

Meetings in Physics 2009 – Abstracts
(in alphabetical order of the names of the presenting authors)

1.

Title: High energy near IR pulses from a two stage broadband OPA based on collinear interaction in Bismuth Triborate

Authors: Masood Ghotbi², Marcus Beutler², Valentin Petrov², Alexander Gaydardzhiev¹, Frank Noack²

Abstract: Efficient generation of tunable femtosecond pulses in the near-IR is demonstrated in a two stage, white light seeded, collinear, femtosecond parametric amplifier (OPA). The OPA, based on BiB₃O₆ crystals in both stages and pumped at 807nm by a 1kHz Ti:Sapphire laser amplifier, provides sub 30fs signal pulses after compression with energies exceeding 200 μJ, which corresponds to 5-fold pulse shortening and ~30% internal conversion efficiency in the 2nd stage. The corresponding idler pulses with more than 100 μJ have sub 60 fs duration without compression. The first stage alone is capable of producing sub 20fs pulses near 1400nm at a microjoule level without using any compression.

Keywords: optical parametric generators and amplifiers; broadband gain; bismuth triborate; femtosecond pulses

PACS: 42.65.Yj Optical parametric oscillators and amplifiers, 42.70.Mp Nonlinear optical crystals, 42.65.Re Ultrafast processes; optical pulse generation and pulse compression

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2.

Title: Impact of global warming on precipitation from midlatitude mixed-phase convective clouds – numerical simulations

Authors: A.Todorova¹, R. Mitzeva¹, B. Tsenova²

Abstract: The present work aims at evaluating the influence of global warming on convective clouds and resulting precipitation.

Simulated precipitation and in-cloud characteristics for different temperature profiles (in the range of expected increase) are compared. Two clouds were modelled - a moderate thunderstorm with cloud top reaching the tropopause and a small cumulonimbus. The results indicate that climate warming leads to an increase of precipitation from the moderate cloud and a decrease of precipitation from the small cloud.

Keywords: modeling, convective clouds, global warming, precipitation

PACS: 92.70.Kb (regional climate change), 92.60.Qx (storms), 92.40.Ea (precipitation), 92.60.hk (convection, turbulence, and diffusion), 92.60.Nv (cloud physics and chemistry)

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3.

Title: Instability indices as an indicator of thunderstorms in the East Bulgaria

Authors: Boryana Markova¹, Rumjana Mizeva²

Abstract: The work is directed to test the ability of some instability indices to be used as an indicator of lightning from convective clouds. Three instability indices are calculated using

environmental conditions of 84 days with precipitation over East Bulgaria from May – September 2006. The cases have been divided into two samples – precipitation with and without lightning. Results show that there is a significant difference of the mean values of the studied indices in both samples. The analyses however reveal that none of the analyzed instability indices alone is able to discriminate between precipitating clouds with lightning and without lightning.

Keywords: Rain; Thunderstorm; Instability indices;

PACS: 92.60.N – Clouds physics and chemistry, 92.60.Pw – Atmospheric electricity, lightning, 92.60.Qx – Storms

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4.

Title: Measurement of Dielectric Substrate Parameters Using Split-Post Dielectric Resonator assisted by 3D Simulators

Authors: Boyan Hadjistamov and Plamen Dankov

Abstract: The measurement of the dielectric material parameters is one of the most important things connected with the modern electronics, computer and communication hardware. The main reason is the new modern manner of design of the electronic devices, based on electromagnetic or schematic simulators, where the precise knowledge of the substrate dielectric constant and loss tangent is very important. We have developed a number of resonance methods for determination of the dielectric parameters of samples in different directions – parallel and normal to the substrate surface. The two-resonator method, based on two cylindrical resonators with different modes TE₀₁₁ and TM₀₁₀, is suitable for determination of the substrate anisotropy at a set of fixed frequencies. Similar applicability has been achieved by the tunable coaxial and re-entrant resonators. In this presentation we investigate a new pair of measurement resonance tools based on dielectric cylindrical, ring or rectangular resonators inserted into metal cavities (entire or split). First of all, we investigate numerically a number of configurations with different dielectric resonators DR in different frequency ranges in order to obtain the best measurement condition and DR shapes. Next, we introduce suitable 3D models of the chosen cavities ensuring best accuracy and computational efficiency. Finally, we present measurement data for the dielectric properties of several known substrates, and compare these results with our previous investigations. We use DR's based on high-quality sapphire and alumina with very high Q factors.

