

14 March 2008

**PATENTS ACT 1977**

APPLICANT                                      Blacklight Power Inc

ISSUE                                          Whether patent application numbers GB  
0614467.9 and GB0705155.0 comply  
with section 1

HEARING OFFICER                              A Bartlett

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**DECISION**

**Introduction**

- 1 This decision concerns the issue of whether the above applications relate to excluded subject matter contrary to section 1(2) of the Act.
- 2 GB0614467.9 ('467 hereafter) is derived from a PCT application filed on 5 January 2005 which was published as WO 2005/067678 on 28 July 2005. The UK application entered the national phase on 21 July 2006 and was subsequently re-printed as GB2426093.
- 3 GB0705155.0 ('155 hereafter) is a divisional application which was filed in response to an examination report that the claims of '467 related to more than one invention. It was published as GB2434466 on 25 July 2007.
- 4 In the final examination report issued on each application, the examiner reported that the claims lacked the inventive step required by section 1(1)(b) and that the inventions defined therein were excluded under section 1(2) as a program for a computer and a mathematical method. Having failed to resolve these issues to the examiner's satisfaction, a hearing was arranged for 26 February where the Applicants were represented by the inventor, Dr Randell Mills, Ms Alex Tomkinson of the Patent Attorneys Bailey Walsh & Co and Dr Mills' US patent attorney, Mr Jeffrey Melcher. The examiner, Mr Ben Widdows also attended. In advance of the hearing the examiner informed the Applicant that the hearing would also address whether the inventions were excluded as a scientific theory or a combination of excluded items.
- 5 At the hearing, Dr Mills gave a detailed presentation covering both the principles

underlying the invention and what the invention looks like in practice. That has proven extremely useful in helping me to understand and visualize it and I am very grateful to him for that.

### **The issues**

- 6 On 15 February, the applicants filed a submission addressing both outstanding objections. In particular this included argument as to why the present inventions were not rendered obvious by the piece of prior art relied upon by the examiner - a prior publication by Dr Mills<sup>1</sup>. As I explained at the hearing, the distinctions identified in the letter are not clearly brought out in the claims presently on file and amendment to reflect those distinctions would be necessary to overcome the inventive step objection. It was however clear to me that the primary issue affecting the patentability of the applications was whether they were excluded. It was therefore agreed to defer consideration of inventive step and to concentrate on the excluded matter issue at this stage. Thus this decision only relates to the issue of excluded matter.

### **The Law and its interpretation**

- 7 Section 1 of the Act sets out the requirements that an invention must fulfil for it to be patentable including, in section 1(2), a list of things for which patent protection is not available. The relevant parts of section 1(2) read:

1(2) It is hereby declared that the following (among other things) are not inventions for the purposes of this Act, that is to say, anything which consists of –

- (a) a discovery, scientific theory or mathematical method;
- (b)
- (c) a scheme, rule or method for performing a mental act, playing a game or doing business, or a program for a computer;
- (d) the presentation of information;

but the foregoing provision shall prevent anything from being treated as an invention for the purpose of this Act only to the extent that a patent or application for a patent relates to that thing as such.

- 8 These provisions are designated in section 130(7) as being so framed as to have, as nearly as practicable, the same effect as the corresponding provisions of the European Patent Convention (EPC), i.e. Article 52. However, the decisions of the Boards of Appeal of the European Patent Office (EPO) under Article 52 of the EPC do not bind me and their persuasive effect must now be limited in view of the contradictions in the Boards' decisions highlighted by the Court of Appeal in *Aerotel/Macrossan*<sup>2</sup> and its express refusal to follow EPO practice.
- 9 As Ms Tomkinkson accepted at the hearing, the test for deciding whether an invention is excluded was set out by the Court of Appeal in its judgment in

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<sup>1</sup> "The grand unified theory of classical quantum mechanics" [MILLS]. International Journal of Hydrogen Energy 27 (2002) 565-590: see esp. Sections 1-13&19-21.

