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The First Physics Congress of Bosnia and Herzegovina

Book of Abstracts

December 20-22, Teslić,
Republic of Srpska, B&H

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December 20-22, Teslić,
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The First Physics Congress of Bosnia and Herzegovina

Scientific Program

Section 1. CONDENSED MATTER PHYSICS (a. Theory, b. Experiment)

Section 2. ATOMIC, MOLECULAR AND OPTICAL PHYSICS

Section 3. PARTICLES AND NUCLEAR PHYSICS

Section 4. MATHEMARICAL PHYSICS AND FIELD THEORY

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The First Physics Congress of Bosnia and Herzegovina

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Invited Lectures

Attophysics

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Abstract. Lasers, as sources of strong electromagnetic field, have enabled the investigation of nonlinear light-matter interaction. Twenty years ago ultrafast lasers have reached a fundamental limit – the duration of the laser pulses in visible and near infrared range was limited to few optical cycles and was measured in femtoseconds (10^{-15} s). The route to generate and measure even shorter attosecond (10^{-18} s) pulses is based on extreme nonlinear optics and on the technology of laser carrier-envelope phase stabilization. Recently, researchers have finally broken the femtosecond barrier and new area of science – attoscience – has emerged. I will discuss these revolutionary attosecond tools and their application to myriad problems in physics. In particular, I will consider the laser carrier-envelope phase stabilization using the stereo-above-threshold ionization experiment. I will also show how is possible to image molecular structures (orbitals) and dynamics using the highly nonlinear interaction between light and molecules.

Quantum diffraction of fast atoms on a crystal surface under grazing angles

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Abstract. Scattering of fast neutral atoms with keV kinetic energies at alkali-halide surfaces under grazing angles (~1deg) displays intriguing diffraction patterns. Although the de Broglie wavelength associated with the motion of the atomic beam is in the sub-picometer scale and much smaller than the lattice constant of crystal, at grazing angles of incidence the diffraction patterns are well visible since the vertical component of momentum becomes small enough to provide the corresponding de Broglie wavelength to be comparable with the lattice constant. On the other hand the persistence of quantum coherence is remarkably strong, even though high surface temperatures and high energies of the incident atoms would lead to the dominance of dissipative processes and decoherence. Results obtained by the simulation of the quantum diffraction of helium beam at a LiF (100) surface in the <110> direction and a comparison with recent experimental data are shown. The simulation is based on the numerical wave packet propagation method, combined with the quantum trajectory Monte Carlo (QTMC) method in order to include decoherence effects, and the atom-surface interaction potential is calculated using a variant of the multi-configuration self consistent field method. This technique holds the promise to open up new approaches for surface diagnostics and analysis.

Nucleon decay in Grand Unification Theories

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Abstract. Nucleon decay due to the gauge boson exchange has been treated as an almost completely model independent signature of grand unified theories for the last three decades. I critically review the relevant d=6 operators for nucleon decay in the most general setting and present accurate parametrization of their model dependency. Even though they are not as model independent as is usually assumed it is still possible to find absolute theoretical bounds on the nucleon lifetime that hold in all grand unified theories (with or without supersymmetry). I present these bounds and discuss their implications in conjunction with the present experimental limits on the grand unified model building. I further apply these results on two possible matter unification scenarios based on SU(5) gauge symmetry-the ordinary and flipped SU(5)-and investigate the way to distinguish between them. I show that if and when nucleon decay is finally observed we might be able to test the underlying gauge structure of the theory if the Yukawa sector is simple enough. However, if one departs from this simple structure one can not only suppress but even rotate nucleon decay away. This I demonstrate in the case of flipped SU(5) theory.

Nonlocal field theories

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Abstract. A physical field is a function of spatial coordinates and time. It plays important role in many parts of theoretical and mathematical physics. Well known examples of fields are: electromagnetic field, gravitational field, scalar field, Dirac field, … There is classical and quantum field theory. Quantum field is a fundamental tool to describe properties of elementary particles. Usually field theory models are local, i.e. Lagrangian contains derivatives only of the first order. However, in order to overcome some usual difficulties, nonlocal field models have been also considered. Modern nonlocal field theories contain an infinite number of derivatives. They appear in conventional and p-adic string theory, noncommutative quantum models and nonlocal cosmology. After a brief overview, we shall present effective nonlocal scalar field theory, which origin is in p-adic string theory.

