DIRAC OPERATORS IN DIFFERENTIAL GEOMETRY AND GLOBAL ANALYSIS – IN MEMORY OF THOMAS FRIEDRICH (1949–2018)

CASTLE BĘDLEWO, OCTOBER 6 – 12, 2019

Thomas Friedrich in October 2017 in his favourite Cafe in Marburg

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Dirac operators in differential geometry and global analysis – in memory of Thomas Friedrich (1949–2018)

Castle Będlewo, October 6 – 12, 2019

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Monday, October 7

09:00 – 09:50 Werner Müller
Spectral theory on locally symmetric spaces of finite volume

– coffee break –

10:30 – 11:10 Carlos Shahbazi
Lipschitz structures

11:20 – 12:10 Anna Fino
An overview on G_2-structures with special metrics

– lunch break –

14:30 – 15:20 Andrei Moroianu
Geometries with parallel skew-symmetric torsion

– coffee break & poster session –

	Session A	Session B
16:40 – 17:10	Mauro Mantegazza *An intrinsic characterization of projective special Kähler manifolds*	Reinier Storm *Lagrangian submanifolds of twistor spaces from superminimal surfaces*
17:20 – 17:50	Changliang Wang *The linear instability of some Einstein metrics*	Włodzimierz Jelonek *QCH Kähler surfaces and complex foliations on Kähler surfaces*

Tuesday, October 8

09:00 – 09:50 Joseph Wolf
Dirac and Laplace operators in representation theory

– coffee break –

10:30 – 11:10 Verena Bögelein
Quantitative isoperimetric inequalities in geometric settings

11:20 – 12:10 Stefan Ivanov
Quaternionic Heisenberg group and solutions to Strominger system with non-constant dilaton in small dimensions

– lunch break –

14:30 – 15:20 Antoni Pierzchalski
Natural differential operators in different geometries

– coffee break –

	Session A	Session B
16:00 – 16:30	Anna A. Kimaczyńska *The bundle of symmetric tensors at the boundary*	Petr Zima *Generalizations of Killing spinors*
16:40 – 17:10	Marius Kuhrt *Spinorial description of metric almost contact manifolds*	Vitaly Balashchenko *Canonical structures on homogeneous Φ-spaces and their applications*

Wednesday, October 9

09:00 – 09:50 Paul-Émile Paradan
Geometric quantization of Spin^c*-manifolds*

– coffee break –

10:30 – 11:10 Gianluca Bande
Sasakian immersions into Sasakian space forms

11:20 – 12:10 Giulia Dileo
Generalizations of 3-Sasakian manifolds and connections with skew torsion

– lunch break & free afternoon –

Thursday, October 10

09:00 – 09:50 Simon Salamon
Twistor spaces and special holonomy

– coffee break –

10:30 – 11:10 Henrik Winther
Quaternion symplectic structures

11:20 – 12:10 Oliver Goertsches
Miscellaneous about almost complex manifolds

– lunch break –

14:30 – 15:20 Kotaro Kawai
Second order deformations of associative submanifolds

– coffee break –

	Session A	Session B
16:00 – 16:30	Guido Franchetti *Harmonic spinors on gravitational instantons*	Svatopluk Krýsl *Elliptic operators on bundles over compact homogeneous spaces*
16:40 – 17:10	Homare Tadano *Some compactness theorems for transverse Ricci solitons on complete Sasaki manifolds*	Leopold Zoller *Geometric structures on biquotients and Hamiltonian non-Kähler actions*

Friday, October 11

09:00 – 09:50 Ulrich Bunke
A coarse view on the index of Dirac operators

– coffee break –

10:30 – 11:10 Aleksandra Borówka
C-projective structures in situations with large symmetry algebras

11:20 – 12:10 Andreas Arvanitoyeorgos
Some results in homogeneous geometry: Invariant Einstein metrics and homogeneous geodesics

– lunch break –

14:30 – 15:20 Jan Slovak
Dirac and further invariant first order operators in various geometries

– coffee break & end of workshop–

Abstracts

Andreas Arvanitoyeorgos – Some results in homogeneous geometry: Invariant Einstein metrics and homogeneous geodesics.

