



Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI (Silicon on Insulator) Trigate

Manu Mitra^{1,*}

*Department of Electrical Engineering, Alumnus of University of Bridgeport, Bridgeport, United States; mmitra@my.bridgeport.edu

Abstract

Quantum mechanical model explains about the various kinds of atomic orbitals that are different in the amount of energy and shapes and classical electrostatics is the stationary electric charges. The charges are defined as positive and negative.

This paper discusses about Quantum mechanical and semi-classical electrostatic in a cross section (perpendicular) of a two dimensional trigate structures; its characteristics such as Quantum electron density, Classical electron density, classical potential distribution plots, its 6 wave functions for two different grids values are presented.

Keyword Terms : Quantum; Quantum Mechanical; Classical Electrostatics; SOI, Silicon on Insulators; Trigate.

1. INTRODUCTION

Matter starts to perform differently in Quantum Mechanics. Its performance is so counter intuitive that it can be represented with symbols and equations. For example electron behaves like particle and a wave? Or electron does not exist in any one particular location and is spread throughout the entire atom? That is the reason we need equations to represent it.

The problem with Bohr's model was electrons was treated as particles that existed in precisely defined orbits. But Erwin Schrödinger theorized the performance of electrons within atom can be better explained by treating them as matter waves mathematically. Hence known as Quantum Mechanical Model. [1]

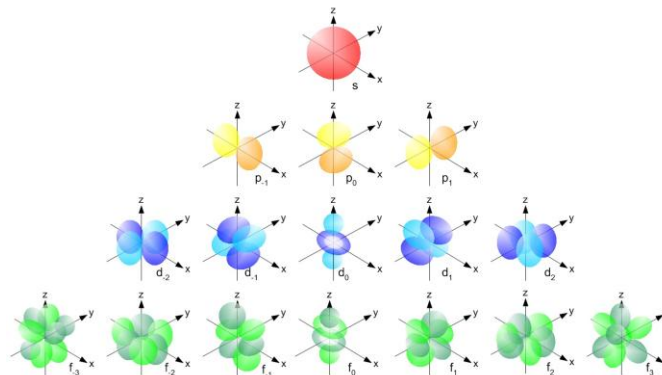


Fig. 1. Illustrates the general shapes of s, p, d, and f orbitals. Image credit: UC Davis Chemwiki, CC BY-NC-SA 3.0 US [1]

1.1 QUANTUM DEVICE LITERATURE REVIEW

Because of quantum confinement of carriers in a thin silicon, the minimum energy for electrons in the conduction

band increases when the thickness of silicon layer is reduced. [3]

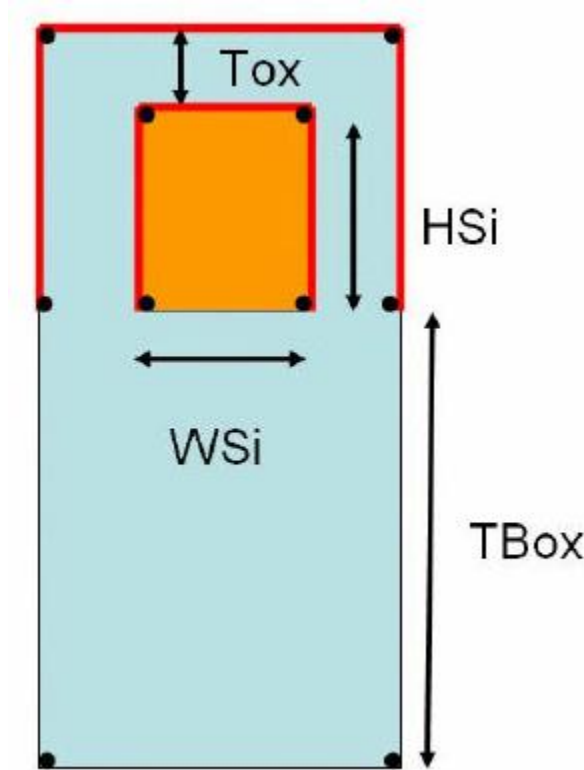


Fig. 2. Illustrates two dimensional Trigate structure for Silicon on Insulation (SOI) [Image Credit Reference No 5]

1. DEVICE SIMULATION

The cross section of Quantum Mechanical and semi-classical electrostatics on SOI Trigates was implemented. [4, 5]

a. Quantum Mechanical and semi-classical electrostatics for grid value 10

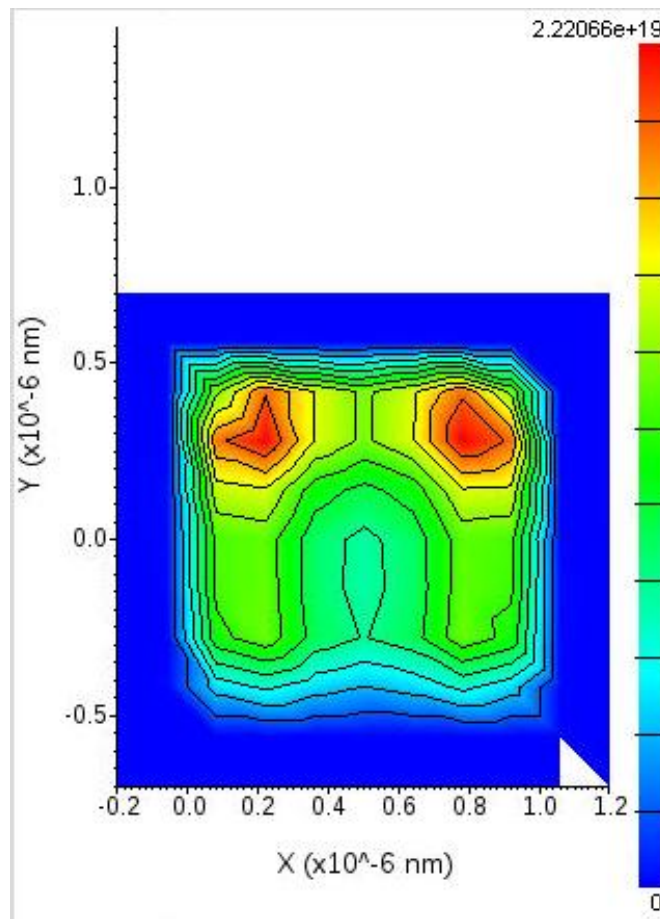


Fig. 3. Illustrates Quantum Electron Density

TABLE I
DATA OF QUANTUM ELECTRON DENSITY

Sl no:	X(cm)	Y(cm)	Quantum Electron Density
1	-7.00E-07	-2.00E-07	1.02E+12
2	-5.60E-07	-2.00E-07	3.20E+11
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	2.06415
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	0.00339982
10	5.60E-07	-2.00E-07	0.0177535
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	1.49E+13
13	-5.60E-07	-6.00E-08	1.85E+15
14	-4.20E-07	-6.00E-08	1.17E+17
15	-2.80E-07	-6.00E-08	3.71E+16
16	-1.40E-07	-6.00E-08	1.03E+17
17	0	-6.00E-08	1.70E+17
18	1.40E-07	-6.00E-08	2.15E+17
19	2.80E-07	-6.00E-08	2.40E+16
20	4.20E-07	-6.00E-08	2.95E+16
21	5.60E-07	-6.00E-08	2.19E+14
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	4.03E+14
24	-5.60E-07	8.00E-08	7.50E+16
25	-4.20E-07	8.00E-08	4.85E+18
26	-2.80E-07	8.00E-08	1.14E+19
27	-1.40E-07	8.00E-08	1.26E+19
28	0	8.00E-08	1.27E+19
29	1.40E-07	8.00E-08	1.54E+19
30	2.80E-07	8.00E-08	1.97E+19

31	4.20E-07	8.00E-08	1.37E+19
32	5.60E-07	8.00E-08	1.39E+16
33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	5.33E+13
35	-5.60E-07	2.20E-07	5.73E+16
36	-4.20E-07	2.20E-07	6.39E+18
37	-2.80E-07	2.20E-07	1.34E+19
38	-1.40E-07	2.20E-07	1.32E+19
39	0	2.20E-07	1.31E+19
40	1.40E-07	2.20E-07	1.60E+19
41	2.80E-07	2.20E-07	2.22E+19
42	4.20E-07	2.20E-07	2.00E+19
43	5.60E-07	2.20E-07	2.13E+16
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	4.93E+13
46	-5.60E-07	3.60E-07	9.84E+15
47	-4.20E-07	3.60E-07	4.81E+18
48	-2.80E-07	3.60E-07	9.32E+18
49	-1.40E-07	3.60E-07	8.90E+18
50	0	3.60E-07	8.92E+18
51	1.40E-07	3.60E-07	1.10E+19
52	2.80E-07	3.60E-07	1.61E+19
53	4.20E-07	3.60E-07	1.61E+19
54	5.60E-07	3.60E-07	1.89E+16
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	5.68E+13
57	-5.60E-07	5.00E-07	4.45E+16
58	-4.20E-07	5.00E-07	3.98E+18
59	-2.80E-07	5.00E-07	7.96E+18
60	-1.40E-07	5.00E-07	7.50E+18
61	0	5.00E-07	7.60E+18
62	1.40E-07	5.00E-07	9.50E+18
63	2.80E-07	5.00E-07	1.37E+19
64	4.20E-07	5.00E-07	1.37E+19
65	5.60E-07	5.00E-07	1.60E+16
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	2.39E+13
68	-5.60E-07	6.40E-07	6.54E+16
69	-4.20E-07	6.40E-07	4.76E+18
70	-2.80E-07	6.40E-07	9.26E+18
71	-1.40E-07	6.40E-07	8.84E+18
72	0	6.40E-07	8.94E+18
73	1.40E-07	6.40E-07	1.10E+19
74	2.80E-07	6.40E-07	1.60E+19
75	4.20E-07	6.40E-07	1.58E+19
76	5.60E-07	6.40E-07	1.55E+16
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	2.08E+13
79	-5.60E-07	7.80E-07	9.98E+16
80	-4.20E-07	7.80E-07	6.48E+18
81	-2.80E-07	7.80E-07	1.34E+19
82	-1.40E-07	7.80E-07	1.32E+19
83	0	7.80E-07	1.30E+19
84	1.40E-07	7.80E-07	1.60E+19
85	2.80E-07	7.80E-07	2.22E+19
86	4.20E-07	7.80E-07	1.98E+19
87	5.60E-07	7.80E-07	1.94E+16
88	7.00E-07	7.80E-07	0
89	-7.00E-07	9.20E-07	2.06E+14
90	-5.60E-07	9.20E-07	5.45E+16
91	-4.20E-07	9.20E-07	4.85E+18
92	-2.80E-07	9.20E-07	1.15E+19
93	-1.40E-07	9.20E-07	1.24E+19
94	0	9.20E-07	1.27E+19
95	1.40E-07	9.20E-07	1.57E+19
96	2.80E-07	9.20E-07	1.99E+19
97	4.20E-07	9.20E-07	1.37E+19
98	5.60E-07	9.20E-07	3.33E+16
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	5.56E+12
101	-5.60E-07	1.06E-06	3.77E+15
102	-4.20E-07	1.06E-06	1.23E+17
103	-2.80E-07	1.06E-06	1.03E+17
104	-1.40E-07	1.06E-06	1.60E+17

105	0	1.06E-06	2.39E+16
106	1.40E-07	1.06E-06	1.75E+16
107	2.80E-07	1.06E-06	2.85E+16
108	4.20E-07	1.06E-06	3.12E+16
109	5.60E-07	1.06E-06	1.60E+16
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	1.33E+12
112	-5.60E-07	1.20E-06	1.56E+12
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	0.0969432
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

