Meetings in Physics 2008 – Abstracts
(in alphabetical order of the names of the presenting authors)

1.
Title: Ultra-broadband continuum amplification in the near-IR using BiB_3O_6 nonlinear crystals pumped at 800 nm

Authors: <u>Alexander Gaydardzhiev</u>[1], Ivaylo Nikolov[1], Ivan Buchvarov[1], Pancho Tzankov[2], Frank Noack[2], Valentin Petrov[2]

Abstract: Ultra-broadband parametric amplification of an white-light continuum in the near-IR (~100 THz, 1.2-2.4 μm) is demonstrated in bismuth triborate BiB3O6, pumped by 45 fs long pulses at 800 nm at a repetition rate of 1 kHz. The continuum energy reached 50 μJ corresponding to conversion efficiency of 20%. The continuum pulse duration of ~70 fs and ~95 fs were obtained using 3-mm and 5-mm thick BiB_3O_6 crystal, respectively.

Keywords: optical parametric generators and amplifiers; broadband gain; bismuth triborate; femtosecond pulses
PACS: 42.65.Yj , 42.70.Mp , 42.65.Re

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2.
Title: Ultrabroadband operation of a femtosecond optical parametric generator based on BiB_3O_6 in the near-IR

Authors: <u>Alexander Gaydardzhiev</u>[1], Ivaylo Nikolov[1], Ivan Buchvarov[1], Frank Noack[2], Valentin Petrov[2]

Abstract: Ultrabroadband optical parametric generation in the near-IR (~135 THz, 1.15-2.4 μm) is demonstrated using bismuth triborate, BiB_3O_6 (BIBO), in a collinear geometry. The white light continuum energy obtained with a single stage reached 15 μJ (conversion efficiency of ≈ 6%). Integral pulse durations as short as 63 fs were derived from the recorded FROG traces, comparable to the 45 fs pulse duration of the 1 kHz Ti:sapphire regenerative amplifier used for pumping at 800 nm.

Keywords: optical parametric generator; broadband gain; bismuth triborate; femtosecond pulses
PACS: 42.65.Yj , 42.70.Mp , 42.65.Re

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3.
Title: New model of the Central Engine of Gamma Ray Burst

Authors: <u>Denitsa Staicova</u>, Plamen Fiziev

Abstract: Since their discovery Gama-Ray bursts (GRBs) proved to be extremely interesting astrophysical objects. Theirs excessive energy output and time variability still cannot be entirely explained by the current models. One reason for that can be found in the fact that in the moment, there's no good model of the central engine of GRB, nor clear idea of its nature and mechanisms of producing such energy. Also there are evidences of its late time activity, which are still unexplained. In this report, we discuss one possible model of that central engine that lies entirely the fundamental equations as Teukolsky Master Equations and uses as little assumptions as possible. The model is general enough to account for both types of GRB

and gives an explanation of the collimation of GRB as well as of the observed flares. A preliminary results are presented.

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4.

Title: Study of η-Meson Production in dd→αη Reaction

Authors: <u>Galina Vankova</u> , R.Tsenov

Abstract: The dd→αη reaction has been investigated at 2.39 GeV/c beam momentum. The total cross sections for polarised and unpolarised beam have been measured as well as differential cross sections for $\cos\theta_{cm} > 0$. They reveal strong anisotropy indicating excitation of higher partial waves at this energy. The fitting procedure for scattering length extraction has been applied.

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5.

Title: A systematic comparison of the properties of band structures in the A = 130 ~ 140 mass region

Authors: G. Deyanova[1] , L. Atanasova[1], D.L. Balabanski[2], K. Gladnishki[2], A.Minkova[2], G. Rainovski[1]

Abstract: The deformed nuclei in the mass $A \sim 130$ region with neutron numbers $N = 75$-79 and $Z = 55$-63 are soft with respect to the triaxiality parameter γ and take a variety of shapes due to the competition of the shape-driving forces of the valence $h_{11/2}$ quasineutron and $h_{11/2}$ quasiprotons which are situated in the upper and the lower part of the same high-j orbital respectively. A systematic comparison of band structures built on these configurations in the odd-A and doubly-odd $_{55}$Cs, $_{56}$Ba, $_{57}$La, $_{58}$Ce, $_{59}$Pr, $_{60}$Nd, $_{61}$Pm, $_{62}$Sm and $_{63}$Eu nuclei will be reported, which demonstrates a gradual transition from well-deformed prolate through triaxial to oblate shapes. These results will be compared to TRS and PRM calculations.