Ulrich Bunke – A coarse view on the index of Dirac operators. I will introduce coarse K-homology as an example of a coarse homology theory. A Dirac operator on a complete manifold gives rise to a universal class in the evaluation of this homology theory on on a certain associated bornological coarse space. I will then explain, how this class gives rise to the classical symbol, the usual index and secondary invariants by applying constructions in coarse homotopy theory. This point of view will allow to show (secondary) index theorems by geometric constructions. All analysis is hidden in the construction of the universal class the homology properties of coarse K-homology.

Anna Fino – An overview on G_2-structures with special metrics. I will review known examples of compact 7-manifolds admitting a closed G_2-structure. Moreover, I will discuss some results on the behaviour of the Laplacian G_2-flow starting from a closed G_2-structure whose induced metric satisfies suitable extra conditions.

Giulia Dileo – Generalizations of 3-Sasakian manifolds and connections with skew torsion. 3-Sasakian manifolds are the most well known class of almost 3-contact metric manifolds. It is known that a 3-Sasakian manifold cannot admit any metric connection with totally skew-symmetric torsion preserving all the three Sasaki structures. An alternative notion of canonical connection was introduced for some almost 3-contact metric manifolds, namely, for 7-dimensional 3-Sasakian manifolds and quaternionic Heisenberg groups [3,4]. In the present talk I will provide a criterion to define a canonical connection on almost 3-contact metric manifolds. The new class of canonical almost 3-contact metric manifolds is exactly the class of manifolds admitting this connection, and includes both 3-Sasakian manifolds and the quaternionic Heisenberg groups. In fact, both examples can be placed in a larger class of canonical manifolds, called 3-(α, δ)-Sasaki. Various aspects of canonical manifolds and their canonical connection can be investigated: the parallelism of the torsion, the Ricci curvature, the metric cone, some G_2-structures in dimension 7. This is a joint work with Ilka Agricola and Leander Stecker [1,2].

[1] I. Agricola, G. Dileo, *Generalizations of 3-Sasakian manifolds and skew torsion*, Adv.Geom. (2019).

[2] I. Agricola, G. Dileo, L. Stecker, *Curvature and homogeneity properties of non-degenerate 3-(α, δ)-Sasaki manifolds*, in preparation.

[3] I. Agricola, A. C. Ferreira, R. Storm, *Quaternionic Heisenberg groups as naturally reductive homogeneous spaces*, Int. J. Geom. Methods Mod. Phys. 12 (2015), 1560007.

[4] I. Agricola, T. Friedrich, *3-Sasakian manifolds in dimension seven, their spinors and G_2-structures*, J. Geom. Phys. 60 (2010), 326–332.

Oliver Goertsches – Miscellaneous about almost complex manifolds. We will survey a choice of recent results on the (non-)existence of almost complex structures on various classes of manifolds.

Stefan Ivanov – Quaternionic Heisenberg group and solutions to Strominger system with non-constant dilaton in small dimensions. It is shown that a solution to the heterotic Killing spinor equations and the anomaly cancellation condition (solution to the Strominger system) satisfy the heterotic equations of motion if and only if the connection on the tangent bundle is an instanton. Solutions to the Strominger system with non trivial 3-form flux, non-trivial instanton and non constant dilaton are presented. The dilaton depends on one variable and is determined as a real slice of the Weierstraß elliptic function. These supersymmetric solutions solve also the heterotic equations of motion (generalized heterotic string version of the Einstein vacuum equations in general relativity) up to the first order of the string constant α'.

Kotaro Kawai – Second order deformations of associative submanifolds. The infinitesimal deformation of an associative submanifold is characterized as a kernel of a twisted Dirac operator. In general, there are obstructions for infinitesimal deformations to be integrable. We study the second-order deformations and show that infinitesimal deformations of a homogeneous associative submanifold in 7-sphere are unobstructed to second order.

