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Magnon Thermal Conductivity and Magnon Scattering in Low Dimensional Cuprates

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We have measured and analyzed the magnon heat conductivity $\kappa_{\rm mag}$ in several low dimensional cuprates containing antiferromagnetic chains, spin-laders and planes, respectively. From our data we have extracted the mean free path $\rm l_{mag}$ of the magnetic excitations using a simple kinetic model. From both, the temperature dependence of the mean free path and its changes as a function of doping we have investigated the relevance of different scattering processes. While non-magnetic Zn impurities have similar consequences for the heat transport in one- and two-dimensional systems our studies suggest pronounced differences in the case of the charge carrier doped compounds. While magnon-hole scattering almost completely suppresses $\kappa_{\rm mag}$ in the two-dimensional materials the strength of this scattering mechanism strongly depends on the hole-mobility in the hole doped spin ladders $(\rm Sr, Ca, La)_{14}Cu_{24}O_{41}$. In the latter compounds our analysis of $\kappa_{\rm mag}$ reveals a strong doping and temperature dependence of the magnon mean free path which is a local probe for the interaction of magnons with the doped holes. In particular, our novel approach to studying spin degrees of freedom via the heat conductivity shows that charge ordering of the holes in the ladders leads to a freezing out of magnon-hole scattering processes.

Keywords : magnon heat transport, low dimensional cuprates