Effects and investigation of superconductivity

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Abstract. Energy and sources of energy are necessary for the survival of human society in general. Unfortunately, there are problems with energy sources: the natural ones (wood, coal, oil, etc.) are exhaustible or insufficient (water, wind, the Sun, etc.), while the artificial ones (nuclear energy) have brought about unresolved difficulties with nuclear waste. In these circumstances, two fundamental tasks are set before physicists-researchers. They are expected to find a process of controlled nuclear fusion and devise ambiance-temperature superconductors. Superconductivity is a very interesting natural phenomenon. Its properties, which are called macroscopic quantum effects, were discovered almost a century ago. Although still relatively a low-temperature phenomenon, their application reaches all the areas of everyday human life. This paper provides a brief description of this – one of the most important and most interesting natural phenomena, which has been so far constantly detected and yet never fully discovered, and presents the results of our research related to solving the riddle of superconductivity mechanism.

Astrophysical Spectroscopy of Extragalactic Objects: From Active Galactic Nuclei to Gravitational Lenses

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Abstract. Activity in galaxies helps us to understand violent processes in the Universe. Spectroscopy is a powerful tool of gas diagnostics of these processes, from which the emission from high-energy X-ray to the radio is coming. Understanding the nature of galaxies with ionized gas in their central parts, that is not associated with O and B stars (Seyfert galaxies, radio galaxies, quasars, QSOs, blazars; collectively called Active Galactic Nuclei - AGN) is a particularly attractive subject in astrophysics today. First, by investigation of the processes in the central part of these objects we can learn about the innermost part of other 'normal' galaxies. Second, AGN are located at different cosmological time-scales, consequently their investigations are cosmologically important. And finally, in heart of AGN massive black holes exist, so, investigation of the radiation from this region (especially in the X-ray) give us opportunity to investigate relativistic effect and plasma condition in a strong gravitational field. Also, the spectra of QSOs can be affected by gravitational microlensing and it can be used for the investigation of this phenomena. Here we will give an overview of investigations in this fields.

Contributed Papers

Section 1.

Condensed Matter Physics

Collision of Hydrogen Molecules Interacting with Two Graphene Sheets

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Abstract. We have performed the computational experiments with two hydrogen molecules and two graphene sheets. H_2-H_2 and H_2-C interactions are described by Lennard-Jones potential. We numerically solve equations of motion of the wave packet centre. The initial molecule velocity is determined by temperature and collisions occur in central point between two sheets. The molecules after collision stay near or get far away graphene. Then one can find what temperatures, grapheme sheet sizes and their distances are favourable for hydrogen storage. It is found that quantum corrections of the molecule classical trajectories are not significant here. Those investigations of possibility of hydrogen storage by physisorption are of interest for improvement of the fuel cell systems. The main disadvantages of our computational experiments are: (1) we can not compute with very large number of C atoms, (2) we assume that C atoms are placed always in their equilibrium positions and (3) the changes of wave packet width are not considered.

Optical phenomena in molecular crystalline nanostructures

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Abstract. In this paper, we have theoretically explored quantum excitation quasi-particles in molecular crystalline nanostructures, i.e. excitons. They are responsible for absorption of the external electromagnetic field in non-conductive materials, both in crystal bulk and (ultra)small samples (ultrathin films and superlattices, quantum wires or nanorods, and quantum dots). We have calculated dispersion laws for these structures and shown how are the energy states of the excitons related with low dimensions of the nano structures. Calculation of the optical properties, i.e. dielectric permittivity show distinctive quantum effects (resonant effects and selective absorption) compared with optical properties of the bulk structures.

Hamiltonian walks on modified 3d Sierpinski gasket fractals

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Abstract. In this paper we consider Hamiltonian walks on the first four members of modified Sierpinski gasket family of fractals settled in 3d space. We establish the scaling law for the number of walks as a function of lattice sites number. Also, we find the values of the exponent σ that characterizes the correction to the leading exponential factor in the scaling law. Obtained results are discussed and compared with the expected behavior of the number of Hamiltonian walks on regular lattices.

Mathematical modelling for photothermal measurements on inhomogeneous solids with thermal memory

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Abstract. A theoretical study for photothermal measurements on inhomogeneous solids, namely the optical gradient solids and thermal gradient solids with thermal memory is presented. We first present a general opto-thermal mathematical model for gradient solids with thermal memory. Then, we discuss the effects of thermal memory, inhomogeneous optical properties and thermal properties in Green's function, transient temperature field and photothermal spectra.

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Stability of the moving Holstein large polaron in one--dimensional molecular crystals

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Abstract. We examine the impact of the polaron motion on its stability. Analysis was carried on within the one-dimensional Holstein's Molecular Crystal Model. The dispersion of phonon modes has been taken into account explicitly. It was found that the large polaron dynamics is described by the nonlocal nonlinear Schrödinger equation. The character of its solutions is determined by the degree of nonlocality which is specified by the polaron velocity and group velocity of lattice modes. Analytic solution for polaron wave function is obtained in the weakly nonlinear limit. It was found that polaron velocity and phonon dispersion have significant impact on the parameters and dynamics of large polarons. Polaron amplitude and effective mass increase while its spatial extent decreases with the rise of the nonlocality degree. The criterion for the stability of large polaron is formulated in terms of the values of the nonlocality degree, magnitude of the basic energy parameters of system and polaron velocity. It turns out that large polaron velocity can not exceed the relatively small limiting value. Similar limitation on large polaron velocity was not found in previous studies. Consequences of these results on the polaron dynamics in realistic conditions are discussed.

