

**UHLENBECK COMPACTNESS AND OPTIMAL  
REGULARITY IN LORENTZIAN GEOMETRY AND FOR  
YANG-MILLS GAUGE THEORIES**

MORITZ REINTJES  
UNIVERSITY OF KONSTANZ

ABSTRACT. I will present the research program of the *Regularity Transformation (RT-)equations*, an elliptic system of partial differential equations which determines (coordinate) transformations that remove apparent singularities in spacetime by establishing *optimal regularity* for connections. The resulting gain of one derivative for these connections suffices to establish *Uhlenbeck compactness* in Lorentzian geometry, including  $L^p$  connections on vector bundles with compact as well as non-compact gauge groups. As an application, our optimal regularity result implies that the Lorentzian metrics of shock wave solutions of the Einstein-Euler equations are non-singular—geodesic curves, locally inertial coordinates and the resulting Newtonian limit all exist in a classical sense—, resolving a longstanding open problem in the field.