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Electron Spin Resonance study of the spin dynamics in three spin-1/2 dimer systems, CsV_2O_5, $VO(HPO_4)\cdot 0.5H_2O$ and $KZn(H_2O)(VO)_2(PO_4)_2(H_2PO_4)$

In the last few decades, low dimensional spin-gapped quantum systems have been widely studied due to the interesting low-lying magnetic excitations they exhibit. Such systems include spin-1/2 alternating chains [1], spin-Peierls systems [2,3], or finite-size systems constituted of an even number of antiferromagnetically (AF)-coupled spins [4,5]. Among the various experimental methods of investigation of these systems, Electron Spin Resonance (ESR) is particularly powerful because it is very sensitive to the anisotropic interactions in these systems. Although many ESR measurements have been reported on such systems, the interpretation of the temperature and angular dependence of parameters such as the ESR linewidth and the shift of the g-value remains somewhat problematic, because there is still no good theory which explains the behaviour of these parameters.

Among the available theories, the most used is the Kubo-Tomita theory [6] which treats the anisotropic interactions as a perturbation and predicts an exchange-narrowing of the ESR linewidth at infinite temperature in strongly correlated systems. More recently, applying the field theory approach to ESR, Oshikawa and Affleck [7] gave the linewidth profile for a spin-1/2 quantum AF chain at low temperature. Another method for interpreting the ESR measurements is the numerical calculation [8,9] of the ESR absorption parameters of the assumed models.

The seminar will focus on my PhD work which aims at investigating, by X-band Electron Spin Resonance spectroscopy, the magnetic properties of the low-dimensional quantum-spin systems, $VO(HPO_4)\cdot 0.5H_2O$ [10], $KZn(H_2O)(VO)_2(PO_4)_2(H_2PO_4)$ [11] and CsV_2O_5 [12], where the magnetic V^{4+} (S= 1/2) ions are arranged in pairs. By studying the temperature dependence as well as the angular dependence of the ESR spectra, we find that these systems, whose magnetic susceptibility may be well fitted either by the susceptibility of spin-1/2 dimer systems or the susceptibility of spin-1/2 AF alternating chains, show a change of behavior as a function of temperature: At room temperature, in accordance with the Kubo-Tomita prediction, an exchange narrowing phenomenon takes place, whereas linewidth broadening and then the appearance of a fine structure are instead observed for helium temperatures where spins are strongly correlated. By a numerical calculation of the ESR absorption parameters we show that this linewidth profile is much better fitted with the model of spin-1/2 AF alternating chains than with that of isolated spin-1/2 dimers. The experimental part of this work has already been published in reference [13].

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