CHAPTER III

NUMERICAL RESULTS

3.1 General Description.

In the last section of the previous chapter, it was shown that the density of states in band tail derived by using Feynman Path Integral method can be written in the form[9,20]

$$\rho_1(\nu,Z) = (Q^3/E_Q\xi'^2)\ a(\nu,Z)\ \exp\left(-b(\nu,Z)/2\xi'\right) \qquad 3.1.1$$

with the dimensionless functions $a(\nu,Z)$ and $b(\nu,Z)$ are given by

$$a(\nu,Z) = \frac{(T+\nu)^{3/2}}{8\pi\sqrt{2}\,Z^6\exp(Z^2/2)\,D_{-3}^2(Z)}, \qquad 3.1.2$$

$$b(\nu,Z) = \frac{\sqrt{\pi}\,(T+\nu)^2}{2\sqrt{2}\,\exp(Z^2/4)\,D_{-3}(Z)}, \qquad 3.1.3$$

T is the kinetic energy of localization of electron in the harmonic model which in reduce unit is given by $T = 3\hbar\omega/4E_Q = 3/2Z^2$. $\nu = (E_o-E)/E_Q$ is the electron energy measured away from the average potential E_o in the unit of E_Q and $Z = (2E_Q/\hbar\omega)^{1/2}$ is a dimensionless variational parameter, replacing ω, used to adjust $\rho_1(\nu,Z)$ until it satisfies the variational condition.

In this chapter the numerical values of density of states, the dimensionless functions $a(\nu,Z)$, $b(\nu,Z)$, $n(\nu,Z)$ and variational parameter Z throughout the deep tail of impurity band will be calculated. To calculate the value of density of states for each ν's, an appropriate value of parameter Z must be known first. This parameter can be evaluated from a variational condition which is used to $\rho_1(\nu,Z)$. Three methods of evaluating the value of Z will be discussed. These three methods are based on two idea, one is to maximize $\rho_1(\nu,Z)$ as suggested by Halperin and Lax[8], and another is to maximize the function

$$P(E,Z) = \int_{-\infty}^{E} dE' \int_{-\infty}^{E'} dE'' \rho(E'',Z) \qquad 3.1.4$$

as proposed by Lloyd and Best[21]. There are two method for maximizing $\rho_1(\nu,Z)$. One is to consider the very deep tail region of density of states where $b(\nu,Z)/2\xi' \gg 1$. In this region the density of states or $\rho_1(\nu,Z)$ is dominated by its exponential term, as was pointed out by Halperin and Lax[8]. In this region $\rho_1(\nu,Z)$ can be maximized by maximizing the exponential part of $\rho_1(\nu,Z)$ or corresponding to minimize the function $b(\nu,Z)$ with respect to the variable Z as was discussed in section 3.2. Another method is to maximize the total function of $\rho_1(\nu,Z)$ which include the functional factor $a(\nu,Z)$. The calculational outline of this method will be discussed in section 3.3. The Lloyd and Best's variational condition is discussed in section 3.4. These three methods of evaluating Z give three equations in the same form, i.e.,

$$F(\nu,Z) = 0 \qquad 3.1.5$$

Each of these equation can not be solved analytically. To solve these equation we must use numerical methods. The details of these numerical methods are given in Appendix B.

The procedure used to evaluate the value of density of states at a specified ν is as follow. The value of ν must be specified first and treated as a constant in (3.1.5). Next, the parameter Z will be varied until it satisfies the equation (3.1.5) and $\frac{\partial F}{\partial Z}(\nu,Z)$ has required sign, plus or minus. Then, from this value of Z and ν we can evaluate the values of all other quantities, such as $a(\nu,Z)$, $b(\nu,Z)$. Finally the value of density of states can be evaluated by using (3.1.1). For convenience we will calculate all values of density of states in dimensionless unit by using the equation

$$\rho_1(\nu,Z) \quad = \quad a(\nu,Z) \exp \left(-b(\nu,Z)/2\xi' \right) \qquad 3.1.6$$

as was introduced in section 2.3.

All numerical results given in this chapter were evaluated for the reduced fluctuation quantity ξ' at the values 50,5, 0.5 and 0.05.

3.2 Minimizing $b(\nu,Z)$.

The condition that $b(\nu,Z)$ has a minimum value with respect to the variable Z is that $\frac{\partial}{\partial Z} b(\nu,Z) = 0$ and its second derivative has positive value. For convenience in differentiation, the function $\ln b(\nu,Z)$ will be minimized instead of $b(\nu,Z)$. This changes the variational condition to

$$\frac{\partial}{\partial Z} \ln b(\nu,Z) \quad = \quad 0 \ . \qquad 3.2.1$$

When we use $b(\nu,Z)$ as defined by (3.1.3) we will obtain

$$\frac{\partial}{\partial Z} \ln b(\nu,Z) = \frac{\partial}{\partial Z} \{\ln(\sqrt{\pi}/2\sqrt{2}) + 2\ln(T+\nu) - Z^2/4 - \ln D_{-3}(Z)\} \qquad 3.2.2$$

After performing the differentiation and using the recursion formula for the parabolic cylinder function[11]

$$\frac{d}{dZ} D_p(Z) = -\frac{1}{2} Z\, D_p(Z) + pD_{p-1}(Z) , \qquad 3.2.3$$

equation (3.2.2) becomes

$$\frac{\partial}{\partial Z} \ln b(\nu,Z) = 3\left(\frac{D_{-4}(Z)}{D_{-3}(Z)} - \frac{2Z^{-3}}{T+\nu}\right) . \qquad 3.2.4$$

Then, from the equations (3.2.4) and (3.2.1), we obtain the equation

$$\frac{D_{-4}(Z)}{D_{-3}(Z)} - \frac{2Z^{-3}}{T+\nu} = 0 \qquad 3.2.5$$

which is used to determine the appropriate value of Z. It can be seen that the fluctuation constant ξ' is not contained in (3.2.5). Thus the values of Z evaluated by minimizing $b(\nu,Z)$ at specified ν are all independent of ξ'. From this reason, the values of $a(\nu,Z)$, $b(\nu,Z)$ and the quantity n given by (2.4.29) for each ν do not depend of ξ'. These results resemble those obtained by Halperin and Lax[8].

Some numerical values of $Z, n, a(\nu,Z)$ and density of states calculated by this method at reduced energy ν are given in Table 3.1.

The graphs of density of states for each ξ' are plotted in Fig. 3.1-3.4 and of quantity $n(\nu,Z)$ is plotted in Fig 3.5.

3.3 Maximizing $\rho_1(\nu,Z)$.

Since $\rho_1(\nu,Z)$ has only positive values, the maximization condition for function $\rho_1(\nu,Z)$ will be the same as for function $\ln \rho_1(\nu,Z)$. As in the previous section, the variational condition used to determine the parameter Z is

$$\frac{\partial}{\partial Z} \ln \rho_1(\nu,Z) = 0 , \tag{3.3.1}$$

and its second derivative must be less than zero. Now, if $\rho_1(\nu,Z)$ given by (3.1.6) is used in the above equation, we get

$$\frac{\partial}{\partial Z} \ln a(\nu,Z) - \frac{1}{2\xi'} \frac{\partial}{\partial Z} b(\nu,Z) = 0 . \tag{3.3.2}$$

From the equation (3.2.4), if we take the derivative of logarithm in the left - hand side and multiply both sides by $b(\nu,Z)$, we obtain

$$\frac{\partial}{\partial Z} b(\nu,Z) = 3b(\nu,Z)\left(\frac{D_{-4}(Z)}{D_{-3}(Z)} - \frac{2Z^{-3}}{T + \nu}\right). \tag{3.3.3}$$

When using $a(\nu,Z)$ defined by (3.1.2) and the recursion formula (3.2.3) to find the logarithmic derivative of $a(\nu,Z)$, we obtain

$$\frac{\partial}{\partial Z} \ln a(\nu,Z) = 6\left(\frac{D_{-4}(Z)}{D_{-3}(Z)} - \frac{3Z^{-3}}{4(T+\nu)} - \frac{1}{Z}\right). \tag{3.3.4}$$

Replacing (3.3.3) and (3.3.4) in (3.3.2), the final result can be written that

$$\frac{2D_{-4}(Z)}{D_{-3}(Z)} - \frac{3Z^{-3}}{2(T+\nu)} - \frac{2}{Z} - \frac{b(\nu,Z)}{2\xi'}\left(\frac{D_{-4}(Z)}{D_{-3}(Z)} - \frac{2Z^{-3}}{T+\nu}\right) = 0. \qquad 3.3.5$$

This equation is used to determine the value of Z that makes $\rho_1(\nu,Z)$ maximum . Since the equation (3.3.5) contains the fluctuation constant ξ' , the root of this equation will depend parametrically on ξ' and in turn the values of other quantity such as $a(\nu,Z)$ and $b(\nu,Z)$ to depend on ξ',too.

