, Dr. Svatopluk Krýsl, over the time frame 2003-2016.
One way of summarizing the philosophy behind this body of work is the aim to generalize what is known for orthogonal spinors (finite dimensional!) and Riemannian manifolds to symplectic spinors (infinite dimensional) and symplectic manifolds.
Although at a superficial level there are quite a few correspondences between both theories, the symplectic case is vastly more complicated due to the infinite dimensions of the Segal-Shale-Weil representation, which plays a crucial role.

The results obtained by the author can be summarized as follows:
1. **Differential forms valued in symplectic spinors**: a decomposition into irreducible symplectic modules is given in Theorem 9. These are called higher symplectic spinor modules. The structure is further elucidated by the elegant appearance of a Howe dual partner osp(1|2) in Theorem 10.
2. **Differential geometry of higher symplectic spinors**: first the decomposition of 1 is lifted to a metaplectic bundle. Then various results are obtained, such as the action of the exterior derivative (similar results as in Slupinski for the orthogonal case), definition of symplectic twistor operators, construction of the related complexes and ellipticity results. Finally some results on the spectrum of the symplectic Dirac operator are obtained, as well as the relation with the symplectic Rarita-Schwinger.
3. **First order invariant operators**: in Theorem 22 the authors determines an interesting symplectic analog of the famous classification of Fegan in the Riemannian case, namely that there is (up to terms of order zero) at most one invariant operator acting between bundles induced by certain irreducible representations.

4. **Abstract Hodge theory**: the author introduces a Hodge type complex in an additive dagger category to abstractly deal with the infinite rank bundles of the previous results, and proves several Hodge type results on these complexes. I'm not an expert on this part of the dissertation, but I found it hard to see the difference between Theorem 25 and 26; so maybe this could be clarified more in the text.

The thesis is organized as follows. In chapter one the author summarizes the goals and achievements in a succinct way. Chapters two and three are devoted to known results: the Segal-Shale-Weil representation and symplectic spinors are introduced and subsequently employed in differential geometry to construct the symplectic Dirac of Habermann and Habermann. I like the addition of Theorem 1, which further explains why the metaplectic group is hard to work with. The author also did a nice job defining the symplectic Clifford algebra and the ensuing spinor multiplication. The fourth chapter then deals with the own contributions of the author, as already discussed above. A rather complete list of references follows.

I highly appreciate that the author points out certain misprints in the published results. This shows his dedication and scientific spirit.

In addition, the author has added the full text of his selected 10 publications on which the thesis is based. They have been published in good to very good journals and cover a complicated and intricate piece of mathematics, for which the author can be congratulated.

In conclusion: I think Dr. Krýsl has written a splendid habilitation thesis, written using more than a decade of deep results. The style of writing clearly indicates the author's mastery of the subject matter. It can be used as a very useful guide to the literature by PhD students and experienced researchers alike.
Based on this dissertation, I can wholeheartedly recommend that he be appointed as associate professor.

Most sincerely, Prof. Dr. Hendrik De Bie