MM 19 Electronic Properties I

Time: Tuesday 16:30–17:45 Room: IFW B

MM 19.1 Tue 16:30 IFW B

Correlation-induced double-plasmon excitations in simple metals studied by inelastic x-ray scattering — •C. Sternemann[1], S. Huotari[2], G. Vankó[2], M. Volmer[1], H. Sternemann[1], G. Monaco[2], A. Gusarov[3,4], H. Lustfeld[3], K. Sturm[3], M. Tolan[1], and W. Schülke[1] — [1]Institute of Physics / DELTA, University of Dortmund, D-44221 Dortmund, Germany — [2]European Synchrotron Radiation Facility, BP 220,*F-38043 Grenoble Cedex, France — [3]Institut für Festkörperforschung, Forschungszentrum Jülich GmbH, D-52425 Jülich, Germany — [4]SCK · CEN, Belgium Nuclear Research Centre,*Boeretang 200, B-2400 Mol, Belgium

Peaklike structures in the high energy-loss tail of the dynamic structure factor of simple metals were predicted by many-body perturbation theory of the homogeneous electron gas beyond the random-phase approximation [1]. Such structures were experimentally observed in the dynamic structure factor of Aluminium and, based on a comparison with the calculations, were attributed to intrinsic double-plasmon excitations because of the distinct momentum transfer dependence of their energy position and intensity [2]. A systematic inelastic x-ray scattering study of this kind of excitations for different materials as a function of electron density was accomplished recently at beamline ID16 of the European Synchrotron Radiation Facility. The measured spectra of the intrinsic plasmon-plasmon excitations will be discussed and compared with corresponding calculations.

[1] K. Sturm and A. Gusarov, Phys. Rev. B **62**, 16474, (2000).
[2] C. Sternemann *et al.*, Phys. Rev. Lett. **95**, 157401, (2005).

MM 19.2 Tue 16:45 IFW B

Cold-atom systems as solid-state simulators: the issue of trapping — •Chris Hooley[1] and Jorge Quintanilla[2] — [1]School of Physics and Astronomy, University of St Andrews, North Haugh, St Andrews, Fife KY16 9SS, U.K. — [2]ISIS facility, Rutherford Appleton Laboratory, Chilton, Didcot, Oxfordshire OX11 0QX, U.K.

Since the achievement of Bose-Einstein condensation in cold trapped gases in 1995, much attention has been devoted to experiments on such systems. Some of this work has involved the imposition of laser standing waves (so-called 'optical lattices') on the atom gas. It has been proposed that such set-ups could be used as simulators — or, more accurately, analogue computers — of the solid state, with the atoms playing the role of electrons and the laser standing wave playing the role of the periodic ionic potential. Immanuel Bloch poetically called these "artificial crystals of light".

In this talk, we critically assess this proposal, concentrating in particular on one important difference between the atom-gas system and the solid state: in the solid state, electrons are confined by hard-wall boundaries, whereas in the atom-gas, they are more usually trapped by a smooth (often harmonic) effective potential. We demonstrate that this can make a qualitative difference to the behaviour of such systems, and explore how the 'simulator' proposal needs to be modified accordingly. We compare our results with recent experimental and numerical work.

MM 19.3 Tue 17:00 IFW B

Electron-phonon coupling reflecting dynamic charge inhomogeneity in copper-oxide superconductors — •D. Reznik[1], L. Pintschovious[1], M. Ito[2], S. Iikubo[2], M. Sato[2], H. Goka[3], M. Fujita[3], K. Yamada[3], G. Gu[4], and J.M. Tranquada[4] — [1]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, P.O.B. 3640, D-76021 Karlsruhe, Germany — [2]Department of Physics, Division of Materials Science, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8602, Japan — [3]Institute for Material Research, Tohoku University, Katahira, Aoba-ku, Sendai, 980-8577, Japan — [4]Physics Department, Brookhaven National Laboratory, Upton, New York 11973

