

## Hyperfine Magnetic Fields Investigation in $\text{CeIn}_3$

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Rare earth and actinide metals, their alloys and intermetallic compounds are systems which generally present exotic properties related to a Fermi liquid behavior of highly correlated electrons. The  $\text{CeIn}_3$  intermetallic compound, with a cubic structure of the  $\text{AuCu}_3$  prototype, is one of these systems with a heavy fermion behaviour at low temperatures, exhibiting an antiferromagnetic order below 10K. In the present work a nuclear spectroscopy, the Time Differential Perturbed  $g$ - $g$  Angular Correlation (TDPAC), was used to measure the magnetic hyperfine field (MHF) at both Ce and In sites in  $\text{CeIn}_3$ . The  $^{111}\text{In}(^{111}\text{Cd})$  probe nucleus was used to investigate the In site, while the  $^{140}\text{La}(^{140}\text{Ce})$  probe nucleus was used to measure the MHF at the Ce site. The samples were prepared by arc melting the constituent elements in appropriate conditions. The results of TDPAC measurements at the In site below 10K showed an electric field gradient (EFG) of  $4.07 \times 10^{17} \text{ V/cm}^2$  and MHF increasing up to 0.2T; and a pure magnetic interaction with MHF increasing up to 33T was observed at the Ce site. Also, in this case, the magnetization curve could be adjusted to the function  $(1-T/T_N)^b$ ,  $b \gg 0.36$ , which includes this compound as a tridimensional "Heisenberg ferromagnet". The MHF at the Ce sites is dominated by the orbital contribution coming mostly from the 4f shell. As a result of APWM method calculation, the contributions of the 4f orbital fields for Ce in the  $\text{CeIn}_3$  and for free  $\text{Ce}^{3+}$  ions are quite different indicating that the 4f shell of Ce exhibits a significant change inside the  $\text{CeIn}_3$  compound. By other side, at the In position, both MHF and EFG originate from the 5p shell. The small value of MHF is due to different energy as well as spatial distribution of spins in 5p sub-shells. The polarization of the 5p sub-shells does not influence the EFG, as it does not occur in the region important for the EFG formation.