REFERENCES

[1] Landau, L. **Phys. Z. Sowjetunion, 3**, (1993) : 646.

[2] Pekar, S. **Untersuchngen uber die Elektronen Theorie der Kristalle**. Berlin : Akademic Verlag, 1954.

[3] Froehlich, H., Pelzer, H. and Zinenau, S. **Phil. Mag., 41**, 1950 : 221.

[4] Lee, T., Low, F., and Pine, D. The Motion of Slow Electrons in a Polar Crystal., **Phys. Rev. 90**, 1953 : 297.

[5] Lee, T., Low, F., and Pine, D. Introduction of a Nonrelativistic Particle with a Scalar Field with Applications to Slow Electrons in a Polar Crystal., **Phys. Rev. 92**, 1953 : 883.

[6] Gurari, M. **Phil. Mag. 44**, 1953 : 324.

[7] Tiablikov, S. **Abhandl - Sowj. Phys. 4**, 1954 : 54.

[8] Allcock, G. Strong-Coupling Theory of the Polaron. in **Polarons and Excitons**. Eds. Kuper, C. and Whitefield, G. Edinburgh : Olive and Boyd, 1993.

[9] Feynman, R. P. and Hibbs, A. R. **Quantum Mechanics and Path integrals.** Taiwan: McGraw-Hill., 1965.

[10] Mitra, T. K., Chatterjee, A. and Mukhopadhyay, S. **Polaron**. Phy. Rep. 1987 : 153.

[11] Appel, J. Polaron. **Solid State. 2**, 1968 : 193.

[12] Devreese, S. T. Path Integrals and Continuum Froehlich Polaron. in **Path Integrals and Their Application in Quantum, Statistical and Solid State Physics.**, London : Plenum Press., 1978.

[13] Lakhno, V. D. **Polaron and Applications.**, Toronto : Wiley, 1994.

[14] Feynman, R. P. Slow Electron in Polar Crystal., **Phys. Rev. 97**, 1955 : 660.

[15] Osaka, Y. **Progr. Theoret. Phys. 25**, 1961 : 517.

[16] Sa-yakanit, V. The Feynman Effective Mass of the Polaron. **Phys. Rev. B19**, 1979 : 2377.

[17] Khandekar, D. C. and Lawande, S. V. Feynman Path Integrals : Some Exact Results and Applications. **Phys. Rep. 137**, 1986 : 117.

[18] Castrigiani, D. and Kokiantonis, N. Classical Paths for a Quadratic Action with Memory and Exact Evaluation of the Path Integral. **Phys. Lett 96A**, 1983 : 55.

[19] Ventriglia, F., Marigliano Ramaglia, V., and Tagliacozzo, A. A Particle Interacting with a Bath : Thermal Averages and Density Matrix. in **Path Summation : Achievement and Goals**. Eds. Lundsquist, S. et. al. Singapore : World Scientific., 1988.

[20] Adamowski, J. and Gerlach, B. Explicit Evaluation of Certain Gaussian Functional Integrals Arising in Problems of Statistical Physics. **J. Math. Phys. 23**, 1982 : 243.

[21] Saitoh, M. Theory of Polaron at Finte Temperatures. **J. Phys. Soc. Japan 49**, 1980 : 878.

[22] Krivoglaz, M. A. and Pekar, S. I. **Bull. Acad. Sci. USSR. 21**, 1957 : 13.

[23] Feynman, R. P. An Operator Calculus Having Applications in Quantum Electrodynamics. **Phys. Rev. 84**, 1951 : 108.

[24] Abe, R. and Okamoto, K. An improvement of Feynman Action in the Theory of Polaron. **J. Phys. Soc. Japan 31**, 1971 : 1337.

[25] Lu, Y. and Rosenfelder, R. Second-order Correction to Feynman's Path Integral Calculation of the Polaron Effective Mass. **Phys. Rev. 46**, 1992 : 5211.

[26] Feynman, R. P. Space and Time Approach to Quantum Mechanics. **Rev. Mod. Phys.** 1948 : 367.

[27] Netrnapit, M. Master's Thesis, Department of Physics, Graduated School, Chulalongkorn University, 1972.,

Wipasuramonton, O. Master's Thesis, Department of Physics, Graduated School, Chulalongkorn University, 1973.

[28] Feynman, R. P. **Statistical Mechanics, A set of Lectures**. Reading : W. A. Benjamin, 1972.

[29] Wang, K.,Wang, Y. and Wan, S. General Properties of a Polaron in Motion. **Phys. Rev. 54**, 1996 : 12852.

[30] Press, W., Flannery, B., Teukolsky, S. and Vetterling, W. **Numerical Recipes in C : The Art of Scientific Computing.** Cambridge : Cambridge University Press, 1988.

APPENDIX

NUMERICAL CALCULATION

There are many methods available for minimizing a function with respect to its arguments depending on behaviour of the function. However, the common thing of all these methods is iteration. A complicated function may be solved by some methods such as the down hill simplex method or the conjugate gradient method, etc. [30]. In our case, the effective mass and the ground state energy are a well behaved function which can be minimized directly by iteration. For our problem, we want to minimize the energy with a condition mentioned in Chapter VI and we may proceed in this manner.

First of all one of the parameters must be guessed and we can determine another one by substitution the first in the conditioned equation (6.1) or (6.2). Then the ground state energy of equation (3.27) can be evaluated from these parameters. By iteration of this process, the minimum value of the energy can be found and the parameter that minimizes this energy will be kept to calculate the effective mass. The important point of our scheme is guessing proper initial values of the parameter. However, for our problem this is not difficult since we know what ranges that the solution will be converged.

We have used the MATHEMATICA solfware for the calculation since it provides many built-in functions that are easy to handle. All the steps can be summarized as

1. Clearing all the variables, setting initial values to the energy which should be a large number.
2. Giving an initial value to one of the parameters.
3. Solving the conditioned equation.
4. Substituting these parameters into the expressions for gound state energy.
5. Comparing result with previous value, if it is not less than the latter then go to step 2 again. If it is less than the previous value then keep this value.
6. Doing this process until the result is stable to the desired digits.

The result will be more accurate if the number of iteration is large. The example of the program is presented as well.

Program of Calculation

```
ClearA[v,w,t,u,GrEnergy,Energy,a]

a=1  ( coupling constant )

Module[ Energy=5,

        Do[ v= 5 Random[];

             w= FindRoot[1+ a v^3 /(3 Sqrt[Pi]) NIntegrate[t^2 Exp[-t]/

                (u^2 t+v(1-u^2/v2)(1-Exp[-v t]))^(1.5),{t,0,Infinity}]

                -(v/u)^2 Exp[(u/v)^2 -1+u^2 v a/(3 Sqrt[Pi]) NIntegrate[

                t^2 Exp[-t]/ (u^2 t+v(1-u^2/v2)(1-Exp[-v t]))^(1.5),{t,0,Infinity}]]

                ,{u,3,4}];

                GrEnergy=N[3(v-w)^2 /(4v) - a v/Sqrt[Pi] NIntegrate[Exp[-t]/

                (w^2 t+v(1-w^2/v2)(1-Exp[-v t]))^(0.5),{t,0,Infinity}]];

                If[ GrEnergy < Energy , Energy= GrEnergy;

                        Print["Ground State Energy  = ",Energy,";",v,";",w] ]

                , {1000} ]

]
```

CURRICULUM VITAE

Mr.Kobchai Tayanasanti was born on May 8, 1972 in Phuket . He received his B.Sc. degree in Physics from Chulalongkorn University in 1993. During his study for Master degree he have received the grant from the Thai Research Fund.