<sup>2</sup> *Aerotel Ltd vs Telco Holdings Ltd & Macrossan's Patent Application* [2007] RPC 7

*Aerotel/Macrossan*. That test comprises four steps:

- (1) properly construe the claim;
- (2) identify the actual contribution;
- (3) ask whether it falls solely within the excluded subject matter;
- (4) check whether the actual or alleged contribution is actually technical in nature.

- 10 Operation of this test is explained in paragraphs 40-48 of the judgment. Paragraph 43 confirms that identification of the contribution is essentially a matter of determining what it is that the inventor has really added to human knowledge and involves looking at the substance of the invention claimed, rather than the form of claim. Paragraph 46 explains that the fourth step of checking whether the contribution is technical may not be necessary because the third step should have covered that.

### **The applications**

- 11 The title of the PCT application from which both applications are derived is “Method and System of computing and rendering the nature of atoms and atomic ions”. In short it is concerned with providing a new and more accurate way of describing the properties of electrons in atoms or ions (such as their energy levels) and representing those properties on a display. I should say at the outset that the physics underlying the invention as disclosed in the applications and comprehensively explained by Dr Mills at the hearing is at the very limit of my understanding. The summary of the physics involved which follows is intended to be just that – a summary – and I acknowledge does not do justice to Dr Mills’ intellectual efforts in developing it. An absolute understanding of the physics involved is not however necessary to decide the present issue.
- 12 The description identifies shortcomings in previous approaches for explaining atomic structure. These approaches fall into two categories, classical mechanics and quantum mechanics. The first – classical mechanics – envisages a model of the atom comprising a central nucleus around which electrons orbit. This classical model has shortcomings. An orbiting charged particle is accelerating and classical physics dictates that an accelerating charge radiates energy. This is contradicted by scientific observations which show that electrons exist in stable orbits. Thus classical mechanics has not proved satisfactory for describing atomic and sub-atomic scale systems.
- 13 On the other hand, quantum mechanics envisages the electrons not as particles orbiting the nucleus but as a wave describing the probability of finding the electron at a given point at any given time. As well as being conceptually difficult to visualize, there are also practical difficulties describing the electrons in this way. It relies on a constraint that the probability of finding the electron tends to zero as the distance from the nucleus tends to infinity. More significantly

however the complexity of describing electrons in this way makes calculations for anything other than single electron systems hugely difficult. Any attempt to calculate them for multi-electron systems is reliant on approximations which are computationally difficult to calculate and ultimately inaccurate. Thus neither system provides a reliable way to describe real atomic systems.

- 14 Dr Mills has developed an alternative approach to describing the electron states of atoms and ions. He has called this “Classical Quantum Mechanics” (“CQM” hereafter) although as he acknowledged at the hearing the “quantum” label might be something of a misnomer.
- 15 He has published numerous academic papers on the subject of CQM as he has refined the theorem, one of which was cited as the nearest prior art against these applications as I have mentioned previously. As described in the patent specifications, according to the CQM theorem the classical wave equation is solved using Maxwell’s equations with the constraint that the bound electrons do not radiate energy. As explained at the hearing the difference between the theorem described in the present applications and that disclosed in his prior publication is that the electron spin function is now properly described making the model more accurate.
- 16 As described by Dr Mills, the attractions of CQM are that it is derived from first principles with the only constraints necessary to apply it coming from actual experimental observations – namely that bound electrons do not radiate energy. According to Dr Mills’ results, CQM predicts electron properties to remarkable levels of accuracy without using huge computational resources.
- 17 CQM theory is at the heart of the inventions Dr Mills is seeking to patent. As last amended (with his Attorney’s letter of 6 August 2007) ‘467 includes 10 claims of which claim 1 is the only independent claim. ‘155 as last amended (with his Attorney’s letter of 22 October 2007) contains 18 claims of which claim 1 is the only independent claim. The independent claims are reproduced in the annex to this decision.
- 18 As explained above the features highlighted in the submission of 15 February 2008 that might distinguish the invention from the prior art cited by the examiner are not brought out in the independent claims. Notably I can see nothing in those claims that limits the invention to modeling multiple electron atoms and ions (where the citation only mentions modeling single or two electron systems) and nothing limiting the claims to using the correct electron spin function. There is also no mention of the force balance equation in the claims of ‘467 which is also relied upon as a distinguishing feature in the 15 February submission. I will however proceed on the basis that the claims of the two applications could be limited so as to not be rendered obvious by that prior document by specifying the details of CQM theory more accurately. It is not a point upon which the present decision turns.

