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International Conference on

Quantum Physics, Optics and Laser Technologies

May 09-10, 2018 Tokyo, Japan

Scientific Tracks & Abstracts

(Day 1)

Alessandra Toncelli et al., J Laser Opt Photonics 2018, Volume 5
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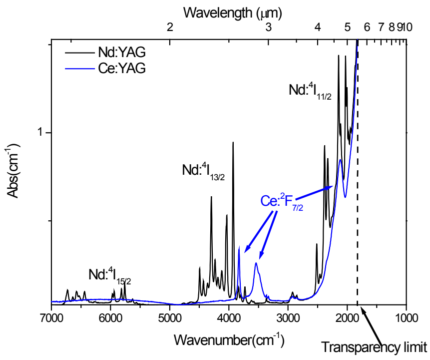
MID-IR spectroscopy of $Nd^{3}+$ and $Ce^{3}+$ ions in crystals

Alessandra Toncelli, Jihua Xu and Alessandro Tredicucci
University of Pisa, Italy



The mid-infrared (MID-IR) region is very interesting for a large number of applications because vibro-rotational levels of many molecules lie in this region. Therefore, the search for new light sources in this range is a very important research topic. Moreover, MID-IR energy levels of rare earth ions in crystals are usually the bottom laser levels for visible or near infrared lasers based on these materials. For these reasons, we performed MID-IR spectroscopy of the Nd^{3+}-Ce^{3+}:YAG system. Ce^{3+} ions are added as sensitizers for Nd^{3+} because Ce^{3+} possesses a strong absorption band at around 450 nm where powerful diode lasers exist. The efficient energy transfer mechanism at visible energy that transfers the Ce excitation to the upper Nd laser level has already been studied, but, at the best of our knowledge, no detailed investigation has been performed about the possible interaction between the MID-IR energy levels of the two ions. This might play an important role in the laser efficiency because of the possible energy match with the bottom laser level of the near-infrared Nd emission. Absorption spectra of Nd:YAG, Ce:YAG and Nd,Ce:YAG have been performed as a function of temperature in the 7000-1000 cm^{-1} wavenumber range to identify the transparency limit of the crystal matrix and the MID-IR energy levels of the two ions. Ce:$^2F_{7/2}$ together with Nd: $^4I_{15/2}$, $^4I_{13/2}$ and $^4I_{11/2}$ Stark sublevels have been observed and identified. Good spectral overlap has been observed between the Ce:$^2F_{7/2}$ Stark components and Nd: $^4I_{13/2}$, and $^4I_{11/2}$ multiplets. This might help in depopulating the lower laser level of the 1.06μm and 1.3 μm laser emission of Nd thus favoring the laser emission at these wavelengths. Moreover, the 4.8-5 μm Nd emission has been observed and characterized at room temperature.

Recent Publications

1. R Marino, I Lorgeré, O Guillot-Noël, H Vezin, A Toncelli, M Tonelli, J-L LeGouët, P Goldner (2016) Energy level structure and optical dephasing under magnetic field in Er^{3+}:$LiYF_4$ at 1.5 μm. *J. Lumin.*; 169: 478-482.

2. N Hamza Belkhir, A Toncelli, Abdul K Parchur, E Alves, R Maalej (2017) Efficient temperature sensing using photoluminescence of Er/Ybimplanted GaN thin films. *Sensors and Actuators B*; 248: 769–776.

Biography

Alessandra Toncelli has obtained her PhD in Physics in 1998 at the University of Pisa. Since 2017 she is Associate Professor at the Physics Department of Pisa. Her scientific interest was initially aimed to the growth and spectroscopy of crystalline materials for photonic applications in visible and near infrared regions. In particular, she studied and characterized the optical and spectroscopic properties of oxide and fluoride crystals with rare earths for laser applications. She has published more than 160 articles on International journals. She currently holds an h-index of 41 both in Scopus and in ISI web of knowledge.

alessandra.toncelli@unipi.it

George Yury Matveev, J Laser Opt Photonics 2018, Volume 5
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Motley string or from 10 to 4