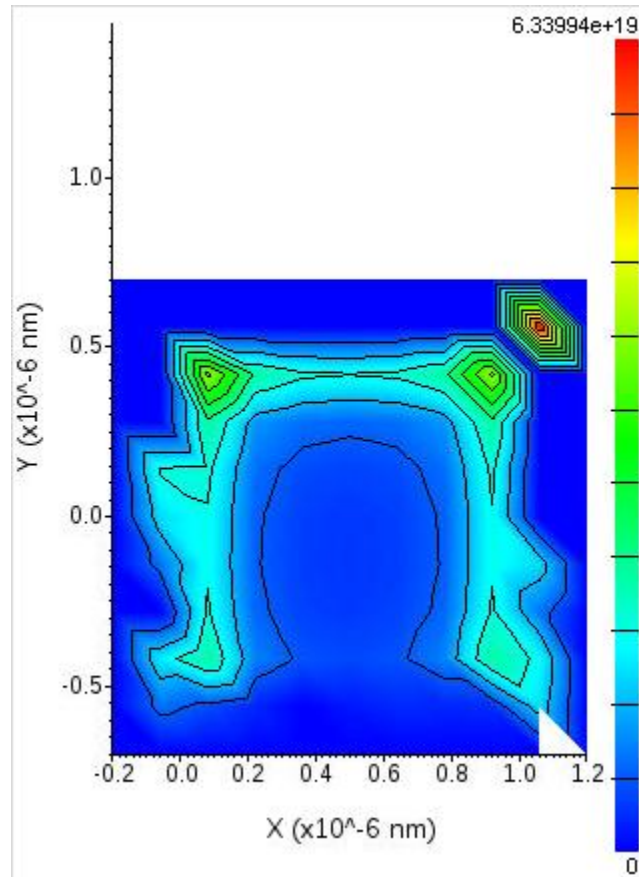


Fig. 4. Illustrates Classical Electron Density

TABLE II
DATA OF CLASSICAL ELECTRON DENSITY

Sl no:	X(cm)	Y(cm)	Classical Electron Density
1	-7.00E-07	-2.00E-07	0
2	-5.60E-07	-2.00E-07	0
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	0
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	0
10	5.60E-07	-2.00E-07	0
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	0

13	-5.60E-07	-6.00E-08	7.01E+18
14	-4.20E-07	-6.00E-08	1.49E+19
15	-2.80E-07	-6.00E-08	0
16	-1.40E-07	-6.00E-08	7.23E+18
17	0	-6.00E-08	1.40E+19
18	1.40E-07	-6.00E-08	1.78E+19
19	2.80E-07	-6.00E-08	0
20	4.20E-07	-6.00E-08	0
21	5.60E-07	-6.00E-08	0
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	0
24	-5.60E-07	8.00E-08	4.72E+18
25	-4.20E-07	8.00E-08	2.18E+19
26	-2.80E-07	8.00E-08	1.78E+19
27	-1.40E-07	8.00E-08	1.67E+19
28	0	8.00E-08	1.69E+19
29	1.40E-07	8.00E-08	1.82E+19
30	2.80E-07	8.00E-08	2.21E+19
31	4.20E-07	8.00E-08	4.16E+19
32	5.60E-07	8.00E-08	0
33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	0
35	-5.60E-07	2.20E-07	2.37E+18
36	-4.20E-07	2.20E-07	8.14E+18
37	-2.80E-07	2.20E-07	6.48E+18
38	-1.40E-07	2.20E-07	6.02E+18
39	0	2.20E-07	6.15E+18
40	1.40E-07	2.20E-07	6.94E+18
41	2.80E-07	2.20E-07	9.61E+18
42	4.20E-07	2.20E-07	2.20E+19
43	5.60E-07	2.20E-07	0
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	0
46	-5.60E-07	3.60E-07	0
47	-4.20E-07	3.60E-07	5.15E+18
48	-2.80E-07	3.60E-07	4.12E+18
49	-1.40E-07	3.60E-07	3.83E+18
50	0	3.60E-07	3.96E+18
51	1.40E-07	3.60E-07	4.68E+18
52	2.80E-07	3.60E-07	7.04E+18
53	4.20E-07	3.60E-07	1.82E+19
54	5.60E-07	3.60E-07	0
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	0
57	-5.60E-07	5.00E-07	1.45E+18
58	-4.20E-07	5.00E-07	4.50E+18
59	-2.80E-07	5.00E-07	3.61E+18
60	-1.40E-07	5.00E-07	3.35E+18
61	0	5.00E-07	3.49E+18
62	1.40E-07	5.00E-07	4.19E+18
63	2.80E-07	5.00E-07	6.49E+18
64	4.20E-07	5.00E-07	1.75E+19
65	5.60E-07	5.00E-07	0
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	0
68	-5.60E-07	6.40E-07	2.65E+18
69	-4.20E-07	6.40E-07	5.15E+18
70	-2.80E-07	6.40E-07	4.13E+18
71	-1.40E-07	6.40E-07	3.83E+18
72	0	6.40E-07	3.96E+18
73	1.40E-07	6.40E-07	4.68E+18
74	2.80E-07	6.40E-07	7.04E+18
75	4.20E-07	6.40E-07	1.83E+19
76	5.60E-07	6.40E-07	0
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	0
79	-5.60E-07	7.80E-07	2.36E+18
80	-4.20E-07	7.80E-07	8.14E+18
81	-2.80E-07	7.80E-07	6.47E+18
82	-1.40E-07	7.80E-07	6.03E+18
83	0	7.80E-07	6.15E+18
84	1.40E-07	7.80E-07	6.95E+18
85	2.80E-07	7.80E-07	9.61E+18
86	4.20E-07	7.80E-07	2.21E+19

87	5.60E-07	7.80E-07	0
88	7.00E-07	7.80E-07	0
89	-7.00E-07	9.20E-07	0
90	-5.60E-07	9.20E-07	2.76E+18
91	-4.20E-07	9.20E-07	2.18E+19
92	-2.80E-07	9.20E-07	1.78E+19
93	-1.40E-07	9.20E-07	1.69E+19
94	0	9.20E-07	1.70E+19
95	1.40E-07	9.20E-07	1.82E+19
96	2.80E-07	9.20E-07	2.22E+19
97	4.20E-07	9.20E-07	4.13E+19
98	5.60E-07	9.20E-07	0
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	0
101	-5.60E-07	1.06E-06	1.40E+19
102	-4.20E-07	1.06E-06	1.61E+19
103	-2.80E-07	1.06E-06	7.56E+18
104	-1.40E-07	1.06E-06	1.36E+19
105	0	1.06E-06	0
106	1.40E-07	1.06E-06	0
107	2.80E-07	1.06E-06	0
108	4.20E-07	1.06E-06	0
109	5.60E-07	1.06E-06	6.34E+19
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	0
112	-5.60E-07	1.20E-06	0
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	0
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

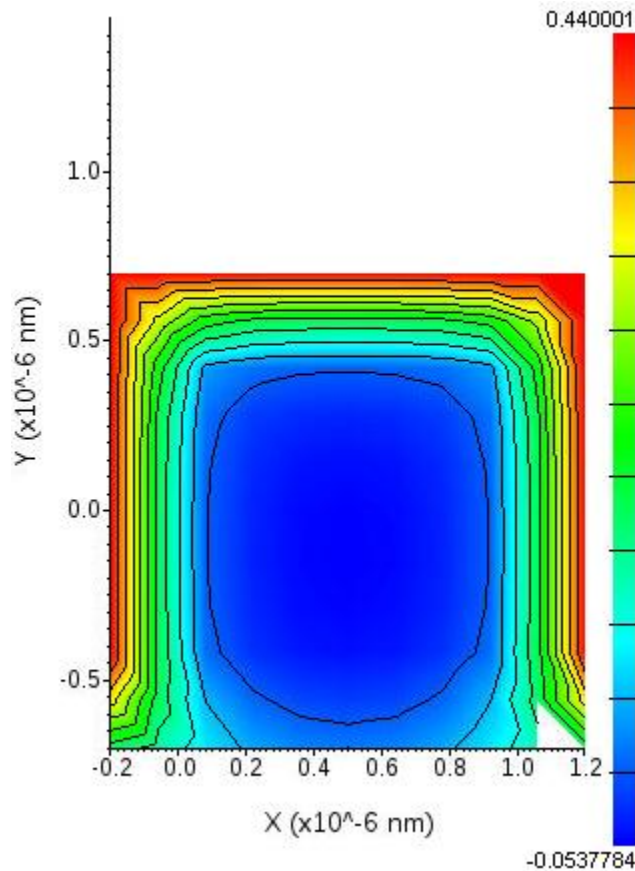


Fig. 5. Illustrates Classical Potential distribution

TABLE III
DATA OF CLASSICAL POTENTIAL DISTRIBUTION

Sl no:	X(cm)	Y(cm)	Classical Potential Distribution
1	-7.00E-07	-2.00E-07	0.151714
2	-5.60E-07	-2.00E-07	0.32271
3	-4.20E-07	-2.00E-07	0.440001
4	-2.80E-07	-2.00E-07	0.440001
5	-1.40E-07	-2.00E-07	0.440001
6	0	-2.00E-07	0.440001
7	1.40E-07	-2.00E-07	0.440001
8	2.80E-07	-2.00E-07	0.440001
9	4.20E-07	-2.00E-07	0.440001
10	5.60E-07	-2.00E-07	0.440001
11	7.00E-07	-2.00E-07	0.440001
12	-7.00E-07	-6.00E-08	0.110382
13	-5.60E-07	-6.00E-08	0.149784
14	-4.20E-07	-6.00E-08	0.154651
15	-2.80E-07	-6.00E-08	0.15392
16	-1.40E-07	-6.00E-08	0.153068
17	0	-6.00E-08	0.153186
18	1.40E-07	-6.00E-08	0.154618
19	2.80E-07	-6.00E-08	0.16129
20	4.20E-07	-6.00E-08	0.188425
21	5.60E-07	-6.00E-08	0.293543
22	7.00E-07	-6.00E-08	0.440001
23	-7.00E-07	8.00E-08	0.0586037
24	-5.60E-07	8.00E-08	0.0348924
25	-4.20E-07	8.00E-08	0.000362286
26	-2.80E-07	8.00E-08	-0.00612175
27	-1.40E-07	8.00E-08	-0.00798058
28	0	8.00E-08	-0.00770819
29	1.40E-07	8.00E-08	-0.00552147
30	2.80E-07	8.00E-08	0.000941722
31	4.20E-07	8.00E-08	0.0233332
32	5.60E-07	8.00E-08	0.190432
33	7.00E-07	8.00E-08	0.440001
34	-7.00E-07	2.20E-07	0.0280499
35	-5.60E-07	2.20E-07	-0.00330493
36	-4.20E-07	2.20E-07	-0.0293655
37	-2.80E-07	2.20E-07	-0.035752
38	-1.40E-07	2.20E-07	-0.0377932
39	0	2.20E-07	-0.037222
40	1.40E-07	2.20E-07	-0.033809
41	2.80E-07	2.20E-07	-0.0245422
42	4.20E-07	2.20E-07	0.000862851
43	5.60E-07	2.20E-07	0.161624
44	7.00E-07	2.20E-07	0.440001
45	-7.00E-07	3.60E-07	0.0111124
46	-5.60E-07	3.60E-07	-0.0193878
47	-4.20E-07	3.60E-07	-0.0421366
48	-2.80E-07	3.60E-07	-0.0482145
49	-1.40E-07	3.60E-07	-0.0501786
50	0	3.60E-07	-0.0493079
51	1.40E-07	3.60E-07	-0.0447591
52	2.80E-07	3.60E-07	-0.0333985
53	4.20E-07	3.60E-07	-0.00530822
54	5.60E-07	3.60E-07	0.155041
55	7.00E-07	3.60E-07	0.440001
56	-7.00E-07	5.00E-07	0.00613134
57	-5.60E-07	5.00E-07	-0.0240096
58	-4.20E-07	5.00E-07	-0.0458038
59	-2.80E-07	5.00E-07	-0.0517954
60	-1.40E-07	5.00E-07	-0.0537784
61	0	5.00E-07	-0.0526999
62	1.40E-07	5.00E-07	-0.0477591
63	2.80E-07	5.00E-07	-0.0356898
64	4.20E-07	5.00E-07	-0.00668112
65	5.60E-07	5.00E-07	0.153818
66	7.00E-07	5.00E-07	0.440001
67	-7.00E-07	6.40E-07	0.0112851
68	-5.60E-07	6.40E-07	-0.0199847
69	-4.20E-07	6.40E-07	-0.0421569

