Velocity of Electrostatic Field within an Atom in Comparison with the Velocity of Electron Circulation

S. ARAVAMUDHAN
DEPARTMENT OF CHEMISTRY
NORTH EASTERN HILL UNIVERSITY
SHILLONG 793022 MEGHALAYA

saravamudhan@hotmail.com

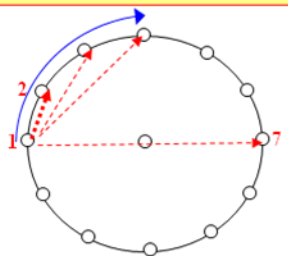
$$v = \frac{6.28 \cdot 10^{0} \cdot 9 \cdot 10^{9} \cdot (1.6\ g\ 10^{-19})^{2}}{6.63 \cdot 10^{-34}} = 2.19 \cdot 10^{6}$$

2.19×10^{6} m/sec
2.19×10^{8} cm/sec
Velocity of light $= 3 \times 10^{10}$ cm/sec speed with which interaction fields travel.

Bohr radius $= 5.24 \times 10^{-9}$ cm
Circumference $= 2.0 \times 3.145 \times 5.24 \times 10^{-9}$ cm $= 32.9596 \times 10^{-9}$ cm
Dist 1-2 $= 32.9596 \times 10^{-9}$ cm/12 $= 2.7466 \times 10^{-9}$ cm
Dist 1-7 $= 10.48 \times 10^{-9}$ cm $= 1.048 \times 10^{-8}$ cm

When electron circulates, there would be no electrostatic field at adjacent points due to field generated by the electron while at the starting point; due to the faster speed of field compared to velocity of particle

Speed of particle motions
Two orders of magnitude slower than the speed of the field



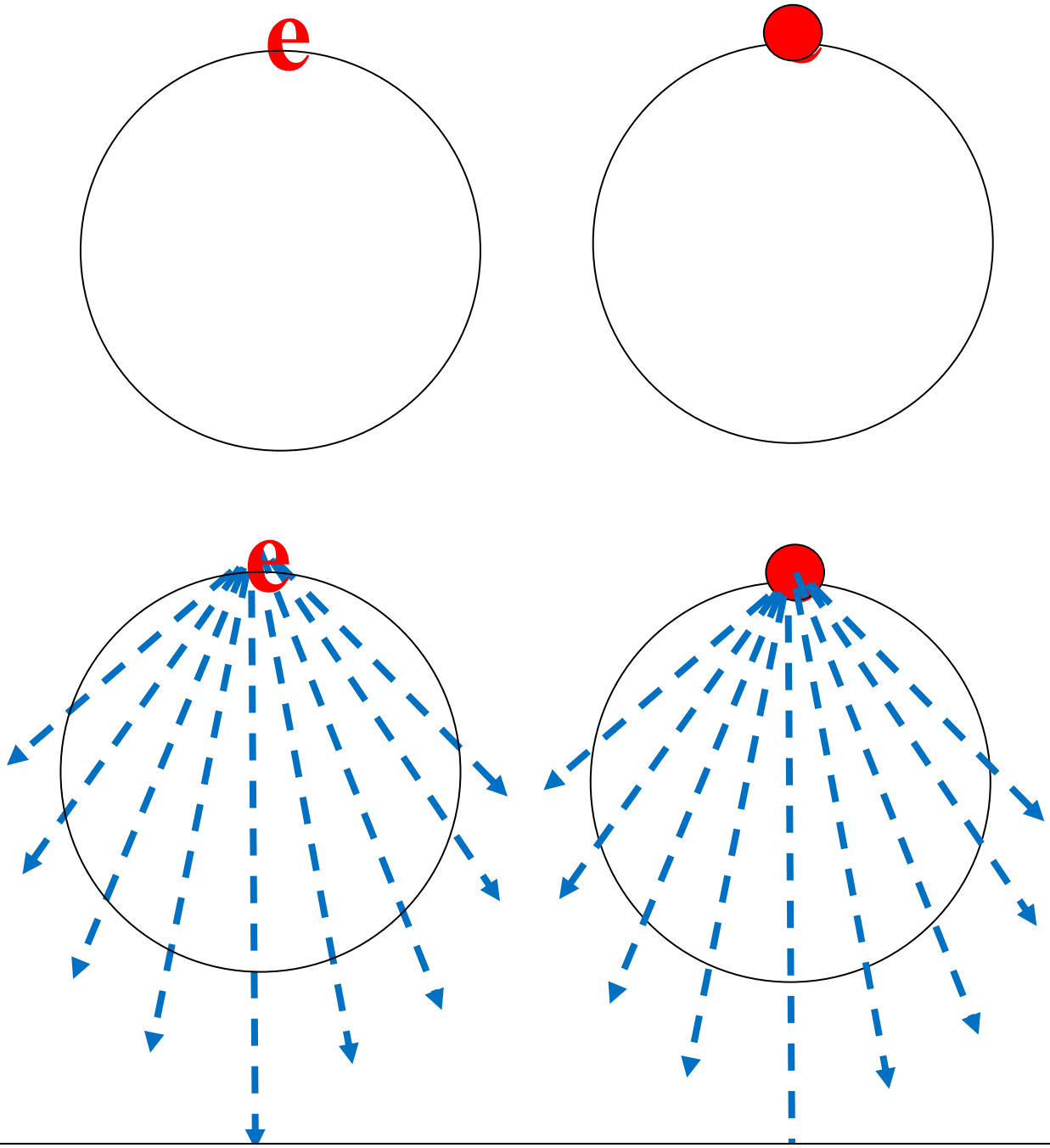
Distance shorter than circumferential length

Ratio of time to travel
Electron/field = **215.6**
Ratio of vel
Field / electron = **137**
Field originated from position 1, would propagate much faster and hence no field present when electron reaches position 7.