George Yury Matveev
IT consultant, Sweden

All known String models (Bosonic, Super string, Heterotic) are formulated in multi-dimensional space time. To get to realistic and observable 4-dimensional world requires new type of theory. To avoid all inconsistencies present in known approaches to compactification we propose Motley String model, which treats all special dimensions equally and complies with known experimental material. First we formulate two postulates: (1) Every special dimension of string has unique intrinsic property which we call color and (2) there is force between special dimensions of string such that it makes dimensions of complementary colors (Redi, Greeni, Bluei) interact and unite in a colorless threads perceived as observable dimensions. Color property of string's special dimensions is somewhat similar to 3 color charges of quarks in Quantum Chromo Dynamics, but has different meaning, since it is viewed here as intrinsic characteristic of special dimensions in Motley String theory corresponding to different values of string tension tensor Ti in different dimensions. String state at very high energies (early universe, Planck length about 10^{-33} cm) is such that all string special dimensions are in a free state similar to quark-gluon plasma of Quantum Chromo Dynamics. At lower energies (modern universe) strong color force becomes dominant and makes String's complimentary (or using classical optics term additive) special dimensions (Red_i, $Green_i$, $Blue_i$) interact to form 3 threads (in case of 9+1 dimensional superstring) which appear to be colorless from distances larger than size of baryons (proton and neutron). Special dimensions of additive colors are glued together. Outside of Planck energy scale special dimensions are confined in colorless 3-dimensional threads. Since in our model all special dimensions are treated uniformly we avoid questions like: Why some special dimensions are compactified while others are not? Also there are no standing waves in curved dimensions of Klein compactification and therefore no extra mass values (Kaluza-Klein tower). Equally important there is no need for Calabi-Yau and somewhat artificial large extra dimensions models invented to explain unseen special dimensions. Motley String theory and idea of colorful special dimensions introduced in this article offers consistent and uniform approach to compactification problem present in all string models (Superstring, Bosonic, Heterotic). It eliminates inconsistencies of compactification mechanisms proposed earlier (Kaluza-Klein, Calabi-Yau manifolds, etc.). Also it solves several major problems present in the Standard Model and Cosmology like; explains number of particle generations (6 quarks and 6 leptons) of standard model and quark/gluon confinement, explains fractional charges of quarks, establishes the link between multi-dimensional string theories and observable 4-dimensional world, offers alternative to Higgs mechanism for particles mass generation and thus explains neutrino's mass and experimentally observed neutrino oscillations and offers solution for dark matter/energy problem of modern astrophysics.

Biography

George Yury Matveev has graduated from Leningrad State University, Department of Physics in 1990 with Diploma in Geophysics. He has joined as Junior Researcher in Ioffe Physical Technical Institute of Academy of Sciences of USSR, Department of Plasma Physics and Astrophysics, where he did research of ion-acoustic waves in plasma. He currently works as IT Consultant on various projects in Stockholm, Sweden doing research in mathematics and physics in his spare time.

george@matveev.se

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Special Session

(Day 1)

V R Lakshmi Gorty, J Laser Opt Photonics 2018, Volume 5
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V R Lakshmi Gorty

SVKM's Narsee Monjee Institute of Management Studies, India
Mukesh Patel School of Technology Management & Engineering, India

The generalized Hankel-Clifford and extended generalized Hankel-Clifford transforms with compact support on certain range

The Paley-Wiener theorem for the generalized Hankel-Clifford and extended generalized Hankel-Clifford transforms is obtained. The generalized Hankel-Clifford and extended generalized Hankel-Clifford transforms of square integrable functions with compact supports, rapid decreasing functions, infinitely differentiable functions with compact supports of analytic functions are studied. The range of the generalized Hankel-Clifford and extended generalized Hankel-Clifford transform of compactly supported functions which are either square integrable (Paley-Wiener theorem) or infinitely differentiable (Paley-Wiener-Schwartz theorem) is characterized. Such developed transforms are supported by an application to Mathematical Physics at the end section of the study.