Numerical values of Z,n, $a(\nu,Z)$, $b(\nu,Z)$ and density of states calculated for $\xi' = 50$ are given in Table 3.2, for $\xi' = 5$ are given in Table 3.3, for $\xi' = 0.5$ are given in Table 3.4, and for $\xi' = 0.05$ are given in Table 3.5. The graphs of density of states are shown in Fig. 3.1 to 3.4, and of quantity $n(\nu,Z)$ is shown in Fig 3.6.

3.4 Maximizing P(E,Z).

To maximize the function P(E,Z) given by (3.1.4) we must transform this function to be a function of dimensionless variable ν and then try to simplify it as much as possible.

From the definition of ν which is $\nu = (E_0 - E)/E_Q$, we can change (3.1.4) to a new form,i.e.,

$$P(\nu,Z) = E_Q^2 \int_{\infty}^{\nu} d\nu' \int_{\infty}^{\nu'} d\nu'' \rho(\nu'',Z) . \qquad 3.4.1$$

This expression can be simplified by integrating by parts as follow : We first let

$$v(\nu') = \int_{\infty}^{\nu'} d\nu'' \rho(\nu'',Z) ,$$

$$du(\nu') = d\nu'$$

and using formula

$$\int v du = uv - \int u dv$$

equation (3.4.1) becomes

$$P(\nu,Z) = E_Q^2 \{ \nu' \int_{\infty}^{\nu'} d\nu'' \rho(\nu'',Z) \Big|_{\infty}^{\nu} - \int_{\infty}^{\nu} \nu' d\nu' \rho(\nu',Z) \}$$

$$= E_Q^2 \{ \nu \int_{\infty}^{\nu} d\nu'' \rho(\nu'',Z) - \lim_{\nu' \to \infty} \int_{\infty}^{\nu'} d\nu'' \rho(\nu'',Z) - \int_{\infty}^{\nu} \nu' d\nu' \rho(\nu',Z) \}$$

The second term goes to zero when $\nu' \longrightarrow \infty$ because $\rho(\nu,Z)$ is a single value function the integration from ∞ to ∞ must be zero. Next grouping the remainder terms and changing the limit of integration the final result becomes

$$P(\nu,Z) = E_Q^2 \int_{\nu}^{\infty} (\nu'-\nu) \rho(\nu',Z) d\nu' \qquad 3.4.2)$$

When we substitute $\rho(\nu,Z)$ by $\rho_1(\nu,Z)$ defined by (3.1.6) we obtain

$$P(\nu,Z) = E_Q^2 \int_{\nu}^{\infty} d\nu' (\nu'-\nu) a(\nu',Z) \exp(-b(\nu',Z)/2\xi'). \qquad 3.4.3$$

The right - hand side of the above equation can be written in terms of incomplete gamma functions by changing the variable of integration from ν' to y' defined as

$$y' = b(\nu',Z)/2\xi' . \qquad 3.4.4$$

Then all functions in (3.4.3) which contain the variable ν' must be transform to the new variable y' such as

$$a(\nu,Z) = \frac{(4\xi'\sqrt{2/\pi}\ \exp(Z^2/4)D_{-3}(Z)^{3/4}y^{3/4}}{8\pi\sqrt{2}\ Z^6 \exp\ (Z^2/2)\ D_{-3}^2(Z)}, \qquad 3.4.5$$

$$(\nu'-\nu\ ) = (4\sqrt{2/\pi}\ \xi'\ \exp(Z^2/4)\ D_{-3}(Z)^{1/2}(y'^{1/2} - y^{1/2}),$$

3.4.6

$$d\nu' = (\sqrt{2/\pi}\ \xi'\exp(Z^2/4)D_{-3}(Z)^{1/2}\ y'^{-1/2}, \qquad 3.4.7$$

where $$y = b(\nu,Z)/2\xi' . \qquad 3.4.8$$

Putting all the above equations (3.4.5) to (3.4.8) in (3.4.3) we get the result

$$P(y,Z) = \frac{(2/\pi)^{7/8}\ E_Q^2\xi'^{7/4}}{2\pi}(Z^6\ \exp(-Z^2/16)\ D_{-3}^{-1/4}(Z))\{\Gamma(7/4,y)$$

$$- y^{1/2}\ \Gamma(5/4,\ y)\}, \qquad 3.4.9$$

where $\Gamma(\alpha,x)$ is the incomplete gamma function defined as

$$\Gamma(\alpha,x) = \int_x^\infty t^{\alpha-1}\ e^{-t}\ dt . \qquad 3.4.10$$

The maximization of P(E,Z) with respect to variable Z will be changed to maximize the new function P(y,Z). For convenience, the function ln P(y,Z) will be considered. The maximization condition becomes

$$\frac{\partial}{\partial Z} \ln P(y, Z) = 0 . \qquad 3.4.11$$

Substituing (3.4.9) into (3.4.11), we obtain

$$- \frac{6}{Z} - \frac{Z}{8} - \frac{1}{4D_{-3}(Z)} \frac{d}{dZ} D_{-3}(Z) + \frac{\frac{\partial y}{\partial Z} \{\frac{d}{dy} \Gamma(7/4,y) - y^{1/2} \frac{d}{dy} \Gamma(5/4,y) - \frac{y^{1/2}}{2} \Gamma(5/4,y)\}}{\Gamma(7/4,y) - y^{1/2}\Gamma(5/4,y)}$$

$$= 0 . \qquad 3.4.12$$

By using (3.2.3) and formula[11]

$$\frac{d}{dx} \Gamma(\alpha,x) = -x^{\alpha} \exp(-x) \qquad 3.4.13$$

equation (3.4.12) becomes

$$3(\frac{D_{-4}(Z)}{4D_{-3}(Z)} - \frac{2}{Z}) - y^{-1/2} \Gamma(5/4,y) \frac{\partial y}{\partial Z} /2\{\Gamma(7/4,y) - y^{1/2}\Gamma(5/4,y)\} = 0$$

3.4.14

From (3.4.8) and (3.3.3), we can evaluate the derivative $\frac{\partial y}{\partial Z}$ and obtain the result

$$\frac{\partial y}{\partial Z} = 3y(\frac{D_{-4}(Z)}{D_{-3}(Z)} - \frac{2Z^{-3}}{T + \nu}) .$$

Using this equation in (3.4.14) and multiplying the result with

$\{\Gamma(7/4,y) - y^{1/2}\Gamma(7/4,y)\}/3$ the equation, (3.4.14), becomes

$$(\frac{D_{-4}(Z)}{4D_{-3}(Z)} - \frac{2}{Z}) \Gamma(7/4,y) - (\frac{3D_{-4}(Z)}{4D_{-3}(Z)} - \frac{2}{Z} - \frac{Z^{-3}}{T+\nu})y^{1/2} \Gamma(5/4,y) = 0, \qquad 3.4.15$$

where y is defined by (3.4.8).

Similarly to the results of section 3.3, the values of $n(\nu,Z)$, $a(\nu,Z)$ and $b(\nu,Z)$ evaluated by using Z's value obtained from (3.4.15) will depend on ξ'.

The numerical values of Z, n, $a(\nu,Z)$, $b(\nu,Z)$ and density of states obtained with this method are list in table 3.6 to 3.9. The graphs of density of states are shown in Fig. 3.1 to 3.4. It can be seen that all of them are close to the graphs obtain by the method of maximizing $\rho_1(\nu,Z)$. The quantity $n(\nu,Z)$ is ploted in Fig. 3.6.

