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INSTYTUT FIZYKI JĄDROWEJ
im. HENRYKA NIEWODNICZAŃSKIEGO
HENRYK NIEWODNICZAŃSKI
INSTITUTE OF NUCLEAR PHYSICS

ZAKŁAD FIZYKI TEORETYCZNEJ
DEPARTMENT OF THEORETICAL PHYSICS

SPRAWOZDANIE ROCZNE
ANNUAL REPORT

1992

Radzikowskiego 152, 31-342 Kraków, POLAND

WYDANO NAKŁADEM
INSTYTUTU FIZYKI JĄDROWEJ
IM. HENRYKA NIEWODNICZAŃSKIEGO
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DEPARTMENT OF THEORETICAL PHYSICS

Head of the Department: *Professor Jan Kwieciński*
Deputy Head: *Assoc. Prof. Leonard Leśniak*
Secretary: *Ewa Pagaczewska*

1. PERSONNEL

Research Staff

M.Sc.	Piotr *BOCHNACKI*
Ph.D.	Piotr *BOŻEK*
Ph.D	Wojciech *BRONIOWSKI*
Ph.D.	Marcin *CERKASKI*
Ph.D.	Piotr *CZERSKI*
Prof.	Wieslaw *CZYŻ*[1]
Ph.D.	Wojciech *FLORKOWSKI*
Ph.D.	Krzysztof *GOLEC-BIERNAT*
Ph.D.	Andrzej *HORZELA*
Prof.	Edward *KAPUŚCIK*[2]
Assoc. Prof.	Marek *KUTSCHERA*
Assoc. Prof.	Leonard *LEŚNIAK*
Prof.	Jan *KWIECIŃSKI*
Assoc. Prof.	Andrzej *MALECKI*
Prof.	Marek *PLOSZAJCZAK*
M.Sc.	Stanisław *ZUBIK*
Assoc. Prof.	Piotr *ŻENCZYKOWSKI*

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[1] also at the Institute of Physics, Jagellonian University, Chairman of the Scientific Council of the Institute of Physics, Jagellonian University Chairman of the Scientific Council of Nicolas Copernicus Astronomical Center

[2] also at the Cracow Pedagogical University

2. OVERVIEW:

Research performed at the Department of Theoretical Physics concerns various theoretical problems of general physics, low, intermediate and high energy nuclear physics, elementary particle physics and astrophysics. Both formal problems as well as the more phenomenologically oriented ones are being considered. Department of Theoretical Physics actively collaborates with other Departments of our Institute as well as with several scientific institutions in Poland and abroad.

The research program is formally grouped into the following three main subjects:

1. the role of the Galilean relativity principle in classical and quantum mechanics,
2. dense and/or hot hadronic matter,
3. structure of hadrons studied in particle and nuclear interactions.

These are the titles of the approved proposals by the State Committee of Scientific Research. The details of the results obtained in various fields are listed below in the abstracts. Besides pure research members of our Department are also engaged in the graduate and undergraduate teaching program. During 1992 one PhD thesis has been completed and at present one research student is working for his PhD.

Head of Theory Department

prof. dr hab. Jan Kwieciński

3. GRANTS

1. Prof. dr hab. J. Kwieciński
   Structure of Hadrons Studied in Particle and Nuclear Interactions,
   no: 2 0198 91 01; 1.10.1991 – 30.09.1994.
2. Prof dr hab. E. Kapuścik
   The Meaning of the Galileo Relativity Principle in Quantum Mechanics,
   no: 2 0342 91 01; 1.10.1991 – 30.09.1994.
3. Doc. dr hab. M. Kutschera
   Dense and/or Hot Hadron Matter,
   no: 2 0204 91 01; 1.10.1991 – 30.09:1994.

4. CONFERENCES AND SEMINARS

W. ALBERICO - University of Torino, Italy

1. Path Integral Approach to the Nuclear Response,
   Department of Theoretical Physics, INP Cracow, February 1992.

P. BOŻEK

1. Fluctuations in the Hadronization,
   International Workshop on "Dynamical Fluctuations and Correlations in Nuclear Collisions", Aussois, France, March 1992,
2. Multiscaling Fluctuations in the Multiparticle Production,
   Theory Workshop on "Dynamical Fluctuations in Heavy Ion Collisions", GANIL, Caen, France, October 1992.

W. BRONIOWSKI

1. Electromagnetic Polarizabilities of the Nucleon,
   University of Maryland, Maryland, USA, March 1992,
2. Electromagnetic Polarizabilities of Hadrons,
   Department of Theoretical Physics, INP Cracow, October 1992.

M. CERKASKI

1. Simple Algorithm for Reduction of Characters of Orthogonal and Symplective Groups,
   Department of Theoretical Physics, INP Cracow, February 1992.
2. Collective Nuclear Dynamics in the Symplectic Model,
   M. Sklodowska-Curie University, Lublin, March 1992.
3. Vibrational Hamiltonian Expansion for Symplectic Nuclear Model,
   Department of Theoretical Physics, INP Cracow, November 1992.

P. CZERSKI

1. Hadronization in a Simple Quark Model,
   University of Padova, Padova, Italy, April 1992.

W. CZYŻ

1. Interactions of Quark with Perturbative Magnetic Vacuum,
   Department of Theoretical Physics, INP Cracow, November 1992,

St. DROŻDŻ - Department of the Nuclear Reactions

1. Chaos and the Statistic Properties of the Nucleus,
   Department of Theoretical Physics, INP Cracow, March 1992.

W. FLORKOWSKI

1. Screening Masses of Mesons in the Nambu–Jona-Lasinio Model,
   GSI, Germany, November 1992.

K. GOLEC-BIERNAT

1. Physical Picture of Anyons,
   Department of Theoretical Physics, INP Cracow, May 1992.
2. Hot Spots Effects at HERA,
   Department of Theoretical Physics, INP Cracow, October 1992;
   INP, Orsay, France, November 1992.

A. HORZELA

1. Classical Mechanics of Confined Particles,
   Department of Theoretical Physics, INP Cracow, January 1992.
2. Galilean Covariant Classical Machanics,
   Workshop on Harmonic Oscillators, University of Maryland, Maryland, College Park, USA, March 1992.
3. Classical Particles Confined with Oscillator Force,
   Workshop on Harmonic Oscillators, University of Maryland, Maryland, College Park, USA, March 1992.
4. The Sign of Wave Function and Its Consequences,
   Department of Theoretical Physics, INP Cracow, November 1992.

P. KAMIŃSKI - graduate student

1. Classical and Quantum Evolution in the Time-Dependent SU(2) Spin System,
   Department of Theoretical Physics, INP Cracow, March 1992.

R. KAMIŃSKI

1. Relativistic Description of the $\pi\pi$ Interaction in S-state,
   Department of Theoretical Physics, INP Cracow, March 1992.
2. Scalar Mesons - A Promising Region for Models Testing of Hadrons. Trial of Classification.
   Department of Theoretical Physics, INP Cracow, December 1992.

E. KAPUŚCIK

1. Galilean Covariant Classical Machanics,
   Workshop on Harmonic Oscillators, University of Maryland, Maryland, College Park, USA, March 1992.
2. Classical Particles Confined with Oscillator Force,
   Workshop on Harmonic Oscillators, University of Maryland, Maryland, College Park, USA, March 1992.
3. Quantized Discrete Space Oscillators,
   Workshop on Harmonic Oscillators, University of Maryland, Maryland, College Park, USA, March 1992.

