GRANTS:

1. *Dr W. Broniowski*
Theoretical Studies of Nucleons and Nuclear Matter,
no: PAN-NSF 9313988; 1. 01. 1994 - 31. 12. 1996;
2. *Dr W. Broniowski*
Theoretical Studies in Hadronic Physics Related to CEBAF,
no: PAA/NSF-94-158; Maria Skłodowska-Curie Fund II,
1. 01. 1994 - 31. 12. 1996;
3. *Prof. E. Kapuścik*
grant No: 2 0342 91 01 (State Committee for Scientific Research),
The Meaning of the Galileo Relativity Principle in Quantum Mechanics;
4. *Assoc. Prof. M. Kutschera*
grant No: 2 0204 91 01 (State Committee for Scientific Research),
Dense and/or Hot Hadron Matter;
5. *Prof. J. Kwieciński*
grant No: 2 0198 91 01 (State Committee for Scientific Research),
Structure of Hadrons Studied in Particle and Nuclear Interactions;
6. *Prof. J. Kwieciński*
grant No: 2 P302 062 04 (State Committee for Scientific Research),
Analysis of Lepton Inelastic Scattering on Nucleons and on Atomic Nuclei;
7. *Prof. J. Kwieciński*
grant No: F0408 (British - Polish Joint Research Collaboration Programme),
Proton Structure and Small x Physics;
8. *Prof. J. Kwieciński*
grant No: ERBCHRXCT 920004; supplementary agreement No: ERBCIPDCT 940016 (within the network coordinated by the University of Grenada, Spain),
Phenomenology of the Standard Model and Alternatives for Present and Future High Energy Colliders.

OVERVIEW:

Research activity of the Department of Theoretical Physics spans a wide variety of problems in theoretical high-energy and elementary-particle physics, theoretical nuclear physics, theory of nuclear matter, quark-gluon plasma and relativistic heavy-ion collisions, theoretical astrophysics, as well as general physics. Some topics, like theoretical astrophysics, have interdisciplinary character requiring theoretical tools of high-energy physics together with the knowledge of the theory of nuclear matter and the theory of condensed matter. There is some emphasis on the phenomenological aspect of the theoretical research, yet more formal problems are also considered.

Theoretical research in high energy and elementary particle physics is concentrated on the theory of deep inelastic lepton scattering in the region of low x and its phenomenological implications for the ep collider HERA at DESY, on the theory of nonleptonic decays of hadrons, and on low energy $\pi\pi$ and $K\bar{K}$ interactions and scalar meson spectroscopy.

Our activity in the theory of relativistic heavy-ion collisions is focussed on the study of quark condensate fluctuations, on the analysis of critical scattering near the chiral phase transition, and on Bose-Einstein correlations in heavy-ion collisions.

Theoretical studies in nuclear physics and in the theory of nuclear matter concern analysis of models, with dynamical symmetry based on group $Sp(6, R)$, for the description of collective modes of atomic nuclei, analysis of the Goldstone bosons in nuclear matter and analysis of saturation properties of nuclear matter.

Research in theoretical astrophysics is mainly devoted to the analysis of magnetic properties of hadronic matter in neutron stars with proton admixtures.

Studies in general physics concern problems related to the Galilean covariance of classical and quantum mechanics.

The detailed results obtained in various fields are summarised in the abstracts listed below.

Our Department collaborates actively with other departments of our Institute and with several laboratories in Poland and abroad.

Besides pure research, members of our Department are also involved in graduate and undergraduate teaching activity, both at our Institute as well as at other academic institutions in Cracow.

Prof. Jan Kwieciński

REPORTS ON RESEARCH:

Multiparticle Correlations in High Energy Collisions

P. Bożek, M. Płoszajczak[1], and R. Botet[2]

[1] GANIL, Caen, France

[2] Laboratoire de Physique des Solides, Université Paris-Sud, Orsay, France

The power–law multiparticle correlations between particles produced in high energy collisions were studied [1]. The implications of the structure of the emitting source on the Bose-Einstein correlations was addressed in ultrarelativistic nuclear collisions. The role of hadronization on the observed correlations was studied in a simple model as well.

Reference:

1. P. Bożek, M. Płoszajczak, and R. Botet, Two and Many Particle Correlations in Nuclear and High Energy Physics, GANIL preprint **P-94-13**, *to appear in Physics Reports.*

Subthreshold Particle Production in Heavy Ion Collisions

P. Bożek and M. Płoszajczak [1]

[1] GANIL, Caen, France

The subthreshold production of particles in intermediate–energy heavy–ion collisions was studied. The model of instabilities was applied to the production of mesons and high–energy photons. The data of the TAPS group on energetic photon production (E_γ >pion mass) were reproduced for the first time. The model was also improved by the inclusion of the Fermi motion.