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Influence of specific parameters on the conductivity of polyaniline

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Abstract. Polyaniline belongs to the group of conjugated polymers. All conjugated polymers are insulators in their non-doped state, and only some of them have the ability to be doped into a conductive state. One of such materials is polyaniline. In this paper we have shown the influence of specific parameters such as activation energies, jump temperatures and pH values on the conductivity of polyaniline.

Stability of amorphous Ni-Zr

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Abstract. Physical properties of metallic glasses differ considerably from those of their crystalline counterparts. The electrical resistivities of amorphous alloys are very high in comparison to their values in crystalline states. Crystallization of metallic glasses cause an abrupt falling in resistivity values and this process is irreversible. The measurements of electrical resistivity is the simplest and perhaps the best method to detect the onset of the crystallization. Master alloys were prepared in an argon arc furnace and amorphous ribbons of NixZr100-x were formed by melt spinning method. The stability of amorphous Ni-Zr alloys were investigated by monitoring of electrical resistance. We have investigated temperature dependance of electrical resistance for amorphous alloys between two eutectical compositions and we have also identified the crystallization temperature for different heating rates.

Synthesis of thick, smooth ultrananocrystalline diamond films by microwave plasma-assisted chemical vapor deposition

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Abstract. The deposition of thick, smooth films of ultrananocrystalline diamond (UNCD) is investigated. UNCD films are synthesized by microwave plasma-assisted CVD using Ar/H2/CH4 input gas mixtures over a pressure range 180-250 Torr, wide temperature range (500-800 ˚C) and microwave power (~ 1 KW). N type Silicon is used as a substrate on deposition time of 5 hours. Silicon wafer is pre-treated with diamond spray and cleaned with acetone. Raman spectra of deposited films will be shown in order to prove existence of diamond films. Optical emission spectra of the plasma are also recorded during deposition showing that C_2 radical is important for the deposition of UNCD film.

Section 2.

Atomic, Molecular and Optical Physics

Electron Transport Properties in N_2O and N_2O-N_2 Mixtures Obtained by Swarm Analysis

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Abstract. We present a swarm analysis of electron scattering cross sections in N_2O. It is the iterative process of adjusting the cross sections in order to achieve the agreement of calculated and measured transport coefficients with satisfactory accuracy. Experimental drift velocities and effective ionization coefficients for pure N_2O and for N_2O-N_2 mixtures (20, 40, 60 and 80% N_20 in N_2O-N_2) are obtained by using a Pulsed-Townsend technique over a broad range of the density-normalized electric field strength (E/N). Transport coefficients are calculated by using two computer codes. The first one, ELENDIF solves the Boltzmann equation in two term approximation, and the second one is based on Monte Carlo (MC) technique. Our analysis shows that commonly used sets of cross sections for N_2O have to be modified in order to fit experimental data while the cross section set for N_2 that we have used is well established and well tested.

Kinetic energy distribution of positive ions from electron induced dissociative ionization of pyrimidine molecule

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Abstract. We report on measurements of kinetic energy distributions of positive ions, formed upon electron induced ionization of gaseous pyrimidine ($C_4H_4N_2$) molecule, which is akin to cytosine and thymine in DNA as well as uracil in RNA. The kinetic energy spectra were obtained for different incident electron energies from 30 eV to 250 eV and under different detection angles (30^o-110^o) defined with respect to the incident electron beam. The results show a considerable fraction of energetic positive ions, the distribution of which depends on the electron energy and the angle of detection.[c]

[c] This work has been supported by MSTD RS under project 141011 and bilateral project Serbia - Slovenia 2008-2009 ("Electron induced fragmentation of organic molecules and small hydrocarbons").