70	-2.80E-07	6.40E-07	-0.0481287
71	-1.40E-07	6.40E-07	-0.0502019
72	0	6.40E-07	-0.0492894
73	1.40E-07	6.40E-07	-0.0447488
74	2.80E-07	6.40E-07	-0.0334144
75	4.20E-07	6.40E-07	-0.00525868
76	5.60E-07	6.40E-07	0.155095
77	7.00E-07	6.40E-07	0.440001
78	-7.00E-07	7.80E-07	0.028184
79	-5.60E-07	7.80E-07	-0.00374491
80	-4.20E-07	7.80E-07	-0.0293874
81	-2.80E-07	7.80E-07	-0.0357701
82	-1.40E-07	7.80E-07	-0.0377637
83	0	7.80E-07	-0.0371889
84	1.40E-07	7.80E-07	-0.0337774
85	2.80E-07	7.80E-07	-0.0245806
86	4.20E-07	7.80E-07	0.000927132
87	5.60E-07	7.80E-07	0.161375
88	7.00E-07	7.80E-07	0.440001
89	-7.00E-07	9.20E-07	0.0591075
90	-5.60E-07	9.20E-07	0.0347361
91	-4.20E-07	9.20E-07	0.00036794
92	-2.80E-07	9.20E-07	-0.00620184
93	-1.40E-07	9.20E-07	-0.00782814
94	0	9.20E-07	-0.00757061
95	1.40E-07	9.20E-07	-0.00551407
96	2.80E-07	9.20E-07	0.000903398
97	4.20E-07	9.20E-07	0.0231618
98	5.60E-07	9.20E-07	0.186829
99	7.00E-07	9.20E-07	0.440001
100	-7.00E-07	1.06E-06	0.108249
101	-5.60E-07	1.06E-06	0.142786
102	-4.20E-07	1.06E-06	0.156128
103	-2.80E-07	1.06E-06	0.154055
104	-1.40E-07	1.06E-06	0.153086
105	0	1.06E-06	0.153223
106	1.40E-07	1.06E-06	0.154803
107	2.80E-07	1.06E-06	0.161056
108	4.20E-07	1.06E-06	0.18725
109	5.60E-07	1.06E-06	0.275721
110	7.00E-07	1.06E-06	0.440001
111	-7.00E-07	1.20E-06	0.151706
112	-5.60E-07	1.20E-06	0.324531
113	-4.20E-07	1.20E-06	0.440001
114	-2.80E-07	1.20E-06	0.440001
115	-1.40E-07	1.20E-06	0.440001
116	0	1.20E-06	0.440001
117	1.40E-07	1.20E-06	0.440001
118	2.80E-07	1.20E-06	0.440001
119	4.20E-07	1.20E-06	0.440001
120	5.60E-07	1.20E-06	0.440001
121	7.00E-07	1.20E-06	0.440001

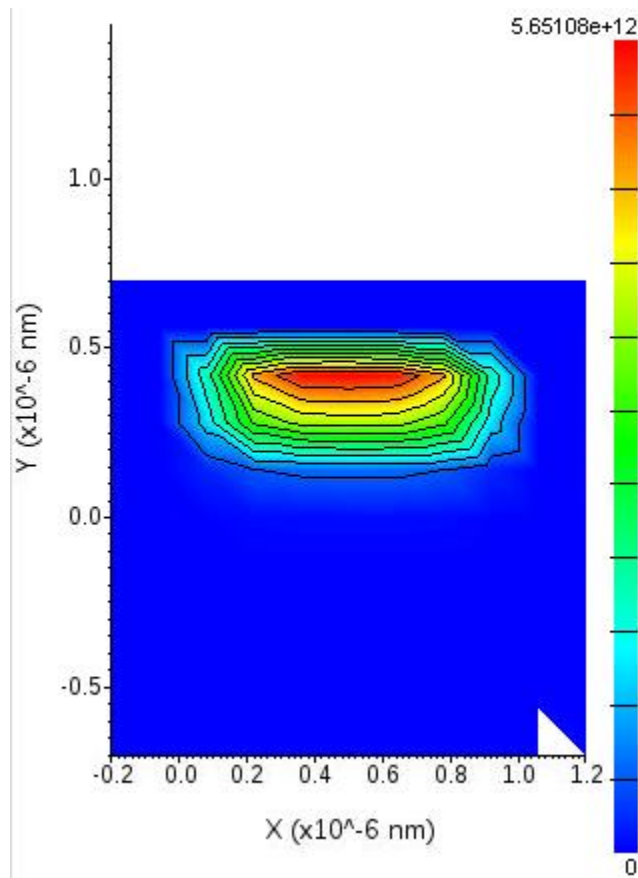


Fig. 6. Illustrates First Wave Function distribution

TABLE IV
DATA OF FIRST WAVE FUNCTION DISTRIBUTION

Sl no:	X(cm)	Y(cm)	First Wave Function
1	-7.00E-07	-2.00E-07	9.25896
2	-5.60E-07	-2.00E-07	1.80142
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	7.88E-10
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	7.56E-10
10	5.60E-07	-2.00E-07	1.79E-10
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	230.225
13	-5.60E-07	-6.00E-08	19733.4
14	-4.20E-07	-6.00E-08	4.76E+06
15	-2.80E-07	-6.00E-08	3.40E+06
16	-1.40E-07	-6.00E-08	5.44E+07
17	0	-6.00E-08	5.79E+08
18	1.40E-07	-6.00E-08	5.48E+09
19	2.80E-07	-6.00E-08	4.25E+09
20	4.20E-07	-6.00E-08	6.71E+09
21	5.60E-07	-6.00E-08	1.08E+07
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	5814.96
24	-5.60E-07	8.00E-08	314761
25	-4.20E-07	8.00E-08	9.74E+07
26	-2.80E-07	8.00E-08	5.74E+08
27	-1.40E-07	8.00E-08	2.98E+09
28	0	8.00E-08	2.27E+10
29	1.40E-07	8.00E-08	1.96E+11
30	2.80E-07	8.00E-08	1.24E+12
31	4.20E-07	8.00E-08	1.82E+12

32	5.60E-07	8.00E-08	5.69E+07
33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	1555.39
35	-5.60E-07	2.20E-07	584415
36	-4.20E-07	2.20E-07	2.37E+08
37	-2.80E-07	2.20E-07	1.38E+09
38	-1.40E-07	2.20E-07	7.14E+09
39	0	2.20E-07	5.60E+10
40	1.40E-07	2.20E-07	5.00E+11
41	2.80E-07	2.20E-07	3.17E+12
42	4.20E-07	2.20E-07	4.75E+12
43	5.60E-07	2.20E-07	8.29E+07
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	1970.3
46	-5.60E-07	3.60E-07	51412.8
47	-4.20E-07	3.60E-07	2.65E+08
48	-2.80E-07	3.60E-07	1.53E+09
49	-1.40E-07	3.60E-07	8.26E+09
50	0	3.60E-07	6.39E+10
51	1.40E-07	3.60E-07	5.85E+11
52	2.80E-07	3.60E-07	3.76E+12
53	4.20E-07	3.60E-07	5.60E+12
54	5.60E-07	3.60E-07	2.41E+07
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	3074.31
57	-5.60E-07	5.00E-07	943029
58	-4.20E-07	5.00E-07	2.61E+08
59	-2.80E-07	5.00E-07	1.48E+09
60	-1.40E-07	5.00E-07	8.24E+09
61	0	5.00E-07	6.43E+10
62	1.40E-07	5.00E-07	6.09E+11
63	2.80E-07	5.00E-07	3.82E+12
64	4.20E-07	5.00E-07	5.65E+12
65	5.60E-07	5.00E-07	2.84E+06
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	1318.32
68	-5.60E-07	6.40E-07	1.10E+06
69	-4.20E-07	6.40E-07	2.61E+08
70	-2.80E-07	6.40E-07	1.54E+09
71	-1.40E-07	6.40E-07	8.02E+09
72	0	6.40E-07	6.55E+10
73	1.40E-07	6.40E-07	5.91E+11
74	2.80E-07	6.40E-07	3.78E+12
75	4.20E-07	6.40E-07	5.55E+12
76	5.60E-07	6.40E-07	5.09E+07
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	933.182
79	-5.60E-07	7.80E-07	1.03E+06
80	-4.20E-07	7.80E-07	2.32E+08
81	-2.80E-07	7.80E-07	1.36E+09
82	-1.40E-07	7.80E-07	7.06E+09
83	0	7.80E-07	5.57E+10
84	1.40E-07	7.80E-07	5.09E+11
85	2.80E-07	7.80E-07	3.21E+12
86	4.20E-07	7.80E-07	4.71E+12
87	5.60E-07	7.80E-07	7.32E+07
88	7.00E-07	7.80E-07	0
89	-7.00E-07	9.20E-07	4482.79
90	-5.60E-07	9.20E-07	228472
91	-4.20E-07	9.20E-07	9.55E+07
92	-2.80E-07	9.20E-07	5.64E+08
93	-1.40E-07	9.20E-07	2.85E+09
94	0	9.20E-07	2.29E+10
95	1.40E-07	9.20E-07	2.05E+11
96	2.80E-07	9.20E-07	1.28E+12
97	4.20E-07	9.20E-07	1.85E+12
98	5.60E-07	9.20E-07	6.00E+07
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	120.004
101	-5.60E-07	1.06E-06	41333.2
102	-4.20E-07	1.06E-06	4.58E+06
103	-2.80E-07	1.06E-06	1.22E+07
104	-1.40E-07	1.06E-06	8.60E+07
105	0	1.06E-06	1.00E+08

106	1.40E-07	1.06E-06	8.00E+08
107	2.80E-07	1.06E-06	5.28E+09
108	4.20E-07	1.06E-06	7.24E+09
109	5.60E-07	1.06E-06	1.57E+09
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	10.8825
112	-5.60E-07	1.20E-06	12.1165
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	4.53E-11
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