### **Applying the test**

- 19 The first two steps in the *Aerotel/Macrossan* test – properly construing the claim and identifying the actual contribution – are not particularly easy to apply in this

case because as was acknowledged at the hearing, the claims as currently drafted do not properly distinguish the invention over the cited prior art. However any argument as to how the inventions are distinguished over that prior art is a matter of detail of the scientific theory involved – how the correct electron spin is factored in and how the non-radiation constraint is defined. Given that scientific theories are excluded under section 1(2)(b), achieving precise definition of the theory is not significant in deciding whether the invention is patentable. I will therefore cut to the quick and consider what in my view is the actual inventive concept without labouring over the precise wording of the claims as currently drafted.

### Step 1

- 20 One term used in the claims does merit some explanation when applying step one. The claims are drafted in terms of a system of and a method for “computing and rendering the nature of bound atomic and atomic ionic electrons”. As I understand it the term “rendering” means converting the output of the calculation performed into a form that can be displayed to a user.
- 21 Thus the invention in ‘467 is defined in terms of a system for calculating the properties of electrons in atoms and ions using a computer to solve the equations derived using Dr Mills’ CQM theorem and displaying the result. The invention in ‘155 is a method of using the same CQM theorem to calculate the energy of each of the electron configurations for an atom or ion and displaying the results for the lowest energy configuration.

### Step 2

- 22 What is the contribution made by the two inventions? At the hearing the Applicants accepted that both applications will stand or fall together and for the sake of convenience I will focus on ‘467 hereafter. As the Court of Appeal made clear in *Aerotel/Macrossan* identifying the contribution is a matter of substance not form. It is abundantly clear from the description that conventional hardware can be used to implement the invention. Thus the contribution is not provided by the hardware through which the invention is put into practice, despite the claims in ‘467 being drafted in terms of system hardware elements. I should add that the Applicants accepted this to be the case.
- 23 At the hearing there was a good deal of discussion as to what the actual contribution was. When asked to identify what they thought the contribution was, the Applicants suggested it was “a dynamic physical model able to physically measure and predict the physical parameters, properties and reactivity of atoms and ions”.
- 24 I have some reservations over this formulation. The invention does not measure anything, rather it models or simulates parameters such as electron energies. Whilst the model may provide predictions of these parameters that are closely borne out by experimental observation, the invention does not perform any actual measurement. Ms Tomkinson also placed great emphasis on the dynamic nature of the model and the fact that it was able to produce 3-D representations of the electron states. That may be so but it seems to me that the dynamic nature of

the model is purely a result of the fact that Dr Mills' theorem for describing the electrons is more accurate and reliable than previous theories making solving the equations that result from it a much faster process.

- 25 In my view this is a case where answering the question "what has the inventor really added to human knowledge" is particularly enlightening. There is in my view no escaping the fact that Dr Mills' alternative theorem for describing the properties of electrons in atoms and ions is at the heart of these inventions. It is that theorem and the computer program for generating and displaying the results of the equations describing that theorem that he has added to the stock of human knowledge. They provide the contribution.
- 26 Ms Tomkinson suggested that the invention provides a tool for controlling the dynamic model. I do not consider that to be an accurate representation of the invention. The model is not in my view controlled by the CQM theory and the program implementing it. The CQM theory and the program are the model.

