General relativity and gravitation

General relativity and gravitation, relativistic astrophysics and cosmology

The general theory of relativity and its applications in astrophysics and cosmology is a field that has been taught and pursued at the FMP CU systematically since the 1970s and its advancement has been associated primarily with the Institute of Theoretical Physics (ITP) and the name of Prof. Jiří Bičák. A number of researchers active in the field today – working not only at the FMP CU but also at other universities and institutes of the Academy of Sciences of the Czech Republic, ASCR—began their professional carriers under his supervision. At present Profs. O. Semerák, P. Krtouš, J. Podolský, Drs. D. Heyrovský and T. Ledvinka from ITP and Profs. V. Karas, V. Pravda from Astronomical and Mathematical Institute of ASCR, and prof. Z. Stuchlík from the Silesian University have their own students and became the leaders in their specific fields. The research profile encompasses mainly mathematical problems of general relativity and its higher dimensional versions, particularly the search for and interpretation of exact solutions of Einstein's equations, investigation of spacetimes involving gravitational radiation, formulation of conservation laws and their relation to various types of symmetries, physics of black holes and of massive discs as gravitational sources, behaviour of particles and fields in curved spacetimes, the issue of cosmological perturbations, various problems in relativistic astrophysics and, more recently, also the application of computers to non?stationary problems involving very strong fields (numerical relativity), approximation methods in theories of gravitation, non?homogeneous cosmological models, and gravitational lenses. The group continues educating students in the fields of relativistic physics and astrophysics. It has extensive international contacts and has completed successfully a number of grant projects. During recent five years, until the end of 2018, its operation was supported particularly by Albert Einstein Center for Gravitation and Astrophysics, a Project of Excellence awarded by the Czech Science Foundation. Within the Center, the group has also enhanced its collaboration with colleagues from the Astronomical Institute of the ASCR, the Institute of Mathematics of the ASCR, and from Silesian University in Opava. Although the Czech Science Foundation has not continued the program of the Centers of Excellence, we keep the Albert Einstein Center alive. For more details, see http://www.albert-einstein-center.cz/ . More recently, the group has been enriched by a number of post-docs from abroad (see http://utf.mff.cuni.cz/)

Selected outputs

- T. Ledvinka and J. Bičák: „Disk sources of the Kerr and Tomimatsu-Sato spacetimes: Construction and physical properties“, Phys. Rev. D 99, 064046 (2019)
- R. Švarc, J. Podolský, V. Pravda, A. Pravdová: „Exact black holes in quadratic gravity with any cosmological constant“, Phys. Rev. Lett. 121, 231104 (2018)
- V. P. Frolov, P. Krtouš, D. Kubizňák, J. E. Santos: „Massive Vector Fields in Rotating Black-Hole Spacetimes: Separability and Quasinormal Modes“, Phys. Rev. Lett. 120, 231103 (2018)
- W. Barker, T. Ledvinka, D. Lynden-Bell, J. Bičák J.: „Rotation of inertial frames by angular momentum of matter and waves“, Classical and Quantum Gravity 34, 205006 (2017)
- P. Čížek, O. Semerák: „Perturbation of a Schwarzschild Black Hole Due to a Rotating Thin Disk“, The Astrophysical Journal Supplement Series 232 (2017) id.14
- L. Ledvina, D. Heyrovský, M. Dovčiak: „ X-Ray Line Profile Variations during Quasar Microlensing“ The Astrophysical Journal (2019) – to appear.