Keywords: cavity resonators, dielectric permittivity, microwave measurement

PACS: 77 22 –d Dielectric properties of solids

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5.

Title: Лазерен фототермичен анализ на материални среди

Authors: Хр. Башева, В. Пенчева, С. Пенчев, Т. Куцарова, И. Недков

Abstract: Представени са експериментални и теоретични резултати получени при лазерен фототермичен анализ на различни материални среди. Разработен е метод основан на фототермична модулация в двуспектрална схема със сензорен и нагриващ лазерен лъч. Разгледаният метод е високо ефективен при изследване и дефектоскопия на полупроводници и метали, нанослоеви от свръхпроводници, анизотропия и фазови

преходи в магнитни среди, както и за прецизен технологичен неразрушаващ контрол независим от външни полета.

Keywords: photothermal effect in material science, superconductors and HTS layers, magnetic and magnetoelectric materials, semiconductor and nanotechnologies (фототермичен ефект в материалознанието, свръхпроводници и ВТС слоеве, магнитни и матнитоелектрични материали, полупроводникови и нанотехнологии)

PACS: 78.20.Nv,74.78.Bz,73.50.Jt,81.07.-b,75.80.+q, 68.55.Ln

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6.

Title: Поведение на протеиновите монослове на ССКП на ФСП на фазовата граница вода /въздух

Authors: Хр. Башева, В. Пенчева, С.Пенчев, И.Минков, М.Бушева

Abstract: Представени са експериментални и теоретични резултати получени при измерването на лангмюирова везна при баростатичен режим на биологични материални среди. Изолирани и изследвани са протеиновите монослоеви на ССКП на фазовата граница вода /въздух, при различни режими. Изследвано е влиянието върху поведението на протеиновите монослоеви при добавка на метални катиони от алкалната и алкалоземната група, промяната на киселинността на средата, инжектирането на ензими – PLA2(фосфолипаза) и облъчването на слоевете със светлина.

Keywords: ССП- светосъбиращ комплексП на фотосистемаП ,ФСП-фотосистема П, протеинови монослоеви, PLA2- фосфолипаза А2

PACS: 87.14.E-, 87.14.ep, 64.75.St

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7.

Title: Test Experiments with LaBr₃(Ce)

Authors: D.Radulov¹, S. Lalkovski¹, P. Detistov¹, D. Balabanski², N. Marginean³, D. Bucurescu³, D. Gita³, R. Marginean³, C. Mihai³, T. Sava³, G. Suliman³, D. Petrescu³, G. Georgiev⁴, J.M. Daugas⁵

Abstract: New type of scintillator detectors, Ce-doped LaBr₃, coupled to XP20D0B PMTs were tested with sources and in-beam. Intrinsic efficiency and energy resolution as a function of energy were studied. The in-beam experiment, performed at IFIN-HH, Romania, aimed to study the time response of the scintillators. ¹²C ions accelerated to 45 MeV, were impinged on a 1,3 mg/cm² thick ⁹⁸Mo target, producing excited ¹⁰⁷Cd nuclei. De-excitation γ -rays were detected by an array, consisting of 7 HPGe and 5 LaBr₃ detectors of different size. The goal was to measure the known half-life of the first excited state in ¹⁰⁷Cd. Delayed coincidence technique was used. Preliminary results from the analysis will be presented.

Keywords: gamma-spectroscopy, scintillator detectors, delayed coincidences, half-life

PACS: 21.10.-k, 21.10.Hw, 21.10.Tg, 23.20.Lv, 27.60.+j, 29.40.Mc

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8.

Title: New root-finding algorithm for systems of complex-valued equations and their application in astrophysics.

Authors: Denitsa Staicova, Plamen Fiziev

Abstract: Abstract: Despite the number of root-finding algorithms, only few of them can handle a non-polynomial complex-valued function with arbitrary number of complex-valued zeros. An established algorithm for numerically solving a system of such equations is not known. We propose a new algorithm for solving a system of 2 equations based on the Muller algorithm that works for large class of functions, including some special functions. We show its application on finding the quasi-normal modes (QNM) of Schwarzschild black hole described by the Regge-Wheeler equations. Numerical results are obtained and compared with the already published by Anderson QNM frequencies.

