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The electronic states of Ce$_3$Sn$_7$

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Ce$_3$Sn$_7$ is an interesting antiferromagnet with a Néel temperatures of 5.3K. The crystal structure of Ce$_3$Sn$_7$ is orthorhombic but is close to tetragonal : a=4.524Å, b=25.742Å, c=4.610Å, which is a superstructure based on the cubic AuCu$_3$-type CeSn$_3$. From the neutron scattering and magnetization experiments, it was proposed by the Bonnet's group that the two Ce atoms at the 2(a) site possess a magnetic moment of 0.36 μ_B/Ce oriented along the [001] direction (c-axis) and one Ce atom at the 4(i) site possesses no magnetic moment.[1]

We measured the electrical resistivity, specific heat, magnetic susceptibility, high-field magnetization, thermal expansion and magnetostricition of an antiferromagnet Ce$_3$Sn$_7$ with the orthorhombic crystal strucuture. The experimental data are found to be well explained on the basis of the crystalline electric field (CEF) 4f-scheme. We also constructed the antiferromagnetic phase diagram for three principal directions. Furthermore, we carried out the de Haas-van Alphen (dHvA) experiment. Fermi surfaces are many in number but are extremely small in volumes, indicating that Ce$_3$Sn$_7$ is a semimetal.[2] We shows the angular dependence of the dHvA frequency for a main branch α as shown in Fig. 1.
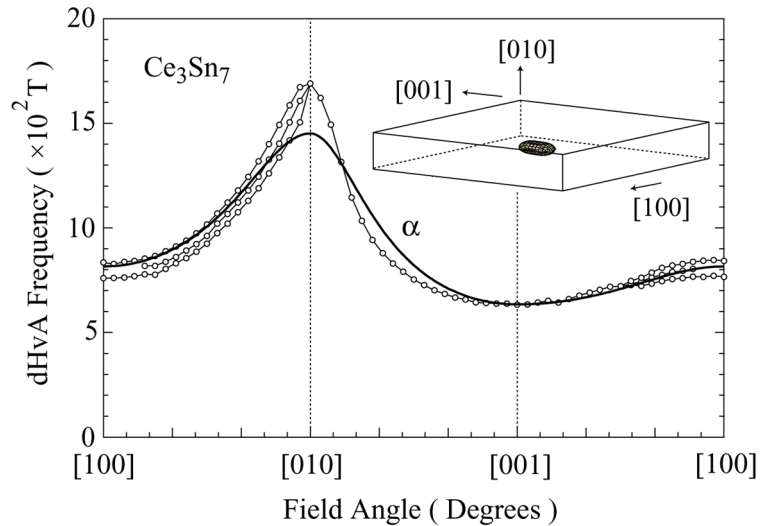

Figure 1: Angular dependence of the dHvA frequency for a main branch α in Ce$_3$Sn$_7$. The thick line indicates the ellipsoidal Fermi surface. The inset shows the Fermi surface of branch α in the flat Brillouin zone.

1) M. Bonnet *et al.*: J. Magn. Magn. Mater. **132** (1994) 289-302
2) Y. Okuda *et al.*: J. Phys. Soc. Jpn. **73** (2004) 2276-2282