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ADVANCED MATERIALS AND NANOTECHNOLOGY

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Dr. Vinicius SANTANA

São Carlos Physics Institute – University of Sao Paulo (IFSC/USP)

Exploring magnetic properties via Electron Spin Resonance

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Seminar room **S2.02** CEITEC
BUT, Purkynova 123

It took long from the discovery of antiferromagnetism in the 1930's until applications could take direct advantage of this phenomenon. Technological development enabled its use for magnetic memories and spintronics devices. Spin collective waves (magnons) are being explored to transport and process information, since spin current carried by magnons are free of Ohmic losses and wave frequencies can reach the promising THz range. Magnetic anisotropy plays an important role in magnetic materials and devices, providing the energy barrier to create different states (0's and 1's). Also, it is related to the canting of magnetic lattices, allowing control of resonance modes. Moreover, it is related to the relaxation time of the magnetization in molecular nanomagnets. Electron Spin Resonance (ESR or Electron Paramagnetic Resonance, EPR) has the capability to explore magnetic interactions and anisotropy besides being able to detect the local environment of paramagnetic systems and exchange coupled systems. Copper dimeric units have long been used as good model systems for studying magnetic interactions between spins in organic/inorganic frames. Synthesis of these frames, namely arrays of dimeric/polymeric units, provide a vast playground for tuning different properties such as the exchange coupling inside the units and among neighbouring units. I will present a weakly coupled antiferromagnetic copper dimer and discuss a dynamic quantum transition detected by ESR in this compound. I will show that the interdimeric exchange frequency collapses the fine structure given by the anisotropic zero-field splitting in the ESR spectra. This collapse allows estimating the interdimeric exchange coupling between neighbouring dimeric units in powder and polycrystalline samples. Also, I will present high-frequency ESR as a tool to calculate the magnetic anisotropy constant using antiferromagnetic resonance modes (magnon modes) in a multiferroic compound, $BiMn_2O_5$. Magnetic anisotropy may lead to magnetoelasticity, which is related to the ferroelectricity in this class of materials.