Table 3.1. Numerical values of the dimensionless function, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for ξ'=50, 5, 0.5, and 0.05. These results are obtained by minimizing $b(\nu,Z)$ with respect to Z (case 1)

ν	Z	$n(\nu$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho(\nu,Z)$ $\xi'=50$	$\xi'=5$	$\xi'=0.5$	$\xi'=0.05$
$1x10^{3}$	0.1546	1.8819	$2.9442x10^{8}$	$1.4378x10^{6}$	0.0000	0.0000	0.0000	0.0000
$6x10^{2}$	0.1831	1.8613	$5.4952x10^{7}$	$5.5262x10^{5}$	0.0000	0.0000	0.0000	0.0000
$2x10^{2}$	0.2634	1.8049	$1.5910x10^{6}$	$7.3642x10^{4}$	0.0000	0.0000	0.0000	0.0000
$1x10^{2}$	0.3311	1.7593	$1.8063x10^{5}$	$2.1401x10^{4}$	0.0000	0.0000	0.0000	0.0000
6x10	0.3919	1.7200	$3.7674x10^{4}$	$8.7984x10^{3}$	$2.3172x10^{-34}$	0.0000	0.0000	0.0000
2x10	0.5624	1.6166	$1.4660x10^{3}$	$1.4040x10^{3}$	$1.1714x10^{-3}$	$1.5556x10^{-58}$	0.0000	0.0000
1x10	0.7059	1.5373	$2.0975x10^{2}$	$4.7030x10^{2}$	1.9021	$7.8876x10^{-19}$	0.0000	0.0000
6	0.8345	1.4716	5.3123x10	$2.1802x10^{2}$	6.0037	$1.8059x10^{-8}$	0.0000	0.0000
2	1.1956	1.3117	3.3594	4.7157x10	2.0963	$3.0078x10^{-2}$	$1.1119x10^{-20}$	0.0000
1	1.5009	1.2006	$6.8151x10^{-1}$	1.9736x10	$5.5945x10^{-1}$	$9.4700x10^{-2}$	$1.8293x10^{-9}$	0.0000
$6x10^{-1}$	1.7763	1.1159	$2.2682x10^{-1}$	1.0921x10	$2.0336x10^{-1}$	$7.6099x10^{-2}$	$4.0980x10^{-6}$	$8.4055x10^{-49}$
$2x10^{-1}$	2.5662	0.9351	$2.6307x10^{-2}$	3.5427	$2.5392x10^{-2}$	$1.8459x10^{-2}$	$7.6120x10^{-4}$	$1.0822x10^{-17}$
$1x10^{-1}$	3.2598	0.8293	$7.7327x10^{-3}$	1.9232	$7.5854x10^{-3}$	$6.3798x10^{-3}$	$1.1301x10^{-3}$	$3.4358x10^{-11}$
$6x10^{-2}$	3.9107	0.7591	$3.3144x10^{-3}$	1.2822	$3.2722x10^{-3}$	$2.9156x10^{-3}$	$9.1949x10^{-4}$	$8.9479x10^{-9}$
$2x10^{-2}$	5.9270	0.6380	$5.9967x10^{-4}$	$5.9764x10^{-1}$	$5.9609x10^{-4}$	$5.6488x10^{-4}$	$3.2988x10^{-4}$	$1.5219x10^{-6}$
$1x10^{-2}$	7.8747	0.5850	$2.1316x10^{-4}$	$3.9159x10^{-1}$	$2.1233x10^{-4}$	$2.0498x10^{-4}$	$1.4410x10^{-4}$	$4.2469x10^{-6}$
$6x10^{-3}$	9.8237	0.5570	$1.0021x10^{-4}$	$2.9263x10^{-1}$	$9.9912x10^{-5}$	$9.7315x10^{-5}$	$7.4783x10^{-5}$	$5.3706x10^{-6}$

Table 3.1. Continue.

ν	Z	n(ν	a(ν,Z)	b(ν,Z)	ρ(ν,Z) ξ′=50	ξ′=5	ξ′=0.5	ξ′=0.05
1×10^{-4}	70.8233	0.5012	2.2481×10^{-7}	3.5492×10^{-2}	2.2473×10^{-7}	2.2402×10^{-7}	2.1697×10^{-7}	1.5765×10^{-7}
6×10^{-5}	91.3745	0.5007	1.0453×10^{-7}	2.7478×10^{-2}	1.0450×10^{-7}	1.0425×10^{-7}	1.0170×10^{-7}	7.9417×10^{-8}
2×10^{-5}	158.1644	0.5002	2.0127×10^{-8}	1.5857×10^{-2}	2.0124×10^{-8}	2.0095×10^{-8}	1.9810×10^{-8}	1.7175×10^{-8}
1×10^{-5}	223.6426	0.5001	7.1168×10^{-9}	1.1211×10^{-2}	7.1160×10^{-9}	7.1088×10^{-9}	7.0374×10^{-9}	6.3620×10^{-9}
6×10^{-6}	288.7028	0.5001	3.3080×10^{-9}	8.6842×10^{-3}	3.3077×10^{-9}	3.3051×10^{-9}	3.2794×10^{-9}	3.0328×10^{-9}
2×10^{-6}	500.0160	0.5000	6.3748×10^{-10}	5.0168×10^{-3}	6.3745×10^{-10}	6.3716×10^{-10}	6.3429×10^{-10}	6.0629×10^{-10}
1×10^{-6}	707.1181	0.5000	2.2584×10^{-10}	3.5509×10^{-3}	2.2583×10^{-10}	2.2576×10^{-10}	2.2504×10^{-10}	2.1796×10^{-10}
6×10^{-7}	912.8797	0.5000	1.0514×10^{-10}	2.7529×10^{-3}	1.0514×10^{-10}	1.0511×10^{-10}	1.0485×10^{-10}	1.0229×10^{-10}
2×10^{-7}	1581.1439	0.5000	2.0285×10^{-11}	1.5914×10^{-3}	2.0284×10^{-11}	2.0282×10^{-11}	2.0252×10^{-11}	1.9964×10^{-11}
1×10^{-7}	2236.0716	0.5000	7.1746×10^{-12}	1.1255×10^{-3}	7.1745×10^{-12}	7.1738×10^{-12}	7.1665×10^{-12}	7.0943×10^{-12}

Table 3.2. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for $\xi'=50$. These results are obtained by maximizing $\rho_1(\nu,Z)$ with respect to Z (case 2)

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
1×10^{3}	0.154525	1.881787	2.954195×10^{8}	1.437798×10^{6}	0.000000
6×10^{2}	0.182895	1.860920	5.536090×10^{7}	5.526248×10^{5}	0.000000
2×10^{2}	0.261564	1.802413	1.653760×10^{6}	7.364390×10^{4}	0.000000
1×10^{2}	0.324708	1.750904	2.008648×10^{5}	2.140664×10^{4}	0.000000
6×10	0.376082	1.699587	4.691248×10^{4}	8.809404×10^{3}	2.585443×10^{-34}
2×10	0.465633	1.485974	3.951985×10^{3}	1.453810×10^{3}	1.918662×10^{-3}
1×10	0.458505	1.167191	2.158224×10^{3}	5.832400×10^{2}	6.325826
6	0.428073	8.459234×10^{-1}	2.252951×10^{3}	3.829576×10^{2}	4.893146×10
2	0.383816	3.283463×10^{-1}	3.042361×10^{3}	2.651815×10^{2}	2.145567×10^{2}
1	0.372357	1.692247×10^{-1}	3.374199×10^{3}	2.455163×10^{2}	2.896721×10^{2}
6×10^{-1}	0.367838	1.026863×10^{-1}	3.523698×10^{3}	2.384859×10^{2}	3.245394×10^{2}
2×10^{-1}	0.363370	3.460092×10^{-2}	3.683097×10^{3}	2.318871×10^{2}	3.623599×10^{2}
1×10^{-1}	0.362262	1.734606×10^{-2}	3.724519×10^{3}	2.303015×10^{2}	3.722919×10^{2}
6×10^{-2}	0.361820	1.041852×10^{-2}	3.741265×10^{3}	2.296741×10^{2}	3.763192×10^{2}
2×10^{-2}	0.361378	3.476457×10^{-3}	3.758113×10^{3}	2.290508×10^{2}	3.803777×10^{2}
1×10^{-2}	0.361268	1.738680×10^{-3}	3.762341×10^{3}	2.288955×10^{2}	3.813972×10^{2}
6×10^{-3}	0.361224	1.043316×10^{-3}	3.764034×10^{3}	2.288335×10^{2}	3.818056×10^{2}
2×10^{-3}	0.361180	3.478080×10^{-4}	3.765728×10^{3}	2.287715×10^{2}	3.822143×10^{2}
1×10^{-3}	0.361169	1.739085×10^{-4}	3.766152×10^{3}	2.287560×10^{2}	3.823165×10^{2}
6×10^{-4}	0.361164	1.043462×10^{-4}	3.766321×10^{3}	2.287498×10^{2}	3.823574×10^{2}
2×10^{-4}	0.361160	3.478243×10^{-5}	3.766491×10^{3}	2.287436×10^{2}	3.823983×10^{2}
1×10^{-4}	0.361159	1.739126×10^{-5}	3.766533×10^{3}	2.287421×10^{2}	3.824085×10^{2}
6×10^{-5}	0.361158	1.043477×10^{-5}	3.766550×10^{3}	2.287415×10^{2}	3.824126×10^{2}
2×10^{-5}	0.361158	3.478259×10^{-6}	3.766567×10^{3}	2.287408×10^{2}	3.824167×10^{2}
1×10^{-5}	0.361158	1.739130×10^{-6}	3.766571×10^{3}	2.287407×10^{2}	3.824177×10^{2}
6×10^{-6}	0.361158	1.043478×10^{-6}	3.766573×10^{3}	2.287406×10^{2}	3.824181×10^{2}
2×10^{-6}	0.361158	3.478260×10^{-7}	3.766575×10^{3}	2.287406×10^{2}	3.824185×10^{2}
1×10^{-6}	0.361158	1.739130×10^{-7}	3.766575×10^{3}	2.287405×10^{2}	3.824186×10^{2}