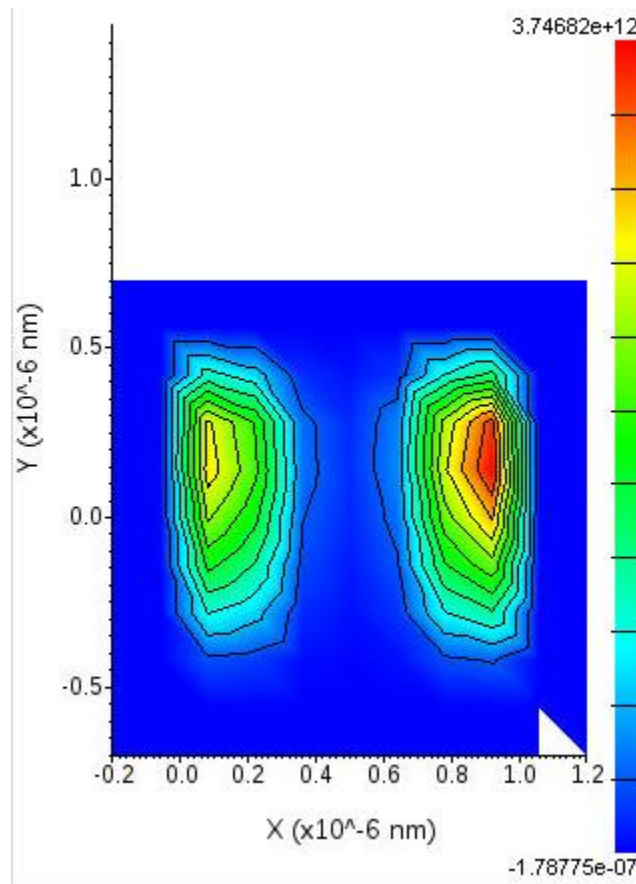


Fig. 7. Illustrates Second Wave Function distribution

TABLE V
DATA OF SECOND WAVE FUNCTION DISTRIBUTION

Sl no:	X(cm)	Y(cm)	Second Wave Function
1	-7.00E-07	-2.00E-07	69804.8
2	-5.60E-07	-2.00E-07	17185.2
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	-1.79E-07
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	1.37E-12
10	5.60E-07	-2.00E-07	2.79E-09
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	845497

13	-5.60E-07	-6.00E-08	7.68E+07
14	-4.20E-07	-6.00E-08	3.28E+09
15	-2.80E-07	-6.00E-08	1.24E+09
16	-1.40E-07	-6.00E-08	8.67E+09
17	0	-6.00E-08	1.74E+10
18	1.40E-07	-6.00E-08	2.08E+10
19	2.80E-07	-6.00E-08	3.95E+07
20	4.20E-07	-6.00E-08	3.53E+07
21	5.60E-07	-6.00E-08	1.60E+07
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	2.05E+07
24	-5.60E-07	8.00E-08	5.67E+09
25	-4.20E-07	8.00E-08	2.87E+11
26	-2.80E-07	8.00E-08	1.04E+12
27	-1.40E-07	8.00E-08	1.80E+12
28	0	8.00E-08	2.43E+12
29	1.40E-07	8.00E-08	2.90E+12
30	2.80E-07	8.00E-08	2.79E+12
31	4.20E-07	8.00E-08	1.16E+12
32	5.60E-07	8.00E-08	2.02E+09
33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	1.47E+06
35	-5.60E-07	2.20E-07	2.69E+09
36	-4.20E-07	2.20E-07	2.25E+11
37	-2.80E-07	2.20E-07	7.93E+11
38	-1.40E-07	2.20E-07	1.33E+12
39	0	2.20E-07	1.79E+12
40	1.40E-07	2.20E-07	2.13E+12
41	2.80E-07	2.20E-07	2.01E+12
42	4.20E-07	2.20E-07	8.23E+11
43	5.60E-07	2.20E-07	2.58E+09
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	863525
46	-5.60E-07	3.60E-07	2.06E+08
47	-4.20E-07	3.60E-07	4.34E+10
48	-2.80E-07	3.60E-07	1.52E+11
49	-1.40E-07	3.60E-07	2.64E+11
50	0	3.60E-07	3.49E+11
51	1.40E-07	3.60E-07	4.23E+11
52	2.80E-07	3.60E-07	4.04E+11
53	4.20E-07	3.60E-07	1.67E+11
54	5.60E-07	3.60E-07	7.77E+08
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	166514
57	-5.60E-07	5.00E-07	3.11E+08
58	-4.20E-07	5.00E-07	1.70E+10
59	-2.80E-07	5.00E-07	5.96E+10
60	-1.40E-07	5.00E-07	9.99E+10
61	0	5.00E-07	1.39E+11
62	1.40E-07	5.00E-07	1.65E+11
63	2.80E-07	5.00E-07	1.61E+11
64	4.20E-07	5.00E-07	6.80E+10
65	5.60E-07	5.00E-07	3.16E+08
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	61185.9
68	-5.60E-07	6.40E-07	1.07E+09
69	-4.20E-07	6.40E-07	5.22E+10
70	-2.80E-07	6.40E-07	1.89E+11
71	-1.40E-07	6.40E-07	3.12E+11
72	0	6.40E-07	4.20E+11
73	1.40E-07	6.40E-07	5.05E+11
74	2.80E-07	6.40E-07	4.78E+11
75	4.20E-07	6.40E-07	2.01E+11
76	5.60E-07	6.40E-07	8.10E+08
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	34754.8
79	-5.60E-07	7.80E-07	7.08E+09
80	-4.20E-07	7.80E-07	2.85E+11
81	-2.80E-07	7.80E-07	1.01E+12
82	-1.40E-07	7.80E-07	1.68E+12
83	0	7.80E-07	2.25E+12
84	1.40E-07	7.80E-07	2.68E+12
85	2.80E-07	7.80E-07	2.51E+12
86	4.20E-07	7.80E-07	1.04E+12

87	5.60E-07	7.80E-07	2.92E+09
88	7.00E-07	7.80E-07	0
89	-7.00E-07	9.20E-07	9.49E+06
90	-5.60E-07	9.20E-07	5.14E+09
91	-4.20E-07	9.20E-07	3.63E+11
92	-2.80E-07	9.20E-07	1.33E+12
93	-1.40E-07	9.20E-07	2.28E+12
94	0	9.20E-07	3.10E+12
95	1.40E-07	9.20E-07	3.75E+12
96	2.80E-07	9.20E-07	3.56E+12
97	4.20E-07	9.20E-07	1.45E+12
98	5.60E-07	9.20E-07	6.26E+09
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	317542
101	-5.60E-07	1.06E-06	2.01E+08
102	-4.20E-07	1.06E-06	4.46E+09
103	-2.80E-07	1.06E-06	7.02E+09
104	-1.40E-07	1.06E-06	1.63E+10
105	0	1.06E-06	1.60E+09
106	1.40E-07	1.06E-06	1.29E+08
107	2.80E-07	1.06E-06	1.38E+07
108	4.20E-07	1.06E-06	3.14E+07
109	5.60E-07	1.06E-06	1.42E+09
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	114302
112	-5.60E-07	1.20E-06	137097
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	-1.20E-07
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

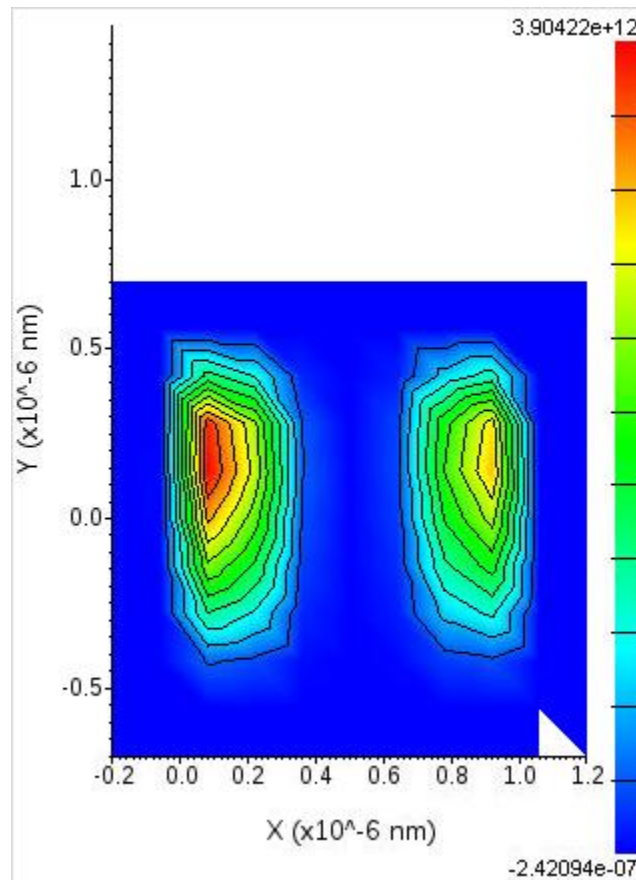


Fig. 8. Illustrates Third Wave Function distribution

TABLE VI
DATA OF THIRD WAVE FUNCTION DISTRIBUTION

Sl no:	X(cm)	Y(cm)	Third Wave Function
1	-7.00E-07	-2.00E-07	93869.7
2	-5.60E-07	-2.00E-07	23750.6
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	-2.42E-07
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	1.82E-12
10	5.60E-07	-2.00E-07	3.77E-09
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	1.13E+06
13	-5.60E-07	-6.00E-08	1.04E+08
14	-4.20E-07	-6.00E-08	4.44E+09
15	-2.80E-07	-6.00E-08	1.68E+09
16	-1.40E-07	-6.00E-08	1.17E+10
17	0	-6.00E-08	2.36E+10
18	1.40E-07	-6.00E-08	2.82E+10
19	2.80E-07	-6.00E-08	5.35E+07
20	4.20E-07	-6.00E-08	4.79E+07
21	5.60E-07	-6.00E-08	2.17E+07
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	2.73E+07
24	-5.60E-07	8.00E-08	7.59E+09
25	-4.20E-07	8.00E-08	3.86E+11
26	-2.80E-07	8.00E-08	1.40E+12
27	-1.40E-07	8.00E-08	2.43E+12
28	0	8.00E-08	3.28E+12
29	1.40E-07	8.00E-08	3.90E+12
30	2.80E-07	8.00E-08	3.76E+12
31	4.20E-07	8.00E-08	1.56E+12
32	5.60E-07	8.00E-08	2.72E+09
33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	1.85E+06
35	-5.60E-07	2.20E-07	3.34E+09
36	-4.20E-07	2.20E-07	2.88E+11
37	-2.80E-07	2.20E-07	1.01E+12
38	-1.40E-07	2.20E-07	1.70E+12
39	0	2.20E-07	2.29E+12
40	1.40E-07	2.20E-07	2.72E+12
41	2.80E-07	2.20E-07	2.57E+12
42	4.20E-07	2.20E-07	1.05E+12
43	5.60E-07	2.20E-07	3.28E+09
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	1.07E+06
46	-5.60E-07	3.60E-07	2.00E+08
47	-4.20E-07	3.60E-07	3.78E+10
48	-2.80E-07	3.60E-07	1.34E+11
49	-1.40E-07	3.60E-07	2.35E+11
50	0	3.60E-07	3.04E+11
51	1.40E-07	3.60E-07	3.67E+11
52	2.80E-07	3.60E-07	3.49E+11
53	4.20E-07	3.60E-07	1.42E+11
54	5.60E-07	3.60E-07	6.75E+08
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	48676.4
57	-5.60E-07	5.00E-07	3.73E+06
58	-4.20E-07	5.00E-07	4.14E+08
59	-2.80E-07	5.00E-07	2.49E+09
60	-1.40E-07	5.00E-07	3.14E+09
61	0	5.00E-07	4.93E+09
62	1.40E-07	5.00E-07	3.61E+09
63	2.80E-07	5.00E-07	1.47E+09
64	4.20E-07	5.00E-07	8.19E+08
65	5.60E-07	5.00E-07	9.02E+06
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	24354.9
68	-5.60E-07	6.40E-07	5.10E+08
69	-4.20E-07	6.40E-07	2.91E+10