A. KOTLORZ - graduate student

1. Equation of State for Quark Matter,
   Department of Theoretical Physics, INP Cracow, April 1992.

M. KUTSCHERA

1. Apparent Effects in Distribution of Matter - the Morikawa Model,
   Institute of Physics, Jagellonian University, Cracow, January 1992.
2. Morikawa Model of Oscillating Universe,
   Department of Theoretical Physics, INP Cracow, February 1992;
   High Energy Physics Department, INP Cracow, March 1992.

3. Detection of Cosmic Background Radiation Fluctuations ,
   High Energy Physics Department, INP Cracow, May 1992.
4. Solar Neutrinos - More of the Mistery ? ,
   Institute of Physics, Jagellonian University, Cracow, October 1992.
5. Measurement of Solar Neutrino Flux in the Gallex Experiment,
   High Energy Physics Department, INP Cracow, November 1992.
6. Proton Crystallization in the Neutron Star Core,
   Department of Theoretical Physics, INP Cracow, November 1992.

J. KWIECIŃSKI

1. Shadowing in Inelastic Lepton-Deuteron Scattering,
   DESY-Zeuthen Workshop on - Deep Inelastic Scattering, Teupitz, April 1992,
2. Jet Production in HERA as a Probe of Small x Physics,
   High Energy Physics Department, INP Cracow, April 1992,
3. Pomeron in QCD - Its Elementary Theory and Possible Phenomenology at HERA,
   Department of Theoretical Physics, INP Cracow, April 1992,
4. Small x Physics - an Introductory Theoretical Review,
   Warsaw Conference on Elementary Particles Physics, Kazimierz, May 1992,
5. Small x Physics in QCD and Its Possible Phenomenological Exploration at HERA,
   Department of Theoretical Physics, DESY, Hamburg, June 1992;
   Department of Applied Mathematics and Theoretical Physics, University of Cambridge, England, October 1992;
   Department of Physics, Manchester University, England, November 1992;
   Rutherford Appleton Laboratory, Chilton, England, December 1992

L. LEŚNIAK

1. Coherent J/Ψ Production on Atomic Nuclei,
   Department of Theoretical Physics, INP Cracow, April 1992.
2. Three Channel Model of the $f_0(975)$ Meson,
   Int. Conf. on the Structure of Baryons and Related Mesons, BARYONS' 92, Yale University, USA, June 1992.
3. Suppression of the J/Ψ Production in the Proton-Nucleus Collisions,
   Department of Theoretical Physics, INP Cracow, October 1992.

R. PESCHANSKI - CEA-Saclay, France

1. Intermittency and Fragmentation,
   Department of Theoretical Physics, INP Cracow, May 1992.

M. PLOSZAJCZAK

1. XXX International Winter Meeting on Nuclear Physics,
   Bormio, Italy, January 27 - February 1, 1992.
2. Workshop of the FOPI Collaboration,
   GSI, Darmstadt, Germany, April 1992.
3. Gordon Conference on Nuclear Chemistry,
   Colby Sawyer College, New London, New Hampshire, June 15-19, 1992.
4. Societe Francaise de Physique,
   3 Journees de la Matiere Condensee, Lille, France, Septembre 2-4, 1992.
5. Quantum Tunneling in the Driven Spin Systems,
   GANIL, Caen, France, October 1992,

A. RADOSZ - Physics Department, Technical University, Wroclaw

1. Higgs Mechanism and 2-Dimensional Superconductivity,
   Department of Theoretical Physics, INP Cracow, December 1992.

K. RYBICKI - High Energy Physics Department

1. Recent Results of LEP and Standard Model,
   Department of Theoretical Physics, INP Cracow, March 1992.

J. SOFFER - Centre de Phys. Theor., Luminy, France

1. Proton Spin Crisis and Violation of the Gottfried Sum Rule in Deep Inelastic Lepton Scattering,
   Department of Theoretical Physics, INP Cracow, April 1992.

St. ZUBIK

1. Incompressibility of the Nucleus and Nuclear Matter,
   Department of Theoretical Physics, INP Cracow, January 1992.

P. ŻENCZYKOWSKI

1. Weak Radiative Hyperon Decays and Vector-Meson Dominance,
   Department of Theoretical Physics, FERMILAB, USA, May 1992;
   1992 Gordon Research Conference "Particle Physics in the 90's", Andover, New Hampshire, USA, July 1992,
2. Weak Radiative Hyperon Decays,
   High Energy Physics Department, INP, Cracow, October 1992;
   Department of Theoretical Physics, INP Cracow, October 1992,
3. Weak Nonleptonic Hyperon Decays and Hadronic Loops,
   High Energy Physics Department, INP, Cracow, November 1992,
4. Meson Cloud Effects in Baryon Spectroscopy,
   Department of Theoretical Physics, Inst. de Sciences Nucléaire, Grenoble, France, November 1992.
5. Are Penguins Black and White ?,
   Department of Theoretical Physics, INP Cracow, December 1992.

5. PROFESSORSHIPS

1. Doc. dr hab. Marek Ploszajczak was awarded the title of professor of physical sciences in December 1992.

6. Ph.D. THESES

1. Piotr BOŻEK
   " Multiparticle Correlations and Intermittency in the High Energy Collisions"
   May 1992, supervisor - prof. dr hab. M. Płoszajczak
2. Andrzej KOTLORZ
   " Quark Matter in Neutron Stars: Predictions of an Effective Chiral Model"
   September 1992, supervisor - doc. dr hab. M. Kutschera
3. Piotr KAMIŃSKI
   "Quantum Tunneling, Chaos and Wave Packet Time-Evolution in the SU(2) Spin-System"
   April 1992, supervisor - prof. dr hab. M. Płoszajczak

7. LECTURES

LECTURES FOR STUDENTS OF PHYSICS AND MATHEMATICS AND SCIENTIFIC STAFF

Prof. dr hab. W. Czyż

1. Quantum Mechanics,
   lectures for graduate physics students at the Institute of Physics Jagellonian University and Institute of Nuclear Physics.

Prof. dr hab. E. Kapuścik

1. Introduction to Nuclear and Elementary Particle Physics,
   lectures for undergraduate physics students at the Cracow Pedagogical University.
2. The Structure of Space Time,
   lectures for undergraduate physics students at the Cracow Pedagogical University.
3. General Physics
   lectures for students of physics at the University of Georgia, Athens, USA.

Prof. dr hab. J. Kwieciński

1. Introduction to Nuclear and Elementary Particle Physics,
   lectures and excercise classes for undergraduate physics students at the Cracow Pedagogical University.

Doc. dr hab. M. Kutschera

1. Introduction to Theoretical Astrophysics,
   lectures for students of physics at the Jagellonian University.

Prof. dr hab. M. Płoszajczak

1. Individual lectures:
   Round Table on Nuclear Fragmentation (Febr. 1992) GANIL, Caen, France; IPN-Orsay, Paris, France, March 1992; CEN-Saclay, Paris, France, April 1992; IPN-Grenoble, France, October 1992; IPN-CNRS, Univ. Nantes, France, November 1992.

Doc. dr hab. P. Żenczykowski

1. Subatomic Physics,
   lectures for undergraduate students of physics, University of Guelph, Guelph, Canada, Winter 1992.
2. Dr P. Żenczykowski - Introductory Physics,
   lectures for undergraduate students of physics, University of Guelph, Guelph, Canada, Spring 1992.

