High Pressure Resonant Magnetic X-ray Scattering: Dream or Reality?

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Synchrotron radiation experiments and high pressure are two well suited techniques due to the fact that the synchrotron beam can be focussed on a small sample area, typically 100x100 microns, compatible with sample sizes used in high pressure, including with the diamond anvil cell. The scope for magnetic diffraction experiments under pressure is enormous, for the study of many magnetic phenomena beyond the pressure range achievable with neutron scattering techniques (usually 2-3 GPa). However several specificities of magnetic X-ray diffraction, notably the low energies, the large scattering angles, and the weak intensity of the magnetic signal, make this technique more difficult than most, to implement under pressure. We describe a specially designed pressure set-up to take into account these aspects and show initial results of resonant magnetic scattering under pressure on the $Ce(Fe_{1-x}Co_x)_2$ system. We also demonstrate the usefulness of the set-up which allows the pressure to be changed and measured at low temperature for other measurements such as structural studies and resonant x-ray absorption studies. This has been used for a recent study on samarium sulfide, allowing the determination of the lattice parameter and samarium valence changes at low temperature (T=4K) in the insulating, metallic and magnetic phases.