Table 3.3. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for $\xi'=5$. These results are obtained by maximizing $\rho_1(\nu,Z)$ with respect to Z (case 2)

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
1×10^{3}	0.154607	1.881906	2.945231×10^{8}	1.437798×10^{6}	0.000000
6×10^{2}	0.183111	1.861225	5.499265×10^{7}	5.526244×10^{5}	0.000000
2×10^{2}	0.263221	1.804650	1.597148×10^{6}	7.364198×10^{4}	0.000000
1×10^{2}	0.330489	1.758499	1.825600×10^{5}	2.140138×10^{4}	0.000000
6×10	0.390252	1.717987	3.850620×10^{4}	8.798533×10^{3}	0.000000
2×10	0.551751	1.604670	1.614590×10^{3}	1.404468×10^{3}	1.632330×10^{-58}
1×10	0.672869	1.502283	2.653617×10^{2}	4.714820×10^{2}	8.864134×10^{-19}
6	0.760669	1.396585	8.292580×10	2.202832×10^{2}	2.248587×10^{-8}
2	0.849037	9.801915×10^{-1}	1.758864×10	5.562118×10	6.755154×10^{-2}
1	0.809316	6.078839×10^{-1}	1.534695×10	3.437833×10	4.931626×10^{-1}
6×10^{-1}	0.778147	3.899603×10^{-1}	1.622284×10	2.889732×10	9.018454×10^{-1}
2×10^{-1}	0.742528	1.369578×10^{-1}	1.812267×10	2.485982×10	1.508599
1×10^{-1}	0.733385	6.923132×10^{-2}	1.875286×10	2.403509×10	1.695262
6×10^{-2}	0.729727	4.171164×10^{-2}	1.902195×10	2.372306×10	1.774089
2×10^{-2}	0.726073	1.396005×10^{-2}	1.930069×10	2.342073×10	1.855339
1×10^{-2}	0.725160	6.986938×10^{-3}	1.937188×10	2.334663×10	1.876034
6×10^{-3}	0.724795	4.193814×10^{-3}	1.940052×10	2.331715×10	1.884355
2×10^{-3}	0.724430	1.398487×10^{-3}	1.942926×10	2.328776×10	1.892700
1×10^{-3}	0.724339	6.993119×10^{-4}	1.943646×10	2.328043×10	1.894790
6×10^{-4}	0.724303	4.196036×10^{-4}	1.943934×10	2.327749×10	1.895627
2×10^{-4}	0.724266	1.398733×10^{-4}	1.944223×10	2.327456×10	1.896464
1×10^{-4}	0.724257	6.993736×10^{-5}	1.944295×10	2.327383×10	1.896673
6×10^{-5}	0.724254	4.196258×10^{-5}	1.944323×10	2.327354×10	1.896757
2×10^{-5}	0.724250	1.398758×10^{-5}	1.944352×10	2.327325×10	1.896840
1×10^{-5}	0.724249	6.993797×10^{-6}	1.944360×10	2.327317×10	1.896861
6×10^{-6}	0.724249	4.196280×10^{-6}	1.944362×10	2.327314×10	1.896870
2×10^{-6}	0.724248	1.398761×10^{-6}	1.944365×10	2.327311×10	1.896878
1×10^{-6}	0.724248	6.993803×10^{-7}	1.944366×10	2.327311×10	1.896880

Table 3.4. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for $\xi'=0.5$. These results are obtained by maximizing $\rho_1(\nu,Z)$ with respect to Z (case 2)

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
1×10^3	0.154616	1.881918	2.944337×10^8	1.437798×10^6	0.000000
6×10^2	0.183133	1.861256	5.495595×10^7	5.526244×10^5	0.000000
2×10^2	0.263387	1.804873	1.591592×10^6	7.364196×10^4	0.000000
1×10^2	0.331074	1.759249	1.808252×10^5	2.140133×10^4	0.000000
6×10	0.391702	1.719778	3.775649×10^4	8.798425×10^3	0.000000
2×10	0.561305	1.615447	1.480137×10^3	1.403989×10^3	0.000000
1×10	0.702573	1.533878	2.146374×10^2	4.703090×10^2	0.000000
6	0.826939	1.464570	5.543087×10	2.180434×10^2	0.000000
2	1.156146	1.281152	3.885192	4.723080×10	1.194909×10^{-20}
1	1.395568	1.129832	9.202279×10^{-1}	1.988970×10	2.117922×10^{-9}
6×10^{-1}	1.565749	9.902191×10^{-1}	3.762687×10^{-1}	1.118498×10	5.223046×10^{-6}
2×10^{-1}	1.767683	5.881956×10^{-1}	1.154482×10^{-1}	4.329987	1.520190×10^{-3}
1×10^{-1}	1.755124	3.407502×10^{-1}	9.422187×10^{-2}	3.185290	3.897604×10^{-3}
6×10^{-2}	1.730308	2.139008×10^{-1}	9.124067×10^{-2}	2.838461	5.339008×10^{-3}
2×10^{-2}	1.695481	7.382775×10^{-2}	9.117979×10^{-2}	2.555852	7.077925×10^{-3}
1×10^{-2}	1.685559	3.717731×10^{-2}	9.157979×10^{-2}	2.494477	7.558962×10^{-3}
6×10^{-3}	1.681482	2.236611×10^{-2}	9.178307×10^{-2}	2.470893	7.756525×10^{-3}
2×10^{-3}	1.677349	7.474622×10^{-3}	9.201044×10^{-2}	2.447847	7.957021×10^{-3}
1×10^{-3}	1.676307	3.739666×10^{-3}	9.207099×10^{-2}	2.442168	8.007603×10^{-3}
6×10^{-4}	1.675889	2.244362×10^{-3}	9.209563×10^{-2}	2.439906	8.027887×10^{-3}
2×10^{-4}	1.675471	7.483072×10^{-4}	9.212050×10^{-2}	2.437649	8.048200×10^{-3}
1×10^{-4}	1.675366	3.741769×10^{-4}	9.212675×10^{-2}	2.437086	8.053283×10^{-3}
6×10^{-5}	1.675324	2.245117×10^{-4}	9.212926×10^{-2}	2.436860	8.055317×10^{-3}
2×10^{-5}	1.675282	7.483910×10^{-5}	9.213177×10^{-2}	2.436635	8.057351×10^{-3}
1×10^{-5}	1.675272	3.741978×10^{-5}	9.213239×10^{-2}	2.436579	8.057859×10^{-3}
6×10^{-6}	1.675268	2.245192×10^{-5}	9.213265×10^{-2}	2.436556	8.058063×10^{-3}
2×10^{-6}	1.675264	7.483993×10^{-6}	9.213290×10^{-2}	2.436534	8.058266×10^{-3}
1×10^{-6}	1.675263	3.741999×10^{-6}	9.213296×10^{-2}	2.436528	8.058317×10^{-3}

Table 3.5. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for $\xi'=0.05$. These results are obtained by maximizing $\rho_1(\nu,Z)$ with respect to Z (case 2).

