HABILITATION THESIS REVIEWER'S REPORT

JORGE LAURET

- Masaryk University.
- Applicant: Ioannis Chrysikos.
- Title: G-structures, Dirac operators with torsion and special spinor fields.
- Reviewer: Jorge Lauret.

It is by now a classical problem in differential geometry the study of G-structures, with very important applications in theoretical or mathematical physics. In the Riemannian case, there is a tremendous research on the geometry and topology of manifolds with special holonomy, including manifolds admitting parallel spinors and hence Ricci-flat holonomy reductions, as Calabi-Yau manifolds, parallel G_2- and parallel $Spin(7)$-manifolds, which play a key role in string theory compactifications and M-theory.

In this thesis, the author studies the following topics:

- Killing and twistor spinors with torsion.
- A new $\frac{1}{2}$-Ricci type formula on the spinor bundle and applications.
- Invariant connections and ∇-Einstein structures on isotropy irreducible spaces.
- Homogeneous 8-manifolds admitting invariant $Spin(7)$-structures.
- Differential geometry of $SO^*(2n)$-type structures.

The habilitation thesis is very well written and, in my opinion, it represents an outstanding advance in the study of metric connections with parallel skew-torsion preserving non-integrable G-structures on Riemannian manifolds. This clearly shows that Chrysikos has established himself as a strong and solid research mathematician. On the other hand, the high level of prestige of most of the journals where he has published his work is impressive. This may also be considered as a strong evidence of the high quality and impact of his research.

Reviewer's questions for the habilitation thesis defence:

(1) Concerning Thm 1.21 in page 23: let ∇ be one of these new (non-Lie bracket) invariant metric connections with totally skew-symmetric torsion T. Is it possible to have that the corresponding torsion 3-form is closed?

(2) In page 26, the author says "... we show that there exists an invariant $Spin(7)$- structure ϕ inducing the normal metric and ...". In both spaces, there are continuous families of normal metrics. Is the referred induced metric the Killing metric? Are there $Spin(7)$-structures inducing the other normal metrics?

Conclusion: The habilitation thesis entitled "G-structures, Dirac operators with torsion and special spinor fields" by Ioannis Chrysikos fulfils requirements expected of a habilitation thesis in the field of Mathematics-Geometry.

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Jorge Lauret