Andrei Moroianu – Geometries with parallel skew-symmetric torsion. A geometry with parallel skew-symmetric torsion is a Riemannian manifold carrying a metric connection with parallel skew-symmetric torsion. Besides the trivial case of the Levi-Civita connection, geometries with non-vanishing parallel skew-symmetric torsion arise naturally in several contexts, e.g. on naturally reductive homogeneous spaces, nearly Kähler or nearly parallel G_2-manifolds, Sasakian and 3-Sasakian manifolds, or twistor spaces over quaternion-Kähler manifolds with positive scalar curvature. In this talk we study the local structure of geometries with parallel skew-symmetric torsion. On every such manifold one can define a natural splitting of the tangent bundle which gives rise to a Riemannian submersion over a geometry with parallel skew-symmetric torsion of smaller dimension endowed with some extra structure. We show how previously known examples of geometries with parallel skew-symmetric torsion fit into this pattern, and construct several new examples. In the particular case where the above Riemannian submersion has the structure of a principal bundle, we give the complete local classification of the corresponding geometries with parallel skew-symmetric torsion.

Werner Müller – Spectral theory on locally symmetric spaces of finite volume. Spectral theory on locally symmetric spaces is closely related to the theory of automorphic forms and has deep connections to number theory. If the underlying manifold is non-compact, canonical geometric operators like Laplace- and Dirac type operators have a large continuous spectrum. This makes it very difficult to study their discrete spectrum, which is one of the main goals. An important tool to study the discrete spectrum is the Arthur-Selberg trace formula. In the talk I will report on some recent developements concerning spectral theory on locally symmetric spaces. Especially I will discuss the Weyl law and the limit multiplicity problem.

Paul-Émile Paradan – Geometric quantization of Spin^c**-manifolds.** In this talk, we will give an overview of the geometric quantization of Spin^c-manifolds. Here we take a slightly different approach from a physics point of view: this quantization is expressed in terms of equivariant indices of Dirac operators. In return, we will see that this process behaves remarkably well compared to Guillemin-Sternberg's "Quantization commutes with reduction" creed.

Antoni Pierzchalski – Natural differential operators in different geometries. We are going to review and order the present knowledge on natural differential operators for different bundles of tensors and different geometric structures. The operators have nice properties and an interesting geometry. They usually depend on the geometric structure of the manifold but also, on the other hand, they encode (e.g. in their spectrum) some geometric data.

Let us mention the Laplace type operator $-\mathrm{div}\circ\mathrm{grad}$ acting on tensor bundles on a Riemannian or symplectic manifold. Here, grad of a tensor is defined in a similar way to the gradient in the bundle skew-symmetric forms defined by Rummler [7]. The negative divergence $-\mathrm{div}$ is the operator formally adjoint to grad. The operator $-\mathrm{div}\circ\mathrm{grad}$ relates to the Lichnerowicz Laplacian which acts on tensors (forms) of any symmetry (cf. also the recent book [6]). The relation involves the curvature.

Another interesting family consist of operators of form S^*S, where S^* is the operator formally adjoint to S and where S is the the elliptic gradient in the sense of Stein and Weiss. We will discuss the boundary behaviour of the investigated operators. In particular, we will discuss natural boundary conditions for the elliptic operators and the ellipticity of these conditions at the boundary [1, 2, 4]. Recall that one of the important consequences of such the ellipticity of a given boundary condition is the existence of a basis for L^2 composed of smooth sections that are the eigenvectors of the operator and satisfy the boundary condition.

References

[1] A. Kimaczyńska, *Differential operators in the bundle of symmetric tensors on a Riemannian manifold*, PhD thesis, Łódź University, Faculty of Mathematics and Computer Science, Łódź (2016), 63 pp.
[2] A. Kimaczyńska, A. Pierzchalski, *Elliptic operators in the bundle of symmetric tensors*, Banach Center Publications, **113** (2017), 193-218.
[3] A. Klekot, A. Pierzchalski, *The gradient and the divergence on a Riemannian manifold* (to appear)
[4] W. Kozłowski, A. Pierzchalski, *Natural boundary value problems for weighted form Laplacians*, Ann. Sc. Norm. Sup. Pisa, VII, (2008), 343-367.
[5] A. Najberg, *The gradient and the divergence on a symplectic manifold*, PhD thesis, Łódź University, Faculty of Mathematics and Computer Science, Łódź (to appear).
[6] R. Percacci, *An Introduction to Covariant Quantum Gravity and Asymptotic Safety*, World Scientific, Singapore, 2017.
[7] H. M. Rummler, *Differential forms, Weitzenböck formulae and foliations*, Publicacions Matematiques **33** (1989), 543-554.