Biography

V R Lakshmi Gorty is presently working as a Professor of Mathematics, Basic Sciences and Humanities, SVKM's NMIMS, MPSTME, Mumbai, India. Her research interests are integral transforms and operational calculus (AMS classification: 44, 42), wavelet transforms (33C05), functional analysis generalized functions (distributions): (AMS-classification: 46 F12), mixed radix system, transforms to Kekre's function, discrete transforms, interdisciplinary research, fractional calculus and generalizations (AMS classification: 26, 26A33) and fractional transforms and generalizations. She is recipient of Bharat Jyoti Award, Certificate of Excellence awarded by India International Friendship Society, Outstanding Scientist Award in December 2015 and Best Scientist/Researcher Award, by IMRF Academic Excellence Award, 2017. She has so far published more than 85 papers in national, international journals and conferences. She has attended 42 seminars and workshops. She is Life Member of many professional bodies like IAIAM, ISTE, INS, SSFA, IMS and Congress Member of IAENG. She is a peer Member of Editorial Board and Reviewer for many international journals.

vr.lakshmigorty@nmims.edu

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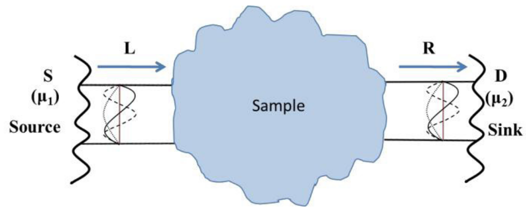
Prosenjit Singha Deo

S N Bose National Centre for Basic Sciences, India

Route to understand non-ergodic quantum systems



Small quantum systems are non-ergodic. Electrons transmitted through a scatterer (region shaded blue) do not access all the states of the scatterer and we do not have the liberty to take an ensemble average or average over impurity configuration. In most transport measurements it is the partial density of states (pdos) that play a relevant role while it is never possible to know exact impurity configuration or the confinement potential that determines it. The pdos also crucially depends on the positions and nature of the leads (marked L and R) and so it is not enough to know the Hamiltonian of the system or the partition function, besides the leads that determine the asymptotic states in the scattering process always have free electron states while many body effects are inevitable inside the scatterer. How a free electron is transmitted through an interacting environment is a formidable theoretical problem as it requires matching a one body wavefunction to a many body wavefunction. We prove that pdos can be determined experimentally from the asymptotic free electron states at the resonances and sometimes it can be negative. There can be large errors in the non-resonant regime but non-resonant pdos is so small in magnitude that they may be ignored. Since our analysis is general, our results are valid for transmission through an interacting environment. From the pdos we can determine all other relevant quantities that can be probed by an experiment and thus we provide a novel and new technique to understand non-ergodic quantum systems. Negative pdos can also give rise to electron-electron attraction and also throws some light on the nature of traversal times. We consider several typical scattering potentials to demonstrate our results. We believe that our results can lead to the development on new technologies.

Recent Publications

1. Urbashi Satpathi, P Singha Deo (2016) Negative partial density of states in mesoscopic systems. *Annals of Physics*; 375: 491.
2. P Singha Deo (2007) Nondispersive backscattering in quantum wires. *Phys. Rev. B*; 75(23): 235330.

Biography

Prosenjit Singha Deo has completed his PhD in 1996 and has remained associated with research and teaching in Physics in premier institutions and universities abroad and in India. He has published more than 50 papers in international journals. He is a Professor at S.N. Bose Centre, Kolkata since 1999 and successfully guided several PhD theses. He has worked on various issues and problems in mesoscopic physics and correlated systems. Some of his current research topics include quantum devices, quantum capacitance, bosonization in higher dimensions, quantum mechanical scattering phase shift in low dimensions, etc.