Bohr Orbit Circumference = 32.9596×10^{-9} cm
Vel of electron = 2.19×10^{8} cm/sec
Time per revolution = 32.9596×10^{-9} cm / 2.19×10^{8} cm sec^{-1}
$= 15.050 \times 10^{-17}$ sec
1/100 rev = 0.151×10^{-17} sec. = 1.51×10^{-18} sec.
Atto sec phenomenon
Time per half rev = **0.7525×10^{-18} sec**
dist of position from start = bohr diameter
Diameter bohr orbit = 10.48×10^{-9} cm
Field vel $= 3 \times 10^{10}$ cm sec^{-1}
Time to propagate by bohr radius $= 10.48 \times 10^{-9}$ cm / 3×10^{10} cm sec^{-1}
$= 3.49 \times 10^{-19}$ sec = **0.349×10^{-20} sec**
Vel field $= 3 \times 10^{10}$ cm sec^{-1}
Vel electron $= 2.19 \times 10^{8}$ cm sec^{-1}
Ratio = 1.37×10^{2} = 137
For dist = 1 bohr radius = electron goes along circumference = **0.7525×10^{-18} sec**
For dist = 1 bohr radius = field travels straight line = **0.349×10^{-20} sec**
Ratio = 0.349×10^{-20} / 0.7525×10^{-18} = $0.4638\ 10^{-2}$ reciprocal $= 2.156 \times 10^{2} = 215.6$

Consideration in this paper is:
WHAT WOULD HAPPEN IF THE VELOCITY RATIO IS << 137?

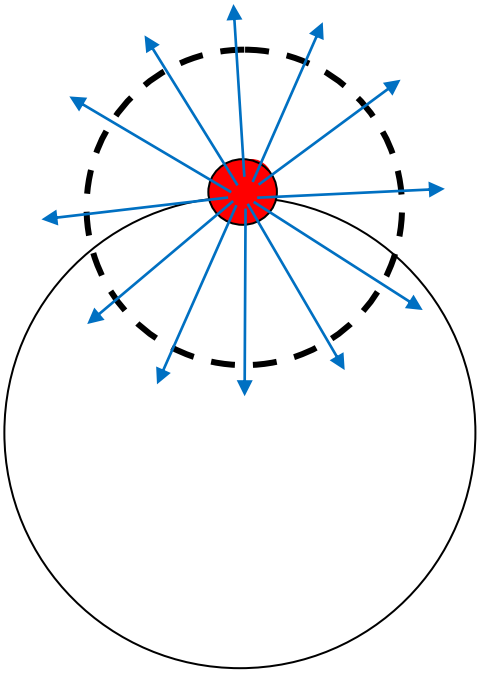
For details of description in terms of electron moving pattern and charge cloud visualization view the PPT Presentation file linked at
http://www.ugc-inno-nehu.com/events-2017.html#E02

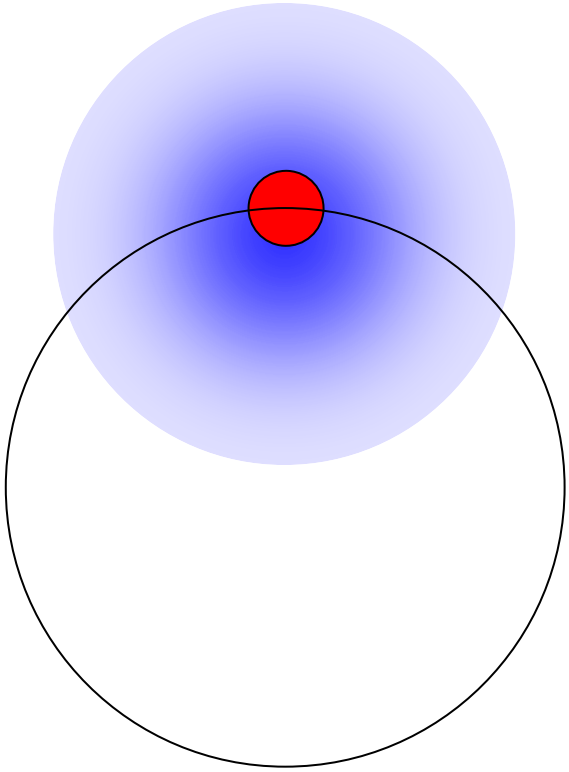


This view is at a particular instant during the electron circulation.