Keywords: Astrophysics, numerical relativity, root-finding algorithms, Regge-Wheeler equation

PACS: 04.25.dg

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9.

Title: Exact Solutions of the Dynamical Equations for Massive Scalar Field in Schwarzschild and Kerr Metrics

Authors: Dimo Arnaudov, Roumen Borissov

Abstract: We present the exact solutions of Klein-Gordon equation in Schwarzschild and Kerr backgrounds. The most important result is that the dynamics of a massive scalar field is described completely by the class of confluent Heun functions. Possible applications and future directions for investigation are outlined.

Keywords: Astrophysics, black holes, confluent Heun function, Klein-Gordon equation, massive scalar field

PACS: 04.20.-q Classical general relativity, 04.70.-s Physics of black holes

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10.

Title: Computer simulations of human interferon gamma binding

Authors: Elena Lilkova¹, Leander Litov¹, Peicho Petkov¹, Petko Petkov², Stoyan Markov³ and Nevena Ilieva⁴

Abstract: One of the principal tools in the theoretical study of biological molecules is the method of molecular dynamics simulations. Here, we present an investigation using MD simulations of the dynamics of hIFN- γ binding to its soluble extracellular receptor, as well as to heparin derived oligosaccharides. A computer model of hIFN- γ binding to its receptor is proposed. We also performed MD simulations of hIFN- γ mutants with mutated residues 86-88. The structural changes are investigated by comparing the lengths of the α -helices in the

original hIFN- γ molecule with those in the mutated forms. Several intriguing mutants are examined in more details.

Keywords: human interferon gamma, human interferon gamma receptor, heparin, molecular dynamics simulations.

PACS: 87.14.ef – Peptides; 87.15.ap - Molecular dynamics simulation; 87.15.bd - Secondary structure; 87.15.hg - Dynamics of intermolecular interactions; 87.15.hp - Conformational changes; 87.15.km - Protein-protein interactions; 87.15.kp - Protein-ligand interactions.
Molecular Dynamics

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11.

Title: Development of a passively mode-locked all solid-state diode-pumped Nd laser

Authors: Hristo Iliev, Anton Trifonov, Ivan Buevarov

Abstract: Development of a diode pumped passively mode-locked neodymium laser is described. All solid-state techniques for passive mode-locking of narrow band laser medium as Semiconductor Saturable Absorber Mirror (SESAM) and frequency doubling nonlinear mirror (FDNM) have been employed. Different laser cavity designs suitable for each of the mode-locked techniques have been developed and tested. Stable mode-locking operation with around 1 W output power of Nd:YVO₄ and Nd:GdVO₄ laser was achieved. The FDNM mode-locking is studied using frequency doubling in bulk nonlinear crystals and periodically poled structures.

Keywords: mode-locking, non-linear mirror, Periodically-Poled KTP, picoseconds laser system

PACS: 42.55.Xi Diode-pumped lasers, 42.60.Fc Modulation, tuning, and mode-locking, 42.65.Ky Frequency conversion; harmonic generation, including higher-order harmonic generation

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12.

Title: Optimization of Resistive Plate Chambers for Positron Emission

Authors: V. Kozhuharov, I. Lessigiarska, L. Litov, B. Pavlov, P. Petkov, I. Tabanliyski

Abstract: Resistive Plate Chambers (RPC) are considered as a potential detectors for Positron Emission Tomography. Here we present the results of investigation of the RPC performance and optimization of their construction by means of GEANT4 simulation. Several different detector designs are investigated in order to obtain maximal efficiency for 511 KeV photons registration. At the same time the efficiency for registration of photons with lower energies is kept as low as possible.

Keywords: resistive plate chambers, optimization, positron emission tomography

PACS: 29.40.Cs, 87.57.uk, 07.05.Tp

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13.

Title: Simulation of electron avalanche development in high electric fields

Authors: V. Kozhuharov, I. Lessigiarska, L. Litov, B. Pavlov, P. Petkov, I. Tabanliyski

Abstract: Resistive Plate Chambers are widely used gaseous detectors of ionizing radiation. The simulation of electron avalanche development inside their gas volume is a nontrivial task, due to the high electric field applied to the detector's electrodes ranging from 4 to 10 MV/m. The developed algorithm for realistic and fast 3D avalanche simulation using a new kind of heterogeneous High Performance Computing algorithm employing a new architecture SIMT (single-instruction, multiple-thread) implemented by NVIDIA video cards multiprocessors is presented. The algorithm is used for RPC studies and for improvement of their performance.

