Seminar: "Geometry&Physics", DFT (IFIN-HH)
(Seminar Homepage) (Indico Page)

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Title: Parallel spinors on globally hyperbolic Lorentzian four-manifolds

Speaker: **Carlos Shahbazi** (University of Hamburg, Dept. of Mathematics)

Abstract: I will discuss the differential geometry and topology of globally hyperbolic four-manifolds (M, g) admitting a parallel real spinor ϵ. Using the theory of parabolic pairs recently introduced in arXiv:1911.08658 , I will first formulate the parallelicity condition of ε on M as a system of partial differential equations, the parallel spinor flow equations, for a family of polyforms on any given Cauchy surface $\Sigma \hookrightarrow M$. Existence of a parallel spinor on (M, g) induces a system of constraint partial differential equations on Σ, which we prove to be equivalent to an exterior differential system involving a cohomological condition on the shape operator of the embedding $\Sigma \hookrightarrow M$. Solutions of this differential system are precisely the allowed initial data for the evolution problem of a parallel spinor and define the notion of parallel Cauchy pair (ε, Θ), where ε is a coframe and Θ is a symmetric two-tensor. I will characterize all parallel Cauchy pairs on simply connected Cauchy surfaces, refining a result of Baum, Leistner, and Lischewski. Furthermore, I will classify all compact three-manifolds admitting parallel Cauchy pairs, proving that they are canonically equipped with a locally free action of $\mathbb{R}^2$ and are isomorphic to certain torus bundles over S^1. Moreover, I will classify all left-invariant parallel Cauchy pairs on simply connected Lie groups, specifying when they are allowed initial data for the Ricci flat equations and when the shape operator is Codazzi. Finally, I will give a novel geometric interpretation of a class of parallel spinor flows and solve it in several examples, obtaining explicit families of four-dimensional Lorentzian manifolds carrying parallel spinors.