8. GRADUATE STUDENTS

1. Robert KAMIŃSKI

9. VISITING SCIENTISTS

1. Prof. W. ALBERICO
   – **Department *of* Theoretical Physics, University of Torino, Torino, Italy, February and October 1992**
2. Dr O. BOYARKIN
   – **Department of Theoretical Physics, University of Grodno, Republic of Lithuania, June 1992**
3. Prof. J.-P. MAILLET
   – **Division de Physique Théorique, Institut de Physique Nucléaire, Orsay, France, June/July 1992**
4. Prof. V. MANFREDI
   – **Department of Physics, University of Padova, Padova, Italy, September 1992**
5. Prof. R. PESCHANSKI
   – **Service de Physique Théorique, CEN-Saclay, Gif-sur-Yvette, France, May 1992**
6. Prof. J. SOFFER
   – **Centre de Physique Théorique, U.E.R. de Luminy, Marseille, France, April 1992**

10. ABSTRACTS

Multiscaling Fluctuations in the Hadronization

P. Bożek, M. Płoszajczak [1]

[1] GANIL, Caen, France

We studied the effect of a low-energy cut-off on the fluctuations in the multiparticle distributions generated by a random cascade. We found that the presence of the cut-off enhances the fluctuations beyond some scale, so that the scaled factorial moments grow faster with the resolution than the power-law [1, 2]. The multiscaling analysis of the scaled factorial moments allows to extract the value of the cut-off and a part of the singularity spectrum of the self-similar cascade. This analysis can be applied to the experimental data at different c.m. energies.

References:

1. P. Bożek, M. Płoszajczak: Fluctuations in the Hadronization. Nucl. Phys. **A545** (1992) 297c
2. P. Bożek, M. Płoszajczak: Multiscaling in the Hadronisation in High Energy Collisions. Preprint **GANIL P-92-16**.

Subthreshold Meson Production in Heavy Ions Collisions

P. Bożek, M. Płoszajczak [1]

[1] GANIL, Caen, France

A mechanism based on the instabilities growth in the collision was proposed to explain the subthreshold particle production in heavy ion collisions. The momentum distributions obtained in this way can fit the total pion production cross section and the differential pion cross section in the pion kinetic energy in heavy ion collisions in the energy range from 25 MeV/n to 90 MeV/n. The estimates of the kaon production at 94 MeV/n give a number about 20 times lower than the present experimental results.

Electromagnetic Polarizabilities of the Nucleon

W. Broniowski, T.D. Cohen [1], M.K. Banerjee [1]

[1] University of Maryland, Maryland, USA

Electric polarizability, α, and magnetic polarizability, β, measure dynamical response of the nucleon to external probes [1, 2]. Their theoretical description is a challenging problem of strong-interaction physics, and up to now none of existing approaches is completely successful. Recent measurements [3, 4, 5] are precise enough to provide strong tests for models of baryonic structure. We have analyzed [6, 7, 8] electromagnetic response of the nucleon in the framework of chiral soliton models, which over the past few years proved to be successful in describing low-energy baryonic physics. Semiclassical methods consistent with large-N_c counting were used (linear response theory [6], quantization via cranking [9]). As opposed to other approaches [10, 11, 12], our method allows the soliton to deform, which results in important dispersive contributions to α and β. We find [6, 7] that in hedgehog models (Skyrmion, chiral quark models, Nambu–Jona-Lasinio model), the average electric polarizability of the nucleon, α_N, is of the order N_c, and the splitting of the neutron and proton electric polarizabilities, $\delta\alpha = \alpha_n - \alpha_p$, is of the order $1/N_c$. We developed a general argument why one expects $\delta\alpha > 0$ in models with a pionic cloud [6]. Our specific model calculation for the sign and magnitude of the splitting ($\delta\alpha = 5.3 \times 10^{-4} fm^3$) is in agreement with recent measurements. The value obtained for α_N, however, is nearly a factor of three too large. This is due to two issues, generic to all chiral soliton models: Firstly, the model used has a too strong pion tail — *e.g.* models with vector mesons can bring α_N down by about a factor of two. Secondly, a more fundamental reason is the degeneracy of the N and Δ in the large-N_c limit, which enhances the effects of the Δ [13]. We have also examined influence of non-minimum substitution terms in the chiral lagrangian on polarizabilities, and found substantial effects [8].

References:

1. V. A. Petrun'kin, Sov. J. Part. Nuc. 12, 278 (1981).
2. T. E. O. Ericson and J. Hüfner, Nucl. Phys. B57, 608 (1961).
3. F. Federspiel et al., Phys. Rev. Lett. 67, 1511 (1991).
4. J. Schmiedmayer, P. Riehs, J. Harvey, and N. Hill, Phys. Rev. Lett. 66, 1015 (1991).
5. A. Zieger et al., Phys. Lett. B 278, 34 (1992).

6. W. Broniowski, M. K. Banerjee, and T. D. Cohen, Phys. Lett. **B283**, 22 (1992).

7. W. Broniowski and T. D. Cohen, Response of Nucleons to External Probes in Hedgehog Models: I. Electromagnetic Polarizabilities, Phys. Rev. **D47**, 299 (1993).

8. W. Broniowski and T. D. Cohen, Response of Nucleons to External Probes in Hedgehog Models: II. General Formalism, Phys. Rev. **D47**, 313 (1993).

9. T. D. Cohen and W. Broniowski, Phys. Rev. **D34**, 3472 (1986).

10. E. M. Nyman, Phys. Lett. **142B**, 388 (1984).

11. M. Chemtob, Nucl. Phys. **A473**, 613 (1987).

12. N. N. Scoccola and W. Weise, Phys. Lett. **B232**, 495 (1989); Nucl. Phys. **A517**, 495 (1990).

13. T. D. Cohen and W. Broniowski, Phys. Lett. **B292**, 5 (1992).

Hedgehog Models vs. Chiral Perturbation Theory

W. Broniowski, T.D. Cohen [1]

[1] University of Maryland, Maryland, USA

We have discovered an interesting connection [13] between hedgehog models (Skyrmions, chiral solitons, NJL-model) and chiral perturbation theory. The first approach is based on the $N_c \to \infty$ limit, and the second on the chiral ($m_\pi \to 0$) limit. These limits do not commute, which for certain class of observables results in an enhancement of hedgehog results compared to chiral perturbation theory. We argue, that "Nature" is in between these two limits. Also, our analysis suggests a strong demand for an "improved chiral perturbation theory", with the baryon decuplet fields introduced explicitly, such as the in the approach of Refs. [14, 15].

References:

1. T. D. Cohen and W. Broniowski, Phys. Lett. **B292**, 5 (1992).

2. E. Jenkins and A. Manohar, Phys. Lett. **B255**, 558 (1991); E. Jenkins, Nucl. Phys. **B368**, 190 (1992).

3. E. Jenkins and A. Manohar, Technical Report UCSD/PTH 91-30, 1991.

Nuclear Collective Motion within the O(N–1) Invariant Dynamics

M. Cerkaski, I.N. Mikhailov [1]

[1] Joint Institute for Nuclear Research, Laboratory of Theoretical Physics, Head Post Office, P.O.B.79, Moscow, Russia

Assuming an $O(N-1)$ symmetry for the interaction term in the N-body Hamiltonian we find a closed subsystem of equations describing the collective motion in a classical way. When studying, in the group geometric way, the mutual corespondency of $O(N-1)$ invariant approach with the $Sp(6,R)$ collective model we find that the nucleons move along trajectories determined by an effective one-body time-dependent harmonic potential being a function of the collective variables. The relation between the equations for the collective motion and the system of equations found elsewhere for the second order moments of the Wigner distribution function is discussed. A class of stationary solutions to the collective equations of motion leads to the cranking model with the selfconsistency relations depending on the $O(N-1)$ scalar part of the potential.

