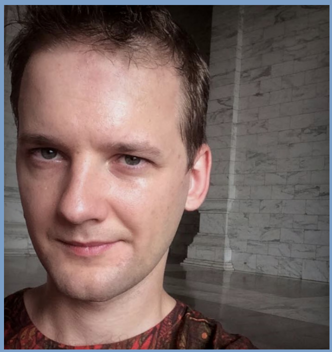


MARTIN KRSSAK

Faculty of Mathematics,
Physics and Informatics CU

Project number
3215/02/01

Project duration
9/2022 -81/2025

"The SASPRO 2 project is an excellent opportunity to pursue my research independently, which is a perfect fit for the current stage of my scientific career. During this project, I expect to fully establish my own line of research and hope to build solid foundations towards starting my own research group in Slovakia.."

S A S P R O 2

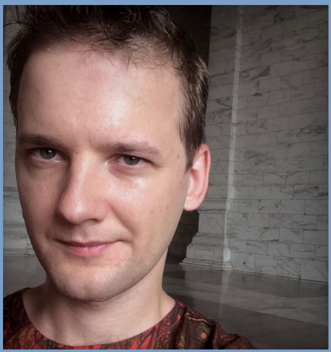
BIOGRAPHY

I have studied physics at Comenius University (bachelor) and Charles University (master), followed by doctoral studies at Bielefeld University (Germany), where I explored applications of holographic methods to heavy-ion physics. Afterwards, I moved for my first post-doc position to São Paulo (Brazil) where I have started to work on the topic directly related to my current project: studying gravity using non-Riemannian geometries, particularly the so-called teleparallel geometry. I have then continued my research by following a series of postdoc positions in Tartu (Estonia), Yangzhou (China), and Bangkok (Thailand), from where I have returned back to Comenius University to pursue the current project.

PROJECT SUMMARY

Alternative Geometries of Gravity

Gravitation is the weakest of four fundamental forces but the most important one at the cosmological scales where it shapes our Universe. The recent groundbreaking discoveries of the accelerated expansion of the Universe, and observations of gravitational waves and black holes have motivated the study of various novel approaches to understanding gravity beyond the standard general relativity. In this project, we propose to study gravity using alternative geometries known as teleparallel geometries that have become increasingly popular in recent years. Our plan is to use these geometries to study the so-called teleparallel equivalent of general relativity and focus on understanding the role of surface terms in the gravitational action since this is the crucial difference with the standard general relativity. In particular, we will focus on developing new methods of regularizing the gravitational action and understating its symmetries. We expect that our results will help us to obtain new insights into thermodynamics of black holes and holographic properties of gravity like the holographic complexity. Moreover, this will allow us to introduce various advanced mathematical concepts in general relativity and demonstrate their importance in the classical physics. In the second part of the project we will focus on studying alternative theories of gravity, particularly various modifications/extensions of general relativity in the teleparallel framework that have recently found many applications in cosmology. We will aim our attention mainly on understanding the problem of dynamics of these models in order to determine which of them are physically consistent and then study their applications in cosmology. We believe that our project will demonstrate the importance of the alternative geometries and establish their use as the standard method in gravitational physics research.



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S A S P R O 2

PUBLICATIONS

1. The covariant formulation of f(T) gravity
M. Krššák and E. N. Saridakis
Class. Quant. Grav. 33 (2016) no.11, 115009, arXiv:1510.08432 [gr-qc]

2. Teleparallel Theories of Gravity: Illuminating a Fully Invariant Approach
M. Krššák, R. J. van Den Hoogen, J. G. Pereira, C. G. Boehmer, A. A. Coley
Class. Quant. Grav. 36 (2019) 18, 183001, arXiv:1810.12932 [gr-qc]

3. Holographic Renormalization in Teleparallel Gravity
M. Krššák
Eur. Phys. J. C 77, 44 (2017), arXiv:1510.06676 [gr-qc]

4. New classes of modified teleparallel gravity models
S. Bahamonde, Ch. Boehmer, M. Krššák
Phys. Lett. B 775 (2017) 37–43, arXiv:1706.04920 [gr-qc]

5. Spin Connection and Renormalization of Teleparallel Action
M. Krššák and J. G. Pereira
Eur. Phys. J. C 75, 519 (2015), arXiv:1504.07683 [gr-qc]

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