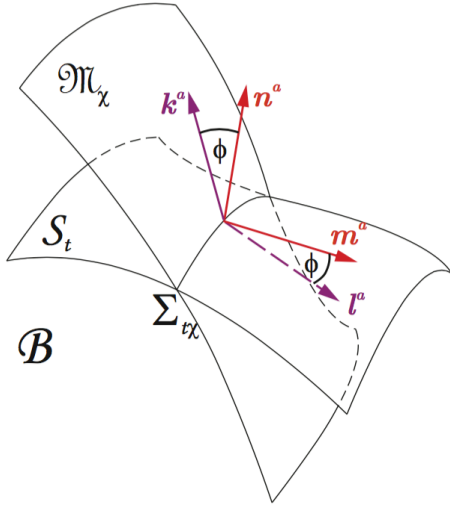


Gravitational waves and scalar perturbations in spherically symmetric scalar-tensor gravity

Cecília Gergely, Zoltán Keresztes, László Árpád Gergely

University of Szeged, lawrencesterne92@gmail.com

The recent detection of gravitational waves¹⁻⁶ (both from the study of the dispersion relations⁷ and from the mere 1.7s delay⁸ of the soft GRB 170817A following GW170817) has confirmed that gravitational waves propagate with the speed of light, disruling many modified gravity theories (certain galileon models, vector-tensor, generalised Proca or bigravity theories). Many scalar-tensor gravity theories however survived the test. The study of perturbations of such models is important to establish the ghost-free and instability-free parameter regimes. This has been investigated⁹ for a wide range of scalar-tensor theories in the spherically symmetric setup, exploring a 2+1+1 decomposition of space-time based on an orthogonal double foliation¹⁰⁻¹¹. The imposition of the perpendicularity in the perturbed space-time however consumed one gauge degree of freedom, allowing the discussion of only the odd sector of the scalar part of perturbations.



In order to be able to discuss the even sector perturbations, we worked out a novel 2+1+1 decomposition of space-time and gravitational dynamics, based on a non-orthogonal double foliation¹². We explore this new formalism in the discussion of the gauge transformations of the perturbations of both the metric tensor and scalar field, achieving an unambiguous gauge-fixing¹³.

This opens up the way for the discussion of the full spectrum of perturbations in spherically symmetric scalar-tensor gravity, including both the odd and even sectors of the scalar part of perturbations and the gravitational waves.

References:

1. LIGO Scientific Collaboration, Virgo Collaboration, *Phys. Rev. Lett.* 116 (2016), 061102
2. LIGO Scientific Collaboration, Virgo Collaboration, *Phys. Rev. Lett.* 116 (2016), 241103
3. LIGO Scientific Collaboration, Virgo Collaboration, *Phys. Rev. Lett.* 118 (2017), 221101
4. LIGO Scientific Collaboration, Virgo Collaboration, arXiv:1711.05578 (2017)
5. LIGO Scientific Collaboration, Virgo Collaboration, *Phys. Rev. Lett.* 119 (2017), 141101
6. LIGO Scientific Collaboration, Virgo Collaboration, *Phys. Rev. Lett.* 119 (2017), 161101
7. LIGO Scientific Collaboration, Virgo Collaboration, *Phys. Rev. Lett.* 116 (2016), 221101
8. LIGO Scientific Collaboration, Virgo Collaboration, *Astrophys. J. Lett.* 848 (2017), L13
9. R. Kase, L. Á. Gergely, S. Tsujikawa, *Phys. Rev. D* 90 (2014), 124019
10. L. Á. Gergely, Z. Kovács, *Phys. Rev. D* 72 (2005), 064015
11. Z. Kovács, L. Á. Gergely, *Phys. Rev. D* 77 (2008), 024003
12. C. Gergely, Z. Keresztes, L. Á. Gergely, *Universe*, to appear (2017)
13. C. Gergely, Z. Keresztes, L. Á. Gergely, in preparation (2017)