70	-2.80E-07	6.40E-07	1.04E+11
71	-1.40E-07	6.40E-07	1.70E+11
72	0	6.40E-07	2.27E+11
73	1.40E-07	6.40E-07	2.70E+11
74	2.80E-07	6.40E-07	2.53E+11
75	4.20E-07	6.40E-07	1.07E+11
76	5.60E-07	6.40E-07	4.51E+08
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	34138
79	-5.60E-07	7.80E-07	5.69E+09
80	-4.20E-07	7.80E-07	2.29E+11
81	-2.80E-07	7.80E-07	8.07E+11
82	-1.40E-07	7.80E-07	1.35E+12
83	0	7.80E-07	1.81E+12
84	1.40E-07	7.80E-07	2.15E+12
85	2.80E-07	7.80E-07	2.01E+12
86	4.20E-07	7.80E-07	8.30E+11
87	5.60E-07	7.80E-07	2.34E+09
88	7.00E-07	7.80E-07	0
89	-7.00E-07	9.20E-07	7.86E+06
90	-5.60E-07	9.20E-07	4.32E+09
91	-4.20E-07	9.20E-07	3.07E+11
92	-2.80E-07	9.20E-07	1.13E+12
93	-1.40E-07	9.20E-07	1.92E+12
94	0	9.20E-07	2.62E+12
95	1.40E-07	9.20E-07	3.17E+12
96	2.80E-07	9.20E-07	3.01E+12
97	4.20E-07	9.20E-07	1.23E+12
98	5.60E-07	9.20E-07	5.31E+09
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	263944
101	-5.60E-07	1.06E-06	1.71E+08
102	-4.20E-07	1.06E-06	3.80E+09
103	-2.80E-07	1.06E-06	5.98E+09
104	-1.40E-07	1.06E-06	1.39E+10
105	0	1.06E-06	1.36E+09
106	1.40E-07	1.06E-06	1.10E+08
107	2.80E-07	1.06E-06	1.17E+07
108	4.20E-07	1.06E-06	2.68E+07
109	5.60E-07	1.06E-06	1.21E+09
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	97014.9
112	-5.60E-07	1.20E-06	116358
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	-1.02E-07
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

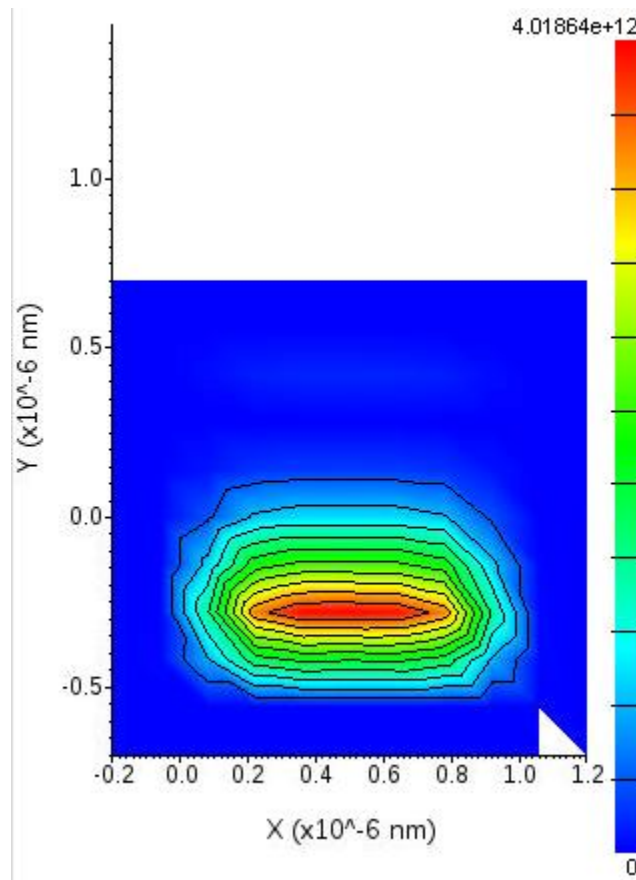


Fig. 9. Illustrates Fourth Wave Function distribution

TABLE VII
DATA OF FOURTH WAVE FUNCTION DISTRIBUTION

Sl no:	X(cm)	Y(cm)	Fourth Wave Function
1	-7.00E-07	-2.00E-07	84978.8
2	-5.60E-07	-2.00E-07	19815.3
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	8.09E-07
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	2.39E-11
10	5.60E-07	-2.00E-07	3.69E-12
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	2.00E+06
13	-5.60E-07	-6.00E-08	1.69E+08
14	-4.20E-07	-6.00E-08	2.74E+10
15	-2.80E-07	-6.00E-08	8.60E+09
16	-1.40E-07	-6.00E-08	1.18E+10
17	0	-6.00E-08	8.91E+09
18	1.40E-07	-6.00E-08	2.94E+09
19	2.80E-07	-6.00E-08	1.41E+07
20	4.20E-07	-6.00E-08	1.81E+08
21	5.60E-07	-6.00E-08	3.11E+05
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	4.98E+07
24	-5.60E-07	8.00E-08	2.70E+09
25	-4.20E-07	8.00E-08	6.90E+11
26	-2.80E-07	8.00E-08	1.44E+12
27	-1.40E-07	8.00E-08	8.41E+11
28	0	8.00E-08	3.23E+11
29	1.40E-07	8.00E-08	8.06E+10
30	2.80E-07	8.00E-08	1.30E+09
31	4.20E-07	8.00E-08	4.43E+10
32	5.60E-07	8.00E-08	1.63E+06

33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	1.33E+07
35	-5.60E-07	2.20E-07	5.08E+09
36	-4.20E-07	2.20E-07	1.66E+12
37	-2.80E-07	2.20E-07	3.52E+12
38	-1.40E-07	2.20E-07	2.03E+12
39	0	2.20E-07	7.84E+11
40	1.40E-07	2.20E-07	2.00E+11
41	2.80E-07	2.20E-07	1.97E+09
42	4.20E-07	2.20E-07	1.17E+11
43	5.60E-07	2.20E-07	2.38E+06
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	1.71E+07
46	-5.60E-07	3.60E-07	4.64E+08
47	-4.20E-07	3.60E-07	1.90E+12
48	-2.80E-07	3.60E-07	4.00E+12
49	-1.40E-07	3.60E-07	2.30E+12
50	0	3.60E-07	8.88E+11
51	1.40E-07	3.60E-07	2.30E+11
52	2.80E-07	3.60E-07	3.02E+09
53	4.20E-07	3.60E-07	1.39E+11
54	5.60E-07	3.60E-07	7.57E+05
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	2.69E+07
57	-5.60E-07	5.00E-07	8.52E+09
58	-4.20E-07	5.00E-07	1.85E+12
59	-2.80E-07	5.00E-07	4.02E+12
60	-1.40E-07	5.00E-07	2.28E+12
61	0	5.00E-07	8.84E+11
62	1.40E-07	5.00E-07	2.33E+11
63	2.80E-07	5.00E-07	3.27E+09
64	4.20E-07	5.00E-07	1.40E+11
65	5.60E-07	5.00E-07	6.96E+04
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	1.19E+07
68	-5.60E-07	6.40E-07	1.01E+10
69	-4.20E-07	6.40E-07	1.89E+12
70	-2.80E-07	6.40E-07	3.96E+12
71	-1.40E-07	6.40E-07	2.28E+12
72	0	6.40E-07	8.84E+11
73	1.40E-07	6.40E-07	2.27E+11
74	2.80E-07	6.40E-07	3.14E+09
75	4.20E-07	6.40E-07	1.37E+11
76	5.60E-07	6.40E-07	1.38E+06
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	7.88E+06
79	-5.60E-07	7.80E-07	8.92E+09
80	-4.20E-07	7.80E-07	1.66E+12
81	-2.80E-07	7.80E-07	3.50E+12
82	-1.40E-07	7.80E-07	2.00E+12
83	0	7.80E-07	7.65E+11
84	1.40E-07	7.80E-07	1.95E+11
85	2.80E-07	7.80E-07	1.70E+09
86	4.20E-07	7.80E-07	1.16E+11
87	5.60E-07	7.80E-07	2.12E+06
88	7.00E-07	7.80E-07	0
89	-7.00E-07	9.20E-07	3.87E+07
90	-5.60E-07	9.20E-07	1.98E+09
91	-4.20E-07	9.20E-07	6.87E+11
92	-2.80E-07	9.20E-07	1.41E+12
93	-1.40E-07	9.20E-07	8.17E+11
94	0	9.20E-07	3.13E+11
95	1.40E-07	9.20E-07	7.92E+10
96	2.80E-07	9.20E-07	9.34E+08
97	4.20E-07	9.20E-07	4.52E+10
98	5.60E-07	9.20E-07	1.96E+06
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	1.05E+06
101	-5.60E-07	1.06E-06	3.56E+08
102	-4.20E-07	1.06E-06	2.84E+10
103	-2.80E-07	1.06E-06	2.08E+10
104	-1.40E-07	1.06E-06	1.90E+10
105	0	1.06E-06	1.57E+09
106	1.40E-07	1.06E-06	2.90E+08

107	2.80E-07	1.06E-06	8.65E+06
108	4.20E-07	1.06E-06	1.88E+08
109	5.60E-07	1.06E-06	4.77E+07
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	101471
112	-5.60E-07	1.20E-06	112888
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	1.29E-07
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

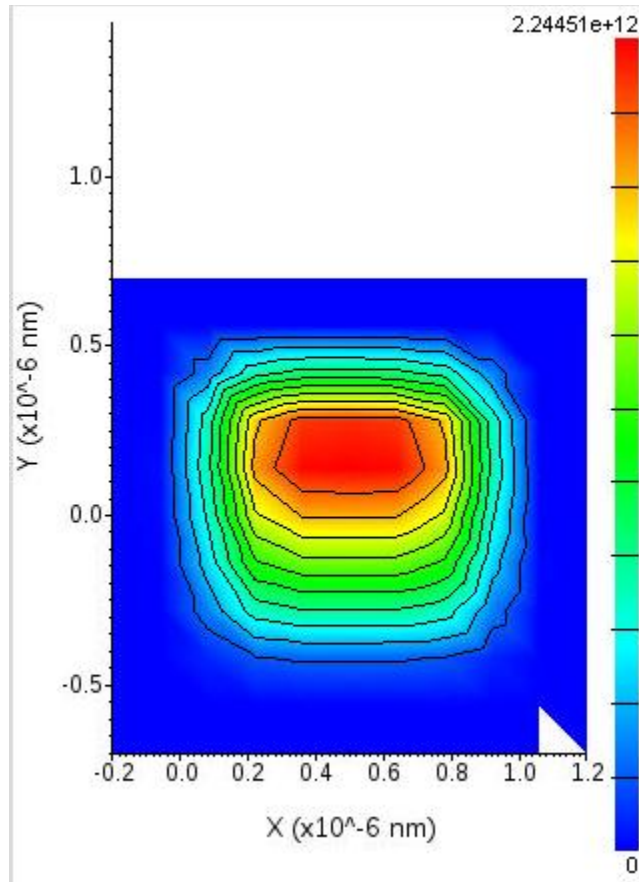


Fig. 10. Illustrates Fifth Wave Function distribution

TABLE VIII
DATA OF FIFTH WAVE FUNCTION DISTRIBUTION

Sl no:	X(cm)	Y(cm)	Fifth Wave Function
1	-7.00E-07	-2.00E-07	8091.88
2	-5.60E-07	-2.00E-07	287.627
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	2.54E-07
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	6.18E-11
10	5.60E-07	-2.00E-07	5.50E-11
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	2.69E+05
13	-5.60E-07	-6.00E-08	7.90E+07
14	-4.20E-07	-6.00E-08	3.78E+09