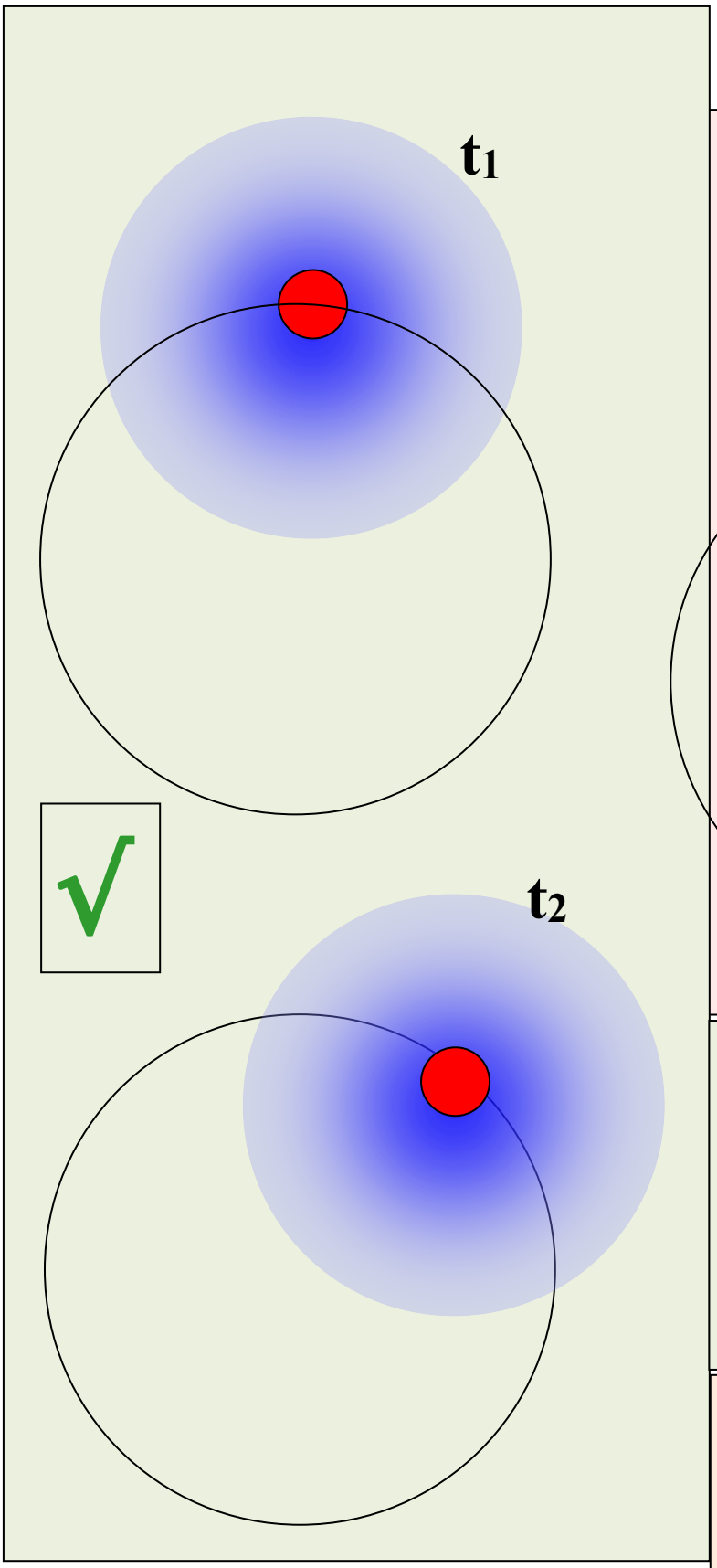
At this instantaneousn position the electron generated electrostatic field is instantaneously comes into effect, whenthe electron reaches that specific position it would look almost as if it has been moving with the electrostatic field due to it. If the electron speed is faster than that of the field it generates, then when electron reaches a particular position, the electron filed at the previous instant wiould still be precvailing and slowly disappearing so that the electron in this present position generated filed takes some time after to come into effect in the neighborghood
What this entails and what cannot happen is indicatyed inSheet-04

In this figure for the discussion the electrostatic field only in the close nearby to the electron is considered for clarity. It should be bone in mind that the strength of the field at a point depends on the inverse square of the distance of the point from the location of electron.



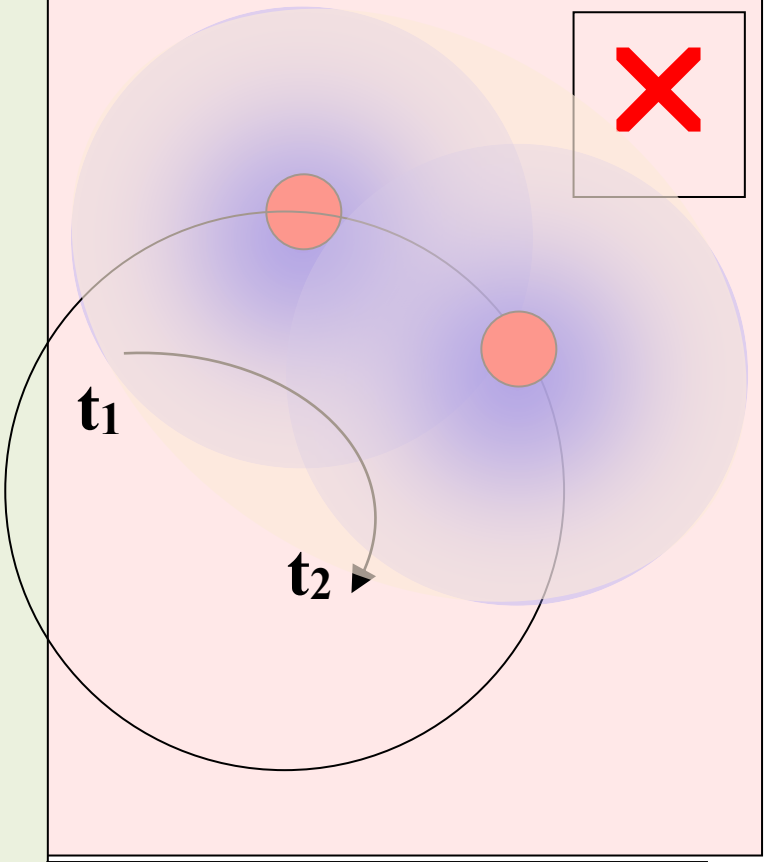


Since the field intensity decreases with increasing distance, in the diffuse cloud representation the color is lighter at the farther region than the regions close to electron location. It must be here noted that even if the electron charge does not diffuse to become a cloud, the field at all the nearby area has to be described by a cloud picture and since electron charge is experienced by the strength of the field, if the field is to be described by cloud-picture, then it seems as if the charge itself experienced as a cloud !



