POLISH NATIONAL AGENCY FOR ACADEMIC EXCHANGE

STER PROGRAMME

name of the unit:		symbol:
THEORETICAL PHYSICS GROUP Institute of Physics, Lodz University of Technology		I-71 https://fizyka.p.lodz.pl/en/
head of the unit:	potential promoters:	contact person:
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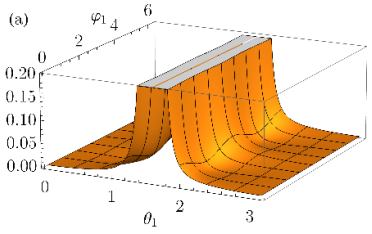
scope of activities:

There are two main areas of interest of the Group. The first one is related to complex methods in general relativity and especially to the study of 4D complex manifolds equipped with a holomorphic metric and congruences of null strings (heavenly, hyperheavenly and weak hyperheavenly spaces). The two, rather broad, topics studied within this area are:

- Lorentzian spaces obtained from complex solutions of Einstein equations,
- neutral signature spaces, especially para-Kähler.

The other area of research corresponds to foundations of quantum mechanics and covers the following overlapping topics:

- quantization (especially deformation quantization),
- quantum systems with discrete phase space,
- photon wave function,
- field theory on noncommutative spaces.



present activities:

- Classification of hyperheavenly spaces combining Petrov types with properties of congruences of null strings.
- Finding metrics (as general as possible) falling into specific types within aforementioned classification.
- Study of geometrical and quantum mechanical properties of photon position operator.
- Quest for appropriate representation of states (including eigenstates) in formal deformation quantization.
- Formulation of deformation quantization framework for systems with discrete phase space.

future activities:

Continuation of current research.

publications/patents, awards, projects:

- Chudecki: On some examples of para-Hermite and para-Kähler Einstein spaces with $\Lambda \neq 0$, J. Geom. Phys. 112, 175 (2017).
- Chudecki, M. Przanowski: On twisting type [N] ⊗ [N] Ricci flat complex spacetimes with two homothetic symmetries, J. Math. Phys. 59, 042504 (2018).
- M. Dobrski, M. Przanowski, J. Tosiek, F. J. Turrubiates: The geometrical interpretation of the photon position operator, Phys. Rev. A 104, 042206 (2021).
- M. Przanowski, J. Tosiek, F. J. Turrubiates: The Weyl-Wigner-Moyal formalism on a discrete phase space. I. A Wigner function for a nonrelativistic particle with spin, Fortschr. Phys. 67 1900080 (2019).

The portfolio of research groups was created as part of the Programme "STER" – Internationalisation of doctoral schools" as part of the realization of the project "Curriculum for advanced doctoral education & taining – CADET Academy of Lodz University of Technology".

- M. Dobrski, Background independent noncommutative gravity from Fedosov quantization of endomorphism bundle, Class. Quantum Grav. 34 075004 (2017).

keywords:

heavenly spaces, hyperheavenly spaces, complex relativity, quantization, deformation quantization, photon wave function

list of internship proposal in this research team :

Hyperheavenly spaces and their Lorentzian slices (the detailed scope can be agreed upon request).