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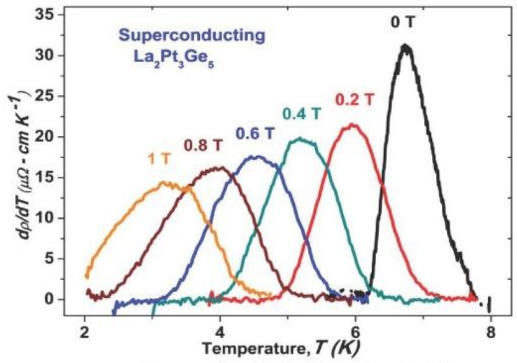
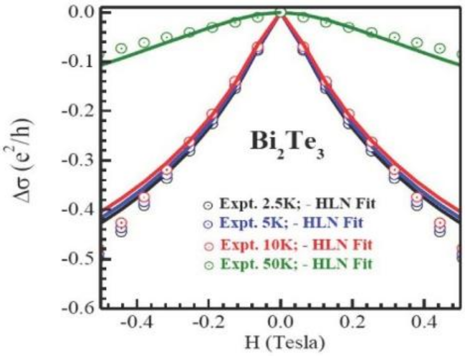
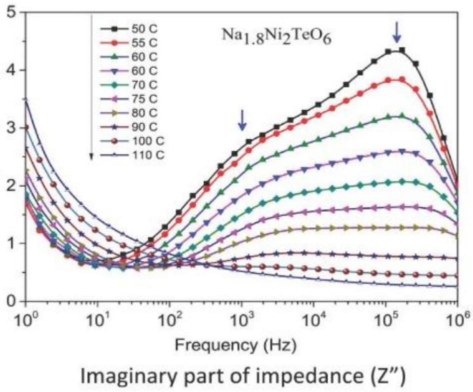
Editors • Arup Biswas, Veerendra K. Sharma and S. M. Yusuf



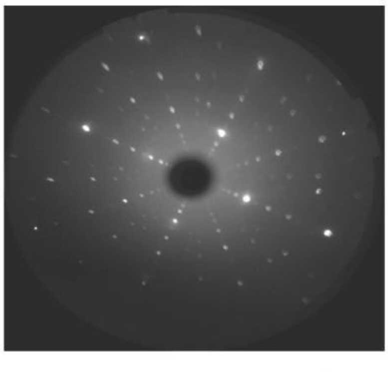
First order derivative of resistivity



Magneto-conductivity



Imaginary part of impedance (Z")



Laue diffraction pattern of SnTe(100)

CONTRIBUTED PAPERS

Light up-conversion and structural properties of Sn and Er^{3+} doped $Ba_{.995}$ $Er_{.005}$ $(Sn_{.06}Ti_{.94})O_3$ ceramics

Mohd. Azaj Ansari; K. Sreenivas

AIP Conf. Proc. 2115, 030001 (2019) https://doi.org/10.1063/1.5112840

Abstract | View article | PDF

Influence of thermal annealing on phase transformation in $Bi_{10}As_{40}Se_{50}$ thin films

Mukta Behera; N. C. Mishra; R. Naik

AIP Conf. Proc. 2115, 030002 (2019) https://doi.org/10.1063/1.5112841

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Pressure induced re-entrant order-disorder like structural phase transition in spinel ferrite nanoparticles

Shekhar Tyagi; Ajay K. Rathore; Gaurav Sharma; Binoy Krishna De; Vivek Dwij; Hemant Singh Kunwar; V. G. Sathe

AIP Conf. Proc. 2115, 030003 (2019) https://doi.org/10.1063/1.5112842

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Crystal structure of Sb_8Te_3 and $Sb_{10}Te_3$

C. Rangasami

AIP Conf. Proc. 2115, 030004 (2019) https://doi.org/10.1063/1.5112843

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Theoretical prediction of high pressure phase transition and elastic properties of Samarium arsenide (SmAs)

Namrata Yaduvanshi; Shilpa Kapoor; Sadhna Singh

AIP Conf. Proc. 2115, 030005 (2019) https://doi.org/10.1063/1.5112844

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Coexistence of relaxor and normal ferroelectricsin $(Ba_{0.82}\ Sr_{0.02}Ca_{0.16})Ti_{0.9}$ $Zr_{0.1}O_3$

Tusita Sau; Poonam Yadav; N. P. Lalla

AIP Conf. Proc. 2115, 030006 (2019) https://doi.org/10.1063/1.5112845

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Pressure induced phase transition in U_2C_3 under pressure: An *ab-initio* investigation

B. D. Sahoo; K. D. Joshi; T. C. Kaushik

AIP Conf. Proc. 2115, 030007 (2019) https://doi.org/10.1063/1.5112846

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Electrical properties of $Ba(Ni_{1/3}Ti_{1/3}W_{1/3})O_3$ ceramic

Prabhasini Gupta; P. K. Mahapatra; R. N. P. Choudhary

AIP Conf. Proc. 2115, 030015 (2019) https://doi.org/10.1063/1.5112854

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Spin-1 bosons in optical superlattice

