Fermi-liquid; this all, however, has to be checked. On the other hand the quasi 1D situation may be more favorable for the "preformed pairs" idea (see e.g. ref. [34]).

7. ON THE NATURE OF THE ORDER PARAMETER [35]

One of the hottest topics in the theory of high-T_c cuprates is the symmetry of the order parameter. One point of view is that the pairing is of "s-type", possibly anisotropic. According to this hypothesis the order parameter does not change its sign along the Fermi surface, and the energy gap has no nodes. This is confirmed by several experiments which definitely demonstrate a finite energy gap, e.g. the Knight shift [36], tunneling conductance in BiSCCO [37] and HgBCCO [38]. The most convincing argument in favor of this point of view is the strong isotope shift of the critical temperature in YBCO with a partial substitution of constituents (Y→Pr, or Ba→La), which we discussed before. This is a clear evidence of a phonon mechanism of superconductivity which leads to an order parameter with no nodes. One of the examples is the model described in the previous sections.

On the other hand there exists also strong evidence in favor of the so called "d-wave" pairing. These are the linear temperature dependence of the penetration depth at low temperatures [39] the Josephson experiments on single crystals [40] and rings, consisting of several grains [41]. One must have in mind, however, that these experiments demonstrate actually only the fact that the order parameter, as function of momentum changes sign and has nodes but do not exclude dependencies differing from the form $\Delta(\mathbf{k}) = \cos k_x - \cos k_y$ which is usually advocated by the proponents of the d-wave hypothesis. Recent direct measurements of the angular dependence of the energy gap by photoemission (J.-C. Campuzano et al., see Fig. 8) did not confirm this form. The only result, which favors it, is the absence of the Josephson effect in a BiSCCO-Pb tunnel junction (surface $\perp$ c) [42] but this result, which could mean that the integral of $\Delta(k)$ over the whole Fermi surface vanishes, is in contradiction with the observation of the Josephson effect in the same geometry with YBCO instead of BiSCCO and with the gap measurements already mentioned.

Our goal is to demonstrate that most of the observations can be explained by a very simple idea which is a development of the E-L model. Compared to it we introduce the following change. We will assume that in addition to the phonon attraction considered in sec. 4 there exists a small and short ranged repulsive interaction U = const. which can represent either some part of the Hubbard repulsion at the copper sites, or the interaction mediated by spin fluctuations (taken alone, such an interaction would lead to d-wave pairing). As in sec. 4, we will presume the following inequalities:

$$p_{F1} \ll \varkappa \ll P_{0y} \ll 1/d \ll K,$$

As shown in sec. 4, under these conditions Δ is constant in the singular region. Substituting $V(k) + U$ into the BCS self-consistency equation,