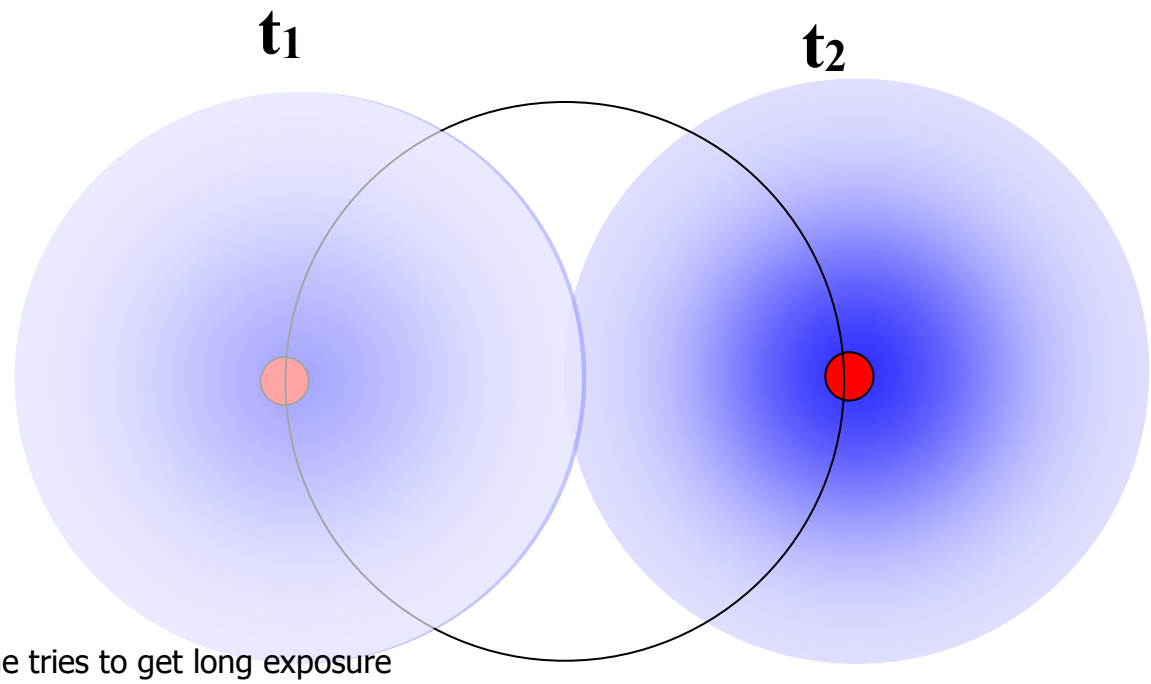
$t_1 < t_2$

$\underline{(t_1 + t_2) / 2}$

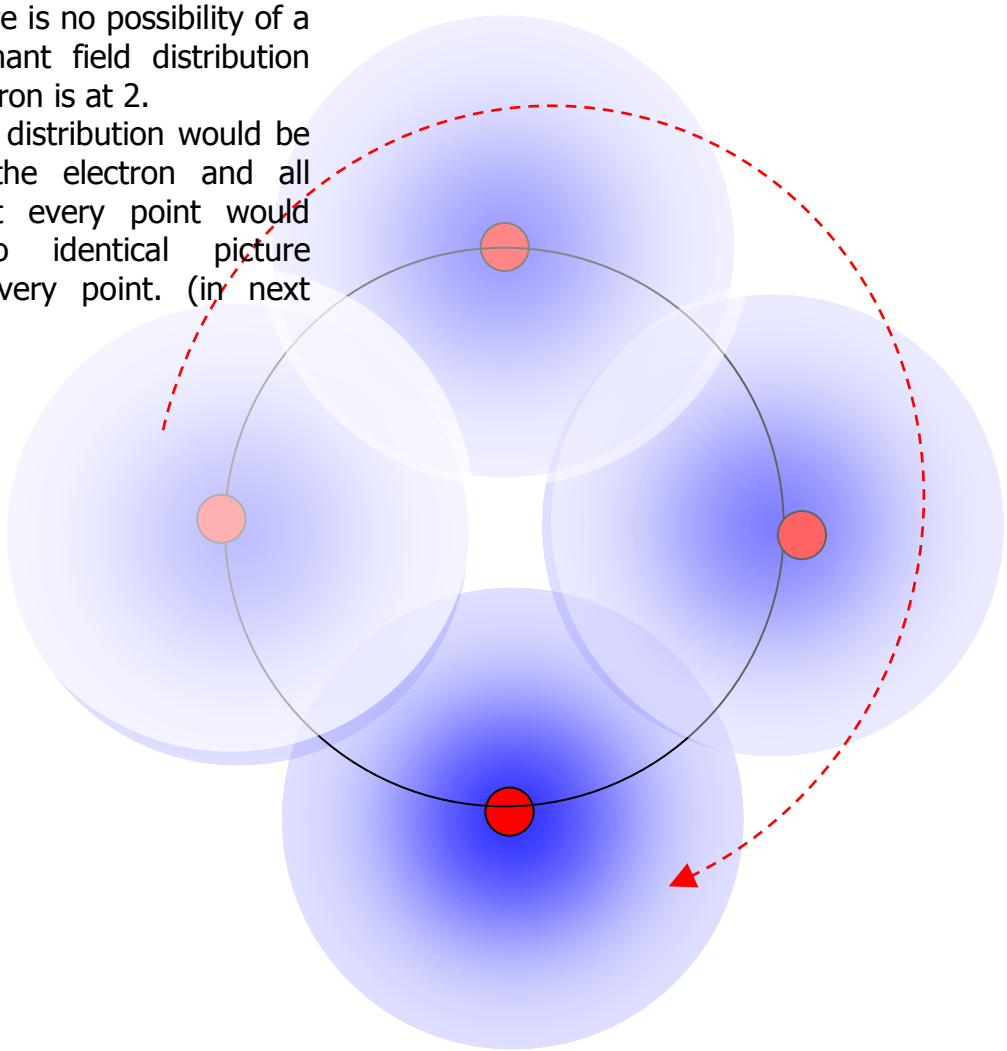


Left: The two instants t_1 and t_2, during a revolution, are indicated with electron location with its field. Since the field travels much faster than the electron charge, no possibility for seeing the field distribution at position 1 when electron is at position 2.