Simon Salamon – Twistor spaces and special holonomy. I shall show how the theory of spinors, metrics with exceptional holonomy and circle actions all relate to Penrose twistor space.

Jan Slovak – Dirac and further invariant first order operators in various geometries. In conformal Riemannian geometry, the Dirac and twistor operators are the most distinguished first order operators apart from the exterior differential. I shall discuss several higher dimensional generalizations of 4-dimensional conformal geometries and similar operators there.

Joseph Wolf – Dirac and Laplace operators in representation theory. This talk will be a survey of the use of Dirac and Laplace operators for geometric construction of unitary representations of Lie groups. This is more or less classical for semisimple Lie groups and a few cases related to Heisenberg groups, but in general the theory for nilpotent and other non-reductive groups seems to be new.

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Gianluca Bande – Sasakian immersions into Sasakian space forms. In this talk I will explain some recent results in collaboration with B. Cappelletti Montano and A. Loi. The main result is the classification of Sasakian immersions of a complete regular Sasakian η-Einstein into a non-compact simply connected space form. This theorem generalises an old result of Kenmotsu.

Verena Bögelein – Quantitative isoperimetric inequalities in geometric settings. In this talk we establish quantitative isoperimetric inequalities in different geometric settings. We start with a quantitative isoperimetric inequality in higher codimension. In a certain sense such an inequality can be regarded as a stability result (second order Taylor approximation) of Almgren's optimal isoperimetric inequality. In the second part of the talk we are interested in the isoperimetric inequality on manifolds. As the simplest manifold we will consider the sphere. It was shown by E. Schmidt that geodesic balls are the unique isoperimetric sets on the sphere. We will present a strong quantitative version of this result. Both results are joint work with Frank Duzaar and Nicola Fusco.

Aleksandra Borówka – C-projective structures in situations with large symmetry algebras. For parabolic Cartan geometries the maximal dimension of the algebra of infinitesimal symmetries in a non-flat case is significantly lower than the dimension of the algebra of infinitesimal symmetries. of the flat structure. This is called the gap phenomenon for parabolic geometries and any structure for which the dimension of the algebra of infinitesimal symmetries equals to the maximal dimension in the non-flat case is called submaximally symmetric. In this talk, we will discuss a relation between the algebras of infinitesimal symmetries of two different types of

parabolic Cartan geometries: c-projective and quaternionic. In particular, we will show that via quaternionic Feix–Kaledin construction from the submaximally symmetric type (1,1) c-projective structure we can obtain a submaximally symmetric quaternionic structure. This is a joint work with Henrik Winther.

Carlos Shahbazi – Lipschitz structures. Lipschitz structures were introduced by T. Friedrich and A. Trautman in a seminal work in 1999 as the most general type of spinorial structure associated with a bundle of faithful complex spinors on a pseudo-Riemannian manifold (M, g). In this talk, I will discuss the extension of the theory of Lipschitz structures to bundles of (real or complex) weakly faithful Clifford modules by establishing mutually quasi-inverse equivalences between the groupoid of bundles of weakly-faithful real/complex Clifford modules and the groupoid of reduced real/complex Lipschitz structures. I will apply this correspondence to bundles of irreducible real Clifford modules on a pseudo-Riemannian manifold (M, g), classifying all Lipschitz structures in every dimension and signature and computing the topological obstructions for (M, g) to admit a bundle of irreducible real spinors. Time permitting, I will discuss further developments on the characterization of the square of a spinor as an algebraically constrained polyform and applications of the theory of Lipschitz structures to the classification of supersymmetric solutions in supergravity theories. Work in collaboration with Vicente Cortés and Calin Lazaroiu.

Henrik Winther – Quaternion symplectic structures. Let (M, Q) be an almost quaternionic manifold. The space of two-forms $\Omega^2(M)$ decomposes into two invariant complementary subbundles by the quaternionic structure group. One of these bundles is characterized by being trivial as an $Sp(1)$-module, and we will say that its sections are of scalar type. An almost quaternion-symplectic structure is then an almost quaternionic manifold equipped with a non-degenerate two-form ω of scalar type. This is equivalent to a G-structure reduction to $G = Sp(1)SO^*(2n)$. We will discuss properties of such structures, sources of examples, and their differential geometry. Joint work with I.Chrysikos.