deo@bose.res.in

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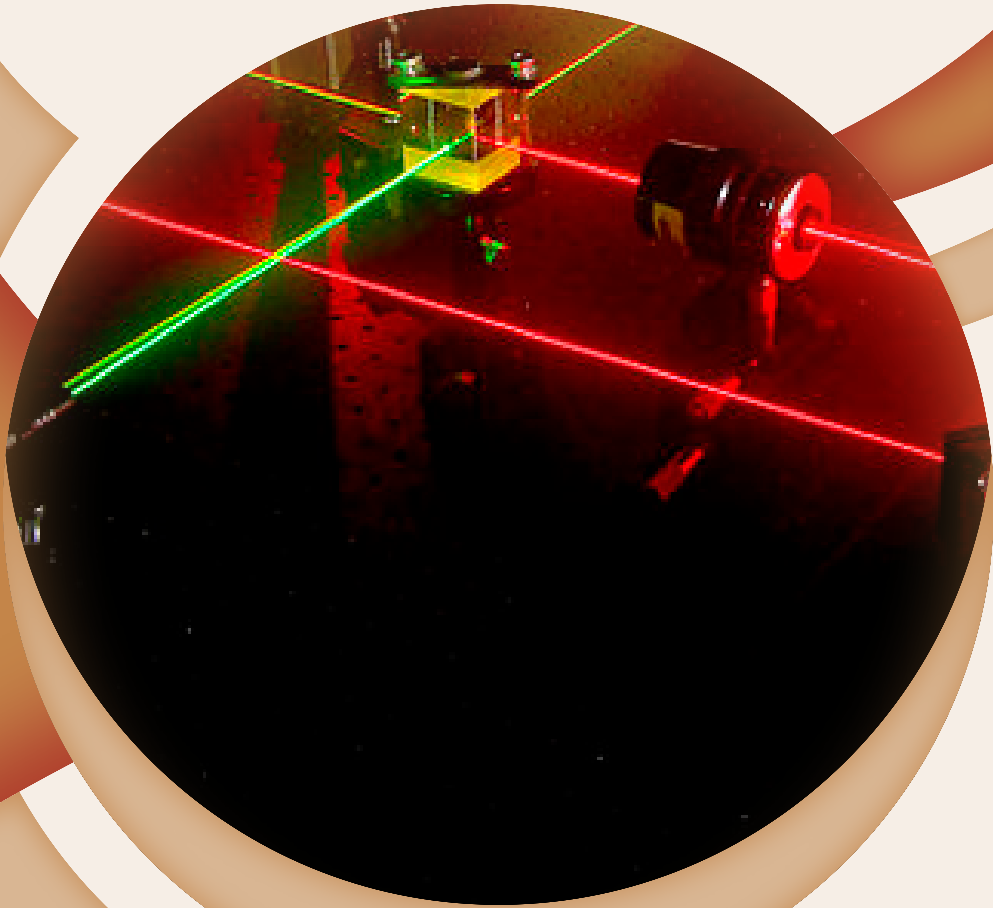

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Scientific Tracks & Abstracts

(Day 2)

Konstantin A Lyakhov et al., J Laser Opt Photonics 2018, Volume 5
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Overcooled gas flow assisted quantum computing

Konstantin A Lyakhov[1], Alexander N Pechen[2] and Heon-Ju Lee[1]
[1]Jeju National University, Republic of Korea
[2]Steklov's Mathematical Institute, Russia