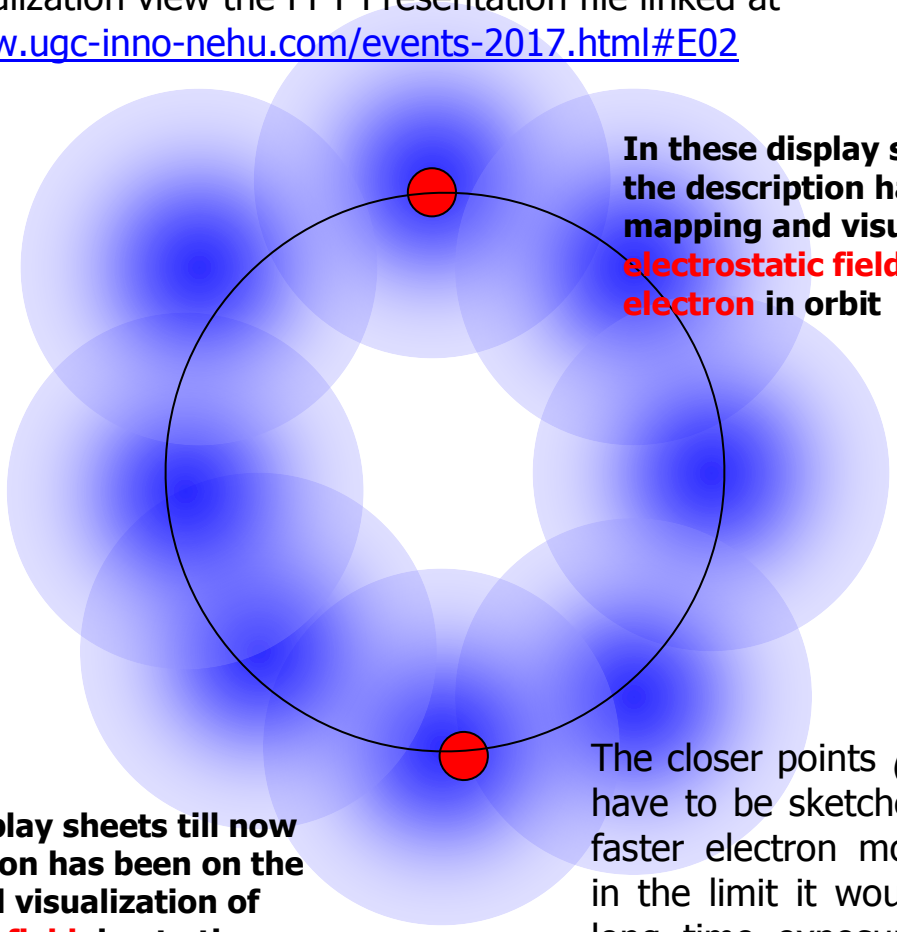
Above: The type of situation to get an average picture of the 2 situations does not arise. The filed distribution at 1 no longer exists when electron is at 2



Even if one tries to get long exposure picture of the fast electron circulation, there is no possibility of a diminished remant field distribution at 1 when electron is at 2.
The same field distribution would be moving with the electron and all distributions at every point would correspond to identical picture repeated at every point. (in next sheet)



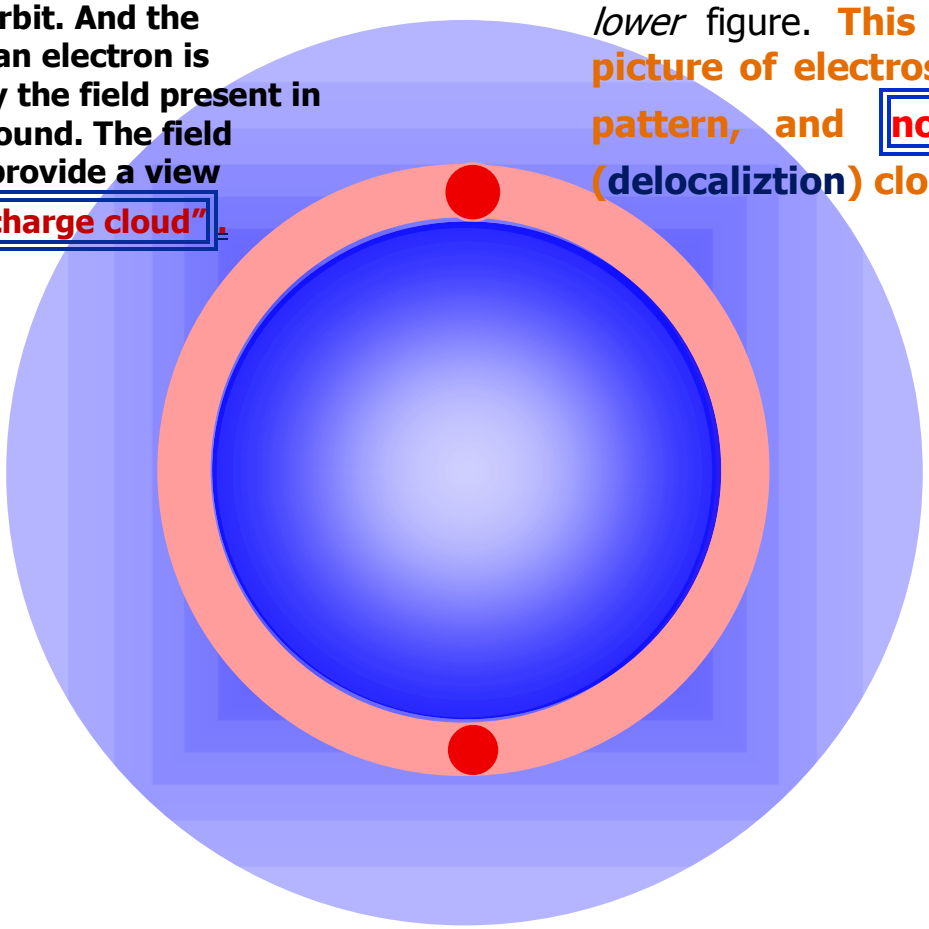
For details of description in terms of electron moving pattern and charge cloud visualization view the PPT Presentation file linked at
http://www.ugc-inno-nehu.com/events-2017.html#E02



In these display sheets till now the description has been on the mapping and visualization of electrostatic field due to the electron in orbit

The closer points *(upper)* would have to be sketched to indicate faster electron movement, and in the limit it would result in a long time exposure view as in *lower* figure. **This is all the picture of electrostatic field pattern, and not charge (delocaliztion) cloud pattern**

In these display sheets till now the description has been on the mapping and visualization of electrostatic field due to the electron in orbit. And the presence of an electron is evidenced by the field present in the space around. The field description provide a view similar to "charge cloud".

