Exchange Anisotropies in Quasi-1D $CuSe_2O_5$ as Revealed by ESR

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The ground state of quasi-1D spin S = 1/2 systems is extremely sensitive to the presence of symmetric and/or antisymmetric anisotropic exchange [Dzyaloshinskii-Moriya (DM) interaction]. Effects on the EPR spectra of these anisotropies along with the staggered g tensor of 1D spin-1/2 systems were studied by Oshikawa and Affleck (OA). We use their theory to explain the ESR results on $CuSe_2O_5$, a quasi-1D spin-1/2 system with intrachain interaction J =160K, in which the staggered g tensor and the DM interaction are allowed by symmetry (Fig. 1).

Electron spin resonance presents one of the most powerful techniques for studying such systems since the presence of anisotropies is reflected in the linewidth of the measured spectra, which are also affected by the staggered field and DM interaction (see Fig. 2). For these reasons, performing the high-field measurements at NHMFL was crucial for this project.

Combining the ESR results with the OA theory we discovered that both the symmetric and the antisymmetric (DM) anisotropic exchange are present in $CuSe_2O_5$, with J_c=0.04J and the DM vector **D**=(-0.044, 0 ,± 0.0255)J (Figs. 2. and 3.)

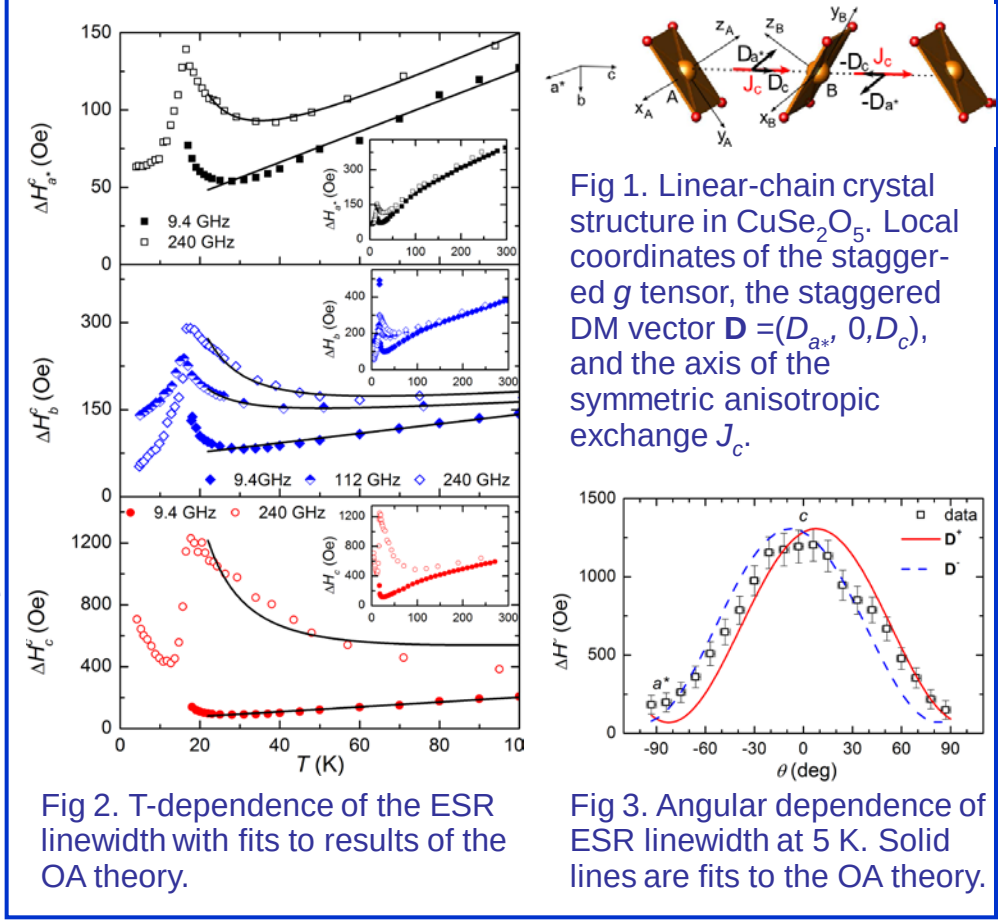

Fig 1. Linear-chain crystal structure in $CuSe_2O_5$. Local coordinates of the staggered g tensor, the staggered DM vector **D** =(D_{a*}, 0,D_c), and the axis of the symmetric anisotropic exchange J_c.

Fig 2. T-dependence of the ESR linewidth with fits to results of the OA theory.

Fig 3. Angular dependence of ESR linewidth at 5 K. Solid lines are fits to the OA theory.

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