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Vitaly Balashchenko – Canonical structures on homogeneous Φ-spaces and their applications. Homogeneous Φ-spaces were first introduced by V.I. Vedernikov in 1964. Fundamental results for regular Φ-spaces and, in particular, homogeneous k-symmetric spaces were obtained by N.A. Stepanov, A. Ledger, A. Gray, J.A. Wolf, A.S. Fedenko, O. Kowalski and others. It turned out that homogeneous k-symmetric spaces G/H admit a commutative algebra $\mathcal{A}(\theta)$ of *canonical* structures [1]. The remarkable feature of these structures is that all of them are invariant with respect to both the Lie group G and the generalized "symmetries" of G/H. The classical example is the canonical almost complex structure J on homogeneous 3-symmetric spaces with its many applications (N.A. Stepanov, A. Gray, V.F. Kirichenko, S. Salamon and others). For $k > 3$ the algebra $\mathcal{A}(\theta)$ contains a large family of classical structures such as almost complex ($J^2 = -id$), almost product ($P^2 = id$), f-structures of K. Yano ($f^3 + f = 0$) and some others [1]. We dwell on several applications of canonical structures.

1) *The generalized Hermitian geometry* (V.F. Kirichenko, D. Blair, S. Salamon and others): canonical nearly Kähler, Killing, Hermitian metric f-structures on homogeneous k-symmetric spaces [2]; left-invariant nearly Kähler and Hermitian f-structures on some classes of nilpotent Lie groups (especially, on 2-step nilpotent and some filiform Lie groups); generalized (in various senses) Heisenberg groups in dimension 5, 6, and 8; heterotic strings.

2) *Homogeneous Riemannian geometry*: the Naveira classification of Riemannian almost product structures; canonical distributions on Riemannian homogeneous k-symmetric spaces; the classes **F** (foliations), **AF** (anti-foliations), **TGF** (totally geodesic foliations); the Reinhart foliations [3].

3) *Elliptic integrable systems*: homogeneous k-symmetric spaces and associated elliptic integrable systems; a new generalization of almost Hermitian geometry; a new contribution to nonlinear sigma models (F. Burstall, I. Khemar [4]).

4) *Metallic structures*: so-called metallic structures (golden, silver and others), which are fairly popular (especially, golden structures) in many recent publications (M. Crasmareanu, C.-E. Hretcanu [5], A. Salimov, F. Etayo and others); canonical structures of metallic family on homogeneous k-symmetric spaces.

5) *Symplectic geometry*: canonical almost symplectic structures on Riemannian homogeneous k-symmetric spaces.

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Guido Franchetti – Harmonic spinors on gravitational instantons. I will focus on the construction of exact zero modes of the Dirac operator twisted by a harmonic connection, and compare the number of solutions found with the index of the Dirac operator obtained via the Atiyah-Patodi-Singer theorem. I will also illustrate how the structure of the space of harmonic spinors and forms is influenced by the topology of the gravitational instanton.

Włodzimierz Jelonek – QCH Kähler surfaces and complex foliations on Kähler surfaces. In the talk we give the classification of generalized Calabi type Kähler surfaces, the class of QCH Kähler surfaces whose opposite almost Hermitian structure is Hermitian and is determined by complex foliation by curves.

Anna A. Kimaczyńska – The bundle of symmetric tensors at the boundary. We investigate some natural differential operators in the bundle of symmetric tensors on a Riemannian manifold. In particular, we will discuss the gradient, the divergence and their composition divgrad. The operator divgrad is a second order strongly elliptic differential operator and it is interesting to investigate its behaviour at the boundary.

References

[1] A. Kimaczyńska, *Differential operators in the bundle of symmetric tensors on a Riemannian manifold*, PhD thesis, Łódź University, Faculty of Mathematics and Computer Science, Łódź (2016), 63 pp.

[2] A. Kimaczyńska, A. Pierzchalski, *Elliptic operators in the bundle of symmetric tensors*, Banach Center Publications, **113** (2017), 193-218.