The work has been accepted for publication in Annals of Physics

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The Equation of State for Nuclear Matter and Finite Nuclei

P. Czerski, H. Müther [1], W.H. Dickhoff [2]

[1] Institut für Theoretische Physik, Tübingen, Germany

[2] Department of Physics, University of Missouri, St. Louis, USA

In this work we discuss the differences in evaluation of the saturation properties of infinite nuclear matter and finite nuclei. We demonstrate that ground - state properties of finite nuclei are much more affected by the finite range of realistic nucleon - nucleon interactions than the saturation point of nuclear matter. These surface effects yield a larger incompressibility for finite nuclei as compared to nuclear matter. Local nucleon - nucleon interactions are determined, which simulate the mail features of the Brueckner G - matrix and allow for a simple calculation and analysis of the ground - state properties [1].

Reference:

1. P. Czerski, H. Müther, W.H. Dickhoff: The Equation of State for Nuclear Matter and Finite Nuclei. Preprint University of Tübingen, Tübingen, (1992)

Screening of Meson Fields in the Nambu–Jona-Lasinio Model

W. Florkowski [1,2], Bengt L. Friman [1,3]

[1] GSI Darmstadt, Germany

[2] INP Cracow, Poland

[3] Institut f. Kernphysik, TH Darmstadt, Germany

The spatial dependence of the finite temperature meson correlation function is studied in the Nambu–Jona-Lasinio model. The screening masses, obtained from the asymptotic behaviour of the static correlation function, are found to differ substantially from the dynamic masses, defined by a pole of the meson propagator. In particular, at high temperatures, the mesonic screening masses are large although there are no well defined meson modes. In the high -temperature limit, the screening masses approach $2\pi T$, which corresponds to a gas of non-interacting, massless quarks. However, in the scalar and pseudo-scalar channels, interaction effects remain well beyond the chiral transition temperature. The overall temperature dependence of the screening masses is in agreement with lattice results.

Global Fit Method at HERA

K. Golec-Biernat

We constructed an efficient computer program which enables to fit input partons distributions to the deep inelastic e-p scattering data from HERA. The main element of the program is a routine which solves the Altarelli-Parisi equations in the next to leading log approximation, with nonlinear shadowing terms.

The program can analyse the data for small x Bjorken region (down to 10^{-4}). We expect to observe new physical effects in this region like an increase of partons distributions or clustering of partons inside the proton (shadowing corrections of a hot spot type).

We study the possibility of seeing these effects in the data from HERA taking into account various kinematical cuts.

Galilean Covariance in Classical and Quantum Mechanics

P. Bochnacki, A. Horzela, E. Kapuścik [1], J. Kempczyński

[1] INP and Cracow Pedagogical University

We have continued to study the properties of the Galilean covariant formulation of classical mechanics. The analysis of its general features has been performed on the example of exactly solvable models of the oscillator type. The Galilean covariant dynamics of single particle generalizes the standard concepts of classical mechanics and gives examples of non-Newtonian mechanics. It rejects conventional non-covariant force laws and replaces them by self-consistent method of determination of acting forces as solutions of the complete set of differential equations which form is specified by the model. The only parameters of the model are coupling constants and they determine the inertial mass and the elasticity constant [3]. The results given by the generalized approach reduce to the standard ones in one particular reference frame in which the force law is satisfied. Basic concepts of Galilean covariant dynamics applied to many body problems allow to describe in a completely consistent way many particle systems which components do not satisfy the standard relations between kinematical and dynamical quantities. In particular within such an approach it is possible to describe confinement as a classical effect of purely kinematical origin [1, 2]. The idea of the Galilean mass [4], being the parameter in the Galilean transformation rules of momentum and kinetic energy, admits its generalization to special relativity theory. Its consequence is introduction of four-vector which time component has definite sign which property may be used to determine the direction of the time flow [5].

References:

1. A. Horzela, E. Kapuścik: Classical Mechanics of Confined Particles. Hadr. J. 15 (1992) 61
2. A. Horzela, E. Kapuścik: Classical Particles Confined with Oscillator Force. Proc. of the Conf. on "Harmonic Oscillators", College Park, MD, USA, 1992
3. A. Horzela, E. Kapuścik: Harmonic Oscillator in the Galilean Covariant Classical Mechanics. Proc. of the Conf. on "Harmonic Oscillators", College Park, MD, USA, 1992
4. A. Horzela, E. Kapuścik, J. Kempczyński: The Galilean Mass of Bodies. Phys. Essays 5 (1992) 314
5. A. Horzela, E. Kapuścik, J. Kempczyński: Relativistic Invariant and the Galilean Mass of Bodies. Proc. of the Conf. on "Gravitational Energy and Gravitational Waves IV", Dubna P2-92-12 (1992)

The Structure of Space-Time.

A. Horzela, E. Kapuścik [1], J. Kempczyński, Ch. A. Uzes [2]

[1] INP and Cracow Pedagogical University

[2] University of Georgia, Athens, 30602 Georgia, USA

The fundamental concept of the research is the hypothesis that the Einstein radiolocation method and its generalization known as the Bondi "k-method" are the only methods allowing to measure space and time coordinates in a way acceptable by special relativity theory. We consider old problems and paradoxes of special relativity concerning the nature of time. Analysing the standard assumptions concerning the velocity of light and rejecting some of them we show that it is possible to construct a version of special relativity in which light moves with uniformly accelerated motion [1]. Nonuniformity of the velocity of light admits also the existence of time machine even within purely classical approach [2]. In [3] and [4] we are giving the new look on the problem of discrete structure of space-time. Analysing the radiolocation method we come to the conclusion that results of any measurement of space-time coordinates should be expressed in terms of rational numbers. It means that physical space-time coordinates take values belonging to discrete set dense in standard space-time continuum. This property is Lorentz invariant and may be used in the construction of discrete models of space-time different from the models of lattice type constructed in process of discretization of continuous models.

References:

1. A. Horzela, E. Kapuścik, J. Kempczyński: Does Light Move Uniformly ? Phys. Essays 5 (1992) 537
2. A. Horzela, E. Kapuścik, J. Kempczyński: Classical Time Machine. Proc. of the Conf. on "Gravitational Energy and Gravitational Waves IV", Dubna P2-92-12 (1992)
3. A. Horzela, E. Kapuścik, J. Kempczyński, Ch. Uzes: On Discrete Models of Space-Time. Prog. Theor. Physics 88 (1992) 4013
4. E. Kapuścik, C.A. Uzes: Quantized Discrete Space Oscillators. Proc. of the Conf. on "Harmonic Oscillators", College Park, MD, USA, 1992

Unknown Properties of Classical Electrodynamics.

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We show that any analysis based on the properties of low velocity limit of classical electrodynamics must take into account proper transformation rules of electrodynamical quantities in the Galilean limit. "Electric" and "magnetic" form of nonrelativistic transformation rules of electrodynamical fields and the transformation rule for the Lorentz force restricts the possibilities of constructing nonrelativistic electrodynamics and does not admit the existence of "magnetic" Lorentz force suggesting magnetic monopoles [1]. Analysing the fundamental concepts of gauge theories we come to the conclusion that in the framework of nonlinear theory it is not absolutely necessary to introduce massless gauge fields in order to save the gauge invariance of Schrödinger equation. In nonlinear theory of the Heisenberg type nonlinear expression constructed from the matter fields plays the role of the gauge field and the gauge field constructed in such a scheme may have mass [2].

