Optical Investigation on the Effect of Vortex Domains on Electronic Transitions in HoMnO$_3$ Single Crystals

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— We investigated on the effect of vortex domain on the electronic transitions of HoMnO$_3$ using optical spectroscopy. We observed different characteristics for d-d and p-d electronic transitions, which are centered near 1.7 eV and 5 eV at room temperature, respectively. The band edge energy of the p-d transition with vortex domains appears to show a clear increase which is attributed to the reduced hybridization between O p and Mn d states, while characteristics of the d-d transition does have distinct difference between vortex and normal states. However, from temperature dependent measurement, on the contrary, we observed the peak position of the d-d transition varying significantly with temperature between 10K to 300K, while the edge energy of the p-d transition is almost invariable. Such huge shifts of the d-d transition peak energy with temperature is known due to the antiferromagnetic superexchange interaction between nearest-neighbor Mn ions separated by oxygens.

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