tra of the ensemble of NV centers in diamond

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The electron spin of the nitrogen-vacancy color centers in diamond is one of the most promising multifunctional quantum systems that has shown a great potential as a sensitive and high-resolution detector of a number of physical quantities, such as electric field, magnetic field, pressure, and temperature. In this study, we experimentally investigated the impact of the weak magnetic field on the photoluminescence of the ensemble of NV centers in diamond. Two resonances were revealed in the region of weak magnetic fields: the first resonance with a width of the order of 20 G, and the second resonance with a width of the order of 180 G. We investigated the factors affecting the amplitude of these resonances. The presence of these optical resonances makes it possible to propose a new concept for creating magnetic field sensors based on a diamond with an ensemble of NV centers without the use of a microwave field.

Tu14P-7 (poster)

Studies in the volume and properties of bound bipartite entangled states via the best separable approximation

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We use the linear programming algorithm introduced in [1] to perform Best Separable Approximation [2] on random sets [3] of density matrices representing bipartite systems of two qutrits. It is known that for this case a small volume of PPT (bound) entangled states exist, and these states form layers on the outer surface of polytope of separable states. We devise a method for estimating from our numerical results the thickness of these layers as well as the percentage of the surface of the separable polytope covered by these. We çompare these results with studies in bipartite systems of dimension 12 and we draw preliminary conclusions on the growth of volume of bound entangled bipartite states with the dimension of the Hilbert space.

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Tu14P-8 (poster)

Methods of revealing unambiguous state discrimination attack on subcarrier wave quantum key distribution system

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In this work we investigate the advanced unambiguous state discrimination (USD) attack that is crucial for quantum key distribution based on coherent states, particularly for subcarrier wave quantum key distribution. In this work we give the detailed description of the attack and propose the general approach for countermeasures.
The sketch of the attack when mutual information between Eve and Bob might be higher than Holevo bound is as follows. We consider that Eve change the actual channel to lossless (or with lower losses) one and performs USD (in general case it might be only performed on only some part of the states). In case of unambiguous identification of the state Eve resends amplified version (in order to maintain the detection rates) of the state to Bob. Otherwise she gets inconclusive result and resends vacuum states. Also Eve can perform additional bitflips in order to maintain error rates since amplified signal will produce less errors. The strategy allows Eve to provide zero-error attack keeping up to 100% of shared bits between Alice and Bob and maintaining both raw key rates and error rates.
We would like to investigate the general conditions that do not allow Eve to maintain detection rates. The proposed analysis seems to be the missing part for extension of the security proofs to the field of implementations based on coherent states and/or without assumption of impractical measurement in Breidbart basis.

Tu14P-9 (poster)

Low-temperature luminescence spectroscopy of nanocomposites with colloidal CdSe quantum dots: study of electron-phonon interaction

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Fabrication and study of photo-physical properties of semiconductor quantum dot-doped solid materials are important and urgent trends of modern physics and materials science. Nanocomposites with semiconductor colloidal quantum dots are used as effective light-emitting devices, luminescent labels [1], gain media for laser generation, sources of nonclassical light for quantum optics and informatics, elements for photovoltaic devices and nanoelectronics. In addition, such structures can be used as multiparameter nanosensors (see e.g. [2]), in particular, as temperature sensors [3]. Developing of a new QD-based materials extremely requires the fundamental study of dynamical processes in QDs themselves whereas search for a new QD labels is related to clarifying the question about their interaction with a solid matrices, in particular, electron-phonon interaction. One of the most effective techniques to study dynamical properties of QD-doped solids is the photon echo spectroscopy [4,5] but conventional luminescence spectroscopy supplemented by temperature measurements also may be useful in such type of studies (see, e.g. [6]).
In this paper we studied CdSe quantum dots (both only cores and ones coated with

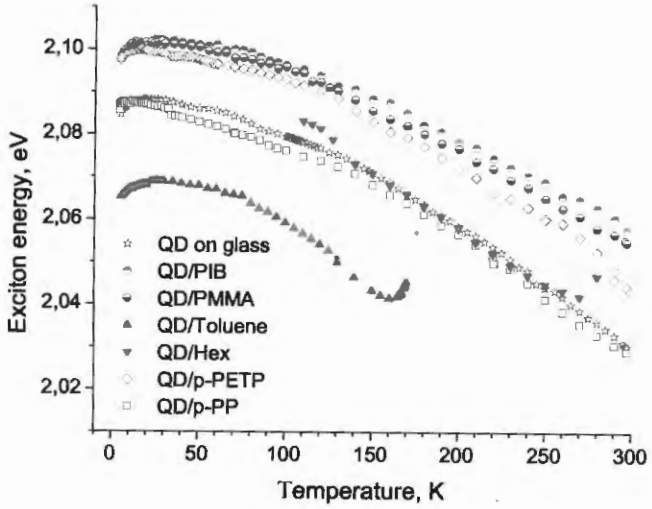

Figure Tu14P-9

Temperature dependences of the exciton energy of CdSe QDs: spread on glass plate and embedded in polyisobutylene (PIB), polymethylmethacrylate (PMMA), frozen toluene (Toluene) and hexadecane (Hex), porous polyethylene terephthalate (p-PETP) and polypropylene (p-PP).

different shells) in free form and embedded in different solid matrices. We measured the temperature dependences of the luminescence spectra (exciton energy) of nanocomposites. With the temperature decrease, the maxima of the exciton bands in a luminescence spectra shift to the UV spectral range (see Fig. Tu14P-9). The temperature shift of the exciton luminescence spectrum can be described using the equation, derived by O'Donnell and Chen [7]. Theoretical model that takes into account the electron-phonon interaction made it possible to quantitatively describe the temperature dependences of the exciton luminescence spectra of QDs, as well as to determine the values of the Huang-Rhys factor and the average energy of phonons in nanocrystals.

Describing the temperature behavior of the position and width of the luminescence spectra of QDs one should take into account an interaction of the electronic transition of the impurity with vibrational excitations, e.g. with local or quasi-local phonons in a solid matrix. In this connection, we have studied the influence of the matrix on luminescence properties of different QD-doped nanocomposites: polymers, frozen glasses and liquid crystals. In addition we studied the temperature changes in the exciton maxima widths. The combination of tbe photon echo and luminescence spectroscopy is a powerful method to study the ultrafast processes of interaction of the impurity ensemble of QDs with a solid matrix as well as the intrinsic dynamics of quantum dots themselves.

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Tu14P-10 (poster)

Optimal Correlation Width for Quantum Imaging

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It is widely known that imaging resolution defined by Rayleigh criterion is $\sqrt{2}$ times better for imaging with correlated photon pairs than for coherent light [1]. However, imaging resolution description in terms of Rayleigh criterion is suitable for direct image observation, but does not provide any