15	-2.80E-07	-6.00E-08	2.33E+09
16	-1.40E-07	-6.00E-08	8.71E+09
17	0	-6.00E-08	1.92E+10
18	1.40E-07	-6.00E-08	2.40E+10
19	2.80E-07	-6.00E-08	2.58E+09
20	4.20E-07	-6.00E-08	1.03E+09
21	5.60E-07	-6.00E-08	1.97E+07
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	1.34E+07
24	-5.60E-07	8.00E-08	2.10E+09
25	-4.20E-07	8.00E-08	7.86E+10
26	-2.80E-07	8.00E-08	2.87E+11
27	-1.40E-07	8.00E-08	4.92E+11
28	0	8.00E-08	6.46E+11
29	1.40E-07	8.00E-08	7.52E+11
30	2.80E-07	8.00E-08	7.05E+11
31	4.20E-07	8.00E-08	2.88E+11
32	5.60E-07	8.00E-08	5.19E+08
33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	1.69E+06
35	-5.60E-07	2.20E-07	3.66E+09
36	-4.20E-07	2.20E-07	1.94E+11
37	-2.80E-07	2.20E-07	7.07E+11
38	-1.40E-07	2.20E-07	1.20E+12
39	0	2.20E-07	1.60E+12
40	1.40E-07	2.20E-07	1.91E+12
41	2.80E-07	2.20E-07	1.80E+12
42	4.20E-07	2.20E-07	7.44E+11
43	5.60E-07	2.20E-07	2.31E+09
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	1.27E+06
46	-5.60E-07	3.60E-07	1.13E+09
47	-4.20E-07	3.60E-07	2.25E+11
48	-2.80E-07	3.60E-07	8.08E+11
49	-1.40E-07	3.60E-07	1.37E+12
50	0	3.60E-07	1.85E+12
51	1.40E-07	3.60E-07	2.23E+12
52	2.80E-07	3.60E-07	2.12E+12
53	4.20E-07	3.60E-07	8.87E+11
54	5.60E-07	3.60E-07	3.96E+09
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	1.28E+06
57	-5.60E-07	5.00E-07	4.91E+09
58	-4.20E-07	5.00E-07	2.23E+11
59	-2.80E-07	5.00E-07	8.07E+11
60	-1.40E-07	5.00E-07	1.37E+12
61	0	5.00E-07	1.86E+12
62	1.40E-07	5.00E-07	2.24E+12
63	2.80E-07	5.00E-07	2.15E+12
64	4.20E-07	5.00E-07	8.97E+11
65	5.60E-07	5.00E-07	3.92E+09
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	4.38E+05
68	-5.60E-07	6.40E-07	6.51E+09
69	-4.20E-07	6.40E-07	2.20E+11
70	-2.80E-07	6.40E-07	8.03E+11
71	-1.40E-07	6.40E-07	1.36E+12
72	0	6.40E-07	1.85E+12
73	1.40E-07	6.40E-07	2.23E+12
74	2.80E-07	6.40E-07	2.12E+12
75	4.20E-07	6.40E-07	8.77E+11
76	5.60E-07	6.40E-07	3.11E+09
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	3.74E+04
79	-5.60E-07	7.80E-07	4.64E+09
80	-4.20E-07	7.80E-07	1.95E+11
81	-2.80E-07	7.80E-07	7.05E+11
82	-1.40E-07	7.80E-07	1.19E+12
83	0	7.80E-07	1.60E+12
84	1.40E-07	7.80E-07	1.91E+12
85	2.80E-07	7.80E-07	1.80E+12
86	4.20E-07	7.80E-07	7.38E+11
87	5.60E-07	7.80E-07	2.17E+09
88	7.00E-07	7.80E-07	0

89	-7.00E-07	9.20E-07	5.90E+06
90	-5.60E-07	9.20E-07	1.54E+09
91	-4.20E-07	9.20E-07	7.83E+10
92	-2.80E-07	9.20E-07	2.86E+11
93	-1.40E-07	9.20E-07	4.80E+11
94	0	9.20E-07	6.40E+11
95	1.40E-07	9.20E-07	7.62E+11
96	2.80E-07	9.20E-07	7.17E+11
97	4.20E-07	9.20E-07	2.89E+11
98	5.60E-07	9.20E-07	1.13E+09
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	6.03E+04
101	-5.60E-07	1.06E-06	1.55E+08
102	-4.20E-07	1.06E-06	3.54E+09
103	-2.80E-07	1.06E-06	5.70E+09
104	-1.40E-07	1.06E-06	1.41E+10
105	0	1.06E-06	3.81E+09
106	1.40E-07	1.06E-06	3.26E+09
107	2.80E-07	1.06E-06	2.90E+09
108	4.20E-07	1.06E-06	1.11E+09
109	5.60E-07	1.06E-06	8.00E+08
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	8398.8
112	-5.60E-07	1.20E-06	9965.2
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	3.44E-08
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

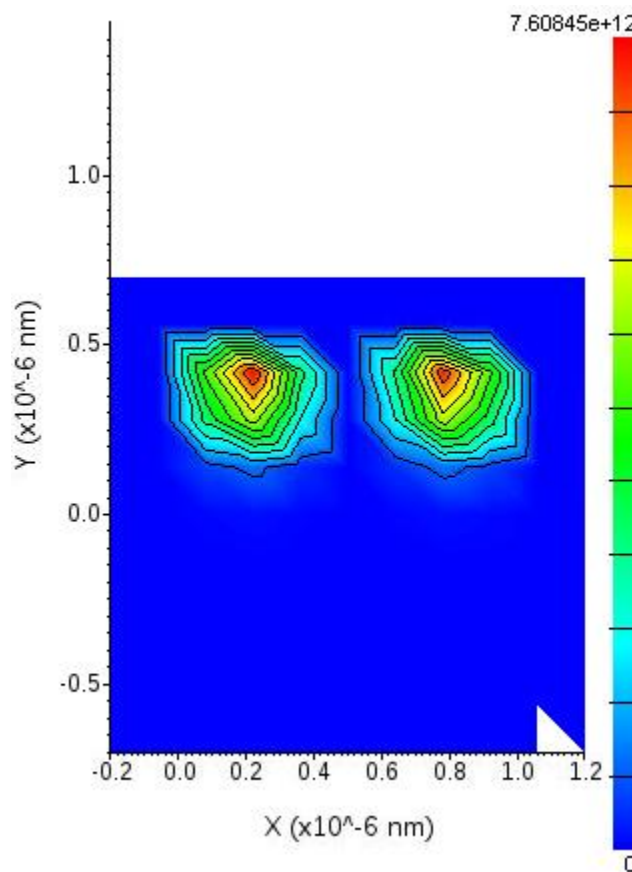


Fig. 11. Illustrates Sixth Wave Function distribution

TABLE IX
DATA OF SIXTH WAVE FUNCTION DISTRIBUTION

Sl no:	X(cm)	Y(cm)	Sixth Wave Function
1	-7.00E-07	-2.00E-07	38.7046
2	-5.60E-07	-2.00E-07	9.18714
3	-4.20E-07	-2.00E-07	0
4	-2.80E-07	-2.00E-07	0
5	-1.40E-07	-2.00E-07	2.60E-09
6	0	-2.00E-07	0
7	1.40E-07	-2.00E-07	0
8	2.80E-07	-2.00E-07	0
9	4.20E-07	-2.00E-07	2.19E-09
10	5.60E-07	-2.00E-07	3.55E-10
11	7.00E-07	-2.00E-07	0
12	-7.00E-07	-6.00E-08	9.06E+02
13	-5.60E-07	-6.00E-08	8.55E+04
14	-4.20E-07	-6.00E-08	1.92E+07
15	-2.80E-07	-6.00E-08	1.29E+07
16	-1.40E-07	-6.00E-08	1.73E+08
17	0	-6.00E-08	1.66E+09
18	1.40E-07	-6.00E-08	1.48E+10
19	2.80E-07	-6.00E-08	1.13E+10
20	4.20E-07	-6.00E-08	1.76E+10
21	5.60E-07	-6.00E-08	2.63E+07
22	7.00E-07	-6.00E-08	0
23	-7.00E-07	8.00E-08	2.17E+04
24	-5.60E-07	8.00E-08	1.17E+06
25	-4.20E-07	8.00E-08	3.67E+08
26	-2.80E-07	8.00E-08	1.97E+09
27	-1.40E-07	8.00E-08	8.80E+09
28	0	8.00E-08	5.93E+10
29	1.40E-07	8.00E-08	4.84E+11
30	2.80E-07	8.00E-08	2.99E+12
31	4.20E-07	8.00E-08	4.31E+12
32	5.60E-07	8.00E-08	1.33E+08
33	7.00E-07	8.00E-08	0
34	-7.00E-07	2.20E-07	4.20E+03
35	-5.60E-07	2.20E-07	1.41E+06
36	-4.20E-07	2.20E-07	6.18E+08
37	-2.80E-07	2.20E-07	3.27E+09
38	-1.40E-07	2.20E-07	1.44E+10
39	0	2.20E-07	9.91E+10
40	1.40E-07	2.20E-07	8.39E+11
41	2.80E-07	2.20E-07	5.17E+12
42	4.20E-07	2.20E-07	7.61E+12
43	5.60E-07	2.20E-07	1.41E+08
44	7.00E-07	2.20E-07	0
45	-7.00E-07	3.60E-07	2.97E+03
46	-5.60E-07	3.60E-07	6.18E+04
47	-4.20E-07	3.60E-07	2.45E+08
48	-2.80E-07	3.60E-07	1.27E+09
49	-1.40E-07	3.60E-07	5.70E+09
50	0	3.60E-07	3.79E+10
51	1.40E-07	3.60E-07	3.28E+11
52	2.80E-07	3.60E-07	2.05E+12
53	4.20E-07	3.60E-07	3.02E+12
54	5.60E-07	3.60E-07	4.36E+07
55	7.00E-07	3.60E-07	0
56	-7.00E-07	5.00E-07	1.15E+02
57	-5.60E-07	5.00E-07	1.26E+04
58	-4.20E-07	5.00E-07	3.75E+06
59	-2.80E-07	5.00E-07	3.51E+07
60	-1.40E-07	5.00E-07	1.08E+08
61	0	5.00E-07	1.04E+09
62	1.40E-07	5.00E-07	4.78E+09
63	2.80E-07	5.00E-07	7.55E+09
64	4.20E-07	5.00E-07	1.52E+10
65	5.60E-07	5.00E-07	6.80E+06
66	7.00E-07	5.00E-07	0
67	-7.00E-07	6.40E-07	5.45E+02
68	-5.60E-07	6.40E-07	6.76E+05
69	-4.20E-07	6.40E-07	2.05E+08