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
1×10^{3}	0.154616	1.881919	2.944247×10^{8}	1.437798×10^{6}	0.000000
6×10^{2}	0.183135	1.861259	5.495228×10^{7}	5.526244×10^{5}	0.000000
2×10^{2}	0.263404	1.804895	1.591038×10^{6}	7.364196×10^{4}	0.000000
1×10^{2}	0.331133	1.759324	1.806526×10^{5}	2.140133×10^{4}	0.000000
6×10	0.391847	1.719957	3.768237×10^{4}	8.798424×10^{3}	0.000000
2×10	0.562267	1.616509	1.467408×10^{3}	1.403984×10^{3}	0.000000
1×10	0.705583	1.536928	2.102326×10^{2}	4.702976×10^{2}	0.000000
6	0.833716	1.470946	5.334774×10	2.180223×10^{2}	0.000000
2	1.191653	1.308768	3.407250	4.715807×10	0.000000
1	1.490468	1.193872	7.008802×10^{-1}	1.973729×10	0.000000
6×10^{-1}	1.755582	1.104275	2.372111×10^{-1}	1.092367×10	8.594818×10^{-49}
2×10^{-1}	2.482404	9.020906×10^{-1}	2.944403×10^{-2}	3.548425	1.143885×10^{-17}
1×10^{-1}	3.066343	7.706156×10^{-1}	9.386728×10^{-3}	1.933156	3.775080×10^{-11}
6×10^{-2}	3.557608	6.722106×10^{-1}	4.416214×10^{-3}	1.297184	1.026720×10^{-8}
2×10^{-2}	4.689045	4.534032×10^{-1}	1.170682×10^{-3}	6.336496×10^{-1}	2.072687×10^{-6}
1×10^{-2}	5.281366	3.135913×10^{-1}	6.597722×10^{-4}	4.530807×10^{-1}	7.107055×10^{-6}
6×10^{-3}	5.568057	2.206612×10^{-1}	5.022863×10^{-4}	3.795886×10^{-1}	1.128286×10^{-5}
2×10^{-3}	5.826434	8.660617×10^{-2}	3.827676×10^{-4}	3.095441×10^{-1}	1.732217×10^{-5}
1×10^{-3}	5.873285	4.496003×10^{-2}	3.601741×10^{-4}	2.934683×10^{-1}	1.914238×10^{-5}
6×10^{-4}	5.888878	2.736353×10^{-2}	3.520282×10^{-4}	2.872798×10^{-1}	1.990385×10^{-5}
2×10^{-4}	5.902471	9.247487×10^{-3}	3.443982×10^{-4}	2.812449×10^{-1}	2.068377×10^{-5}
1×10^{-4}	5.905543	4.639272×10^{-3}	3.425714×10^{-4}	2.797613×10^{-1}	2.088157×10^{-5}
6×10^{-5}	5.906735	2.787271×10^{-3}	3.418498×10^{-4}	2.791708×10^{-1}	2.096101×10^{-5}
2×10^{-5}	5.907905	9.303228×10^{-4}	3.411333×10^{-4}	2.785819×10^{-1}	2.104062×10^{-5}
1×10^{-5}	5.908194	4.653151×10^{-4}	3.409550×10^{-4}	2.784349×10^{-1}	2.106055×10^{-5}
6×10^{-6}	5.908309	2.792260×10^{-4}	3.408838×10^{-4}	2.783761×10^{-1}	2.106852×10^{-5}
2×10^{-6}	5.908424	9.308761×10^{-5}	3.408126×10^{-4}	2.783174×10^{-1}	2.107650×10^{-5}
1×10^{-6}	5.908453	4.654534×10^{-5}	3.407948×10^{-4}	2.783027×10^{-1}	2.107850×10^{-5}

Table 3.6. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for $\xi'=50$. These results are obtained by maximizing the function $P(\nu,Z)$ with respect to Z (case 3).

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
1×10^3	0.154521	1.881782	2.954607×10^8	1.437798×10^6	0.000000
6×10^2	0.182883	1.860903	5.538094×10^7	5.526248×10^5	0.000000
2×10^2	0.261439	1.802242	1.658163×10^6	7.364417×10^4	0.000000
1×10^2	0.324188	1.750204	2.026196×10^5	2.140755×10^4	0.000000
6x10	0.374734	1.697749	4.782678×10^4	8.811418×10^3	2.583255×10^{-34}
2x10	0.461763	1.479573	4.136822×10^3	1.458487×10^3	1.916633×10^{-3}
1x10	0.466845	1.184659	1.939097×10^3	5.728232×10^2	6.307541
6	0.452510	9.005319×10^{-1}	1.574961×10^3	3.497677×10^2	4.767032x10
2	0.425655	3.891447×10^{-1}	1.427870×10^3	2.003833×10^2	1.925018×10^2
1	0.417464	2.081811×10^{-1}	1.416433×10^3	1.730210×10^2	2.510586×10^2
6×10^{-1}	0.414080	1.283661×10^{-1}	1.413983×10^3	1.630411×10^2	2.769271×10^2
2×10^{-1}	0.410647	4.397950×10^{-2}	1.412598×10^3	1.535805×10^2	3.041074×10^2
1×10^{-1}	0.409782	2.214167×10^{-2}	1.412406×10^3	1.512939×10^2	3.110990×10^2
6×10^{-2}	0.409436	1.332168×10^{-2}	1.412346×10^3	1.503879×10^2	3.139169×10^2
2×10^{-2}	0.409089	4.452823×10^{-3}	1.412295×10^3	1.494868×10^2	3.167470×10^2
1×10^{-2}	0.409002	2.227948×10^{-3}	1.412283×10^3	1.492623×10^2	3.174564×10^2
6×10^{-3}	0.408967	1.337138×10^{-3}	1.412279×10^3	1.491726×10^2	3.177403×10^2
2×10^{-3}	0.408932	4.458356×10^{-4}	1.412275×10^3	1.490829×10^2	3.180244×10^2
1×10^{-3}	0.408924	2.229332×10^{-4}	1.412274×10^3	1.490605×10^2	3.180955×10^2
6×10^{-4}	0.408920	1.337636×10^{-4}	1.412273×10^3	1.490515×10^2	3.181239×10^2
2×10^{-4}	0.408917	4.458909×10^{-5}	1.412273×10^3	1.490425×10^2	3.181523×10^2
1×10^{-4}	0.408916	2.229470×10^{-5}	1.412273×10^3	1.490403×10^2	3.181594×10^2
6×10^{-5}	0.408915	1.337686×10^{-5}	1.412273×10^3	1.490394×10^2	3.181623×10^2
2×10^{-5}	0.408915	4.458965×10^{-6}	1.412273×10^3	1.490385×10^2	3.181651×10^2
1×10^{-5}	0.408915	2.229484×10^{-6}	1.412273×10^3	1.490383×10^2	3.181658×10^2
6×10^{-6}	0.408915	1.337691×10^{-6}	1.412273×10^3	1.490382×10^2	3.181661×10^2
2×10^{-6}	0.408915	4.458970×10^{-7}	1.412273×10^3	1.490381×10^2	3.181664×10^2
1×10^{-6}	0.408915	2.229485×10^{-7}	1.412273×10^3	1.490381×10^2	3.181664×10^2

Table 3.7. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for $\xi'=5$. These results are obtained by maximizing the function $P(\nu,Z)$ with respect to Z (case 3).

