A41: Scattering resonances for ultracold atoms in periodically modulated traps

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Interaction control in ultra-cold atomic gases is one of the most breakthrough in atomic physics. Now one can routinely changes the scattering length over a broad range from attractive to repulsive by changing an external magnetic field. In this talk, we discuss an extended proposal to tune the interaction also by an external periodic modulation. Here, we consider an interacting Bose gas where: i) the interaction between the atoms is described in terms of the Fermi pseudopotential, and ii) the external trap is isotropic allowing the decoupling of center of mass and relative degrees of freedom. There, it is possible to drive the particles into resonance with bound molecular states that induces resonant scattering. In the vicinity of this resonance, a "dressed" molecular state exists with a finite lifetime due to the interaction with an external modulation. This effects are reflected in the interaction characteristics in the reduced dimensional system when some directions in the atomic motion are essentially frozen. In particular, we discuss the Fano resonance line shape of the one dimensional scattering strength and its dependence on the modulation characteristics.

A42: Quantum Speed Limit Time in the Thermal Spin-Boson System with and without Tunneling

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In this paper, we study the spin-boson model with and without tunneling terms, in detail. The spin-bosonic model without tunneling is studied by using the thermofield dynamics approach. By considering temperature, we show that states of the environment, while they become entangled with system, approach thermal coherent states with different phases. In addition, we achieve a criterion for driving the quantum speed limit time. Based on this criterion, we study the interplays of the environmental cutoff frequency as well as the impacts of environmental temperature on the quantum speed limit time, in both cases, i.e., spin-boson system with and without tunneling. We indicate that increasing temperature as well as cutoff frequency will make the quantum speed limit time is decreased, in the spin-boson without tunneling term, despite the fact that is increased in the spin-boson system with tunneling term.

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B01: Elegant vector Laguerre-Gaussian beams as normal modes at planar photonic structures

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Although the notion of elegant (complex-valued) Gaussian beams was introduced by Siegman a long time ago [1], they are still considered mostly as the scalar solutions to paraxial approximation of the Helmholtz equation. Moreover, their nonparaxial counterparts are usually obtained in terms infinite series in powers of a small parameter yielding only successive corrections to the paraxial solutions [2]. On the other hand, the

different approach to the beam or pulse propagation problems, that based on a bidirectional spatiotemporal representation of the beam field governed by a complete set of Maxwell's equations, has been also proposed in the past [3, 4]. This technique has been extensively used, for example, in construction localized pulse solutions in the shape of fundamental Gaussian beam with modified power spectrum, like focus wave modes or x-waves [5]. However, the similar approach can be also applied efficiently to problems of propagation of paraxial or nonparaxial beams of higher order than that of the fundamental Gaussian, in addition possessing their vortex spatial phase structure. In this report it is shown how to obtain the exact closed-form bidirectional vortex beam solutions by use of the elegant Laguerre-Gaussian (eLG) functions [6, 7]. These functions are obtained by derivatives of the fundamental Gaussian beam of the elegant type in terms of new complex transverse spatial variables. TM and TE vector beam components are constructed from the complex Hertz potentials oriented in the propagation direction and generated by these eLG functions. Each transverse beam component comprises only two–nonparaxial and paraxial–field ingredients distinguished uniquely by a beam paraxial parameter and its inverse, respectively. This parameter is defined by the ratio of a waist radius to a diffraction length of the beam. In the case of beam incidence onto a planar multilayer, the beam TM and TE transverse field components satisfy reflection and transmission matrix equations with generalized Fresnel coefficients of the structure being eigenvalues of these equations. Therefore, the solutions obtained appear suitable not only for the description of the vortex beam propagation in free space, but also for the more complex analysis of interactions of such beams with layered medium structures.

The final solutions consist of compositions of a few eLG vector beams, each of them is given in the exact analytical form obtained in a quite similar way to what is known from the paraxial treatment of beam-interface interactions [8]. Attractive properties of the eLG vortex beams, especially related to their helical phase structure, were experimentally demonstrated recently in the paraxial range of the eLG beams, in the context of optical trapping and manipulations of nanocontainers [9]. Moreover, the exact form of the eLG beam solutions should show their particularly attractive potential in a rigorous theoretical description of interactions of narrow beams, that is of the order of a field wavelength or less in their waists, with multi-layered and horizontally nanopatterned metasurfaces, metalenses and other modern nanophotonic components of flat optics.

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B02: Massive Generation of Contextual Quantum Sets

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"What gives quantum computers that extra oomph over their classical digital counterparts? An intrinsic, measurable aspect of quantum mechanics called contextuality, it now emerges." [1] This also gives an additional impetus to a massive generation of Kochen-Specker (KS) contextual sets we started in [2-5].

In this talk we shall present new classes of such sets in 4-, 6-, and 8-dimensional Hilbert spaces with billions of KS sets each as well as methods we make use of to generate them. The main breakthrough in massive generation of KS sets has been achieved by representing them by means of the so-called MMP diagrams which are