70	-2.80E-07	6.40E-07	1.19E+09
71	-1.40E-07	6.40E-07	5.66E+09
72	0	6.40E-07	3.97E+10
73	1.40E-07	6.40E-07	3.39E+11
74	2.80E-07	6.40E-07	2.05E+12
75	4.20E-07	6.40E-07	2.89E+12
76	5.60E-07	6.40E-07	1.73E+07
77	7.00E-07	6.40E-07	0
78	-7.00E-07	7.80E-07	2.61E+03
79	-5.60E-07	7.80E-07	2.45E+06
80	-4.20E-07	7.80E-07	5.35E+08
81	-2.80E-07	7.80E-07	3.08E+09
82	-1.40E-07	7.80E-07	1.43E+10
83	0	7.80E-07	1.02E+11
84	1.40E-07	7.80E-07	8.61E+11
85	2.80E-07	7.80E-07	5.21E+12
86	4.20E-07	7.80E-07	7.42E+12
87	5.60E-07	7.80E-07	1.25E+08
88	7.00E-07	7.80E-07	0
89	-7.00E-07	9.20E-07	1.47E+04
90	-5.60E-07	9.20E-07	7.50E+05
91	-4.20E-07	9.20E-07	3.29E+08
92	-2.80E-07	9.20E-07	1.86E+09
93	-1.40E-07	9.20E-07	8.43E+09
94	0	9.20E-07	6.12E+10
95	1.40E-07	9.20E-07	5.12E+11
96	2.80E-07	9.20E-07	3.08E+12
97	4.20E-07	9.20E-07	4.31E+12
98	5.60E-07	9.20E-07	1.55E+08
99	7.00E-07	9.20E-07	0
100	-7.00E-07	1.06E-06	4.25E+02
101	-5.60E-07	1.06E-06	1.61E+05
102	-4.20E-07	1.06E-06	1.70E+07
103	-2.80E-07	1.06E-06	4.30E+07
104	-1.40E-07	1.06E-06	2.75E+08
105	0	1.06E-06	2.97E+08
106	1.40E-07	1.06E-06	2.22E+09
107	2.80E-07	1.06E-06	1.41E+10
108	4.20E-07	1.06E-06	1.87E+10
109	5.60E-07	1.06E-06	4.01E+09
110	7.00E-07	1.06E-06	0
111	-7.00E-07	1.20E-06	42.742
112	-5.60E-07	1.20E-06	47.5349
113	-4.20E-07	1.20E-06	0
114	-2.80E-07	1.20E-06	0
115	-1.40E-07	1.20E-06	1.99E-10
116	0	1.20E-06	0
117	1.40E-07	1.20E-06	0
118	2.80E-07	1.20E-06	0
119	4.20E-07	1.20E-06	0
120	5.60E-07	1.20E-06	0
121	7.00E-07	1.20E-06	0

b. Quantum Mechanical and semi-classical electrostatics for number of grids value 50