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
$1x10^3$	0.154607	1.881905	$2.945273x10^8$	$1.437798x10^6$	0.000000
$6x10^2$	0.183110	1.861224	$5.499465x10^7$	$5.526244x10^5$	0.000000
$2x10^2$	0.263208	1.804633	$1.597584x10^6$	$7.364199x10^4$	0.000000
$1x10^2$	0.330432	1.458425	$1.827314x10^5$	$2.140139x10^4$	0.000000
6x10	0.390085	1.717780	$3.859369x10^4$	$8.798557x10^3$	0.000000
2x10	0.550279	1.602972	$1.636684x10^3$	$1.404613x10^3$	$1.630779x10^{-58}$
1x10	0.667907	1.496728	$2.753170x10^2$	$4.718785x10^2$	$8.839174x10^{-19}$
6	0.750481	1.385162	8.866031x10	$2.210000x10^2$	$2.237807x10^{-8}$
2	0.844802	$9.751926x10^{-1}$	1.806975x10	5.589327x10	$6.753644x10^{-2}$
1	0.840511	$6.403557x10^{-1}$	1.224529x10	3.223173x10	$4.877113x10^{-1}$
$6x10^{-1}$	0.829572	$4.317115x10^{-1}$	1.081795x10	2.517827x10	$8.723014x10^{-1}$
$2x10^{-1}$	0.813056	$1.620035x10^{-1}$	9.797988	1.945391x10	1.400440
$1x10^{-1}$	0.808143	$8.344617x10^{-2}$	9.596742	1.821645x10	1.552364
$6x10^{-2}$	0.806100	$5.066680x10^{-2}$	9.521567	1.774189x10	1.615057
$2x10^{-2}$	0.804013	$1.709102x10^{-2}$	9.449301	1.727873x10	1.678780
$1x10^{-2}$	0.803485	$8.579958x10^{-3}$	9.431679	1.716470x10	1.694866
$6x10^{-3}$	0.803273	$5.148695x10^{-3}$	9.424679	1.711929x10	1.701317
$2x10^{-3}$	0.803061	$1.718274x10^{-3}$	9.417707	1.707398x10	1.707778
$1x10^{-3}$	0.803008	$8.593925x10^{-4}$	9.415968	1.706268x10	1.709395
$6x10^{-4}$	0.802986	$5.156968x10^{-4}$	9.415273	1.705815x10	1.710042
$2x10^{-4}$	0.802965	$1.719194x10^{-4}$	9.414579	1.705363x10	1.710689
$1x10^{-4}$	0.802960	$8.596225x10^{-5}$	9.414405	1.705250x10	1.710851
$6x10^{-5}$	0.802958	$5.157796x10^{-5}$	9.414336	1.705205x10	1.710915
$2x10^{-5}$	0.802956	$1.719286x10^{-5}$	9.414266	1.705160x10	1.710980
$1x10^{-5}$	0.802955	$8.596455x10^{-6}$	9.414249	1.705149x10	1.710996
$6x10^{-6}$	0.802955	$5.157879x10^{-6}$	9.414242	1.705144x10	1.711003
$2x10^{-6}$	0.802955	$1.719295x10^{-6}$	9.414235	1.705140x10	1.711009
$1x10^{-6}$	0.802955	$8.596478x10^{-7}$	9.414233	1.705138x10	1.711011

Table 3.8. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and Of the variational parameter, Z, for $\xi'=0.5$. These results are obtained by maximizing the function $P(\nu,Z)$ with respect to Z (case 3).

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
1×10^{3}	0.154616	1.881918	2.944341×10^{8}	1.437798×10^{6}	0.000000
6×10^{2}	0.183132	1.861256	5.495615×10^{7}	5.526244×10^{5}	0.000000
2×10^{2}	0.263386	1.804871	1.591636×10^{6}	7.364196×10^{4}	0.000000
1×10^{2}	0.331068	1.759242	1.808423×10^{5}	2.140133×10^{4}	0.000000
6×10	0.391684	1.719757	3.776519×10^{4}	8.798426×10^{3}	0.000000
2×10	0.561144	1.615268	1.482283×10^{3}	1.403990×10^{3}	0.000000
1×10	0.701948	1.533242	2.156673×10^{2}	4.703137×10^{2}	0.000000
6	0.825390	1.463021	5.594826×10	2.180537×10^{2}	0.000000
2	1.145288	1.272439	4.050053	4.727810×10	1.188077×10^{-20}
1	1.365687	1.108496	1.009755	1.999578×10	2.090057×10^{-9}
6×10^{-1}	1.512315	9.555258×10^{-1}	4.367551×10^{-1}	1.135343×10	5.122803×10^{-6}
2×10^{-1}	1.697622	5.551807×10^{-1}	1.393719×10^{-1}	4.529499	1.503276×10^{-3}
1×10^{-1}	1.730704	3.329014×10^{-1}	1.010547×10^{-1}	3.256469	3.893048×10^{-3}
6×10^{-2}	1.737810	2.155593×10^{-1}	8.921482×10^{-2}	2.816119	5.338414×10^{-3}
2×10^{-2}	1.740148	7.761600×10^{-2}	7.919811×10^{-2}	2.419130	7.048552×10^{-3}
1×10^{-2}	1.739909	3.956528×10^{-2}	7.696173×10^{-2}	2.326854	7.511643×10^{-3}
6×10^{-3}	1.739717	2.392330×10^{-2}	7.609588×10^{-2}	2.290731	7.700329×10^{-3}
2×10^{-3}	1.739470	8.036263×10^{-3}	7.524616×10^{-2}	2.255059	7.890869×10^{-3}
1×10^{-3}	1.739400	4.025895×10^{-3}	7.503624×10^{-2}	2.246211	7.938785×10^{-3}
6×10^{-4}	1.739371	2.417402×10^{-3}	7.495255×10^{-2}	2.242680	7.957982×10^{-3}
2×10^{-4}	1.739341	8.064231×10^{-4}	7.486901×10^{-2}	2.239153	7.977197×10^{-3}
1×10^{-4}	1.739333	4.032894×10^{-4}	7.484815×10^{-2}	2.238272	7.982003×10^{-3}
6×10^{-5}	1.739330	2.419923×10^{-4}	7.483981×10^{-2}	2.237920	7.983926×10^{-3}
2×10^{-5}	1.739327	8.067033×10^{-5}	7.483147×10^{-2}	2.237567	7.985849×10^{-3}
1×10^{-5}	1.739326	4.033594×10^{-5}	7.482939×10^{-2}	2.237479	7.986330×10^{-3}
6×10^{-6}	1.739326	2.420175×10^{-5}	7.482856×10^{-2}	2.237444	7.986522×10^{-3}
2×10^{-6}	1.739326	8.067313×10^{-6}	7.482772×10^{-2}	2.237409	7.986714×10^{-3}
1×10^{-6}	1.739326	4.033664×10^{-6}	7.482751×10^{-2}	2.237400	7.986762×10^{-3}

Table 3.9. Numerical values of the dimensionless functions, $a(\nu,Z)$, $b(\nu,Z)$, $\rho_1(\nu,Z)$, $n(\nu,Z)$ and of the variational parameter, Z, for $\xi'=0.05$. These results are obtained by maximizing the function $P(\nu,Z)$ with respect to Z (case 3).

ν	Z	$n(\nu,Z)$	$a(\nu,Z)$	$b(\nu,Z)$	$\rho_1(\nu,Z)$
1×10^{3}	0.154616	1.881919	2.9444247×10^{8}	1.437798×10^{6}	0.000000
6×10^{2}	0.183135	1.861259	5.495230×10^{7}	5.526244×10^{5}	0.000000
2×10^{2}	0.263404	1.804895	1.591042×10^{6}	7.364196×10^{4}	0.000000
1×10^{2}	0.331132	1.759323	1.806543×10^{5}	2.140133×10^{4}	0.000000
6×10	0.391845	1.719955	3.768324×10^{4}	8.798424×10^{3}	0.000000
2×10	0.562250	1.616491	1.467622×10^{3}	1.403984×10^{3}	0.000000
1×10	0.705519	1.536864	2.103248×10^{2}	4.702976×10^{2}	0.000000
6	0.833547	1.470788	5.339856×10	2.180224×10^{2}	0.000000
2	1.190405	1.307819	3.422610	4.715859×10	0.000000
1	1.486419	1.191253	7.086073×10^{-1}	1.973860×10	0.000000
6×10^{-1}	1.746368	1.099067	2.420534×10^{-1}	1.092614×10	8.556461×10^{-49}
2×10^{-1}	2.435568	8.832632×10^{-1}	3.146299×10^{-2}	3.556891×10	1.123101×10^{-17}
1×10^{-1}	2.949708	7.342188×10^{-1}	1.067861×10^{-2}	1.949879	3.633286×10^{-11}
6×10^{-2}	3.344445	6.182240×10^{-1}	5.401184×10^{-3}	1.323331	9.667985×10^{-9}
2×10^{-2}	4.099911	3.661781×10^{-1}	1.815734×10^{-3}	6.889955×10^{-1}	1.848344×10^{-6}
1×10^{-2}	4.422467	2.306962×10^{-1}	1.197415×10^{-3}	5.260302×10^{-1}	6.219061×10^{-6}
6×10^{-3}	4.576645	1.546117×10^{-1}	9.852422×10^{-4}	4.605156×10^{-1}	9.852561×10^{-6}
2×10^{-3}	4.745664	5.830604×10^{-2}	7.951979×10^{-4}	3.953385×10^{-1}	1.525956×10^{-5}
1×10^{-3}	4.789930	3.013038×10^{-2}	7.513759×10^{-4}	3.791886×10^{-1}	1.694580×10^{-5}
6×10^{-4}	4.807818	1.832268×10^{-2}	7.342786×10^{-4}	3.727539×10^{-1}	1.766084×10^{-5}
2×10^{-4}	4.825796	6.190992×10^{-3}	7.174317×10^{-4}	3.663357×10^{-1}	1.839945×10^{-5}
1×10^{-4}	4.830304	3.106080×10^{-3}	7.132594×10^{-4}	3.647339×10^{-1}	1.858781×10^{-5}
6×10^{-5}	4.832108	1.866199×10^{-3}	7.115949×10^{-4}	3.640935×10^{-1}	1.866357×10^{-5}
2×10^{-5}	4.833914	6.229185×10^{-4}	7.099330×10^{-4}	3.634533×10^{-1}	1.873957×10^{-5}
1×10^{-5}	4.834365	3.115659×10^{-4}	7.095179×10^{-4}	3.632933×10^{-1}	1.875860×10^{-5}
6×10^{-6}	4.834546	1.869652×10^{-4}	7.093519×10^{-4}	3.632293×10^{-1}	1.876622×10^{-5}
2×10^{-6}	4.834726	6.233026×10^{-5}	7.091859×10^{-4}	3.631653×10^{-1}	1.877384×10^{-5}
1×10^{-6}	4.834771	3.116620×10^{-5}	7.091445×10^{-4}	3.631493×10^{-1}	1.877575×10^{-5}