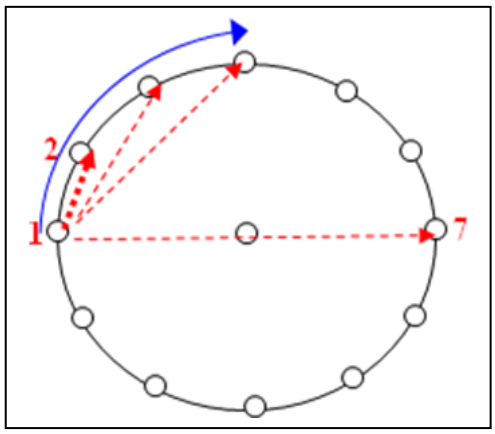


Consideration in this paper is:
WHAT WOULD HAPPEN IF THE VELOCITY RATIO IS << 137?

All the numerical values are obtained from the Bohr's model for atom, and the Hydrogen atom is a case of single electron and single nucleus attraction. The stability of the Hydrogen atom must be an Electron-nucleus attraction based system, further constrained by requirements of Energy and Angular momentum quantization. Hence, in Bohr's model, no minimization criterion is envisaged entirely based on energy optimization of a system involving attractive and repulsive energy. Thus besides the radial attraction of electron towards the nucleus, due to comparable speeds of "electrostatic field" and the"electrical charge-carrier, the electron" if the electron in one position experiences the field sue its own position at a previous instance, then there could be a repulsive interaction factor that could be brought in to optimize in the single electron-nucleus case of hydrogen atom.

HOW CAN SUCH A ATTRACTIVE-REPULSIVE SYSTEM CAN BE ENVISGED, EVEN IF IT BE HYPOTHETICAL, IS THE CONSIDERATION IN THIS PAPER.

Considering the diagram below, the dashed lines may indicate the field from electron position 1, and the lines of field reach out to certain locations 2, 3, 4, ….,7 of the same electron during its revolution around central nucleus. Thus at position 2 if the field emanating from position 1 still persaists, then at position 2 the electron must experience a repulsion due to its own presence at the previous instant. Such a possibility seem to be counter intuitive, and has been emphatically ruled out and excluded as a possibility in some of the text books of quantum mechanics. In fact not only the numerical values excluded such a possibility, but also cleared the quantum mechanical models of atoms possible without much complications of electron experiencing its own field and having a built in repulsion energy along with the charge. Like the stability of nucleus requiring sub nuclear particles, electron stability as an entity would have been a altogether a different story.

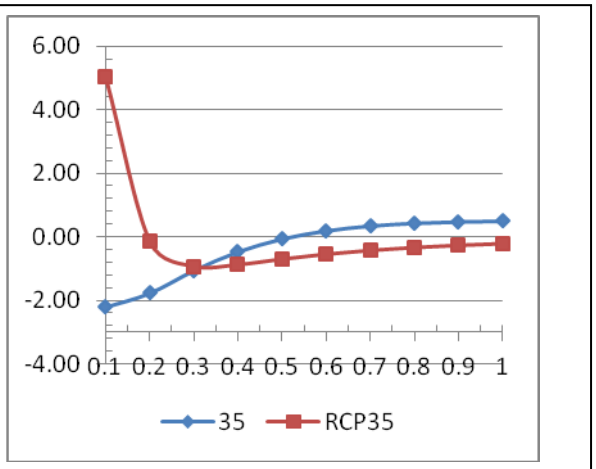


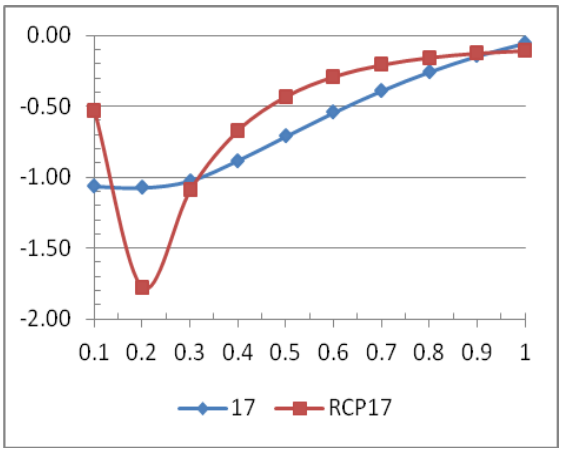
A simple model to simulate such a situation could be as follows:

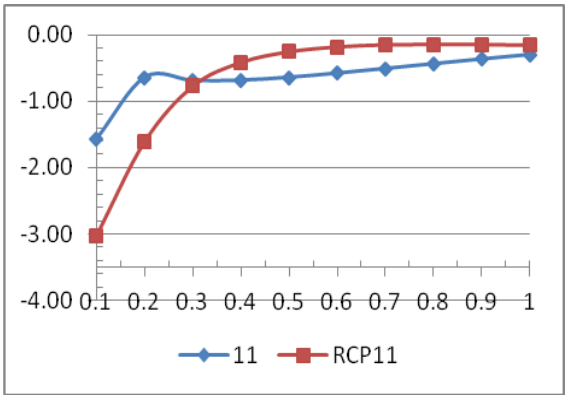
The electron is revolving and at certain discrete (convenient equal intervals along the circumference) positions also could be experiencing its own field that emanated from location 1, then if there are **'n'** such discrete points on the circumference, all the positions the same electron at different instance of time during the revolution. This typically means the situation when the field travels slower compared to the electron movement. Then as a long exposure picture, from the point of view of the fast electron and very slow electrostatic field, one may presume the filed from position 1 experiences by the electron every point along the circumference. AS considered the long exposure view can be approximated by placing electron charge **e/n at every one of the n points,** that is, normalization criterion. Accordingly one can calculate electron charge e/n value repelling e/n at then various distances of e/n charge locations. This repulsion may be compensated by electron-nucleus radial repulsion, and the radius of the orbit can be set by optimization for minimum value of the energy.