The attempt to understand cuprate superconductors is complicated by the presence of multiple strong interactions. While many believe that antiferromagnetism is important for the superconductivity, there has been resurgent interest in electron-lattice coupling. The conventional superconductor MgB2 has a very strong electron-lattice coupling predicted by standard theory. We show that there is a similarly strong anomaly in the Cu-O bond-stretching phonon in cuprate superconductors however, this behavior is completely absent in conventional calculations. Instead, the anomaly is strongest in compounds that exhibit static stripe order. It occurs at a wave vector corresponding to the charge order. The results suggest that this giant electron-phonon anomaly, which is absent in undoped and over-doped non-superconductors, is associated with charge inhomogeneity. It follows that electron-phonon coupling may be important to understanding superconductivity although its contribution to the mechanism is likely indirect.

MM 19.4 Tue 17:15 IFW B

Effect of Mn doping on the specific heat of the high Tc superconductor YBaCuO — •Ashok Rao[1], Radhe Shyam[1], Anirban Das[1], Y. F. Lin[2], K.M. Sivakumar[2], Y. -K Kuo[2], Bhasker Gahtori[3], and S K Agarwal[3] — [1]Sikkim Manipal Institute of Technology, Majitar,Rangpo, Sikkim-737132,India — [2]Department of Physics, National Dong-Hwa University, Hualien 974, Taiwan — [3]National Physical Laboratory, K.S. Krishnan Marg, New Delhi-1100012, India.

There have been several efforts to get new super conducting materials while seeking to explain the transport mechanism in ceramic high temperature superconductors [1].Several investigators have carried out the substitution effects in the high Tc superconductors which has helped in understanding the mechanism of superconductivity and to improve the magnetic properties, like flux pinning etc.We present first reports of the investigations of specific heat on Mn-doped compounds Y1Ba2 (Cu1-xMnx)3Oy ($0 < x < 2\%$). The specific heat of the samples was determined using high-resolution ac calorimeter. It is observed that the transition temperature of Mn doped samples of YBaCuO samples do not change appreciably.Jump in specific heat was observed for samples with low concentration of Mn, however for concentrations above 1%, small change in slope is observed. It may be mentioned that replacing 0.5% Cu by Mn has little effect on the transition temperature; however, the jump decreases by a factor of 3.This clearly demonstrates that these constituents are being incorporated into the superconductors as a whole and not in the form of a local cluster. References 1.Rao A 2004 J. Phys. Condens. Matter 16 1439

MM 19.5 Tue 17:30 IFW B

Structural and Electronic properties of the Layered $Na_{0.46}CoO_2$ — •Dimitri Argyriou[1], L.C. Chapon[2], C. Milne[1], O. Prokhnenko[1], and P.G. Radaelli[2] — [1]Hahn-Meitner-Institut, Glienicker Str. 100, Berlin D-14109, Germany — [2]ISIS Facility, Rutherford Appleton Laboratory, Chilton, Didcot, UK

The onset of antiferromagnetic ordering coupled to a sharp rise in the resistivity of $Na_{0.5}CoO_2$ has recently been taken as evidence of charge ordering in this half doped cobaltate[1]. We have used neutron powder diffraction to investigate the lattice response to this charge and magnetic ordering using high resolution powder diffraction from 2 till 600K. Our sample is a little off the ideal composition x=0.46, but shows the identical transitions at T_{co}=52K and at 87K, as other single crystal sample of nominal x=0.5 composition. We find that the orthorhombic structure of $Na_{0.46}CoO_2$ (P*nmm*) is stable from 460K to 2K, even below the charge ordering transition at 50K. At room temperature we can clearly identify two Co sites which are distinguishable from their octahedral distortions. One site, labeled Co(1) is at the center of a CoO_6 octahedron that shows an octahedral distortion 5 times larger than the octahedron centered in the Co(2) site. The average bondlength for both Co sites is essentially the same, 1.890Å, suggesting the same bond-valence. With lowering temperatures below T_{co}, we find no anomalies in Co-O bondlengths or octahedral distortion parameters, suggesting that the sharp increase in the resistivity at 50K may arise from an effect other than charge ordering.

[1] M.L. Foo, et al. Phys. Rev. Lett. 92, 247001 (2004).