References:

1. A. Horzela, E. Kapuścik, Ch. Uzes: Comment on paper: "Magnetic Monopoles, Galilean Invariance and Maxwell's Equations", by F. S. Crawford (Am. J. Phys.60 (1992) 109). Preprint INP 1586/PH (1992)
2. A. Horzela, E. Kapuścik, Ch. Uzes: Comment on paper: "Introductory Gauge Invariance", by R. Barlow (Eur. J. Phys. 11 (1990) 45). Preprint INP 1585/PH (1992)

Relativistic Effects in the $\pi\pi$ and $K\bar{K}$ Interactions

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A separable potential formalism is formulated and used to describe the $\pi\pi$ and $K\bar{K}$ interactions in the $I^G(J^{PC}) = 0^+(0^{++})$ states. An energy range from the $\pi\pi$ threshold up to 1.4 GeV is considered. Two-channel S - matrix is obtained using the Lippmann-Schwinger equation with relativistic propagators in both channels. Eight parameters of the potentials are fixed by comparison with experimental data with a help of the χ^2 test. A very good description of the data is found ($\chi^2 = 0.93$ per one degree of freedom). Three resonances have been found in this energy region: $f_0(500)$ ($M=506^{+9}_{-10}$ MeV, $\Gamma=494^{+4}_{-5}$ MeV), $f_0(975)$ ($M=973\pm2$ MeV, $\Gamma=29\pm2$ MeV) and $f_0(1400)$ ($M=1430\pm5$ MeV, $\Gamma=145^{+27}_{-22}$ MeV). The $f_0(975)$ can be interpreted as a $K\bar{K}$ bound state. The masses and widths of the $f_0(975)$ and $f_0(1400)$ are in good agreement with the Particle Data Group Tables. The $f_0(500)$ state may be associated with often postulated very broad scalar resonance under the $K\bar{K}$ threshold (sometimes called σ or ϵ meson). The scattering lengths in the $\pi\pi$ and $K\bar{K}$ channels have also been obtained and are in agreement with experimental estimations.

Relativistic approach seems to describe adequately the $\pi\pi$ and $K\bar{K}$ interactions. It provides qualitatively new results (for example the appearance of the $f_0(500)$) in comparison with previously used nonrelativistic approach [1] where the χ^2 fits to data have not been done. Interactions in both channels are found to be attractive and have short range form factors.

Reference:

[1] F. Cannata, J.-P. Dedonder, L. Leśniak, Z. Phys. **A334** (1989) 457.

Model of an Accretion-Induced Magnetic Field Decay

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We propose polarised protons in the core of a neutron star as the source of the magnetic field. The effective proton magnetic moment is density-dependent and changes sign at some density n_r and so does the magnetisation. Neutron stars with central density close to n_r have dipole magnetic fields of the order of $10^{12}G$. For heavier stars the field decreases fast with the mass, goes through zero, and then increases, albeit in opposite direction. The abrupt change of the magnetic field occurs on a mass scale of 0.1 solar mass. This model account well for recent evidence that decay of magnetic field occurs only for neutron stars which accreted matter in their evolution [1].

Reference:

1. M. Kutschera, W. Wójcik: Accretion-Induced Magnetic Field Decay and Polarised Protons in the Neutron Star Core. Acta Phys. Pol. **B23** (1992) 947

Behaviour of Protons in the Neutron Star Core

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We study interactions of a proton impurity with density oscillations of the neutron matter in a Debye approximation. The proton-phonon coupling is of the deformation-potential type at long wavelengths. It is weak at low density and increases with the neutron matter density. We calculate the proton's effective mass perturbatively for a weak coupling, and use a canonical transformation technique for stronger couplings. The proton's effective mass grows significantly with density, and at higher densities the proton impurity can be localised. This behaviour is similar to that of the polaron in solids. We obtain properties of the localised proton in the strong coupling regime from variational calculations, treating the neutron matter in the Thomas-Fermi approximation [1].

In [2] we construct a solid-like variational wave function for protons localised in dense neutron star matter. The localised protons are centered on the lattice sites and the neutron background is described by periodic Bloch wave functions. The self-consistent periodic structure arises due to a collective mean field. For low proton fraction the periodic potential is weak and the neutron Fermi surface is well approximated by a sphere. With the Skyrme forces we find that the proton solid is of lower energy than a uniform matter for densities above $n_t \approx 4n_0$, where $n_0 = 0.17 fm^{-3}$ is the nuclear saturation density. We discuss implications of the proton crystallization for properties of dense matter in neutron stars.

References:

1. M. Kutschera, W. Wójcik: Proton Impurity in the Neutron Matter: A Nuclear Polaron Problem. Preprint **INP 1603/PH** (1992)
2. M. Kutschera, W. Wójcik: Self-Consistent Proton Crystallization in Dense Neutron Star Matter . Preprint **INP 1606/PH** (1992)

Maximum Quark Core in a Neutron Star for Realistic Equations of State

M. Kutschera, A. Kotlorz

For recently developed realistic equations of state we establish conditions the quark matter equation of state should satisfy in order to produce as big as possible quark core inside neutron stars. We impose constraints that the phase transition to quark matter occurs above nuclear saturation density and the maximum neutron star mass exceeds $1.55 M_\odot$. The quark phase is described phenomenologically by a two-parameter bag model equation of state. The maximum quark core is found in case of a continuous phase transition to quark matter. Its size is determined by the transition density which is as yet unknown. The maximum neutron star mass, however, depends only weakly on the transition density. It is much more sensitive to the second parameter of the bag model equation of state and the above mass constraint severely limits its value. We compare the most favorable parameters of the quark equation of state with predictions of various quark matter models and find them to fall into allowed range [1].

Reference:

1. M. Kutschera, A. Kotlorz: Maximum Quark Core in a Neutron Star for Realistic Equations of State. Preprint **INP 1611/PH** (1992)

Small x Physics in Deep Inelastic Lepton-Hadron Scattering

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In [1] the physics of deep-inelastic lepton-hadron processes in the region of small x, where x is the Bjorken scaling variable is reviewed. The theoretical concepts concerning the Regge limit of deep-inelastic scattering are summarized and recent theoretical results on the small x limit of parton distributions in perturbative QCD are discussed. Presently available experimental data on the free and bound nucleon structure functions at small x are reviewed in detail and their theoretical interpretations (including the low x, low Q^2 region) are discussed. QCD predictions are given for the deep-inelastic scattering structure functions F_2 and F_L in the small x ($10^{-5} < x < 10^{-2}$) and moderately large Q^2 region relevant for HERA ($Q^2 \sim 10GeV^2$).

Reference:

1. B. Badelek, K. Charchula, M. Krawczyk, J. Kwieciński: Small x Physics in Deep Inelastic Lepton-Hadron Scattering. Rev. Mod. Phys. 64 (1992) 927

Shadowing in Inelastic Lepton-Deuteron Scattering

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Shadowing in inelastic lepton-deuteron scattering is analysed using the double interaction formalism where we relate shadowing to inclusive diffractive processes [1]. Both the vector meson and parton contributions are considered for low and high Q^2 values including QCD corrections with parton recombination for high Q^2. These Q^2 values were chosen to correspond to existing experimental data and to possible HERA measurements. Detailed discussion of various shadowing mechanisms is given.

