9.7 cm

$Ce_3Pt_3Bi_4$, $Ce_3Pt_3Sb_4$, $Ce_3Au_3Sb_4$ AND $Ce_3Cu_3Sb_4$: KONDO INSULATORS, KONDO LATTICES, FERROMAGNETS, METALS OR SEMICONDUCTORS?

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$Ce_3Pt_3Bi_4$ was the material which first has been claimed to be a Kondo insulator. There is evidence, especially from the Knight shift that the magnetic susceptibility is zero for zero temperature, but there is a peak near 100 K. That is, Ce must be in a nonmagnetic state for $T \to 0$, namely Ce^{4+}. As well from resistivity as from optical reflectivity a gap of several meV has been deduced. The Luttinger theorem permits only the Fermi level in a gap with an even $f-d$ count, which is only the case for Ce^{4+}. The proximity of an empty $4f^1$ state above, but close to E_F leads to $f-d$ hybridization. Pt is electrically neutral in this compound. Similar, but not so pronounced in its effects is $Ce_3Pt_3Sb_4$. In $Ce_3Au_3Sb_4$ Au donates one electron to Sb, so Ce is Ce^{3+}, the material is antiferromagnetic and has no gap, at most a zero gap. In $Ce_3Cu_3Sb_4$ Cu donates also one electron to Sb, so Ce is again trivalent, and the material was claimed to be ferromagnetic, but it only has a spontaneous moment of 0.66 μ_B/Ce and is probably a canted antiferromagnet. It was also claimed to be a semiconductor, but resistivity, Hall effect and optical reflectivity clearly show that no gap exists.

13.4 cm

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