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6.

Title: Static and dynamic properties of tethered membranes: A Monte Carlo simulation study

Authors: <u>Hristina Popova</u> and Andrey Milchev

Abstract: We study a coarse-grained bead-spring continuum model of a self-avoiding tethered membrane with hexagonal coordination by means of extensive Monte Carlo computer simulations. We find that the membrane undergoes several folding transitions from a high-temperature flat phase to multiple-folded structure as the temperature is steadily decreased. Using a suitable order parameter, these phase transitions are shown to be of first order. The equilibrium shape of the membranes is analyzed by calculating the eigenvalues $\lambda^2_{max} \geq \lambda^2_{med} \geq \lambda^2_{min}$ of the inertia tensor.

We present a systematic finite size scaling analysis of the radius of gyration and the eigenvalues of the inertia tensor at different phases of the observed cascade of folding

transitions. In the high temperature flat phase, the radius of gyration R_g grows with the linear size of the membrane L as $R_g \sim L^\nu$, where the exponent $\nu \approx 1.0$. The eigenvalues of the inertia tensor scale as $\lambda_{max} \sim \lambda_{med} \sim L^\nu$ and $\lambda_{min} \sim L^{\nu min}$, where the roughness exponent $\nu_{min} \approx 0.7$. These exponents indicate that the self-avoiding tethered membranes are flat but spatially undulated. In the single folded phase, below the first folding transition, the exponent $\nu \approx 1.0$ stays unchanged and only the roughness exponent decreases by half, $\nu_{min} \approx 0.36$, which indicates a more stretched folded state. We also find that the Rouse relaxation time τ_R of a self-avoiding membrane in the high temperature flat phase scales as $\tau_R \sim L^{2\nu+2}$, which in good agreement with the theoretical predictions.

We also study the anomalous diffusion dynamics of a tethered membrane and focus on the sub-diffusive motion of the membrane's central node at temperatures above the membrane folding transition. At long times $t \geq \tau_R$ the mean square displacement of the center of mass of the sheet, $<R_c^2>$, as well as that of its central node, $<R_n^2>$, show the normal Rouse diffusive behavior with a diffusion coefficient D_N scaling as $D_N \sim N^{-1}$ with respect to the number of segments N in the membrane. For short times $t < \tau_R$ we observe a multiscale dynamics of the central node, $<R_n^2> \sim t^\alpha$, where the anomalous diffusion exponent α changes from $\alpha \approx 0.86$ to $\alpha \approx 0.27$, and then to $\alpha \approx 0.5$, before diffusion turns eventually to normal. By means of simple scaling arguments we show that our result $\alpha \approx 0.27$ can be related to particular mechanisms of membrane dynamics which involve different groups of segments in the membrane sheet.
Keywords: tethered membrane, computer simulation, Monte Carlo method, scaling analysis, phase transition, diffusion
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7.
Title: Sub-Doppler spectroscopy of Cs-vapour layers with thickness less than the irradiating light wavelength
Authors: K.Vaseva[1], P.Todorov[1], S. Cartaleva[1], D. Slavov[1], S.Saltiel[2]
Abstract: We present experimental and theoretical studies of sub-Doppler-width fluorescence spectra of Cs-vapour layers with thickness $L=(1/2)\lambda,(3/4)\lambda$, irradiated by narrow-band frequency-tunable laser light with wavelength $\lambda=852nm$. The atomic systems are separated in two groups: closed and open optical transitions. Significant broadening of the optical transition is measured experimentally with the vapour layer thickness enhancement and with the Cs atom concentration rising, and analyzed theoretically.
Keywords: laser spectroscopy; extremely thin vapour cell; sub-Doppler spectroscopy
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8.
Title: Study of $\pi^0 \to e^+e^-e^+e^-$ Branching Ratio
Authors: M. Dyulendarova, V. Kozhuharov, L. Litov, E. Marinova, S. Stoynev
Abstract: We present an observation of the decay $\pi^0 \to e^+e^-e^+e^-$ (double Dalitz) by studying $K^\pm \to \pi^\pm e^+e^-e^+e^-$ with respect to $K^\pm \to \pi^\pm e^+e^-\gamma$. The preliminary result of the branching ratio of the investigated decay is given in the paper.
Keywords: charged kaon, rare decays, double Dalitz decay, branching ratio