The shadowing effects are found to be very small, less then 2% or so, in agreement with the recent precise measurements performed by the New Muon Collaboration. The contribution of shadowing term to the Gottfried sum from the region $x > 0.004$ and for $Q^2 = 4GeV^2$ is estimated to be equal to - 0.025 [2].

References:

1. B. Badełek, J. Kwieciński: Shadowing in Inelastic Lepton-Deuteron Scattering. Nucl. Phys. B370 (1992) 278
2. B. Badełek, J. Kwieciński: Shadowing in Inelastic Lepton-Deuteron Scattering. Nucl. Phys. B (Proc. Suppl.) 29A (1992) 30

Electroproduction Structure Function F_2 in the Low Q^2, Low x Region

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The nucleon structure function F_2 in the low Q^2, low x region is *constructed*. The analysis has been motivated hy the results of the electroproduction experiments for which measurements at low values of x have been performed at the expense of lowering Q^2 down to 1 GeV^2 or less. Contributions from both the parton model with QCD corrections suitably extended to the low Q^2 region and from the low mass vector mesons were taken into account. The former contribution results from the large Q^2 structure function analysis which includes the recent F_2 measurements by the New Muon Collaboration. Predictions of the model are compared with the results of the electroproduction measurements [1].

Reference:

1. B. Badełek, J. Kwieciński: Electroproduction Structure Function F_2 in the Low Q^2, Low x Region. Phys. Lett. B295 (1992) 263

Deep Inelastic Events Containing a Measured Jet as a Probe of QCD Behaviour at Small x

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We examine the proposal that deep inelastic (x, Q^2) scattering events which contain an identified jet, with transverse momentum $k^2 \simeq Q^2$, allow an ideal determination of the QCD behaviour at small x. We solve the Lipatov equation to predict the shape of the jet spectrum in such events and show that measurements at HERA should be able to verify, interalia, whether the gluon indeed has the theoretically anticipated $xg \sim x^{-\lambda}$ small x behaviour with the intercept $\alpha_P = 1 + \lambda$ of the bare QCD Pomeron possibly as large as 1.5 [1]. We calculate the cross sections at HERA for relevant choices of the deep inelastic and jet kinematic variables and we indicate the signature of the $x^{-\lambda}$ behaviour [2, 3].

References:

1. J. Kwieciński, A.D. Martin, P.J. Sutton: Deep-Inelastic Events Containing a Measured Jet as a Probe of QCD Behaviour at Small x. Phys Rev. D46 (1992) 921
2. J. Kwieciński, A.D. Martin, P.J. Sutton: Probing the Lipatov Singular Small x Behaviour at HERA. Phys. Lett. B287 (1992) 254
3. A. D. Martin, J. Kwieciński, P.J. Sutton: Identifying the Lipatov $x^{-\lambda}$ Behaviour at HERA. Nucl. Phys. B (Proc. Suppl.) 29A (1992) 67

QCD Predictions for Deep Inelastic Structure Functions at HERA

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Perturbative QCD is used to predict the deep inelastic electron-proton structure functions $F_{T,L}(x, Q^2)$ in the small x region ($x \sim 10^{-3}$) from an experimental knowledge of the behaviour at larger x. Shadowing corrections are quantified [1].

Reference:

1. A.J. Askew, J. Kwieciński, A.D. Martin, P.J. Sutton: QCD Predictions for Deep Inelastic Structure Functions at HERA. Preprint Univ. of Durham, **DTP 92/78** (1992)

Pomeron in Perturbative QCD - - Its Elementary Theory and Possible Phenomenology at HERA

J. Kwieciński

Theoretical ideas concerning the Pomeron in perturbative QCD are reviewed. The Lipatov equation with asymptotic freedom effects taken into account is recalled and the corresponding spectrum of eigenvalues controlling the bare Pomeron intercept analysed. Possible phenomenological implications of the perturbative QCD Pomeron for deep inelastic scattering at HERA ep collider are briefly discussed [1].

Reference:

1. J. Kwieciński: Pomeron in Perturbative QCD - Its Elementary Theory and Possible Phenomenology at HERA. Acta Phys. Pol. **B23** (1992) 607

J/Ψ Absorption Effects in the Coherent Production on Nuclei

L. Leśniak

J/Ψ coherent production and attenuation on nuclei by high energy muons and photons is studied. A simple one parameter model leads to a good description of the New Muon Collaboration and Fermilab data. It is found that the effective absorption cross section of the $c\bar{c}$ pair on a target nucleon is about 6 mb [1].

Reference:

1. L. Leśniak: J/Ψ Absorption Effects in the Coherent Production on Nuclei. Preprint INP 1608/PH (1992)

Initial-State Effects on J/Ψ Suppression in Proton-Nucleus Collisions

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The suppression of J/Ψ production in pA collisions is investigated with emphasis on the nuclear effects on the initial states before gluon fusion. We focus in particular on the effect of the modification of the gluon distribution in the projectile proton due to multiple collisions in the target nucleus. It is found that the gluon depletion effect in the broken projectile can significantly influence the observed suppression factor [1].

Reference:

1. R.C. Hwa, L. Leśniak: Initial State Effects on J/ψ Suppression in Proton-Nucleus Collisions. Phys. Lett. 295B (1992) 11

$\pi\pi$ and $K\bar{K}$ Channel Coupling

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We investigate the origin of the attraction in the $K\bar{K}$ channel around the threshold by introducing an additional channel to the $\pi\pi$ and $K\bar{K}$ channels in a separable potential formalism assuming, in general, no direct interaction in the $K\bar{K}$ channel. To reproduce the features of the data, we find that the threshold of the additional channel is much above the $f_0(975)$ meson position. We show that this three-channel problem can be reduced to an effective two-channel problem where the $f_0(975)$ behaves as if it were a $K\bar{K}$ molecule bound by the coupling to the exotic channel. This picture is also supported by the fact that a single pole only, in the complex $K\bar{K}$ momentum plane, is associated to the $f_0(975)$ meson [1]. A further study of the $f_0(975)$ structure is possible in the production process of the $K\bar{K}$ pairs on nuclei in the energy region of a few eV. A suppression of the $f_0(975)$ production on nuclei should be observed as well as the enhanced yield of the K^+ mesons with respect to the K^- mesons in the relative s-wave. It would be very useful to make measurements on hydrogen and deuterium targets in order to get simultaneously an information about the production processes on single nucleons. The model calculations of the $\pi\pi$ and $K\bar{K}$ cross-sections around 1 GeV and the $K\bar{K}$ scattering lengths together with evaluations of the $f_0(975)$ extension done in [2] can be relevant in planning future experiments on $f_0(975)$ production on Saturne (Saclay), COSY (Julich), CEBAF (Newport News) and other accelerators [3].

References:

1. F. Cannata, J.-P. Dedonder, L. Leśniak: $\pi\pi$ and $K\bar{K}$ Channel Coupling, II. The $f_0(975)$ Meson and $K\bar{K}$ Threshold Effects. Z. Phys. A343 (1992) 451
2. F. Cannata, J.-P. Dedonder, L. Leśniak, Zeit. Phys. A 334 (1989) 457
3. F. Cannata, J.-P. Dedonder, L. Leśniak: Three Channel Model of the $f_0(975)$ Meson . Contributed papers, BARYONS' 92, p.41. Int. Conf. on the Structure of Baryons and Related Mesons, June 1-4, 1992; Yale Univ., USA

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The Effect of the Compression on the Transition Potential in the Nuclear Surface

St. Zubik

Up to now Pb^{208} is the only nucleus where an experimental evidence for a monopole mode of vibration of nuclei can be subjected to systematic study.