Electron scattering by magnesium: excitation of the 3s 3p ^{3}P state

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Abstract. Differential cross section (DCS) for electron impact excitation of the 3s3p ^{3}P state in magnesium at incident electron energy of 10 eV has been measured. The energy-loss spectra within energy range (ΔE) from 0 to 5 eV have been recorded up to 150^o. The absolute DCS was determined by using inelastic (3s3p ^{3}P)-to-inelastic (3s3p $^1P_1$ resonance state) intensity ratios and DCSs for the resonance state (*Filipović et al 2006 J. Phys. B: At. Mol. Opt. Phys.* **39** 2583). The result is analysed and compared with previous experimental data and theoretical calculations.[d]

[d] This work has been partly supported by MSTD of the Republic of Serbia under project No 141011 and by MST of the Republic of Srpska under project 06/0-020/961-33/06

Atomic and molecular processes in a strong laser field

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Abstract. Atomic and molecular processes in intense laser fields have received much attention in the last years. When an atom or molecule is exposed to an intense laser field, a series of nonperturbative phenomena may occur. In particular, two of those phenomena, high-order above-threshold ionization (HATI) and high-order harmonic generation (HHG), are of great interest for a deeper understanding of the laser-matter interaction. Both of them can be described using the so-called three-step model. In the first step, the target (atom, ion, or molecule) is ionized. In the second step, the electron is driven back by the laser field and revisits its parent ion. For the HHG process, in the third step, the electron recombines with the parent ion and one high-energy photon is emitted. The third step of the HATI process is different: the laser driven electron backscatters off the parent ion and can be accelerated to high energies. The energy spectra of all above-mentioned processes are characterized by a plateau which finishes by an abrupt cutoff. We present the spectra of the mentioned processes calculated using various theoretical approaches. In order to verify our theory, we simulate recent experiments performed in Germany, Netherlands and Japan.

Section 3.

Particles and Nuclear Physics

Tetraquark $cq\bar{q}\bar{q}$ Mass Spactrum from Meson and Baryon Fit with Fermi-Breit Hyperfine Interaction

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Abstract. Using the Fermi-Breit (color-spin) interaction Hamiltonian we perform a study of the masses and mass spectra of the scalar charmed tetraquarks in the following representations: $\overline{15}_S$, $\overline{3}_S$ and $\overline{6}_A$, $\overline{3}_A$. Using four fits: light and heavy meson fits and light and heavy baryon fits, we obtained masses and mass spectra for 27 different tetraquarks composed of a charm quark *c* and of the three light flavors *u*, *d*, *s*: 11 cryptoexotic (3 D_s^+, 4 D^+, 4 D_s^0) and 16 explicit exotic states. We presented and analysed these four different tetraquark mass spectra.

Jets in pp and PbPb collisions at LHC energies simulated within PYTHIA, HIJING and HYDJET++ models

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Abstract. Results of two particle azimuthal correlations analysis for high p*t* charged pions from pp and PbPb collisions at $\sqrt{s}$=14 TeV and $\sqrt{s_{NN}}$=5.5 TeV, respectively generated using PYTHIA, HIJING and HYDJET++ Monte Carlo codes are presented. Depending on physics involved in different models a rich structure in the near side and the away side peak is obtained. Jet properties strongly depend on position in the overlapping region where hard scatterings happened. Propagating through the dense medium causes the changes of jet features. They are seen in dependence of the system size, centrality dependence as well as in the dependence of the transverse momentum of particles associated to the leading particle of the jet. Generally, a narrow jet-like pattern at the near side is nearly unaffected by the medium, while a strong modification at the away side implies energy transfer of the hard scattered parton to the medium formed in the collision.

Activity concentration of radionuclides in soil in Republic of Srpska (Bosnia and Herzegovina)

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Abstract. Soils are naturally radioactive, primarily because of their mineral content. The main natural radionuclide are potassium 40 (K-40) and radioactive nuclides of the uranium 238 (U-238) and thorium 232 (Th-232) decay series. The natural radioactivity may vary from one type soil to another. The sources of radioactivity in soils other than those of natural origin are mainly due to the following: fallout from past atmospheric explosions of nuclear devices and following nuclear accidents; mining and mineral extraction industries, industries working with mineral materials enriched in naturally radioactive elements and various economic sector in which naturally or artificially radioactive element are used; extensive use of fertilizers rich in phosphates for agricultural propose. The main objective of the measurement of soil radioactivity is to asses the impact of release or remobilization of radioactive materials on the environment and on the population through its direct and indirect exposures (inhalation and ingestion pathways). Soils samples collected at different locations of Republic of Srpska were analysed for U-238, Ra-226, Cs-137, Th-232 and K-40 using high resolution gamma spectrometry. Caesium 137 (Cs-137) is originated from Chernobyl catastrophe. A location of sampling units for routine surveillance/monitoring was fixed by legal requirements of Republic of Srpska.