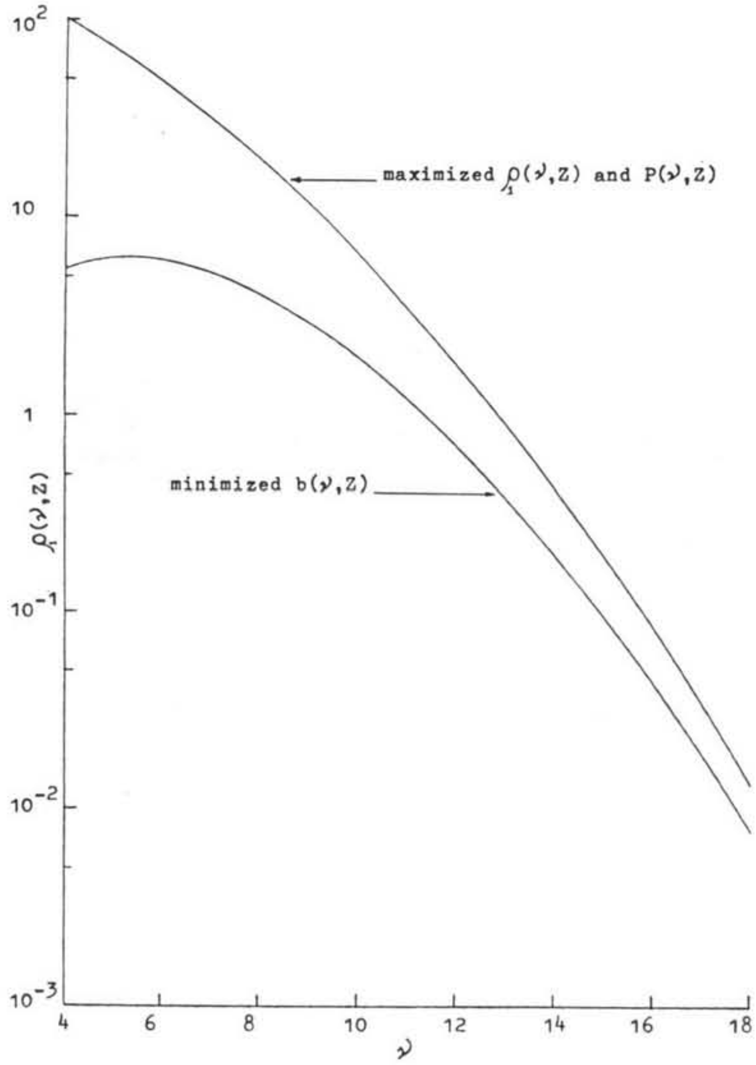

Fig. 3.1. The density of states, $\rho_1(\nu,Z)$, plotted againt ν for $\xi' = 50$.

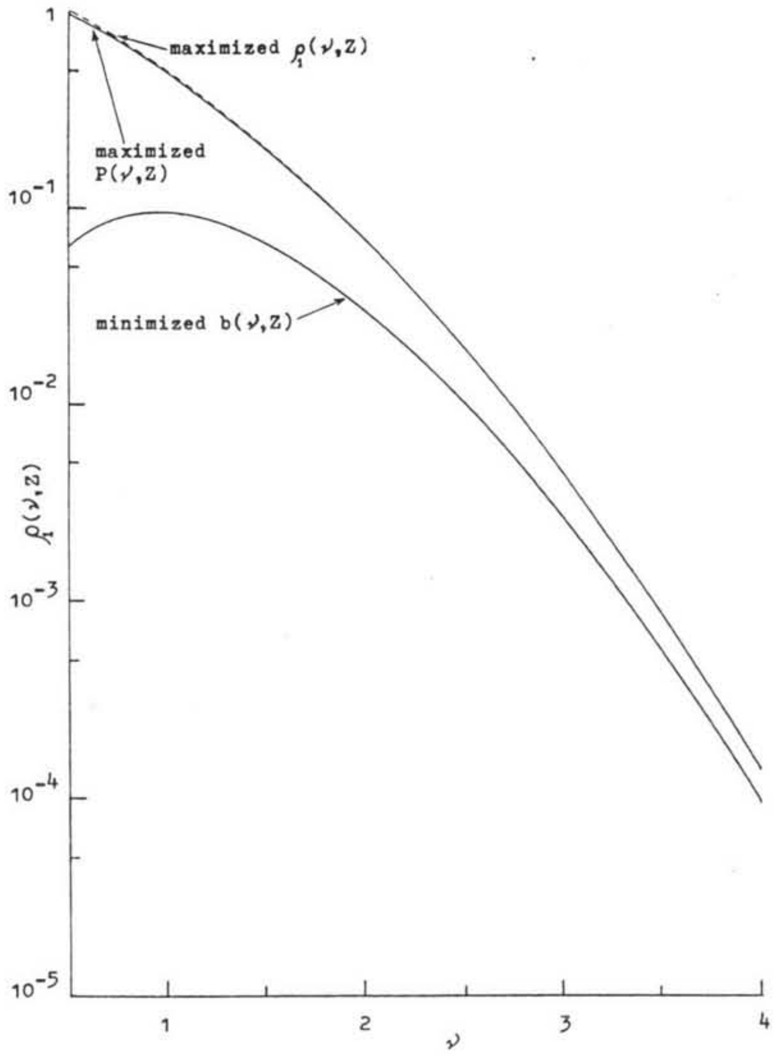

Fig. 3.2. The density of states, $\rho_1(\nu,Z)$, plotted againt ν for $\xi' = 5$.

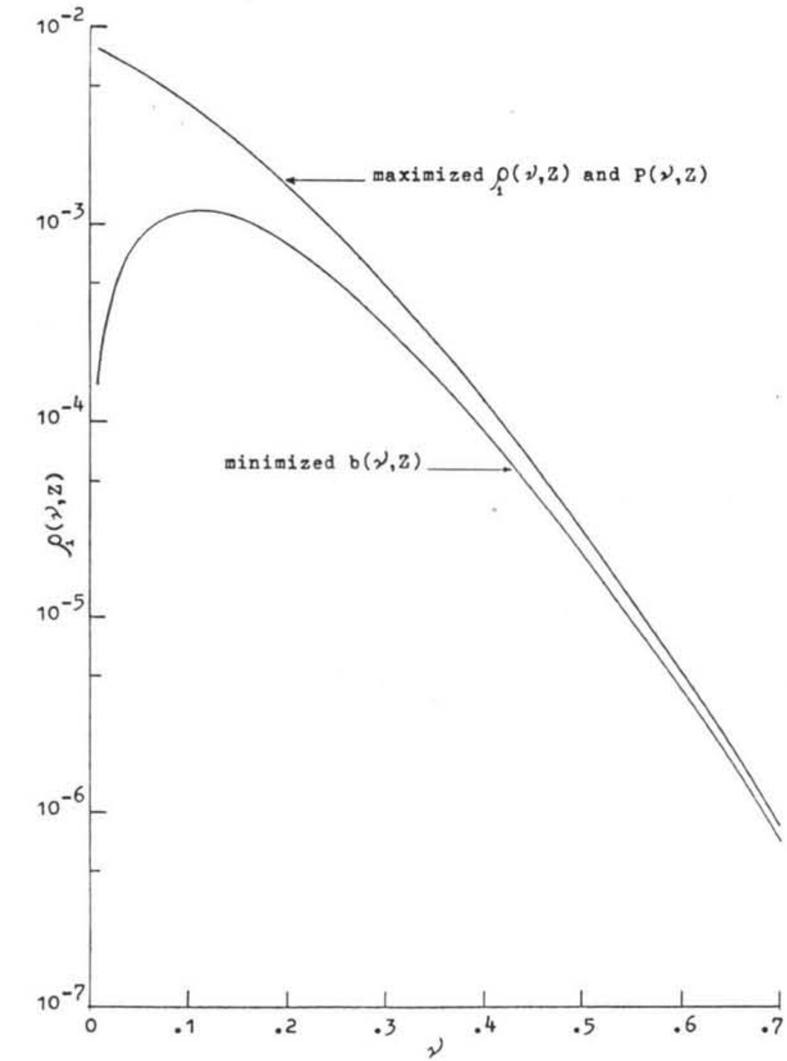

Fig. 3.3. The density of states, $\rho_1(\nu,Z)$, plotted againt ν for $\xi' = 0.5$.

