

When the Fermi surface is distorted by warping, the enclosed volume must remain unchanged from the spherical case. For warping of the form (IV-1) Cooper and Raimis [6] give the enclosed volume as

$$V = 4\pi/3 k_0^3 [1 + .57 A^2 + 1.85 A_1^2] \quad (IV-9)$$

We shall see later that $|A| < .04$ and $|A_1| < .09$ for all the alkali metals; in addition A and A_1 are always negative. Under these conditions the contribution of the terms in A^2 and A_1^2 to the expression in the bracket is less than 2 percent. To a good approximation the volume enclosed by the warped Fermi surface is just that of a sphere with radius k_0 , and since the enclosed volume must equal that of the Fermi sphere, k_0 equals k_s and

$$k_0 a/2\pi = .62 \quad (IV-9a)$$

The data of Ham were fitted by choosing a level of energy such that the maximum and minimum values of $ka/2\pi$ for this energy averaged to .62. The values of A , A_1 , and k_0 for this energy were computed using Eq. (IV-1) and values $ka/2\pi$ given by Ham's E vs. k curves. If the value of $k_0 a/2\pi$ obtained differed by more than 1 percent from .62 we repeated the procedure for a different value of energy.

In Table 4-1 we tabulate the results of this procedure. Since the actual curves of E vs. k are not shown we give the value of $ak/2\pi$ at the Fermi energy for the principal directions. The last figure on the values for A and A_1 is given even though the precision of the fit and of the E vs. k curves used does not justify it; rounding off would obscure some of the changes of warping parameter with lattice constant. In addition, the values of A and A_1 for cesium are sensitive to the choice of Fermi energy since k changes very rapidly with energy in this particular case. In Table 4-2 we give values of the warping parameters for lattice constants corresponding to atmospheric pressure and to $15,000 \text{ kg/cm}^2$; these values are obtained from a linear interpolation between the values of lattice constant shown in Table IV-1.

Examination of Table 4-1 shows that the k vectors in the 100 and 111 directions are usually equal; for this case (IV-1) leads to the condition $A = .47 A_1$. We have used this relation in computing B and B_1 for values of

A_1 between .00 and -.08, using the expressions given in Appendix 1. The result can be expressed as

$$B/A = B_1/A_1 = 3.3 - 60 A_1, \text{ for } A_1 < 0. \quad (\text{IV-10})$$

C. Dependence of n^* on Pressure

We have obtained a range of values for A and A_1 from Ham's work and we can express B and B_1 in terms of A and A_1 . We now notice that the terms arising from the sixth-order Kubic harmonics dominate the expression for n^* Eq. (IV-6). Using the relation (IV-10) for B and setting $C = 0$ we find that the terms in A and B contribute only about 1 percent to n^* for $|A| \leq .03$. We can simplify the fitting of the data with no significant error by considering only the contribution of terms in A_1 , B_1 , and C_1 to n^* . The expression for n^* then becomes:

$$n^* = 1 + 12.3 A_1^2 - 24.6 A_1 (C_1 - B_1) - .615 (C_1 - B_1)^2 \quad (\text{IV-11})$$

A non-zero value of C_1 can cause n^* to decrease as $|A_1|$ increases. Investigation of the behavior of n^* vs. A_1 for different forms of C_1 is straightforward but tedious. In Fig. 4-1 we give some curves of n^* vs. A_1 obtained using Eq. (IV-11) with the supplementary condition (IV-10) and various forms of C_1 . The values $C_1 = -.3$ and $C_1 = -.4$ were chosen because they represent the simplest non-zero C_1 's and because their magnitude gives values of n^* for $A_1 = 0$ that are in the same range as the observed values in the alkalis. The values $C_1 = -.3 + 4.5 A_1$ and $C_1 = -.4 + 5 A_1$ are chosen because the terms in A_1 approximately cancel the terms in A_1^2 occurring in the expression for n^* and give a steeper initial slope of the n^* vs. A_1 curve. Certain features of these curves should be noted.

They show that n^* can decrease as the warping, $|A_1|$, increases; the experimental data and Ham's calculations do not conflict.

The size of the changes in n^* produced by changes in A_1 of the magnitude indicated by Table 4-2 is consistent with the size of the observed changes. Looking at the part of the curve before the minimum we see that changes in A_1 of .02 produce changes of the order of 10 percent in n^* .