*Abstract:  Rare earth elements are known for their magnetic and optical properties, employed in a myriad of technological applications. We study the molecular manifestations of these properties using magnetic, spectroscopic and computational techniques. We are interested in understanding how molecular structure dictates the interactions 4f electron spins have with the environment (viz. vibrational or phonon states), with other electron spins, and with electric fields. In this talk I will discuss some of our recent works in this area.*