Center for Theoretical Physics, Polish Academy of Sciences

Websites:
www.cft.edu.pl/en
https://www.youtube.com/channel/UCBmbEBj4eybdApFesQCcc2w

Research Topics

Classical and Quantum Field Theory group
www.cft.edu.pl/~kijowski

1) Analysis of the canonical structure of classical field theory,
2) Geometric Quantization and time measurements in quantum mechanics,
3) Variational and canonical structure of General Relativity Theory,
4) Formulation of classical and quantum theory of gauge fields in terms of gauge invariants,
5) Lattice Gauge Field Theory,
6) Positivity and quasi-localizability of gravitational energy,
7) Relativistic mechanics of continuous media and relativistic thermodynamics,
8) Back-reaction in classical electrodynamics,
9) Mathematical foundations of the calculus of variations and its physicsal applications.

We collaborate closely with the Physics and Mathematics Department, University of Warsaw and several other institutions in Poland and abroad. More information can be found on our webpage.

Quantum Dynamics Group
www.cft.edu.pl/p_view/p_view.php?login=marek

Research is focused around the following topics
1) Quantum dynamics of composite systems
2) Quantum and classical integrability and chaos
3) Geometry of quantum states of composite systems
4) Entanglement and other quantum correlations
5) Quantum logics
6) Control of quantum systems

At the moment the group consist of the group leader and ten young researchers with PhD/MSc degree. The group collaborates closely with other groups at the Center (Geometric Structures Group, Classical and Quantum Field Theory Group) as well as many Polish (Mathematical Institute of the Polish Academy of Sciences, Mikolaj Kopernik University in Toruń, Jagiellonian University in Kraków) and foreign (Universities in Bochum, Freiburg, Cologne, Naples, Institute of Photonic Sciences in Barcelona) scientific groups.

Quantum gases group
www.cft.edu.pl/~rzazewski

1) Thermodynamics of weakly interacting quantum gases
2) Solitons and vortices in quantum gases
3) Dipolar effects in quantum gases
4) Rydberg atoms in Bose-Einstein condensate
5) Quantum measurements of Bose-Einstein condensate
6) Fluctuations and correlations in quantum gases
7) Soluble few particle models

We collaborate closely with a group at the Institute of Physics, PAS and with a group at the University of Białystok. Our close international partner is Tilman Pfau from Univeristy of Stuttgart.

Geometric Structures Group
www.cft.edu.pl/~nurowski

1) Geometric methods in non-linear differential equations,
2) Cartan Geometry and Parabolic Geometry,
3) Non-integrable vector distributions,
4) Geometric control theory,
5) Conformal and projective structures in General Relativity and Cosmology,
6) Complex geometry and twistors,
7) Applications of Lie theory in quantum information and control.

Our research involves active collaboration with the group of M. Kuś at the Center for Theoretical Physics PAS, B. Jakubczyk at the Institute of Mathematics PAS, as well as numerous international experts in Europe, USA, Mexico, Australia and New Zealand.

Theoretical Astrophysics Group

http://www.cft.edu.pl/astrofizyka/?page_id=98

Theoretical astrophysics group in the Center of Theoretical Physics, PAS, conducts research in the field of compact stars, black holes and neutron stars, that are observed in our Universe. The comprehensive studies of black holes in their cosmic environment are performed with joint efforts of astronomers and physicists. We are using the most advanced tools of numerical relativity and hydrodynamics, and we continuously confront the results of our computations with the observational data available thanks to the modern space satellites and ground based telescopes. Our team consists currently of four young researchers with PhD/MSc degree as well as several collaborators from other institutions in Poland and abroad.

Observational Cosmology Group

http://www.cft.edu.pl/p_view/p_view.php?login=czerny

The study concentrates around the quasar structure, evolution and applications of quasars to determine the properties of the dark energy responsible for the accelerated expansion of the universe. Quasars are the most distant persistent sources of radiation in the Universe, they are rare and extermely active galactic nuclei containing supermassive black holes. Quasars are thus they are excellent tracers of the Universe properties. Our method of dark energy tracing is based on quasar variabity which allows us to determine the quasar absolute luminosity. The corresponding model has been developed within our group. The project requires performing observations with one of the largest telescopes in the world - 11 m Southern African Large Telesope - as well as theoretical work aimed at understanding of the quasar structure. The project is done in collaboration with astronomers from the Copernicus Astronomical Center, Polish Academy of Sciences, Jagiellonian University, and a number of astronomers from abroad. Group leader, Bożena Czerny, is the representative of Poland to the Management Committee of the COST Action No. TD1403 "Big Data Era in Sky and Earth Observation".