In ref.[1] one can find experimental cross sections of inelastic alpha-particles scattering and results of the DWBA analysis for four values of bombarding energy $E_\alpha = 96$, 127, 172 and 218 MeV in the forward direction at scattering angle from 3^0 to 15^0. Since in this energy range of incident α-particles one can expect estimate that the PWBA calculation would give a good at least for the first maximum in angular distribution at scattering angle around 5^0. So we can check our approach to the liquid drop model of the nucleus, when one takes into account compressibility and viscosity of nuclear matter.

The calculation scheme which we explore is exactly as it is presented in the brilliant paper by J.P. Blaizot [2] with exception, that our velocity field is the solution of Navier-Stokes equation. So the transition density and consequently the transition potential separates into two components a volume δV_{vol} and surface δV_{surf} according to general prescription

$$\delta V(r) = f_0(r)\delta\rho(r),$$

where $f_0(r)$ depends only on the local density.

Now, because δV_{vol} depends on the equilibrium density in the nuclear interior, which is constant and slightly bigger then saturation density, whereas there is the delta function $\delta(r - R_0)$ in the surface potential, one can expect to detect an effect for impact parameter to be larger with increasing incident energy of the scattered particle at the some scattering angle. This is expected due to very strong density dependence of the Landau F_0 parameter in the surface region, as is seen on a plot of F_0 calculated in Hartree-Fock approximation for zero range density dependent phenomenological interaction (Fig.2 in ref.[2]).

Taking $f_0(r) = 35$ MeV for the δV_{vol}, which is precisely the depth of the square well potential infered from (p,p) and (p,n) experiments, which in turn emerges as a value of $f_0(r)$ calculated for the density near saturation density, where $F_0 = 0.25$.

Then in our calculation the strength of the surface potential is the only parameter to be fitted to get experimental value of the cross section, when the position of the resonance energy is fitted by compressibility K of nuclear matter and was found to be 166 MeV.

As the result, PWBA calculations confirm almost perfectly our expectation. We have found that $f_0(R) = -50, -80, -100$ and -105 MeV respectively for $E_\alpha = 96$, 127, 172 and 218 MeV.

Now we can calculate $f_0(R)$ from the plot of F_0 (ref.[2]) and see that these values correspond to the surface values of the density, which is believed to be around of 2/3 saturation density. Since absolute value of $f_0(R)$ increases, when an incident energy increases, one can say, that with increasing of incident energy the surface of the nucleus moves toward the lower density i.e. impact parameter increases.

References:

[1] S. Shlomo et al., Phys. Rev. C36 (1987) 1317
[2] J.P. Blaizot, Phys. Reports 64 (1980) 171-248

Weak Nonleptonic Hyperon Decays and Hadronic Loops

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The influence of hadronic-loop effects on the SU(3) structure of the soft- pion contribution to the S-wave weak nonleptonic hyperon decays is studied in the framework of the Unitarized Quark Model. The effects considered originate from the interference of strong and weak amplitudes of the P-wave hyperon decays. It is found that the quark sea generated in this way renormalizes the f/d ratio from its quark model value of -1 to around -1.6. This is in remarkably good agreement with the phenomenological estimates performed by Pham, who obtained $(f/d)_{softpion,experiment} = -1.5$. A brief discussion of the uncertainties of the approach is also given.

20-200 MeV Neutrinos in SNO and the MSW Adiabatic Region

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It is pointed out that a long-baseline neutrino oscillation experiment involving Fermilab and Sudbury Neutrino Observatory could reach the region of neutrino mass differences singled out by the adiabatic solution of the solar neutrino problem. The importance of such an independent laboratory-based information on the region of mass differences accessible so far only through solar experiments is stressed.

11. PUBLICATIONS

11.1 Articles

1. B. Badełek, K. Charchuła, M. Krawczyk, J. Kwieciński:
   Small x Physics in Deep Inelastic Lepton-Hadron Scattering.
   Rev. Mod. Phys. **64** (1992) 927

2. B. Badełek, J. Kwieciński:
   Electroproduction Structure Function F_2 in the Low Q^2, Low x Region.
   Phys. Lett. **B295** (1992) 263

3. B. Badełek, J. Kwieciński:
   Shadowing in Inelastic Lepton-Deuteron Scattering.
   Nucl. Phys. **B370** (1992) 278

4. P. Bożek, M. Płoszajczak:
   Fluctuations in the Hadronization.
   Nucl. Phys. **A545** (1992) 297c

5. P. Bożek, M. Płoszajczak, A. Tucholski:
   Finite-Size Effects in the Intermittency Analysis of the Fragment- Size Correlations.
   Nucl. Phys. **A539** (1992) 693

6. W. Broniowski, M.K. Banerjee, T.D. Cohen:
   Splitting of the Neutron and Proton Electric Polarizabilities in a Hedgehog Model .
   Phys. Lett. **B283** (1992) 22

7. F. Cannata, J.-P. Dedonder, L. Leśniak:
   $\pi\pi$ and $K\bar{K}$ Channel Coupling, II. The $f_0(975)$ Meson and $K\bar{K}$ Threshold Effects.
   Z. Phys. **A343** (1992) 451

8. T.D. Cohen, W. Broniowski:
   The Role of the Δ Isobar in Chiral Perturbation Theory and Hedgehog Soliton Models.
   Phys. Lett. **B292** (1992) 5

9. W. Czyż, A. Dyrek:
   Production of Hard Photons in Electron-Positron Annihilation into Hadrons.
   Z. Phys. **C54** (1992) 311

10. W.Florkowski, B.L. Friman, G. Baym, P.V. Ruuskanen:
    Convective Stability of Hot Matter in Ultrarelativistic Heavy-Ion Collisions.
    Nucl. Phys. **540** (1992) 659

11. A. Horzela, E. Kapuścik:
Classical Mechanics of Confined Particles.
Hadr. J. **15** (1992) 61

12. A. Horzela, E. Kapuścik, J. Kempczyński:
Does Light Move Uniformly ?
Phys. Essays **5** (1992) 537

13. A. Horzela, E. Kapuścik, J. Kempczyński:
The Galilean Mass of Bodies.
Phys. Essays **5** (1992) 314

14. A. Horzela, E. Kapuścik, J. Kempczyński, Ch. Uzes:
On Discrete Models of Space-Time.
Prog. Theor. Physics **88** (1992) 4013

15. R.C. Hwa, L. Leśniak:
Initial State Effects on J/ψ Suppression in Proton-Nucleus Collisions.
Phys. Lett. **295B** (1992) 11

16. J. Kwieciński:
Pomeron in Perturbative QCD - Its Elementary Theory and Possible Phenomenology at HERA.
Acta Phys. Pol. **B23** (1992) 607

17. J. Kwieciński, A.D. Martin, P.J. Sutton:
Deep-Inelastic Events Containing a Measured Jet as a Probe of QCD Behaviour at Small x.
Phys Rev. **D46** (1992) 921

18. J. Kwieciński, A.D. Martin, P.J. Sutton:
Probing the Lipatov Singular Small x Behaviour at HERA.
Phys. Lett. **B287** (1992) 254

19. M. Kutschera, W. Wójcik:
Accretion-Induced Magnetic Field Decay and Polarized Protons in the Neutron Star Core.
Acta Phys. Pol. **B23** (1992) 947

20. P.V. Pobylitsa, E. Ruiz Arriola, Th. Meissner, F. Gruemmer, K. Goeke, W. Broniowski:
Pushing the Nambu–Jona-Lasinio Soliton and the Zero-Point Energy.
J. Phys. **G18** (1992) 1455

21. P. Żenczykowski:
SU(3)-Symmetry Structure of Weak Nonleptonic Hyperon Decays and Hadronic Loops.
Phys. Rev. **D45** (1992) 3153

11.2 Proceedings of Conferences

1. B. Badelek, J. Kwieciński:
Shadowing in Inelastic Lepton-Deuteron Scattering.
Nucl. Phys. B (Proc. Suppl.) **29A** (1992) 30

2. R. Botet, M. Płoszajczak:
Intermittency Patterns of Fluctuations in Disaggregating Systems.
Proc. XII Sitges Conference on Complex Fluids, June 1 - 5, 1992,
ed. L. Garrido, Springer Verlag (1992).