A study of the coincidence summing of gamma-rays of Co-60

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Abstract. A study of the coincidence summing of gamma-rays of Co-60 has been presented. In gamma-ray spectrometry with germanium detector, the summing effects have to be taken into account at low source detector distance. The peaks due to coincidence summing of X+X, X + gamma, gamma + gamma rays can complicate the spectrum obtained by this type of detector and significantly change the counting rates of single peaks. There is theoretical model developed for coincidence summing of X- and gamma-rays for radionuclides with complex decay schemes. The detailed computation of the Co-60 spectra was performed by application of the previously published theory applied to Ba-133 (*Novković et al 2007 Nuclear Instruments and Methods in Physics Research* A **582** 592).
This model enables to write equations for single peaks, the coincidence sum peaks and the total count rate. The efficiencies of detection and the activity are the unknowns in the count rate equation system. They can be determined by simultaneously finding the roots of the equation system. The theory was applied to the Co-60 decay scheme.

T-matrix pole extraction using coupled channel method

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Abstract. T-matrix poles are determined by using Carnagie-Melon-Berkeley (CMB) coupled channel method in a model developed by a group from Ruđer Bošković Institute. The amplitudes from many contemporary partial wave analysis of $\pi N \rightarrow \pi N$ and $\pi N \rightarrow \eta N$ scattering data are used as an input. The obtained results for S11 T-matrix poles for each partial wave input are discussed. Predictions for the first two poles are stable. In a addition, there is a clear indication for the existance of the third pole near 1,7 GeV which is still not fuly accepted in the literature. Our results are also compared with corresponding results from the other methods of pole extraction.

Partial wave relations as a test of consistency of results of partial wave analysis with the Mandelstam analyticity

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Abstract. For almost three decades there was no partial wave analysis of the pion-nucleon scattering data which incorporates analytic properties of the invariant amplitudes as a strong constraint in all kinematical regions where experimental data exist. Partial waves at low energies are required to perform a reliable analytic continuation of invariant scattering amplitudes into unphysical parts of the Mandelstam plane below the s-channel threshold. Furthermore, these partial waves are a part of the input from the elastic pion-nucleon channel in the multichannel partial wave analysis of the pion-nucleon scattering data. Using results from several contemporary partial wave analyses, it is shown how partial wave relations, derived from the dispersion relations along hyperbolas in the Mandelstam s-u plane, may be used as a sensitive test of consistency of partial waves with the Mandelstam analyticity.

Radon exhalation levels and gamma radiation dose rate at Slana Banja in Tuzla City

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Abstract. In this paper are presented the results for measurements of radon activity concentration and gamma radiation dose rate at Slana Banja, which is located in Town center. This locality is the famous tourist attraction in Bosnia and Herzegovina. Investigations of radon gas activity in environment are very popular. It is known that exposure to high concentration of radon gas cause irradiation of respiration's organs, which can lead to lungs cancer. Radon is classified as carcinogenic substance of Class I. On the other hand, exposure to specific radon concentration can be used in health therapy. Radon therapy is one of the oldest therapies that people used and still do. Increased radon flow from ground which is registered at the particular places of this attractive locality, being in the immediate vicinity of University Clinical Center Tuzla, opens potential possibilities for establishing a Health Center for inhalation therapy. It would be the first Center of this kind in B&H. In this work are used the most modern exploring methods and measuring systems for radon activity detection and observing of gamma radiation field. The results of these measurements will be used to fill data base of radon activity concentration map for Bosnia and Herzegovina.

Section 4.

Mathematical Physics and Field Theory

ACD method with approximation of *1/x* by the Chebyshev polynomials of the third kind

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Abstract. The Analytic Continuation by Duality (ACD) method is used to estimate dispersive integrals in low-energy QCD phenomenology and in technicolor models. The method uses a polynomial approximation of the $1/x$ function, usually a best-L_p approximation. There are several sources of error in the ACD estimates which, along with the oscillatory behavior of the best-L_p approximations, render them unreliable. In an attempt to improve the ACD estimates, we use the weighted least-squares approximations. A weight function that emphasizes the better-known large-momentum expansion of the vacuum polarization near the high-energy (ultra-violet) end of the integral is expected to improve the estimates. The most convenient of such weights corresponds to Chebyshev polynomials of the third kind. We have checked this approximation on a simple model spectrum – two infinitely sharp resonances – since for this model the fitting (polynomial approximation) is the only source of error. The approximation does not improve the estimates with respect to the unweighted approximation, although they are better than for the symmetric weights that correspond to Chebyshev polynomials of the first and second kinds. Therefore, another method of approximation is needed to minimize the fitting error in the ACD method, although this may require some information about the spectral function.

Section 5.

Astronomy and Astrophysics

Variability of the X-ray Emission from Accretion Disks around Supermassive Black Holes

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Abstract. Here we discuss the variability of the X-ray emission from accretion disks around supermassive black holes (BHs) in the centres of Active Galactic Nuclei (AGN). According to the unification model of AGN, they derive their extraordinary luminosities from energy release by matter accreting towards, and falling into, a central supermassive black hole with mass ranging from 107 to 109 solar masses. The central BH of AGN is surrounded by an accretion disk which is a powerful source of the X-ray radiation. A common property of all AGN is that their X-ray radiation has rapid and irregular variability. This variability could be due to accretion disk instability, reflecting in perturbations of the disk emissivity, or it could be caused by some external effects, such as gravitational microlensing and absorption by X-ray absorbers. Here we present the most important results of our recent investigations in this field.