### Step 3

- 27 Does the contribution fall solely in excluded matter? Ms Tomkinson argued that it does not. She said that the end result – the dynamic model – was a practical tool for predicting real parameters and properties of materials. She argued that the end result was more than just the mere interaction of the program with the computer used to implement the invention. She also drew my attention to a decision<sup>3</sup> of the Boards of Appeal of the EPO which suggested that (in the eyes of the EPO at least) providing visual indications of the conditions prevailing within a system solved a technical problem and was patentable. I am not convinced by any of these arguments.
- 28 Taking the EPO case law first, as I have mentioned above I am not bound to follow decisions of the Boards of Appeal of the EPO, particularly following the *Aerotel/Macrossan* judgment. Even if I were however, I do not think the facts of that case supports Ms Tomkinson's argument. In particular, at paragraph 3.4 of that decision it is stated (in rejecting one proposed form of claim):
- "Summarising this analysis of the claimed method steps, it is noted that none of these steps contains either an indication of a novel structural feature of the computer or anything else that would go beyond the implementation of the mathematical method by a programmed general-purpose computer, including a conventional monitor for displaying the result of the calculation."
- 29 It is clear to me from this passage that merely displaying the result of the calculations performed by the present invention is not necessarily sufficient for the contribution to be in a non-excluded area. I could point to a host of other case law to support that view, of which *Fujitsu*<sup>4</sup> is the most relevant to the present case. Indeed I think *Fujitsu* is highly relevant to the present case.
- 30 As discussed at the hearing the invention in *Fujitsu* provided a new tool for

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<sup>3</sup> T 0953/94

<sup>4</sup> Fujitsu Limited's Application [1997] RPC 608

modeling crystal structure combinations where the end result was displayed on the screen for the user to view. The Court of Appeal accepted in *Fujitsu* that the invention provided a new tool that reduced labour and error but concluded all the same that it was excluded as a program for a computer. In contrast to decisions of the EPO Boards of Appeal, I am of course bound by previous decisions of the Court of Appeal (as indeed is the Court of Appeal itself). Indeed the Court of Appeal explicitly stated in the *Aerotel/Macrossan* judgment that the new approach it adopted was consistent with the previous approach (adopted in *Fujitsu*) and did not change what was patentable. In my view the steps in the present invention of computing the energy states satisfying Dr Mills' theorem and displaying the results are a paradigm example of a computer program. Whilst the present invention might provide a new, eminently useful tool whose output is a visual indication (of atomic or ionic structures), it is clear from *Fujitsu* that that is not sufficient for the exclusions to be avoided. Furthermore qualitative considerations have no bearing on the decision as to whether an invention is excluded. That the present invention might provide a better, faster more accurate model for predicting electron properties than was previously available does not matter. A better excluded invention is still excluded.

- 31 There are of course some differences between the facts that existed in *Fujitsu* and those in the present case, notably what is being modeled and how the models are derived. However, that does not affect the relevance of the reasoning or result in *Fujitsu* to the present case. In my view the only significant difference between *Fujitsu* and the present applications relates to the exclusions into which the respective contributions fall. The contribution in *Fujitsu* was found to fall solely within the computer program exclusion. In the present case I do not think the contribution falls solely within the computer program exclusion. There is more to it than that. Nor does it fall solely within the scientific theory exclusion. However any contribution that does not fall solely in the computer program exclusion falls within the scientific theory exclusion (and vice versa). Thus in my view the contribution in '467 falls solely within excluded matter being a combination of a scientific theory and a computer program.
- 32 Precisely the same considerations apply in '155. That the invention in that application is claimed as a "method for computing and rendering" has no bearing on the issue of whether it is excluded since it is the substance of the invention that is important not the form of claim adopted. The theory underlying the invention and the program for solving the equations defining that theory in '155 are the same as those in '467, the program merely identifying and displaying the result for the lowest energy configuration. Thus the contribution in '155 also falls solely within excluded matter as a combination of a scientific theory and a computer program.
- 33 In reaching this conclusion I have described the steps of solving the equations describing CQM theory and displaying the results as being a paradigm example of a computer program. The solving step could also be viewed as a mathematical method – indeed the examiner reported that the inventions were excluded under that head in his latest examination report on each application. Thus as well as being a combination of scientific theory and computer program, the contribution could also be viewed as a combination of scientific theory,

mathematical method and computer program. This would make no difference to the end result – no element of the contribution made by the inventions falls outside excluded matter.