3. W. Broniowski, T.D. Cohen:
Chiral Model Predictions for Electromagnetic Polarizabilities of the Nucleon. A "Consumer Report".
Proc. of the Workshop on Hadron Structure from Photo-Reactions at Intermediate Energies. BNL, May 28-29, 1992; ed. A.M. Nathan and A.M. Sandorf, p.23

4. W. Broniowski, T.D. Cohen:
Twisting and Streching the Hedgehogs. *Large-N_c* Analysis of Electromagnetic Polarizabilities of the Nucleon.
Contr. papers BARYONS' 92, p.46. Int. Conf. on the Structure of Baryons and Related Mesons, June 1-4, 1992; Yale Univ., USA

5. F. Cannata, J.-P. Dedonder, L. Leśniak:
Three Channel Model of the $f_0(975)$ Meson .
Contributed papers, BARYONS' 92, p.41. Int. Conf. on the Structure of Baryons and Related Mesons, June 1-4, 1992; Yale Univ., USA

6. A. Horzela, E. Kapuścik:
Classical Particles Confined with Oscillator Force.
Proc. of the Conf. on "Harmonic Oscillators", College Park, MD, USA, 1992

7. A. Horzela, E. Kapuścik:
Harmonic Oscillator in the Galilean Covariant Classical Mechanics.
Proc. of the Conf. on "Harmonic Oscillators", College Park, MD, USA, 1992

8. A. Horzela, E. Kapuścik, J. Kempczyński:
Relativistic Invariant and the Galilean Mass of Bodies.
Proc. of the Conf. on "Gravitational Energy and Gravitational Waves IV",
Dubna **P2-92-12** (1992)

9. A. Horzela, E. Kapuścik, J. Kempczyński:
   Classical Time Machine.
   Proc. of the Conf. on "Gravitational Energy and Gravitational Waves IV", Dubna **P2-92-12** (1992)

10. P. Kamiński, M. Płoszajczak, R. Arvieu:
    Quantum Tunneling in the Driven SU(2) Model.
    Proc. XXX International Winter Meeting on Nuclear Physics, Bormio, Italy, January 27 - February 1, 1992, ed. I. Iori, (1992) 471.

11. E. Kapuścik, C.A. Uzes:
    Quantized Discrete Space Oscillators.
    Proc. of the Conf. on "Harmonic Oscillators", College Park, MD, USA, 1992

12. A. D. Martin, J. Kwieciński, P.J. Sutton:
    Identifying the Lipatov $x^{-\lambda}$ Behaviour at HERA.
    Nucl. Phys. B (Proc. Suppl.) **29A** (1992) 67

13. M. Płoszajczak, P. Bożek, A. Tucholski:
    Fluctuations in the Multifragmentation.
    Proc. XXX International Winter Meeting on Nuclear Physics, Bormio, Italy, January 27 - February 1, 1992, ed. I. Iori, (1992) 60.

11.3 Preprints

1. A.J. Askew, J. Kwieciński, A.D. Martin, P.J. Sutton:
   QCD Predictions for Deep Inelastic Structure Functions at HERA.
   Preprint Univ. of Durham, **DTP 92/78** (1992)

2. R. Botet, M. Płoszajczak:
   The Fragmentation - Inactivation Binary Model.
   Preprint **GANIL P-92-22**

3. P. Bożek:
   Multiparticle Correlations and Intermittency in High Energy Collisions.
   Preprint **GANIL P-92-12** (1992)

4. P. Bożek:
   Radiative Energy Loss in the Quark-Gluon Plasma.
   Preprint **GANIL P-92-21** (1992)
5. P. Bożek, M. Płoszajczak:
   Multiscaling in the Hadronization in High Energy Collisions.
   Preprint **GANIL P-92-16**.
6. W. Broniowski, T.D. Cohen:
   Response of Nucleons to External Probes in Hedgehog Models. I. Electromagnetic Polarizabilities.
   Univ. of Maryland *preprint* **PP-92-193** (1992); Technical Report DOE/ER/40322-155
7. W. Broniowski, T.D. Cohen:
   Response of Nucleons to External Probes in Hedgehog Models. II. General Formalism.
   Univ. of Maryland preprint **PP-92-225** (1992); Technical Report DOE/ER/40322-163
8. T.D. Cohen, W. Broniowski:
   Hedgehog Models Versus Chiral Perturbation Theory The Role of the Delta Isobar.
   Univ. of Maryland preprint **PP-92-191** (1992); Technical Report DOE/ER/40322-154
9. M. Cerkaski, I.N. Mikhailov:
   Microscopic Group Theoretical Formulation of Nuclear Collective Dynamics.
   Preprint **INP 1585/PH** (1992)
10. P. Czerski, H. Müther, W.H. Dickhoff:
    The Equation of State for Nuclear Matter and Finite Nuclei.
    Preprint University of Tübingen, Tübingen, (1992)
11. A. Horzela, E. Kapuścik, Ch. Uzes:
    Comment on paper: "Magnetic Monopoles, Galilean Invariance and Maxwell's Equations", by F. S. Crawford (Am. J. Phys.**60** (1992) 109).
    Preprint **INP 1586/PH** (1992)
12. A. Horzela, E. Kapuścik, Ch. Uzes:
    Comment on paper: "Introductory Gauge Invariance", by R. Barlow (Eur. J. Phys. **11** (1990) 45).
    Preprint **INP 1585/PH** (1992)
13. P. Kamiński, S. Drożdż, M. Ploszajczak, E. Caurier:
    The Even-Odd Anomalous Tunneling Effect.
    Preprint **GANIL P-92-19** (1992)

14. M. Kutschera, A. Kotlorz:
Maximum Quark Core in a Neutron Star for Realistic Equations of State.
Preprint **INP 1611/PH** (1992)

15. M. Kutschera, W. Wójcik:
Self-Consistent Proton Crystallization in Dense Neutron Star Matter .
Preprint **INP 1606/PH** (1992)

16. M. Kutschera, W. Wójcik:
Proton Impurity in the Neutron Matter: A Nuclear Polaron Problem.
Preprint **INP 1603/PH** (1992)

17. L. Leśniak:
J/Ψ Absorption Effects in the Coherent Production on Nuclei.
Preprint **INP 1608/PH** (1992)

18. P. Żenczykowski, J. Law:
20-200 MeV Neutrinos in SNO and the MSW Adiabatic Region.
Report Sudbury Neutrino Observatory, **SNO-STR-92-075** (1992)