The flux ratio of the [O III] λλ5007, 4959 Å lines in AGN

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Abstract. Here we present the measurements of the flux ratio of the [OIII] λλ4959, 5007 Å emission lines for the sample of 10 AGNs, obtained from SDSS Database and from the published observations. We selected the sample using the criteria of high signal to noise ratio and the same line shapes of λ4959 and λ5007 lines. We separated our sample in two subsamples: first one with red asymmetry of [OIII] λλ4959, 5007 Å lines, where we obtained the average flux ratio of 2.981 ± 0.268 and second one with no asymmetry of [OIII] λλ4959, 5007 Å lines, where we obtained the average flux ratio of 2.885 ± 0.173. For the total sample of ten spectra we found that the flux ratio is 2.943 ± 0.149 so the theoretical value of 2.98 befalls within the error band of our result.

The Fe II emission and evolution of Active Galactic Nuclei

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Abstract. Optical Fe II (λλ44005400 Å) lines are one of the most interesting features of Active Galactic Nuclei (AGN) spectra. Their extreme emission can not be explained by standard photoionization models and geometrical place of the Fe II emission region in AGN structure is still open question. Also, there are many correlations between the Fe II lines and other AGN spectra properties ([O III] lines, X, IC and radio continuum, etc.) which need physical explanation. There are some indications that those correlations could be explained inside of evolutionary model of AGN. In order to investigate the role of optical Fe II lines in AGN evolution, we analyzed 111 AGN spectra, obtained from SDSS Database. We fitted Fe II lines with calculated template and other considered lines with sum of Gaussian funcitons. After comparing the kinematics (widths and shifts) of Fe II lines with other optical lines, we found that the Fe II lines probably originate in an Intermediate Line Region (ILR). Also, we analyzed correlation between the EW Fe II and EW [O III] lines for the samples with different redshifts, and we found that EW Fe II – [O III] relation depends of the object age, i.e. it is changing during the AGN evolution. The physical explanation of those obtained results will be part of our future work.

Section 6.

Applied Physics

On the fire resistance of building elements protected by intumescent paints

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Abstract. In the fire protection, the intumescent paints are used on the surface of the elements of building construction as to give them a certain fire resistance. When exposed to the fire they expand and form a char on the surface of the element, protecting it from the fire a certain period of time. It is necessary in the Fire Engineering to know more closely the fire resistance of the building elements protected by the intumescent paints. In this paper we have taken a simpler model to calculate the fire resistance of the building elements protected by the intumescent paints through the temperature fields in the elements, which consist of the char and the element. A standard fire curve was applied to such a structure. In this way we get the heating of the structure and through it the time when it reach a defined temperature. The period of expansion of the paint and forming of the char is relatively short and is not taken into account. It can be determined through the preliminary tests and was taken approximately as 5 minutes. The properties of the char as density, thermal conductivity and specific heat are taken from the literature and the calculations are made with the two-dimensional numeric program TASEF for three different paints. The results are summarized in the heating curves of the structures from which the fire resistance can be determined.

Mechanism of thermogenesis in diathermia

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Abstract. This paper deals with the idea of applying high-frequency currents in therapeutical purposes. Scientist Nikola Tesla based this idea on the fact that these currents are not harmful for the organisms of living beings, because while passing through the organisms they cannot cause electrolytic decomposition due to fast change of the direction of the current flow, and as such can only apply upon the surface of the organs, causing the skin-effect and certain positive physiological impact. Nowadays, in almost entire world, the Tesla's idea of the application of high-frequency currents for therapeutical purposes is called diathermia (Greek: dia-through, thermos-heat), which comprises generation of the heat in internal organs of the human body by means of the current.

The influence of the choice of the background function on the peak area in gamma spectroscopy with semiconductor detector

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Abstract. In this paper spectra from standard sources Ra-226 and U-238 are measured, and on the basis of those data the efficiency calibration, for particular source geometry, is done. Afterwards the activity of Th-232 source is estimated, as verification of the efficiency calibration. Spectra from point sources Cs-137 and Co-60 are analyzed too. On these data the energy calibration of the gamma spectroscopy system is done. The influence of the choice of the background function on the peak area, in point sources Cs-137 and Co-60 spectrum, is examined. It is shown that the choice of these functions does not notably change the area of well-defined peaks with not so high counting rates, which was case in the examined spectra.