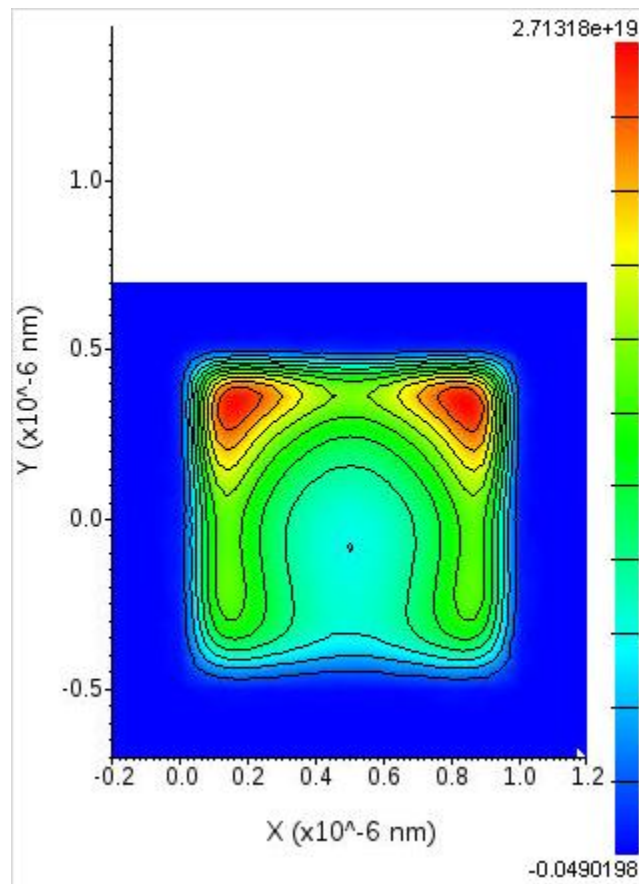


Fig. 12. Illustrates Quantum Electron Density

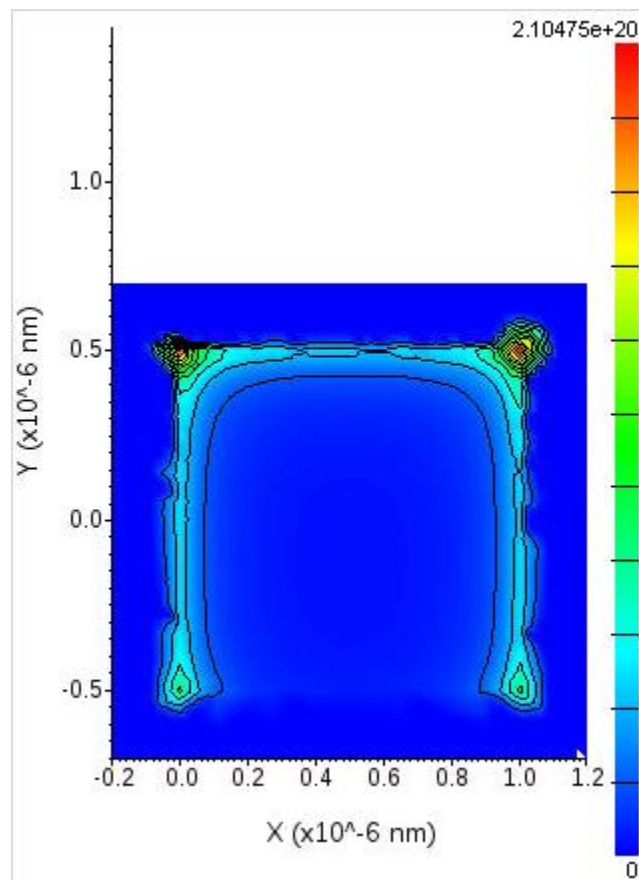


Fig. 13. Illustrates Classical Electron Density

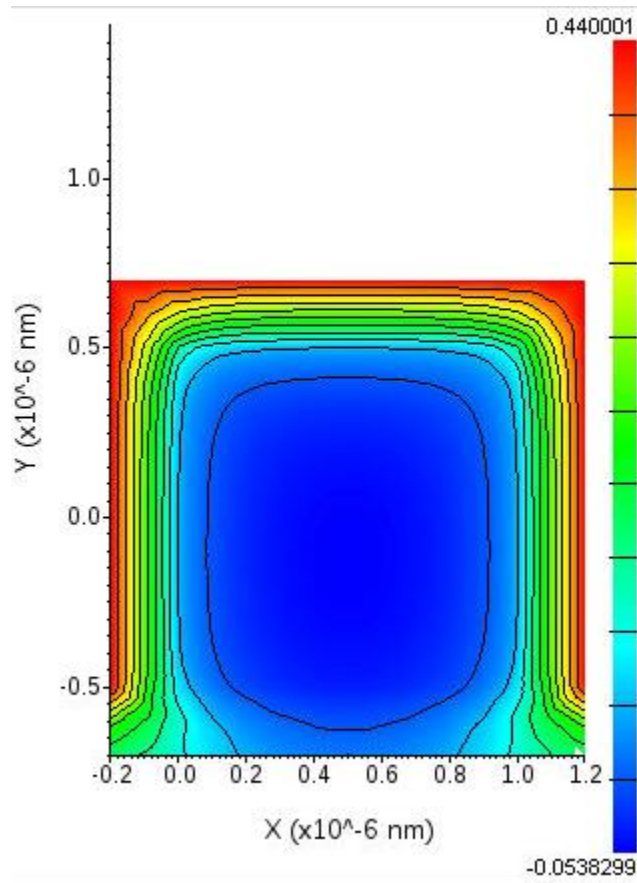


Fig. 14. Illustrates Classical Potential Distribution

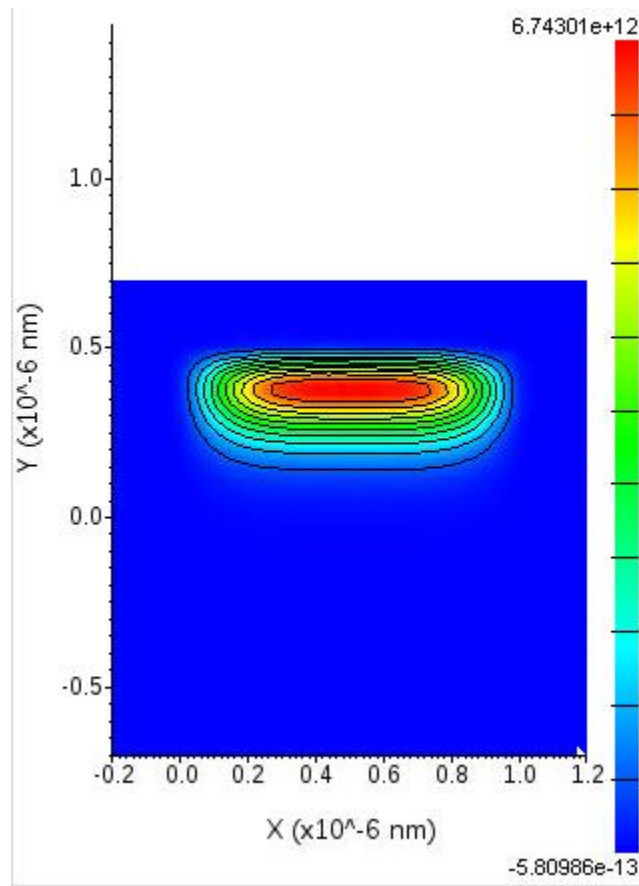


Fig. 15. Illustrates First Wave Function Distribution

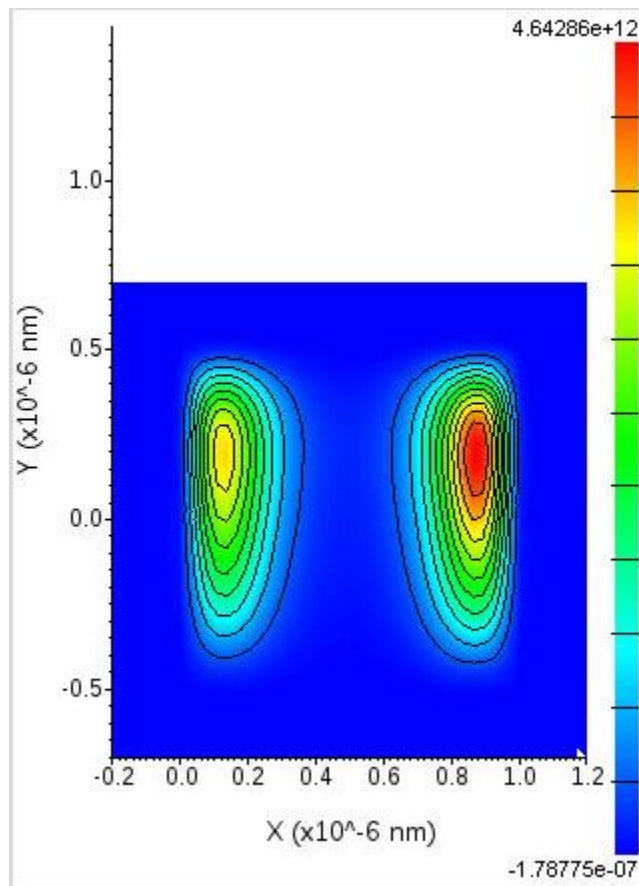


Fig. 16. Illustrates Second Wave Function Distribution

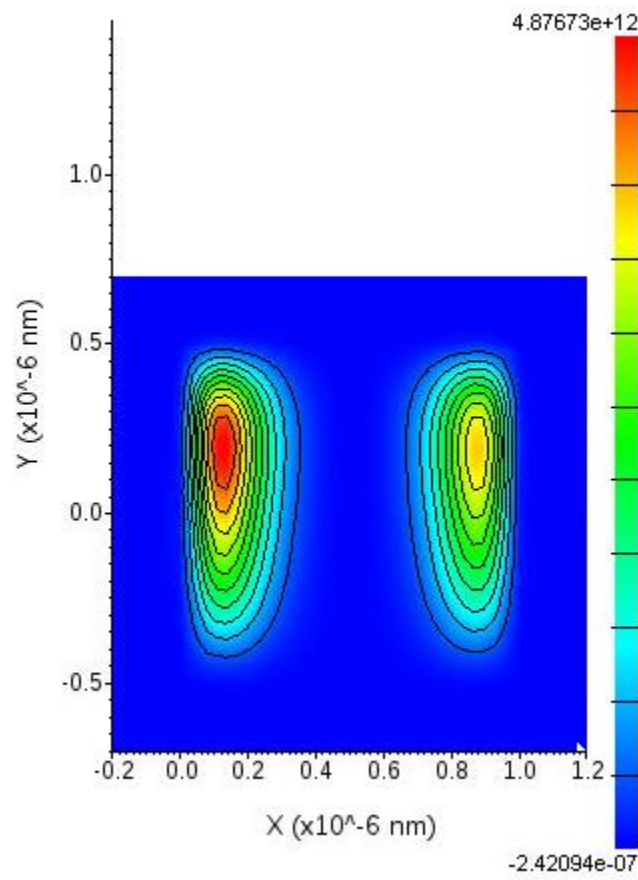


Fig. 17. Illustrates Third Wave Function Distribution

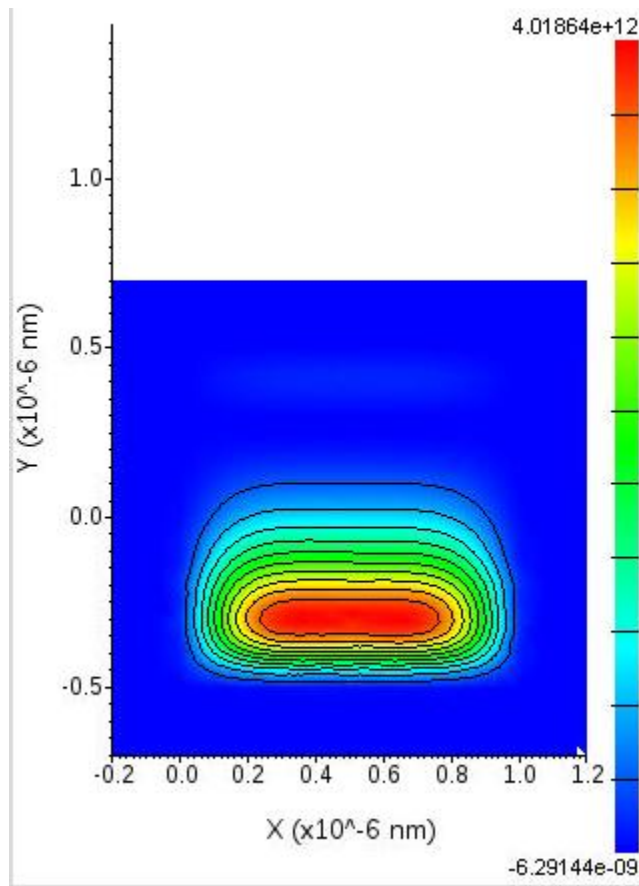


Fig. 18. Illustrates Fourth Wave Function Distribution

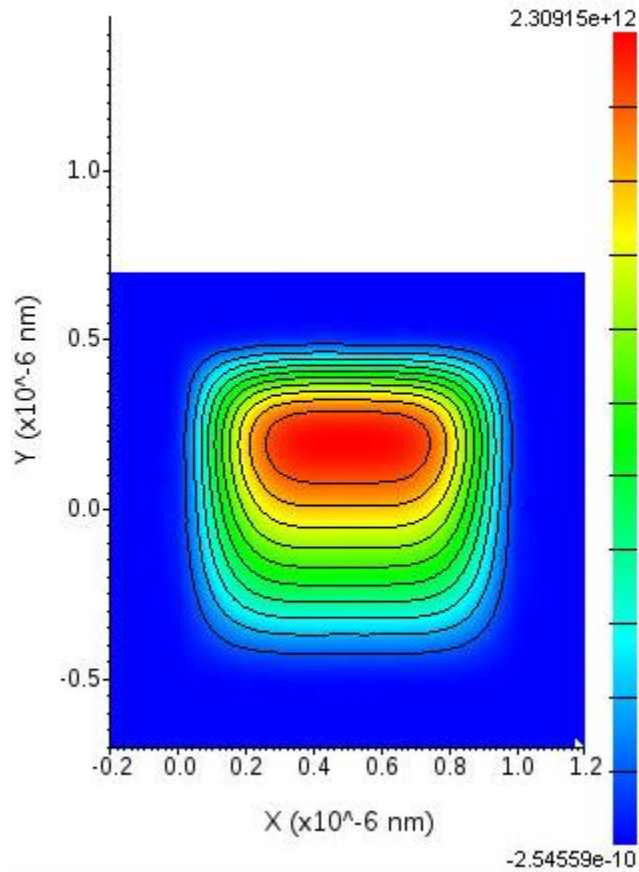


Fig. 19. Illustrates Fifth Wave Function Distribution

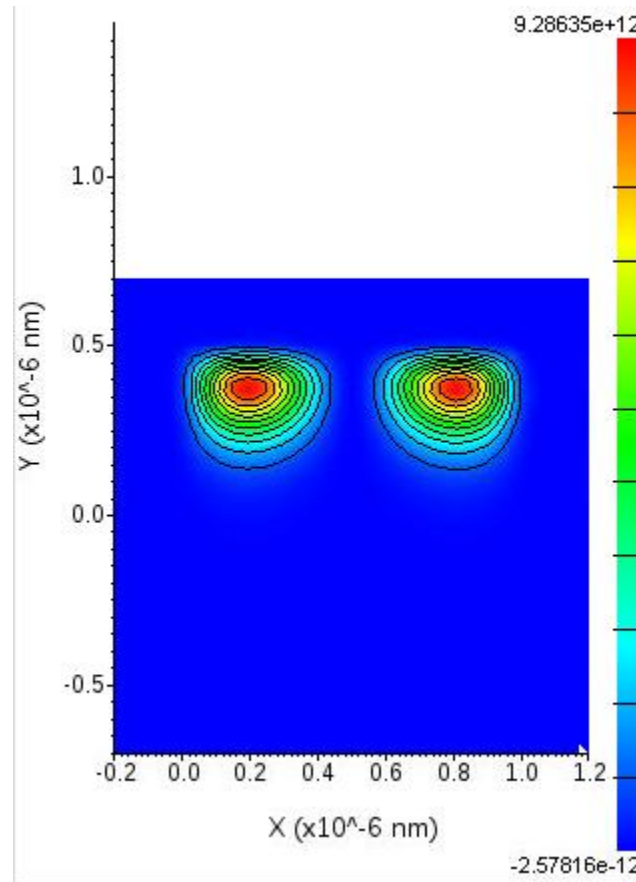


Fig. 20. Illustrates Sixth Wave Function Distribution

2. RESULTS

Results for Grid with height and width of value 10

1. Quantum Electron Density (Fig 3) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted and resultant data is documented in the Table I
2. Classical Electron Density (Fig 4) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted and resultant data is documented in the Table II
3. Classical Potential Distribution (Fig 5) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted and resultant data is documented in the Table III
4. First, Second, Third, Fourth, Fifth and sixth wave function distribution (Fig 6, 7, 8, 9, 10, 11) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted and resultant data is documented in the Tables IV, V, VI, VII, VIII, IX respectively.

Results for Grid with height and width value of 50

5. Quantum Electron Density (Fig 12) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted
6. Classical Electron Density (Fig 13) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted.
7. Classical Potential Distribution (Fig 14) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted.
8. First, Second, Third, Fourth, Fifth and sixth wave function distribution (Fig 14, 15, 16, 17, 18, 19) for Quantum Mechanical and Semi-Classical Electrostatics Characteristics on SOI Trigate is plotted respectively.

3. CONCLUSION

One of vital usage of Quantum Mechanical and Semi-classical electrostatics is to calculate current in trigate. The minimum energy of sub-bands and the threshold voltage increases as the cross sectional area of the semiconductor device is decreased

and the electron concentration in the channel is increased. The current is decreased especially in the devices with the very small cross sections. [3]

This paper depicts visual representation of Quantum electron density, classical electron density, classical potential distribution, six wave function distribution and its resultant data is presented.

4. AUTHOR NOTES

Resultant data Table for Grid with height and width value 50 are omitted in this paper due to very large numbers.

5. NOMENCLATURE

a. Quantum Mechanical and semi-classical electrostatics for grid value 10

1. Gate Voltage: 1V
2. Width (WSi): 10nm
3. Height (HSi): 10nm
4. Number of Grids along width and height: 10
5. Gate Oxide Thickness (Tox): 2nm
6. Buried Oxide Thickness (TBox): 20nm

b. Quantum Mechanical and semi-classical electrostatics for grid value 50

1. Gate Voltage: 1V
2. Width (WSi): 10nm
3. Height (HSi): 10nm
4. Number of Grids along width and height: 50
5. Gate Oxide Thickness (Tox): 2nm
6. Buried Oxide Thickness (TBox): 20nm

c. General Conditions:

1. Room Temperature: 300K
2. Metal Gate Work Function: 4.61(eV)
3. Substrate Doping: $N_a=1.0e12$ $N_d=1.0e10$
4. Orientation of a plane for the oxide interface and cross section:100

6. ACKNOWLEDGMENT

Author would like to thank Prof. Navarun Gupta, Prof. Hassan Bajwa, Prof. Linfeng Zhang and Prof. Hmurcik for their academic support. Author also thanks anonymous reviewers for their comments.

7. CONFLICTS OF INTEREST

There are no conflict of interest as per Author's point of view.

8. REFERENCES

- [1] Khan Academy. (2018). The quantum mechanical model of the atom. Retrieved from <https://www.khanacademy.org/science/physics/quantum-physics/quantum-numbers-and-orbitals/a/the-quantum-mechanical-model-of-the-atom>
- [2] Oak Park School. (2018). Quantum Mechanical Model of the Atom. Retrieved from <https://www.oakparkusd.org/cms/lib5/CA01000794/Centricity/Domain/863/QuantumMechanicalModel.pdf>
- [3] Colinge, J.-P & Alderman, John & Xiong, Weize & Cleavelin, Rinn. (2006). Quantum-mechanical effects in trigate SOI MOSFETs. *Electron Devices, IEEE Transactions on*. 53. 1131 - 1136. 10.1109/TED.2006.871872.
- [4] Hyung-Seok Hahm; Andres Godoy (2015), "Quantum and Semi-classical Electrostatics Simulation of SOI Trigrates," <https://nanohub.org/resources/MCTrigate>. (DOI: 10.4231/D3NP1WK34).
- [5] F.J. Garcia Ruiz, A. Godoy, F. Gamiz, C. Sampedro, and L. Donetti, "A Comprehensive Study of the Corner Effects in Pi-Gate MOSFETs Including Quantum Effects" *IEEE Trans. Electron Devices*, vol. 54(12), pp. 3369-3377, 2007.

BIOGRAPHY



Manu Mitra was born in Hyderabad, India in the year 1986. He did his diploma in Electronics and Instrumentation Engineering (D.E.I.E.) at Krishnadeveraya Government Polytechnic in the year 2005 at Wanaparty, India. Then he did his Bachelor of Technology in Electronics and Communication Engineering in the year 2008 at P. Indra Reddy Memorial Engineering College at Chevalla, India. Then he completed Masters in Electrical Engineering in the year 2009 at University of Bridgeport, Bridgeport, CT USA. As of today he has approved patent(s) from United States and Trademark and Office (USPTO) and many approved papers. He is an IEEE Member (Member No: 80399531) and member of Golden Key International Honor Society (Member No: 16342916). His interests are but not limited to Quantum

Mechanics, Physics, Information Technology, Nanotechnology.