In this talk, the author will discuss possibility of implementation of quantum computations by resonant excitation of target isotopologues in the gas flow. Population of quantum states of selectively excited isotopologues can be manipulated by the sequence of laser pulses. For optimal control of excitation level, laser pulses should be specifically shaped. Moreover, their periodicity also plays essential role. Supersonic overcooled gas flow is the best tool for implementation of quantum turing machine, because molecular spectra are well resolved and, therefore, better control over them by laser field can be realized. Decoherence level in ensemble of molecules and clusters, representing gas flow, can be controlled by its rarefaction degree and extension. Evolution of quantum states population is guided by the battery of femtosecond lasers installed along the gas flow direction. Each laser emits laser pulse is of predesigned shape, which is related to some command written for the quantum computer (unitary transformation). The quantum state in the end of gas flow is the result of calculation. If gas flow transition time is not long enough to complete all sequence of required commands, received final state (intermediate solution) is recorded and translated into laser pulse shape, assigned for initialization. Otherwise, initialization laser pulse is step-like with intensity just high enough to excite all isotopologues to the same quantum state. Final quantum state of the gas flow is read by the classical computer by finalizing measurement, which is implemented as following: Once irradiated gas flow feeds spectrometer, where electrons, corresponding to resulting quantum state, are ejected by applied ionizing laser pulse. Obtained electron energy spectra, bearing information of original optical spectrum, are recorded by the network of surrounding electrodes and then amplified. By analog-digital convertor electrical currents induced on electrodes are transformed into digital format for further processing on the classical computer. In order, to diminish unavoidable errors induced by quantum noise, this procedure should be reiterated a number of times, corresponding to desired accuracy level. Design of a new device implementing quantum computations based on overcooled gas flow selective excitation is proposed.

Recent Publications

1. Lyakhov K A, Lee H J (2015) Optimal design of experimental setup for boron isotopes separation by the Laser Assisted Retardation of Condensation Method. *Journal of Nanoscience and Nanotechnology*; 15(11): 8502-8507(6).
2. Lyakhov K A, Lee H J (2015) Some Features of Experimental Setup Design for Isotopes Separation by the Laser Assisted Retardation of Condensation Method. *Journal of Laser Applications*; 27: 022008.

Biography

Konstantin A Lyakhov has received his PhD in Theoretical Physics in J.W. Goethe University (Frankfurt) in 2008. His research was focused on polymers and fuel cells simulations. His research interests include laser applications, isotopes separation, quantum computing, images recognition, optimal control, vacuum science and technology and applied plasma physics.

lyakhov2000@yahoo.com

Notes:

Vladimir G Chigrinov, J Laser Opt Photonics 2018, Volume 5
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Liquid crystal display and photonics devices: New trends

Vladimir G Chigrinov
Hong Kong University of Science and Technology, Hong Kong

Liquid Crystal (LC) devices for displays and photonics are dominating in the market and will be the basic technology for advanced display and electronics in the nearest 10 years. Photoalignment materials can be effectively used in LC alignment and patterning for new generations of LC devices that provide extremely high resolution and optical quality of alignment both in glass and plastic substrates, photonics holes, etc. New liquid crystal devices include ORW E-paper, field sequential color Ferroelectric Liquid Crystal (FLC) projectors, photo-patterned quantum rods and 100% polarizers, q-plates, sensors, switchable lenses, windows with voltage controllable transparency, security films and switchable antennas.

Biography

Vladimir G Chigrinov has obtained his PhD degree in Solid State Physics (Liquid Crystals) in the Institute of Crystallography, USSR Academy of Sciences in 1978. In 1988, he became a Doctor of Physical and Mathematical Science and obtained a degree of a Professor in 1998. Since 1973, he was a Senior Leading Researcher and then Chief of Department in Organic Intermediates & Dyes Institute (NIOPIK). He has worked as a Leading Scientist in the Institute of Crystallography, Russian Academy of Sciences and joined HKUST in 1999, as an Associate Professor. He is a Member of Editorial Board of *Liquid Crystals Today* since 1996 and Associate Editor of *Journal of SID* since 2005. He is an author of 6 books, 15 reviews and book chapters, 281 journal papers, 617 conference presentations and 112 patents and patent applications, including 28 US patents in the field of liquid crystals. His research interests include computer modeling of various electrooptical effects in liquid crystals, photo-aligning technique for LCD applications, LC devices in fiber optics and fast multistable ferroelectric liquid crystal devices.

eechigr@ust.hk

Valeriy I Sbitnev, J Laser Opt Photonics 2018, Volume 5
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Hydrodynamical aspect of the physical vacuum