Overview of radiation protection in Federation of B&H and use of thermoluminescent dosimeters

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Abstract. Health protection of people exposed to ionising radiation in Federation of B&H is regulated by the Law for radiation protection (Official Gazette of Bosnia and Herzegovina, 88/07). One of the types of exposure to ionising radiation is professional exposure. Radiation Protection Centre has a database on institutions that are using sources of ionising radiation, people who work in controlled areas and doses they receive. There are 153 institutions recorded to use sources of ionising radiation. Out of 1222 professionally exposed persons 699 of them (57.2%) was surveyed for health problems. Health survey covers general medical examination, as well as urine and blood tests. The safest method of monitoring of persons professionally exposed to ionising radiation (in medicine, industry, science) is personal dosimetry. Personal dosimetry is tightly related to exposure of people working with sources of ionising radiation in medicine, industry, science etc. Themoluminescent dosimeters (TLD) are suitable for acquiring important information on dose distribution during radiotherapy or diagnostic use of radiation. Dosimeters used in personal dosimetry are Lithium-fluoride (LiF) that is tissue equivalent and for its use there is no need for filtration systems. Dosimetry control covers 1126 persons. Out of that number 97% persons have dose lower than 0.99 mSv per year. Communication between Radiation Protection Centre and radiation protection officers follows degree of irradiation of persons or groups. In the case of overexposure there is a possibility to act according to Regulations about dose limits (Official Gazette of Federation of B&H, 8/04).

Patient doses in interventional cardiology

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Abstract. The goal of this study was to make initial dose estimation for patients undergoing invasive cardiac procedures. Patient doses in cardiac catheterization labs are known to be very high. It is one of the rare radiological procedures where deterministic doses can be achieved. Clinical Centre of Sarajevo University has one cardiac fluoroscopy/DCM x-ray unit – Siemens Coroskop. It works in two different operational modes: fluoroscopy (25 fps) and digital cine mode (25 and 12.5 fps). Modes have different beam quality, 10.7 and 3.70 mmAl, respectively. Prior to measurements quality control test were performed and no significant discrepancies were found. Doses for 16 patients were measured using KAP-meter RTI Doseguard 100. Patients examined in this cardiac lab go through diagnostic and/or therapeutic procedures. Depending on complexity and type of procedures they may receive lower or higher doses ranging from 6.45 Gycm² to 81.7 Gycm². Mean value of KAP was 36.6 Gycm² with standard deviation of 22.7 Gycm². Other quantity measured is peak skin dose (PSD). Gafchromic film was placed underneath of patient. It recorded the dose received by the patient's skin. Doses to skin were ranging from 0.041 Gy up to 2.3 Gy. Three patients received more than 1 Gy, the mean value was 0.62 Gy per patient. KAP-meter doses were within values reported in the literature. No deterministic effects were reported, but the doses to patients' skin are still high. This means that doses to skin during invasive cardiology are high, even when KAP doses are relatively small. Education in the field of radiation protection of cardiologists and other staff working in the cardiac lab is essential.

Concept of transparent thermal insulators

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Abstract. Transparent thermal insulators are capturing emitted sun lights towards them, transform it into heat and conserve that heat. Those can provide passive heating of living spaces. Applying transparent thermal insulators would considerably decrease needs for fossil fuels, global pollution of atmosphere, global warming and quantity of waste materials in nature.

Mathematical modeling of unsteady turbulence occurrence in double-diffusive flows

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Abstract. Calculation of transport processes relies on mathematical engineering methods which have been developed by using averaged transport equations closed with models of turbulence. This paper presents the application of mathematical modeling and numerical computation of the dynamics of the temperature and concentration fields in simulated salt-gradient solar ponds. The pond is treated as a double-diffusive system, initially stably stratified by downward salinity gradient and with stable stratified temperature distribution which has been disturbed by heating from the bottom. Double-diffusion/convection processes are often found in thermal applications and energy conversion systems, particularly for energy storage (salt solar ponds), as well as in other engineering areas, in environment, astrophysics and geology. Prediction of behavior of such systems in transient regimes is important for the optimization of designs and operating conditions. Time-dependent Reynolds-averaged Navier-Stockes (T-RANS) technique used for simulating such kind of turbulent flows provoked by disturbing the stable stratification of one scalar field. Since the mass transport was modeled as a passive scalar without direct interaction with heat transport equation, it couldn't have provided satisfactory accuracy for calculated results. The scope of this work was to implement comprehensive equations for mass transfer into the T-RANS tool making it capable of solving double-diffusive problems. The mass transport equations were adapted to the model and the results tested on different test cases. This paper shows the technique we used and results provided from the calculation.