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9.
Title: Shashlyk type photon veto detector
Authors: M. Dyulendarova, V. Kozhuharov, L. Litov, E. Marinova, M. Ivova Rikova
Abstract: An experimental proposal to measure the $BR(K^+ \to \pi^+ \nu\nu)$ with a 10%precision has been accepted by the CERN SPS committee. This rare decay offers unique opportunities for testing the Standard Model and measuring the CKM parameter |Vtd|. The Standard Model expectation $(BR(K^+ \to \pi^+ \nu\nu) = 0,8.10^{-10})$ makes the background suppression crucial for the success of the experiment. To suppress the dominant background originating from the decay $K^+ \to \pi^+ \pi^0$ photon vetoes have to be envisaged. Detection with inefficiency less than 10^{-4} is necessary for photons with energy higher than 5 GeV. A shashlyk type photon veto detector fulfilling these requirements was constructed and tested in the NA48 beam setup. The preliminary results will be presented.
Keywords: kaon decays, Standard Model, photon veto
PACS: 13.20.Eb, 13.25.Es, 13.30.Ce
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10.
Title: Absorption spectra study of Cs-vapour layer with thickness close to the wavelength of the irradiating light
Authors: P. Todorov[1], I. Maurin[2], S. Cartaleva[1], K. Vaseva[1], C. Andreeva[1], D. Slavov[1], S. Saltiel[3], D. Bloch[3]
Abstract: We present experimental study of absorption spectra on the D_2 line of Cs-vapour-layer with thickness of $5/4\lambda$, irradiated by frequency tunable mono-mode diode laser light (λ=852nm). Different behavior is demonstrated for closed and open optical transitions. For the closed transition, well pronounced Dicke narrowing is observed starting from low light intensity, which is preserved with the light power enhancement. Opposite, the open transitions do not show Dicke resonance under the same conditions.
Keywords: atomic spectroscopy, thin vapor layer, optical pumping
PACS: 42.62.Fi, 42.50.Gy, 42.50.Ct
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11.
Title: Fluorescence and Raman Characteristics of Photosystem II Particles
Authors: Atanaska Andreeva[1], Silvia Abarova[1], Katerina Stoitchkova[1], Mira Busheva[2]
Abstract: Resonance Raman and low temperature (77K) fluorescence spectroscopy are applied to the Photosystem II particles of higher plants. 77K fluorescence emission spectra and their changes were studied at addition of different concentrations of the mild detergent *n*-dodecyl *β*-D-maltoside under excitation was at 488 nm. It is shown that increasing the detergent concentration up to 0.01 % caused stronger decrease of the energy transfer from outer antenna to the inner antenna than to the complexes of RC. At higher concentrations than 0.01 %, the energy transfer to RC complexes of Photosystem II is also diminished and the fluorescence maximum is blue-shifted to 680 nm, the maximum of trimeric complexes of the outer antenna. This indicates that the energetic coupling between the outer antenna and other complexes is destroyed. Resonance Raman spectra of the long wavelength lutein and 9-*cis*

neoxanthin in particles of Photosystem II are identified. The results are discussed in their relation with the mechanism of non-photochemical quenching.

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12.

Title: Density-functional study of electronic and structural properties of titanium nitride

Authors: <u>Vladislav Antonov</u>[1] and Ivanka Iordanova[2]

Abstract: The first principles calculations, based on density functional theory (DFT) with norm-conserving pseudo potentials and plane-wave wavefunctions base set were performed to investigate electronic and structural properties of titanium nitride. Three crystallographic planes, namely {100}, {110} and {111}, most commonly observed during growth process of TiN layers were investigated. Simulations were performed using two exchange-correlation functionals in the form of local density approximation (LDA) and generalized gradient approximation (GGA) and pseudopotentials generated by the schemes of Hartwigsen-Goedecker-Hutter, Troullier-Martins and Fritz-Haber-Institute. The calculated electron density, lattice parameters and surface energies were compared with the available experimental and theoretical results.

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