DE HAAS-VAN ALPHEN STUDY OF THE FERMI SURFACE OF Ce\textsubscript{x}La\textsubscript{1-x}B\textsubscript{6} AS A FUNCTION OF COMPOSITION: THE EVOLUTION OF FIELD-DEPENDENT QUASIPARTICLE EFFECTIVE MASSES

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Introduction

LaB\textsubscript{6} is a paramagnetic metal with an empty 4f shell whereas CeB\textsubscript{6} is a dense Kondo compound. The Fermi surface of CeB\textsubscript{6} resembles closely that of LaB\textsubscript{6}, suggesting that f electron might be localized. However, the large mass enhancement in CeB\textsubscript{6} suggest that the f electrons in CeB\textsubscript{6} are rather itinerant than localized. When the La ions are gradually replaced by Ce ions, which introduce the f electrons into the metal, it has been found that the FS topology and the quasiparticle effective masses transformed continuously from that of pure LaB\textsubscript{6} to that of pure CeB\textsubscript{6}. Moreover it is claimed that the dHvA signal originates from only a single spin FS sheet as the Ce concentration increases.

Results and Discussion

The de Haas-van Alphen effect has been studied in single crystals of Ce\textsubscript{x}La\textsubscript{1-x}B\textsubscript{6} (0 < x < 0.075) using pulsed magnetic fields at NHMFL-LANL of up to 60 T and temperatures 0.38 K < T < 4.0 K. The low-field effective mass grows smoothly with increasing x. Moreover, for x > 0, the effective mass becomes a function of magnetic field, decreasing as the field rises. These results may be fitted using the extended Lifshitz-Kosevich formalism due to Wasserman, the decrease in mass reflecting the suppression of spin fluctuations by the field. The data also show that a previously-observed effect, attributed to complete spin polarization of one of the Fermi-surface sheets for x ≥ 0.05, is in fact an artifact of the field-dependent mass, ignored in previous works.

![Figure 1](image1.png)

**Figure 1** Effective mass of α\textsubscript{3} orbit (F= 7800 kT) vs. B for different Ce doping concentrations.

**Figure 2:** Fit of the effective mass of α\textsubscript{3} orbit using Wasserman function\textsuperscript{2} for Ce 6.25% and 7.5% doping concentration. Similar fits are obtained for lower concentrations.

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References
