Interplay between superconductivity and CDW in Cuprates and dichalcogenides form IXS

M. Le Tacon*[1], S.M. Souliou[1,2], A. Bosak[2], M. Leroux[3], P. Rodiere[3], I. Errea[4], M. Calandra[5], B.Keimer[1]

[1]Max-Planck-Institut fur Festkorperforschung, Heisenbergstrase 1, D-70569 Stuttgart, Germany
[2]European Synchrotron Radiation Facility, Grenoble, France
[3]Universite Grenoble Alpes, CNRS, Institut Neel, F-38000 Grenoble, France
[4]IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain
[5]IMPMC, UMR CNRS 7590, Univ. Paris 06, 75005 Paris, France

I will focus on the interplay between superconductivity and charge density waves in superconducting cuprates and dichalcogenides.

High resolution inelastic x-ray scattering was used to observe of a quasi-elastic 'central peak' in underdoped $YBa_2Cu_3O_{6.6}$, demonstrating the static nature of the CDW correlations, attributed to the pining of CDW nanodomains on defects [1]. Low energy phonons also exhibit anomalously large superconductivity induced renormalizations close to the CDW ordering wave vector, providing new insights regarding the long-standing debate of the role of the electron-phonon interaction, a major factor influencing the competition between collective instabilities in correlated-electron materials. Relationship to the well-known anomalies in reported in the higher energy phonon branches will be discussed. Finally, dependence of these effects with pressure will be reported.

Pressure has also been used to tune the ground state of a less correlated material, 2H-$NbSe_2$. There a fast hardening of the soft phonon mode with pressure is observed, much faster than predicted by calculations carried out at the harmonic level. Inclusion of the full anharmonic potential in the calculation yields an excellent agreement with the experimental data, and further allows demonstrating the major role of the electron-phonon interaction in the superconducting mechanism [2, 3].

References

[1] M. Le Tacon *et al.*, Inelastic X-ray scattering in $YBa_2Cu_3O_{6.6}$ reveals giant phonon anomalies and elastic central peak due to charge-density-wave formation. *Nat. Phys.* **10**, 52-58 (2014).

[2] M. Leroux *et al.*, Strong anharmonicity induces quantum melting of charge density wave in 2H-$NbSe_2$ under pressure. *Phys. Rev. B* **92**, 140303 (2015).

[3] M. Leroux *et al.*, Anharmonic suppression of charge density waves in 2H-NbS_2. *Phys. Rev.* B **86**, 155125 (2012).

*Corresponding author: m.letacon@fkf.mpg.de