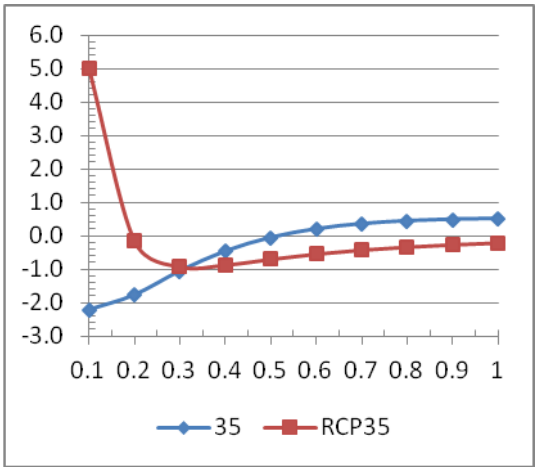
Without discussing much of the algorithm, it is mentioned here that a FORTRAN program for such a model consideration could be written and executed and the results are reported in the following sheets. The possible inferences and the pros and cons of the hypothetical inverse situation of field travelling much slow compared to the electron velocity itself, are yet to be evaluated.

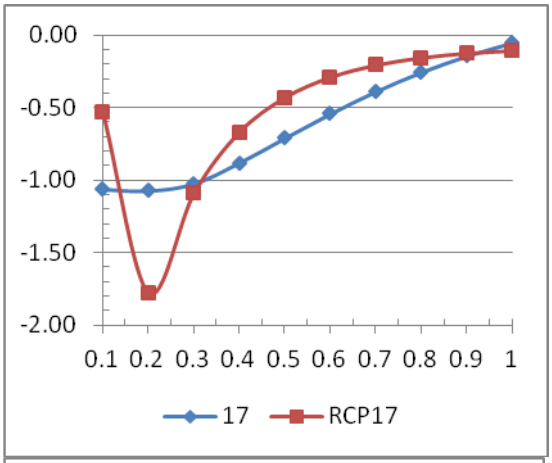
Comparison of 15 deg 24 points and 10 deg 36 points

