# 10th Northern German Differential Geometry Day
(Hamburg – Hannover – Kiel)

# Hamburg University, Friday, June 21, 2019

## Schedule:

**11:00** lecture hall GEOM H6
**Olivier Biquard (École Normale Supérieure, Paris)**
*Renormalized volume for ALE Ricci-flat 4-manifolds*

**12:00** lecture hall GEOM H3
**Sebastian Goette (Universität Freiburg)**
*Extra twisted connected sums and their nu-invariants*
**13:00 – 15:00**
Lunch Break

**15:00** lecture hall GEOM H4
**Gilles Courtois (Institut de Mathématiques de Jussieu, Paris)**
*Entropy of manifolds and their fundamental groups*

**16:00** lecture hall GEOM H4
**Lorenzo Foscolo (Heriot-Watt University, Edinburgh)**
*Infinitely many new families of complete cohomogeneity one G2 manifolds*

**Venue:**     Hamburg University, Department of Mathematics
Bundesstraße 55, 20146 Hamburg

**Organizers:**     Vicente Cortés and Klaus Kröncke (Hamburg)
Roger Bielawski, Lynn Heller and Knut Smoczyk (Hanover)
Jens Heber and Hartmut Weiß (Kiel)

# Abstracts

Olivier Biquard (Paris)
*Renormalized volume for ALE Ricci-flat 4-manifolds*
*(11:00 - 12:00)*

We introduce a renormalized volume for ALE Ricci-flat 4-manifolds, and prove that is satisfies an inequality, with equality only in the case of a cone. Joint work with Hans-Joachim Hein.

Sebastian Goette (Freiburg)
*Extra twisted connected sums and their nu-invariants*
*(12:00 - 13:00)*

Joyce's orbifold construction and the twisted connected sums by Kovalev and Corti-Haskins-Nordström-Pacini provide many examples of compact Riemannian 7-manifolds with holonomy $G_2$ (i.e., $G_2$-manifolds). We would like to use this wealth of examples to guess further properties of $G_2$ manifolds and to find obstructions against holonomy $G_2$, taking into account the underlying topological $G_2$-structures.
The Crowley-Nordström v-invariant distinguishes topological $G_2$-structures. It vanishes for all twisted connected sums. By adding an extra twist to this construction, we show that the v-invariant can assume all of its 48 possible values. This shows that $G_2$-bordism presents no obstruction against holonomy $G_2$. We also exhibit examples of 7-manifolds with disconnected $G_2$-moduli space. Our computation of the v-invariants involves integration of the Bismut-Cheeger η-forms for families of tori, which can be done either by elementary hyperbolic geometry, or using modular properties of the Dedekind η-function.

Gilles Courtois (Paris)
*Entropy of manifolds and their fundamental groups*
*(15:00 - 16:00)*

The Milnor-Švarc Lemma says that the entropy of a closed Riemannian manifold does not vanish if and only if its fundamental group has exponential growth but does not give any link between the minimal entropy of a manifold and its fundamental group. In my talk, I will describe these notions and explain that such a link exists when the fundamental group is hyperbolic in the sense of Gromov.

Lorenzo Foscolo (Edinburgh)
*Infinitely many new families of complete cohomogeneity one G2 manifolds*
*(16:00 - 17:00)*

I will present joint work with Mark Haskins and Johannes Nordström on cohomogeneity one G2 metrics, that is, G2 holonomy metrics acted upon by a group of isometries with generic orbits of codimension one. We construct infinitely many new one-parameter families of simply connected complete noncompact G2-manifolds with controlled geometry at infinity. The generic member of each family has so-called asymptotically locally conical (ALC) geometry. At a special parameter value, the nature of the asymptotic geometry changes, and we obtain a unique member of each family with asymptotically conical (AC) geometry. On approach to a second special parameter value, the family of metrics collapses to an AC Calabi-Yau 3-fold. We also construct a closely related singular G2 holonomy space with an isolated conical singularity in its interior and ALC geometry at infinity. Our infinitely many new simply connected AC G2 manifolds are particularly noteworthy: only the three classic examples constructed by Bryant and Salamon in 1989 were previously known.