Svatopluk Krýsl – Elliptic operators on bundles over compact homogeneous spaces. Invariant elliptic operators on homogeneous bundles over compact homogeneous spaces has been studied for a long time. We give a result for bundles which are unitary and homogeneous, generalizing results of Borel, Weil, Bott, Schmid, Wong and others on realizations of foremost irreducible representations of semi simple Lie groups.

Marius Kuhrt – Spinorial description of metric almost contact manifolds. It is well known that in 6 resp. 7 dimensions, the existence of a spinor field of constant length is equivalent to a reduction to SU(3) resp. G_2. In this talk, we describe how a large class of metric almost contact manifolds can be characterized by a 2-dimensional subbundle of the spinor bundle, thus generalizing classical results by Friedrich-Kath (the existence of two Killing spinors in odd dimensions is equivalent to an Einstein-Sasaki structure). As a side result we introduce and describe H-parallel metric almost contact manifolds. This is joint work with Ilka Agricola.

Mauro Mantegazza – An intrinsic characterization of projective special Kähler manifolds. Projective special Kähler manifolds are not only interesting on their own, in fact they find an important application in quaternion Kähler geometry, where they are the starting ingredient to create new quaternion Kähler manifolds, via a construction known as the c-map. In this talk I will present an intrinsic characterisation of projective special Khler manifolds that will shed more light on this type of structure. Moreover, I will display the benefits of this characterisation by using it to classify projective special Kähler Lie groups in dimension four and by showing its consequences on the c-map.

Reinier Storm – Lagrangian submanifolds of twistor spaces from superminimal surfaces. In this talk a bijective correspondence between superminimal surfaces of an oriented Riemannian 4-manifold and particular Lagrangian submanifolds of the twistor space over the 4-manifold is proven. More explicitly, if the image of a Lagrangian submanifold of the twistor space under the bundle map to the 4-dimensional base is a 2-dimensional surface, then this surface is a superminimal surface. Conversely, for every superminimal surface a Lagrangian submanifold of the twistor space which projects to this surface is given. In particular this produces many Lagrangian submanifolds of the nearly Kähler twistor spaces $\mathbb{C}P^3$ and $\mathbb{F}_{1,2}(\mathbb{C}^3)$, which are also Lagrangian submanifolds of the Kähler structures on these manifolds.

Homare Tadano – Some compactness theorems for transverse Ricci solitons on complete Sasaki manifolds. The aim of this talk is to discuss the compactness of complete Ricci solitons. Ricci solitons were introduced by R. Hamilton in 1982 and are natural generalizations of Einstein manifolds. They correspond to self-similar solutions to the Ricci flow and often arise as singularity models of the flow. The importance of Ricci solitons was demonstrated by G. Perelman, where they played crucial roles in his affirmative resolution of the Poincar'e conjecture. In this talk, after we review basic facts on Ricci solitons, I would like to give some new compactness theorems for complete Ricci solitons. Our results generalize the compactness theorems due to W. Ambrose (1957), J. Cheeger, M. Gromov, and M. Taylor (1982), M. Fernández-López and E. García-Río (2008), M. Limoncu (2010, 2012), Z. Qian (1997), Y. Soylu (2017), G. Wei and W. Wylie (2009), and S. Zhang (2014). Moreover, I would also like to extend such compactness theorems for complete Ricci s olitons to the case of transverse Ricci solitons on complete Sasaki manifolds.

Changliang Wang – The linear instability of some Einstein metrics. I will report on some joint work with Prof. Uwe Semmelmann and Prof. McKenzie Wang on the linear stability question of Einstein metrics. We proved the linear instability of some Einstein metrics with positive scalar curvature, in particular, including some families of Riemannian manifolds with real Killing spinors.

Petr Zima – Generalizations of Killing spinors. Generalized Killing spinors are solutions of a first order system of PDEs which generalizes the Killing spinors by replacing the Killing number with a symmetric endomorphism field which can have more distinct eigenvalues. The eigendistributions of the endomorphism field can be viewed as part of an additional special Riemannian structure and in this sense the equations are not invariant with respect to the spin-Riemannian structure alone.

