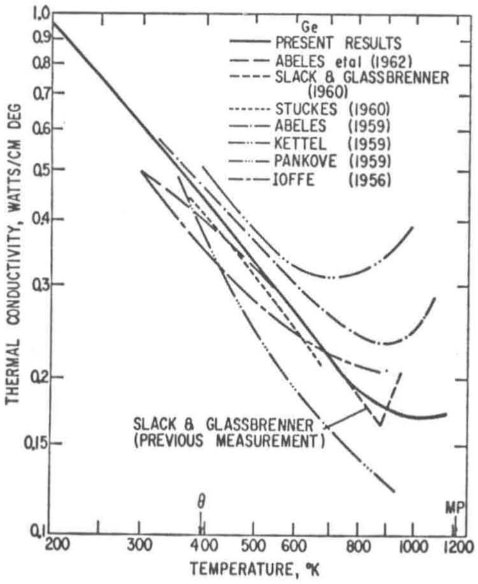

FIG. 8. Comparison of present and previous high-temperature K versus T results for Ge.

of the two experiments. The reason for this probably real discrepancy is not completely understood.

INTERPRETATION OF LOW-TEMPERATURE MEASUREMENTS

In the temperature range below 300°K, the K results on Si and Ge can be interpreted using Callaway's formalism.[37–39] The K due to heat transport by phonons is given by

$$K=\frac{k}{2\pi^2 v}\left(\frac{kT}{\hbar}\right)^3\int_0^{\theta/T}\tau_C(x,T)\frac{x^4e^x}{(e^x-1)^2}dx, \qquad (1)$$

where k = Boltzmann's constant, v = average sound velocity, T = absolute temperature, $\hbar$ = Planck's constant, θ = Debye temperature, $x=(\hbar\omega/kT)$, ω = phonon frequency, and τ_C is a combined relaxation time. The complicating effects[37] of normal phonon scattering have been neglected. The combined relaxation time is thus taken as

$$\tau_C^{-1}=\tau_B^{-1}+\tau_I^{-1}+\tau_U^{-1}, \qquad (2)$$

where τ_B, τ_I, τ_U are the relaxation times for boundary, isotope, and umklapp scattering of the phonons.

The particular form of the relaxation times shall now be examined. Klemens[40,41] has derived a relaxation time for scattering by point imperfections. His results are valid for isotope scattering.

$$\tau_I^{-1}(\omega)=3V_0\Gamma\omega^4/\pi v^3, \qquad (3)$$

where V_0 = average volume per atom in the crystal, and Γ = point impurity scattering parameter.[42] For umklapp scattering the following semiempirical expression[43] will be used:

$$\tau_U^{-1}=B_U\omega^2 T. \qquad (4)$$

TABLE II. Literature references to the thermal conductivity of Si and Ge for $T\geq 300$°K.

Mtrl	Author	Method	Temp. range °K	Year	Ref.
Si	Koenigsberger and Weiss	c	293	1911	14
	Kuprovski and Geld	b	380–1190	1956	15, 16
	Kingery	c	370–540	1959	17
	Mette *et al.*	e	550–770	1960	18
	Stuckes	c	300–580	1960	19
	Morris and Hust	c	300–700	1961	20
	Abeles *et al.*	d	310–1200	1962	21, 22
	Shanks *et al.*	d	300–1400	1963	23
	Morris and Martin	c	680–1000	1963	24
Ge	Greico and Montgomery	c	298	1952	26
	McCarthy and Ballard	c	280–370	1955	27
	Ioffe	a	300–870	1956	28
	Shtenbeck and Baranskii	a	200–370	1957	29
	Baranskii and Konopliasova	a	80–370	1958	30
	Abeles	a	320–1070	1959	31
	Kettel	a	390–1000	1959	32
	Pankove	e	370–970	1959	33
	Stuckes	c	310–680	1960	34
	Devyatkova and Smirnov	a	80–440	1960, 62	35, 36
	Slack and Glassbrenner	a, b	3–1020	1960	6
	Abeles *et al.*	d	310–1070	1962	21, 22

[a] Absolute, steady-state, longitudinal heat flow.
[b] Absolute, steady-state, radial heat flow.
[c] Comparative, steady-state longitudinal heat flow.
[d] Variable state, thermal diffusivity.
[e] Other.

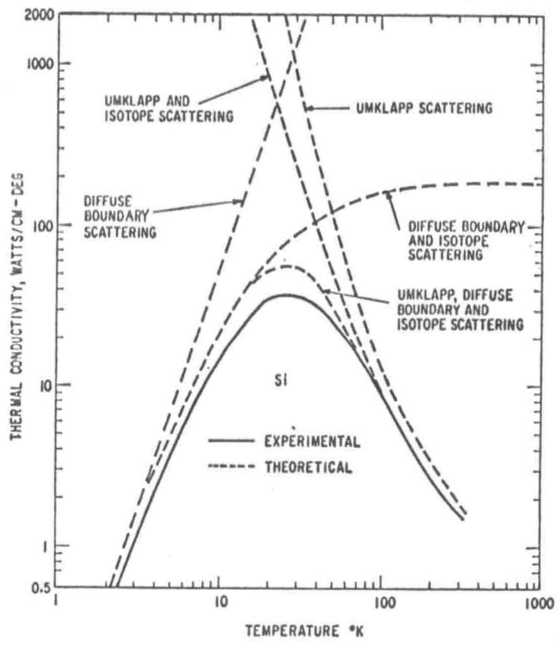

FIG. 9. Comparison of the low-temperature K results for Si with the theory in which various phonon scattering mechanisms are considered.

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