Muon Spin Relaxation Study on the Magnetic Order of π-electrons in the Cesium and Sodium Superoxide

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Alkali metal superoxides (AO_2) are one of ideal model systems to investigate the π-electron magnetism. The KO_2 and RbO_2 systems exhibit the antiferromagnetic (AF) order at temperature of 7 K and 15 K, respectively. Meanwhile, CsO_2 and NaO_2 have been less studied due to the difficulty in synthesizing samples. All AO_2 compounds undergo structural distortions splitting the degeneracy of π^* orbitals causing an magnetic ordered state, so that a magnetically ordered state is expected to appear below in CsO_2 as well [1,2]. In the case of NaO_2, very little is known about spin states at low temperauress while a 1D AF spin chain has again been predicted to form [3].

We have carried out muon-spin-relaxation (μSR) measurements on CsO_2 and NaO_2 at the RIKEN-RAL Muon Facility in the UK and at the Paul Scherrer Institut (PSI) in Switzerland in order to investigate the magnetic properties of these superoxides. Figure 1 shows the μSR time spectrum of CsO_2 in the zero-field condition. The appearance of the spontaneous muon-spin precession was observed below 10K indicating the formation of a magnetically ordered state. With further decreasing temperature below 10K, the frequency of muon spin precession became larger indicating the growth of internal fields at muon sites. At this moment, we did not observe any strong signs of the appearance of the magnetic order in NaO_2 down to 0.3K.

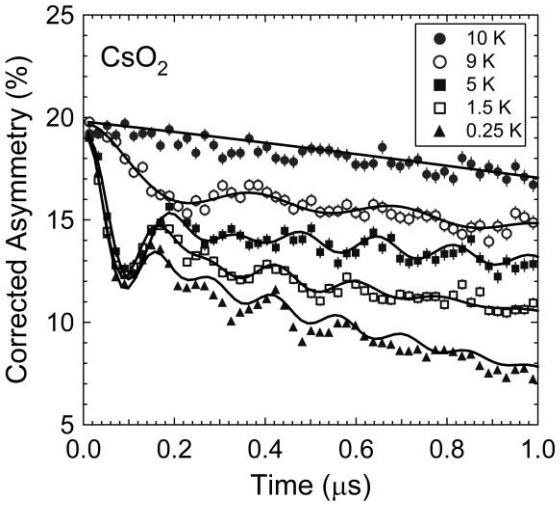

Figure 1: μSR time spectrum of CsO_2 measured in the zero-field condition at various temperatures.

References

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