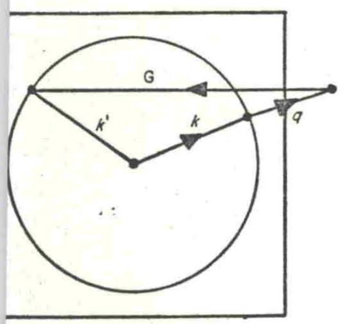
y the appropriate lattice

they provide a means by
tem can be communicated
efore provide an immediate
lso important because G is
is small, U-processes make
is is particularly important



IG. 17. Umklapp process.

equation 37) severely limits
ecause $\hbar\omega$ (which is of order
temperatures) is so small
ificantly change the electron
eratures, kT itself is very
ed electron states only very
ns that because of the Pauli
mi level (effectively on the
nly into other states (which
emselves on the Fermi sur-
n and to states on the Fermi
cussions and illustrations of
equally to impurity scatter-

process (or N-process) and a
e shown, the Fermi surface
e Brillouin zone is shown as
at is that the Fermi surface

does not touch the zone boundary and this corresponds to the case of the alkali metals at least at normal pressures. As we saw above, their Fermi surfaces are nearly spherical and do not touch the zone boundaries. (For the noble metals, however, the Fermi surfaces do touch the zone boundaries and the distinction between N- and U-processes is no longer useful.)

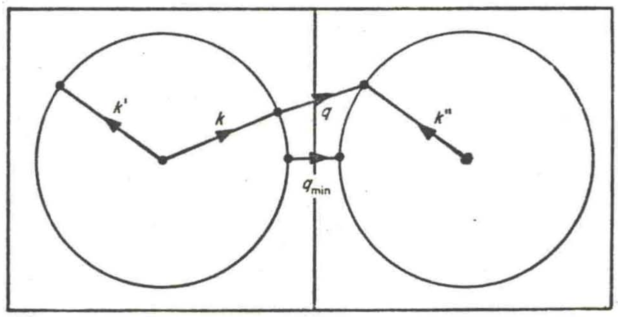


FIG. 18. A U-process in the repeated zone scheme showing minimum q vector for a U-process.

It is seen from Fig. 18 that when the Fermi surface does not touch the zone boundaries, there is a minimum value of q required to induce a U-process. Let us suppose that $q_{\min}$ is this minimum value in a particular direction and that ω is the corresponding frequency of the phonon propagating in this direction. Then at low temperatures the number of such phonons excited is proportional to $e^{-\frac{\hbar\omega}{kT}}$. If c is the phonon velocity, this probability may be re-written in terms of $q_{\min}$ as $e^{-\frac{\hbar c q_{\min}}{kT}}$. Clearly, therefore, under these circumstances, U-processes must die out at sufficiently low temperatures. On the other hand, their importance may persist down to quite low temperatures, if in some directions c is particularly small and $q_{\min}$ not too large. Bailyn has shown that this is true in the alkali metals. These metals are very strongly anisotropic in their elastic properties and in certain directions there are low-lying transverse modes of vibration which can cause U-processes down to quite low temperatures. Moreover, because they almost reverse the electron momentum, these processes dominate the resistivity throughout the temperature region in which ϱ_{ph} is still measurable (at the lowest temperatures ϱ_{ph} is lost in the background of residual scattering).