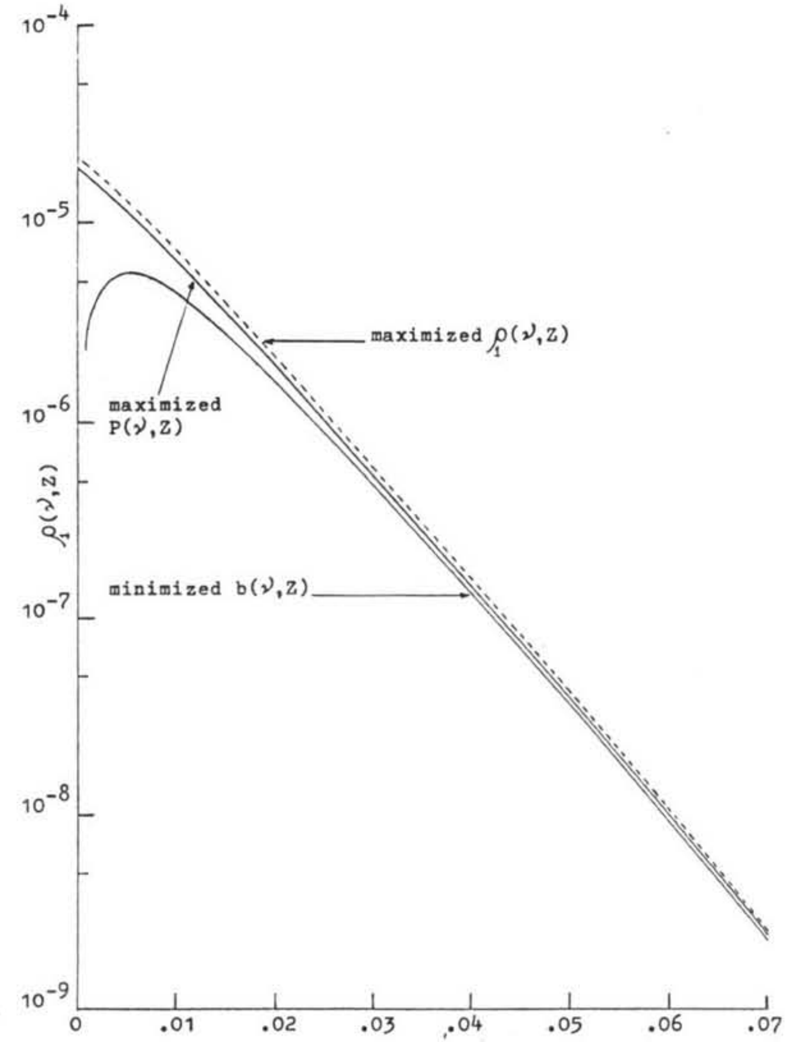

Fig. 3.4. The density of states, $\rho_1(\nu,Z)$, plotted againt ν for $\xi' = 0.05$.

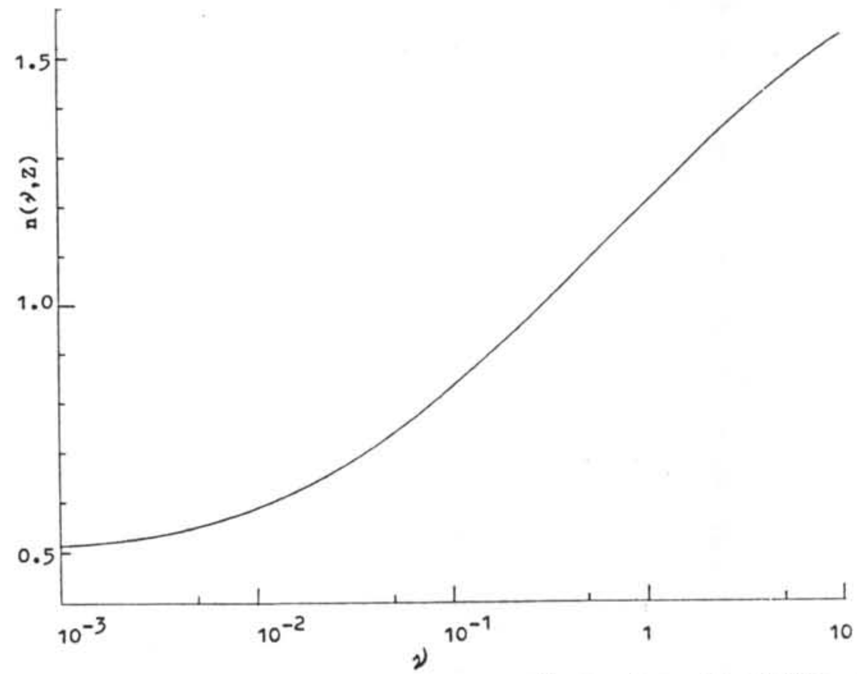

Fig. 3.5. The logarithmic derivative $n(\nu,Z) = [\partial \ln b(\nu,Z)]/[\partial \ln \nu]$ of the exponent $b(\nu,Z)$ in the density of states plotted againt ν for any values of ξ'. The curve is obtained for the case 1.

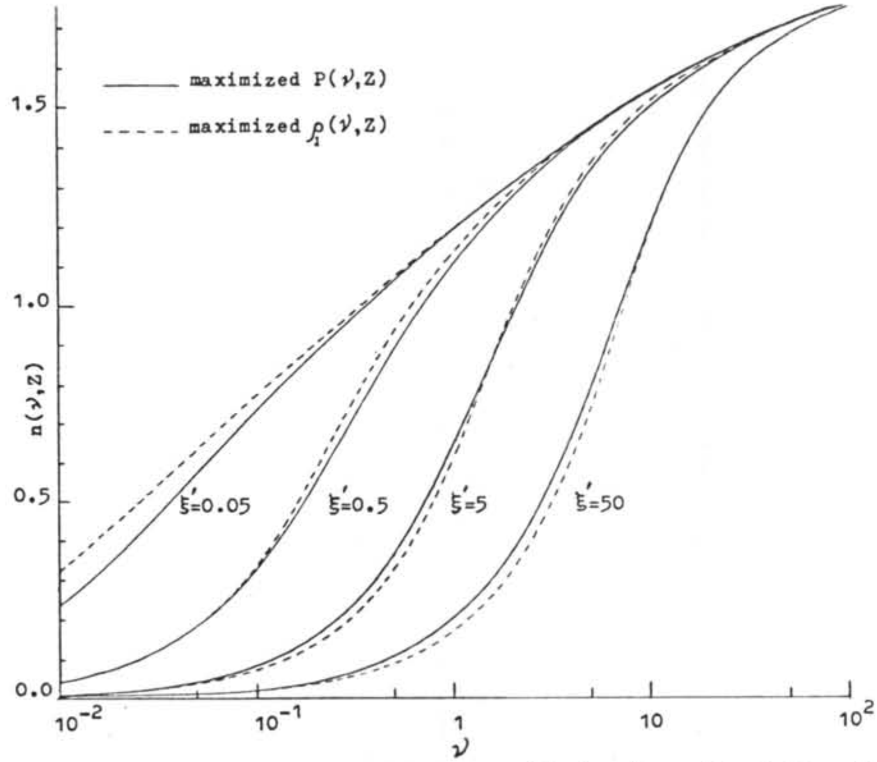

Fig. 3.6. The logarithmic derivative $n(\nu,Z) = [\partial \ln b(\nu,Z)]/[\partial \ln \nu]$ of the exponent $b(\nu,Z)$ in the density of states plotted againt ν for 4 values of ξ'. The curves are obtained for the case 2 and 3.