Chetana G. F. Gaonker; B. K. Alavani; A. Das; R. V. Pai

AIP Conf. Proc. 2115, 030016 (2019) https://doi.org/10.1063/1.5112855

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Preparation of low-cost porous mullite balls from kaolin and alumina using naphthalene as pore-former

Amit Kumar Yadav; Lubna Farheen; Sunipa Bhattacharyya

AIP Conf. Proc. 2115, 030017 (2019) https://doi.org/10.1063/1.5112856

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Theoretical and experimental investigation of different phases in as cast equiatomic CrFeMoNbV alloys

A. Saikumaran; R. Mythili; S. Saroja; K. A. Irshad; S. Kalavathy; Rajesh Ganesan

AIP Conf. Proc. 2115, 030018 (2019) https://doi.org/10.1063/1.5112857

Abstract View article PDF

Spin-1 Bosons in optical superlattice

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Abstract. In this paper, we analyze superfluid, insulator and various magnetic phases of ultracold spin-1 bosonic atoms in two-dimensional optical superlattices. Our studies have been performed using Cluster Mean Field Theory. Calculations have been carried out for a wide range of densities and the energy shifts due to the superlattice potential. We find superlattice potential do not change the symmetry of the polar superfluid phases. Superlattice potentials induce Mott insulator phases with half-integer densities. The phase diagram is obtained using superfluid density, nematic order and singlet density. Second order Rényi entanglement entropy is also calculated in different phases. The results show that Rényi entanglement entropy is large in the nematic Mott insulator phase.

INTRODUCTION

Ultracold atoms in optical lattices and superlattices provide us with the realization of engineered quantum many-body lattice models [1]. One remarkable development in this context is the realization of Bose gases in the optical lattices. Superfluid (SF) to Mott Insulator (MI) quantum phase transition in cold bosonic atoms has received great scientific attention since its theoretical prediction in the context of Bose Hubbard model (BHM), and followed by its experimental realization [2-4]. When traps are purely optical, Alkali atoms like ^{87}Rb, ^{23}Na and ^{30}K, with hyperfine spin F=1, have spin degrees of freedom and thus, the interaction between bosons is spin-dependent [5]. The interaction is ferromagnetic (e.g. ^{87}Rb) or anti-ferromagnetic (e.g. ^{23}Na), depending upon scattering lengths of singlet and quintuplet channels [6]. The spin-dependent interaction in spinor gases exhibits richer quantum effects than their single-component counterparts and it not only modifies the nature of phase diagrams but also allows the study of superfluidity and magnetism.

The optical superlattices are obtained by super-imposition of two monochromatic lattices with slightly different wavelengths [7]. Manipulating the relative phase between the two standing waves and their respective depths independently, a periodic pattern of potential wells with two different depths at two adjacent sites is obtained. This difference in the depth of two adjacent sites is the measure of superlattice potential. In this report, we investigate spin-1 ultracold bosons loaded into 2-dimensional bi-chromatic optical superlattices.

MODEL AND METHOD

The spin-1 Bose–Hubbard model, which describes spin full bosons in an optical superlattice, is given by

$$\mathcal{H} = -t\sum_{\langle i,j\rangle,\sigma}\left(a^{\dagger}_{i,\sigma}a_{j,\sigma} + a^{\dagger}_{j,\sigma}a_{i,\sigma}\right) + \frac{U_0}{2}\sum_i \hat{n}_i(\hat{n}_i - 1) + \frac{U_2}{2}\sum_i(\vec{F}_i^2 - 2\hat{n}_i) - \sum_i \mu_i\hat{n}_i, \quad (1)$$

where first term represents hopping of bosons between nearest neighbour sites $\langle i,j\rangle$ with an amplitude *t*. Here $a_{i,\sigma}$ ($a^{\dagger}_{i,\sigma}$) represents annihilation (creation) operator at site *i* with spin projection $\sigma = \{-1, 0, 1\}$, number operator $\hat{n}_{i,\sigma} = a^{\dagger}_{i,\sigma}a_{i,\sigma}$ and $\hat{n}_i = \sum_\sigma \hat{n}_{i,\sigma}$. Spin operator $\vec{F}_i = (F_i^x, F_i^y, F_i^z)$ where $F_i^\alpha = \sum_{\sigma,\sigma'} a^{\dagger}_{i,\sigma} S^{\alpha}_{\sigma,\sigma'} a_{i,\sigma'}$ with $\alpha = x, y, z$ and $S^{\alpha}_{\sigma,\sigma'}$ are standard spin-1 matrices. Spin independent (dependent) interaction $U_0(U_2)$ arises due to the difference in the scattering length a_0 and a_2 in the spin S=0 and S=2 channels respectively. The spin dependent interaction U_2 can be positive (anti-ferromagnetic) or negative (ferromagnetic) depending on the values of a_0 and a_2 [5]. The site dependent chemical potential $\mu_i = \mu + (-1)^i\delta$ where μ controls the bosons density and δ is the shift in energy due to superlattice potential. Here, we consider a bi-chromatic superlattice and thus, the whole lattice is bipartite into A and B sub-lattices with $\mu_A = \mu + \delta$ and $\mu_B = \mu - \delta$.

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