We introduce another generalization of Killing spinors given by a second order system. A nontrivial example of this second order Killing spinor is the so called canonical spinor of a 3-Sasakian manifold in dimension 7. The canonical spinor was discovered by I. Agricola and T. Friedrich and they showed that it is an example of generalized Killing spinor. The advantage of our approach is that our system of PDEs is invariant and makes sense in general without prior assumption of special Riemannian structure.

Finally we also suggest further generalizations of higher order which can be of interest for future research.

Leopold Zoller – Geometric structures on biquotients and Hamiltonian non-Kähler actions. Abstract: We construct symplectic and Kähler structures on biquotients of the form $G//T$, where G is a compact Lie group and $T \subset G \times G$ is a torus of dimension $\mathrm{rk}(G)$. Studying the symmetries of these structures, we find similarities and differences to the homogeneous setting. In particular, we identify one of our biquotients with Tolman's and Woodward's example of a Hamiltonian non-Kähler action, answering the questions of whether this space carries a (non-equivariant) Kähler structure.

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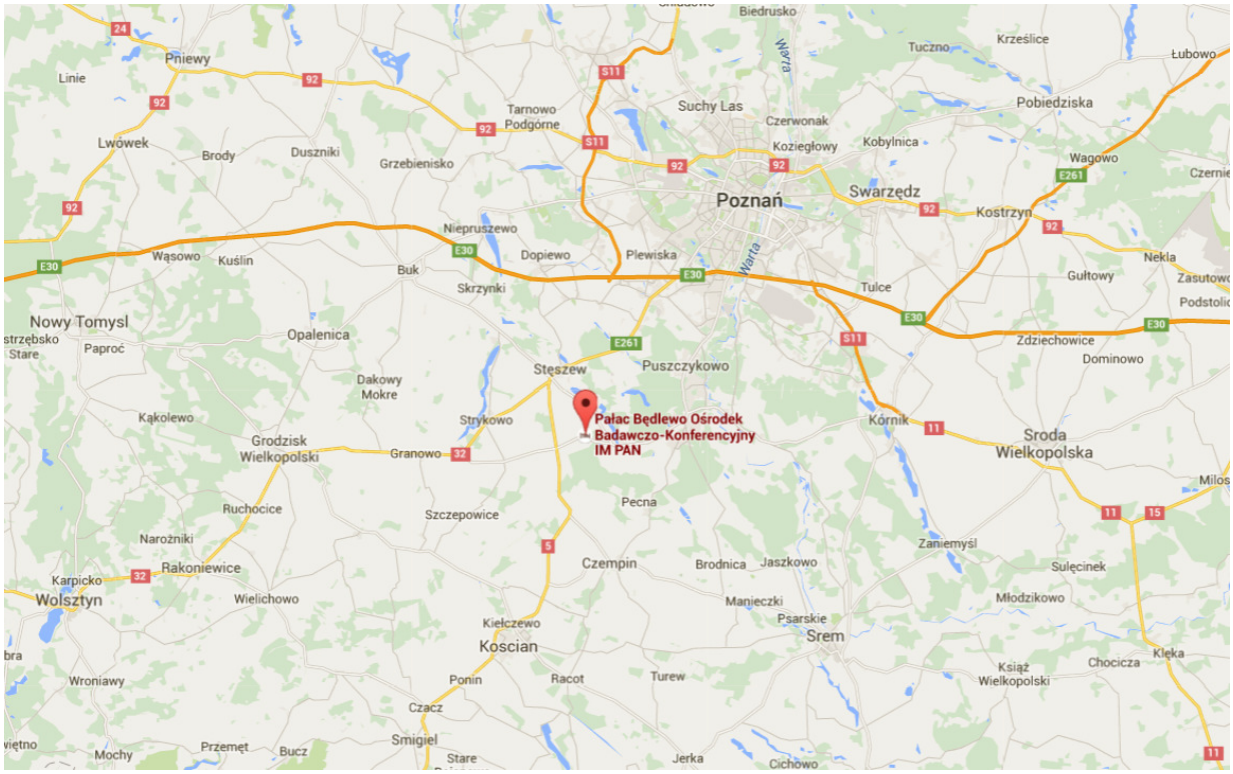
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Prof. Dr. sc.
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$\lambda^2 \geq \frac{n}{4(n-1)} \mathrm{Scal}^2_{\min}$