Valeriy I Sbitnev
National Research Center Kurchatov Institute, Russia

At present, we imagine the physical vacuum as a superfluid quantum medium containing enormous amount of particle-antiparticle pairs arising and annihilating continuously. It is the Bose-Einstein condensate existing at super low temperatures of the cosmic space. OK, let it be so. Then a motion of this cold superfluid quantum medium can be described in the non-relativistic limit by pair of equations - the Navier-Stokes equation and the continuity equation. However, the first equation describes motion of a classical viscous fluid. We need to modify this equation. The modifications concern to the pressure gradient ▼P and to the term incorporating the viscosity of the fluid. The modification of the pressure gradient leads to appearance of the quantum potential, Q, which turns out to be equal to the pressure divided by the density distribution, ρ. Namely, Q=P/ρ. As a result, the above-mentioned pair of equations leads to emerging the Schrodinger equation when defining the wave function in the polar form bearing information about the velocity, v, of the fluid and the density distribution. With regard to the modification of the viscosity, it would seem that, in the first approximation, we could discard it. This is not a good idea. Instead, we suppose

$$\langle \mu(t) \rangle = 0_+, \qquad \langle \mu(t)\mu(0) \rangle > 0. \tag{1}$$

That is, the viscosity coefficient is a parameter fluctuating about zero. It means that there is an energy exchange within this superfluid medium. It is the zero-point energy fluctuations. By multiplying the modified Navier-Stokes equation by the operator curl, we come to the vorticity equation

$$\frac{\partial \omega}{\partial t} + (\omega \cdot \nabla)v = \nu(t)\nabla^2 v. \tag{2}$$

This equation in the cylindrical coordinate system permits to consider the vortex in its cross-section geometry. Solutions for the vorticity ω and for the angular velocity v are as follows:

$$\omega(r,t) = \frac{\Gamma}{4\Sigma(\nu,t,\sigma)} \exp\left\{-\frac{r^2}{4\Sigma(\nu,t,\sigma)}\right\}, \quad v = \frac{\Gamma}{2r}\left(1 - \exp\left\{-\frac{r^2}{4\Sigma(\nu,t,\sigma)}\right\}\right). \tag{3}$$

$$\Sigma(\nu,t,\sigma) = \int_0^t \nu(\tau)d\tau + \sigma^2 \xrightarrow[t\to\infty]{} \sigma^2. \tag{4}$$

Here Γ is the integration constant and ν=μ/ρM is the kinematic viscosity; ρM is the mass density of the superfluid medium, and σ is an arbitrary constant such that the denominators in equation (3) are always positive. The solution (3) is non-decreasing in time and has a non-zero vortex core slightly fluctuating in time. It comes to the Gaussian coherent vortex cloud with time.\

olga.sbitneva@gmail.com

Iraj Khalilymoghadam, J Laser Opt Photonics 2018, Volume 5
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Gravity and light repel each other

Iraj Khalilymoghadam
Iran

Scientists believe gravity is neutral on light I can prove the opposite of that which is absolutely new opinion. I divide light in 2 sorts: 1) light of the mass that makes them visible, 2) light of the sun or any source in the universe. In my opinion any vertical thing we see is higher than the real height and it depends on gravity. Something that is 10 meters long horizontally looks about 13 meters vertically. Gravity has been forming and shaping mass during million years. A hundred million years ago everything was huge because gravity was big, so because of this opposition earth rotation was faster, day and nights were shorter and year was shorter. If we go back to that time with this body we will be dwarf and if we travel to million years later we'll be huge for those people and animals. In fact gravity streaches shape of the matter vertically. “”Gravity wards off light and light pushes gravity.”” A force is pushing earth so sun is not swallowing earth and planets. This force is light. Gravity of sun pulls earth and light pushes it so it's rotating.

irajkhalily@gmail.com

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Discovery of analytical method defined of wave parameters gravitation field