Keywords: gaseous detectors, avalanche multiplication, gas gain, Townsend coefficient, resistive plate chambers, HPC, parallel algorithm, CUDA

PACS: 29.40.Cs, 29.40.Gx, 51.50.+v

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14.

Title: Role of the input spectral phase on the output parameters in some nonlinear optical processes

Authors: Ivaylo Ivanov and Solomon Saltiel

Abstract: Investigation of the role of the spectral phase on the processes of second harmonic generation and cross-polarized wave generation is presented. The effect of the second and the third order input spectral phases on the output spectrum and the efficiency of these two processes is presented. We show that the linear and quadratic input chirp lead to decrease of the efficiency of the processes.

Keywords: Nonlinear Optics, Second Harmonic Generation, Cross Polarized Wave Generation

PACS: 42.65.-k

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15.

Title: Measurements of the planetary boundary layer development and aerosol optical depth over urban area by lidar and sun photometer

Authors: Tsvetina Evgenieva and Ivan Kolev

Abstract: Investigation of various optical characteristics of the atmospheric aerosol during the convective boundary layer formation over an urban area situated in a mountain valley (Sofia, Bulgaria) was carried out. The planetary boundary layer (PBL) is that part of the troposphere that is directly influenced by the presence of the Earth's surface and responds to surface forcing with a timescale of about an hour or less. It consists of three major layers: mixing layer (ML), residual layer (RL) and stable boundary layer (SBL). The height of the boundary layer is a crucial quantity for air quality modeling or forecasting. Aerosol optical depth (AOD), Ångström coefficients and precipitable water vapor amount are very important physical parameters for characterizing aerosols. Routine observation of total atmospheric column AOD and water vapour globally is a fundamental way of determining aerosol optical characteristics and its influence in the global radiation budget and climate change. This work aims at: (i) comparing the AOD measured by a sun photometer with the one obtained from the lidar data; (ii) juxtaposition of the AOD behaviour to the PBL development and (iii) comparing the experimental lidar data with theoretical data obtained following Whiteman and

McKee's model. Active (lidar) and passive (sun photometer) remote sensing devices were used to implement this study. The AOD values obtained using the two devices during simultaneous measurements performed in clear sunny days are juxtaposed. The experimentally obtained ML and RL heights are compared with theoretical data obtained by the Whiteman and McKee's model. The experimental results for the ML height show variations from HML=400 m in winter to HML=1200 (1800) m in spring and summer. The main specific feature of the aerosol structure in 2007 (not observed in previous years) is the presence of aerosol layers in winter, spring and autumn due to advection from certain powerful local sources. Three kinds of behaviour of the AOD were observed. In the first two AOD has maximum before the ML to reach its maximum height or when it reaches the latter. These maxima could be due to the moisture fluxes raised by the thermals depending on the soil humidity and the radiation power of the sun. In the third one AOD gradually increases during the PBL development as a result of the interaction between the formation of ML and mountain valley circulation as well as of the presence of powerful local sources of pollutions in the valley.

Keywords: planetary boundary layer, aerosol optical depth, lidar, sun photometer

PACS: 92.60.Fm, 92.60.Mt and 92.60.Sz

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16.

Title: First Principles Study of Electronic and Crystallographic Structure and Elastic Properties of Calcium Hydroxylapatite

Authors: V. Antonov and I. Iordanova

Abstract: The first principles calculations, based on density functional theory with ultra-soft pseudo potentials were performed to investigate the electronic and crystallographic structure and elastic properties of calcium hydroxylapatite ($\text{Ca}_5(\text{PO}_4)_3(\text{OH})$), which is used for bone and dental prostheses. Simulations were performed using generalized gradient approximation exchange-correlation functional. The calculated electron density, lattice parameters, atomic positions and elastic constants were compared with the available experimental and theoretical results.

Keywords: hydroxylapatite, first principles, crystal structure, elastic constants

PACS: 71.15.Mb; 81.05.Je; 61.50.Ah; 62.20.D-

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