

# GR computations with the Python-based free computer algebra system SageMath

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We shall present the ongoing effort, coordinated via the SageManifolds project [1], to extend the Python-based and open-source mathematics software system SageMath [2] towards differential geometry and tensor calculus [3]. All SageManifolds code is now merged in SageMath, after a review process [4]. Using various examples from general relativity, modified gravity and AdS/CFT correspondence, we shall illustrate new functionalities of SageMath regarding the computation of the Riemann curvature tensor and the curvature invariants, changes of coordinates and vector frames, exterior calculus, geometry of embedded submanifolds and the integration of geodesics. Some of these examples involve SymPy [5] as the symbolic backend instead of SageMath's default one.

[1] <https://sagemanifolds.obspm.fr/>

[2] <http://www.sagemath.org/>

[3] E. Gourgoulhon & M. Mancini : *Symbolic tensor calculus on manifolds: a SageMath implementation*, Les cours du CIRM **6, I** (2018); [\[arXiv:1804.07346\]](https://arxiv.org/abs/1804.07346)

[4] <https://trac.sagemath.org/ticket/18528>

[5] <https://www.sympy.org/>