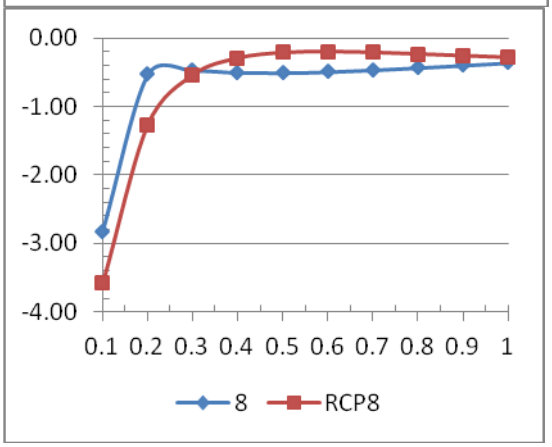


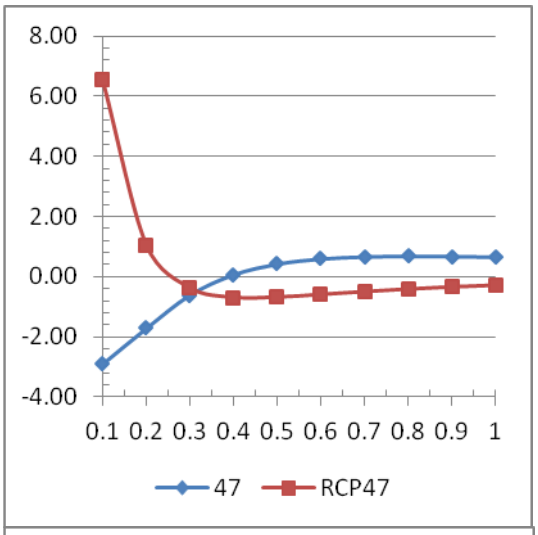


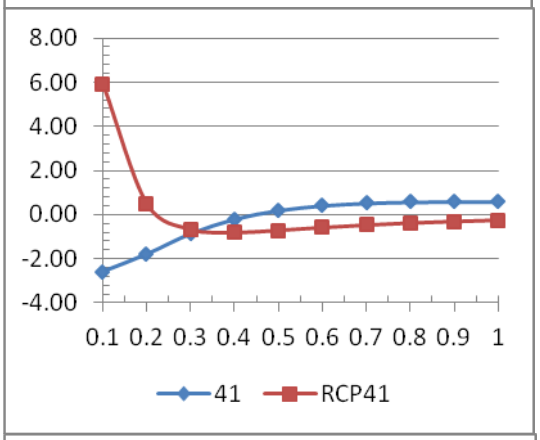


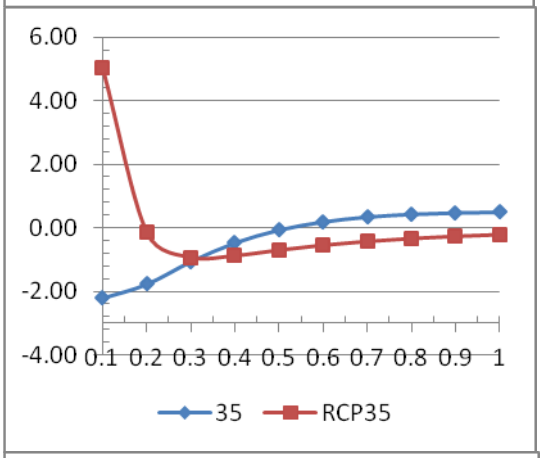


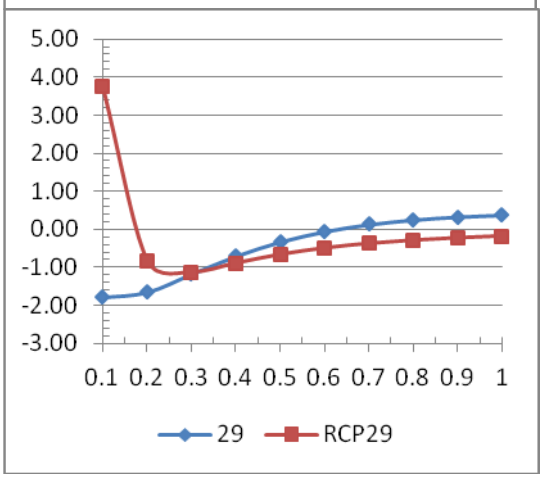


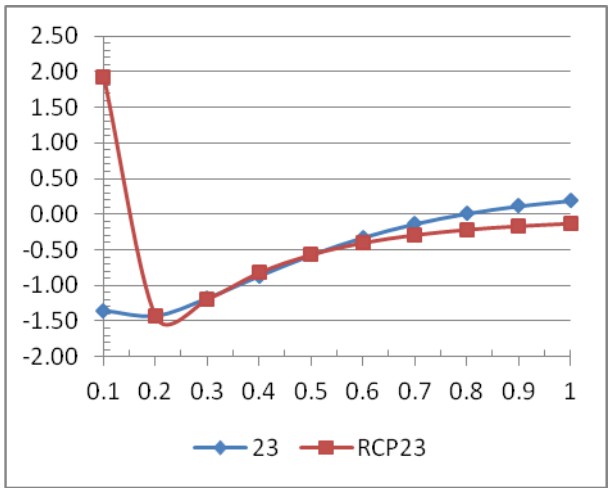


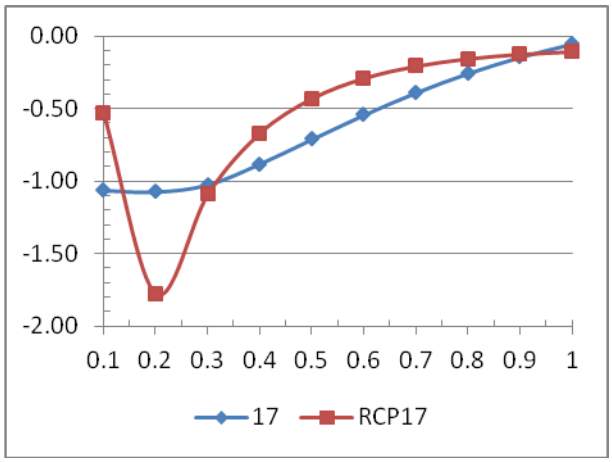

8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
47
RCP47

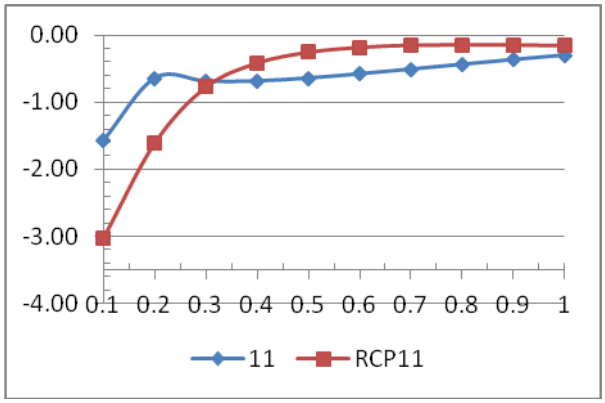

8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
41
RCP41

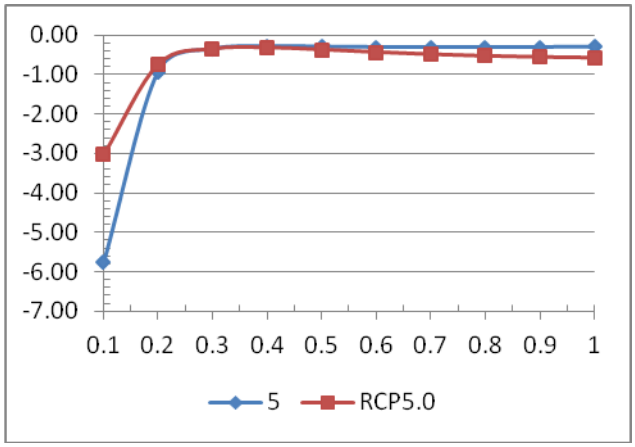

6.00
4.00
2.00
0.00
-2.00
-4.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
35
RCP35


5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
29
RCP29


2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
23
RCP23


0.00
-0.50
-1.00
-1.50
-2.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
17
RCP17


0.00
-1.00
-2.00
-3.00
-4.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
11
RCP11


0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
-7.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
5
RCP5.0

MAIN OBSERVATION BY THIS EFFORT HAS BEEN THAT FOR A VARIATION OF 'n' and calculation of repulsion and attraction, summation for various radius of the electron circulation repeatedly indicated a specific value of "0.2" units where a minimum occurred. Since these numbers were assigned as relative quantities to test a viable program, the actual significance of this value with respect to Bohr's model is yet to be realized.