Extended basic equations of fluid mechanics and verifications in ideal gas flows through microcapillaries

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Abstract. This article provides a revision of the classical equations of fluid mechanics as applied to ideal gas flows and shows the extensions needed in cases of strong density and temperature gradients such as microconduits gas flow. Derivations embrace conventional expressions of the mentioned equations stressing the physical inconsistencies of the classical treatments of molecular transport processes, as well as the more general treatments of the mass, heat and momentum transport terms, which lead to the extended forms of basic fluid equations that are derived in the paper. Verifications of the theoretical considerations are provided both analytically and experimentally. Pressure-driven microconduit gas flow under isothermal conditions is studied. In fact, the solution for the gas flow through long microconduits can be obtained using the extended Navier-Stokes equations without introducing any ad-hoc boundary conditions and modelling parameters. The experimental setup has been built up to measure the mass flow rates and pressure drop across the conduits with aim to investigate validity of derived extended form of equations. Introductory studies have shown good results which made further, more detailed approach to this topic more than justified.

Explanation for the rainbow phenomen: from Ibn-Al-Haytham to Newton

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Abstract. In history of physics, there are different opinions on who explained the dispersion of light, regarding the formation of a rainbow. European textbooks on history of physics state that the first explanation on the formation of a rainbow was given by the European scientist in the 16th and 17th century. Some authors state that the formation of rainbow was first explained by Persian mathematician and physicist al-Farisi (1260-1320). It is interesting that explanations of European scientists century are almost identical to the al-Farisi's from the 14th century. This paper presents: a) contemporary interpretation of the formation of a rainbow; b) explanations given by certain European scientist in 13th, 16th and 17th century (Robert Grossetestes, Theodoric of Freiberg, Antoine de Dominis, Rene Descartes, Isaac Newton); c) explanations given by certain scientist in the Middle East, in 11the, 12the, 13the and 14th century (Ibn al-Haytham, Ibn Sina, Qutb al-din al- Shirasi, al-Farisi). We will leave it to the readers to decide on their own who on was the very first to explain the dispersion of light.

Measurement of indoor radon concentration by using CR-39 nuclear track detectors in the environ of Bihać valley

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Abstract. The results of indoor radon concentration survey in the area of the municipality of Bihać are presented. The measurement of the indoor radon activity is done by the nuclear track detectors method. For the first time this method is used in Bosnia and Herzegovina. Indoor radon concentration measurement method by nuclear track detectors is one of the most popular methods used for integral indoor radon concentration measurement. In the period from november 2006 to february 2007 around 100 locations were chosen for measurements by means of CR-39 track detectors (poly-allyl-diglycol-carbonate) which are used indoor radon concentrations measurement. The results showed the average indoor radon activity concentration value of 82.1 Bq/m^3. This result leads to the annual dose estimate of 1.65 mSv/y. There are localities in the municipality of Bihać with high concentration of indoor radon activity (above 150 Bq/m^3) due to the fact that whole Bihać valley is situated on sediment rocks, which are of porous structure, and the most of the houses are built by the construction material manufactured from sediment rocks.

Patient dose in mammography to the women aged 34 – 42 years

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Abstract. Although data have been published on the radiation dose involved in screening women in the EU in the age range 40 – 49 and 50 – 64 years, data have not been published for the screening of younger women, when one might expect higher doses and different risk benefit balance. Therefore, data on radiation doses arising from screening younger women (age range 34 – 42 years) as part of the Bosnian age trial have been collected and reviewed. The dose for 52 women were received. The dose estimates were corrected to take account of variations in composition with age and breast thickness and in spectra used. The average received doses was 1,568 mGy per oblique film and 1,394 mGy per craniocaudale film.

Image quality of pixellated X-ray detector

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Abstract. Materials with atomic number Z, as high as possible, are considered for solid state X-ray imaging detectors in order to absorb the radiation efficiently. However, the energy and yield of the fluorescence photons of the given material increase with atomic number and represent limiting factor for the image quality. We evaluate the spatial resolution and image contrast of the pixellated detectors, made from intermediate-Z materials, in the case of pixel size adapted to mammography. Finally, we discuss the minimum object size, which can be detected by these detectors in the photon energy range of medical applications.

Some physical properties of mineral montmorillonite with review of methods which we used in investigation

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Abstract. Crystallographic properties of mineral montmorillonite as well as its physico-chemical properties stimulate the great number of scientists: physicists, chemists, geologists, mineralogists and so on. Using different thermodynamic methods characteristic values have been described i.e. parameters of the mentioned minerals. According to determined some physico-chemical values have been analyzed the dynamic properties of the montmorillonite with different spectroscopic methods: infrared, Raman, neutron and with dielectric impedance spectroscopies. Using well known properties of each method we studied their particular ionic species in interpretation of the mentioned mineral. Mineral montmorillonite is well known as principal component of the natural material bentonite and after transformations caused by thermal treatment.