Valentiyn Alekseevitch Nastasenko
Kherson State Maritime Academia, Ukraine

A strict definition that the wave parameters of the gravitation field is an actual and important task for understanding the basics of material world. Its solution is the main goal of this work. Feature of this scientific work is strict physical-mathematical method of calculation the gravitation field frequency ν_G, which based on fundamental physical constants: Speed of light in vacuum *c*, Plank's constant *h* and gravitational constant G. This wave characteristic ν_G is identified with the Plank's level frequency of oscillation ν_p:

$$\nu_G = \nu_p = \sqrt{\frac{c^5}{Gh}} = \sqrt{\frac{\left[0.299792458 \cdot 10^9 \left(\frac{m}{s}\right)\right]^5}{6.67408 \cdot 10^{-11}\left(\frac{m^3}{kg \cdot s^2}\right) \cdot 6.626070040 \cdot 10^{-34}\left(\frac{kg \cdot m^2}{s}\right)}} = 7.39995 \cdot 10^{42}\left(s^{-1}\right).$$

The found value of ν_G allows determining its other waves and substantial parameters gravitational field, the main ones being as follows:

The period T_G of oscillation wave: $$T_G = \frac{1}{\nu_G} = \frac{1}{7.39995 \cdot 10^{42}(s^{-1})} = 1.35136 \cdot 10^{-43}(s).$$

The wavelength λ_G of the oscillation: $$\lambda_G = \frac{\tilde{n}}{\nu_G} = \frac{0.299792458 \cdot 10^9 \left(\frac{m}{s}\right)}{7.39995 \cdot 10^{42}\left(s^{-1}\right)} = 4.05128 \cdot 10^{-35}(m).$$

The amplitude A_G of the oscillations which within $A_G = \lambda_G = 4.05128 \cdot 10^{-35}(m),$ the limits of the restriction of all interactions to the speed of light c at the frequency of oscillation period T_G, actually coincides with the wavelength λ_G:

Wave energy: $E_G = h\nu_G = 6.626070040 \cdot 10^{-34}(J \cdot s) \cdot 7.39995 \cdot 10^{42}(s^{-1}) = 4.90328 \cdot 10^9(J).$

On the basis of found parameters it is possible to define all the other parameters of gravitation field.

Biography

Valentiyn Alekseevitch Nastasenko, the Kherson State Maritime Academy Ukraine, faculties Electrical engineering and electronics, the department of transport technologies. Professor of the Department of Transport Technologies candidate of Dr. technical sciences. His scientific interests include quantum physics, the theory of gravitation, fundamentals of the material world and the birth of the universe and he has authored more than 50 scientific works in these spheres.

Nastasenko2004@ukr.net

High power/energy high repetition rate mono-module disk laser

V V Apollonov
Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia

The mono-module disk laser concept is an effective design for diode-pumped solid-state lasers, which allows the realization of lasers with super-high output energy/power, having very good efficiency and also excellent beam quality. Since the first demonstration by acad. N.G. Basov with colleagues of disk laser in 1966 the output power of mono-module disk has been increased to the level of few kW in Continuous Wave (CW) mode of operation. Well developed "Zig-Zag" disk laser technology does not look like as a perspective one for further output parameters growing. The scaling laws for mono-module disk laser design show that the limits for CW mode of operation is far beyond 100 kW for output power and the energy can be higher than 100 J in pulse-periodic mode of operation. Due to the efficient porous cooling technology and possibility of amplified spontaneous emission (ASE) suppressing the operation of the big size mono-module disk laser geometry is possible in CW and pulse-periodic (P-P) modes at extremely high output energy/power.

Biography

V V Apollonov is a leading specialist in the area of basic principles of creation and development of high power laser systems and high power laser radiation interaction with matter. He is the author of 1920 publications (18 books, 546 presentations, 148 patents, 954 articles and 92 chapters. He is the Member of European and American Physical Society, SPIE, AIAA, American Society for QE and the Member of Specialized Scientific Council of Russia. He is a Full Member of Russian Academy of Natural Science and Academy of Engineering Sciences, Member of the Presidium RANS.

vapollo@kapella.gpi.ru

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