- 34 Thus however the claims might be amended so as to distinguish the version of CQM here from that disclosed in Dr Mills' previous publications, claims to a system or method of computing and rendering the nature of bound atomic and atomic ionic electrons using that theorem are excluded.

#### Step 4

- 35 Having found the contribution to fall solely within excluded matter in step 3 I do not need to consider step 4

#### **Saving amendments**

- 36 At the hearing we discussed whether there might be any saving amendment that might form the basis of a valid claim. In particular Ms Tomkinson and Dr Mills drew attention to various passages in the description that identify potential uses of the modeling tool.

- 37 For example, on page 1 of the description it is stated that "the displayed information is useful to anticipate reactivity and physical properties, as well as for educational purposes. The insight into the nature of bound electrons can permit the solution and display of other atoms and ions and provide utility to anticipate their reactivity and physical properties". There is a similar statement on page 62. Additionally it is stated on page 8 that "the presented exact physical solutions for the atom and all ions having a given number of electrons can be used to predict the properties of elements and engineer compositions of matter in a manner which is not possible using quantum mechanics".

- 38 In the Applicants' view these passages demonstrate that the invention is not abstract in nature – rather it provides a genuinely useful tool whose output represents real things and which could be used in all manner of real world applications. Indeed, in his demonstration at the hearing Dr Mills showed how the tool could be used to predict properties such as bond lengths and angles, and how it might be useful in developing new pharmaceutical compounds or in medical testing. The gist of their submissions seems to be that if the claimed invention were constrained to such a use, then it would be patentable.

- 39 I am not persuaded by those arguments. There is no mention in the specification itself of the prediction of bond lengths or angles. Even if there was, and a claim was included that was limited to predicting those parameters, then it would still be excluded since I can see no difference between predicting energy states and bond properties. Similarly in my view a claim to a system or method for predicting the properties or reactivity of atoms or ions using the invention currently claimed would also be excluded. It would still amount to a model for predicting properties whose contribution would fall solely in excluded matter.

- 40 On the use of the invention to manufacture or engineer compositions of matter, once again I think *Fujitsu* is highly relevant. As I have already said, in that case



the Court of Appeal decided that the method of modeling crystal structures defined in claim 1 was excluded as a program for a computer. The Court also expressly considered a claim (claim 9) to a method of manufacturing a crystal structure incorporating that method. In rejecting that claim as also relating to a program for a computer as such Aldous L.J. said at page 618 line 14:

“There is only one invention. The fact that it is claimed as a method, a way of manufacture or an apparatus having appropriate features is irrelevant.”

- 41 Whilst the potential uses of the invention formed part of his presentation, there is no disclosure in the specification itself of the use of the invention in a method of manufacture beyond the passing reference to “engineer compositions of matter”. It seems to me that in the absence of any such disclosure then the only “method of manufacture” claim that would be supported would be of the same form as that rejected by the Court of Appeal in *Fujitsu*. Following the reasoning in *Fujitsu* (as I must) the contribution made by such a claim would be the same as I identified for the current form of claim and would also fall solely in excluded matter.

#### Documents incorporated by reference

- 42 The specification includes references to some 40 or more documents whose contents are “incorporated herein by reference”. At the hearing the Applicants argued that these documents provided copious disclosure of potential uses of the invention contained within the specification itself and sought to rely upon these references as providing support for claims limited to such use of the invention. Those references are numerous and in some cases very long – one in particular extending to over 1000 pages. Following the hearing the Applicants kindly agreed to identify relevant passages from these documents to support their submissions on this point. They duly obliged with a response dated 10 March in which they sought to rely on a number of passages from just one document, namely a book published by Dr Mills entitled “The Grand Unified Theory of Classical Quantum Mechanics” as published in January 2005.
- 43 This element of the Applicants’ case raises two issues – the extent to which passages in “documents herein incorporated by reference” can be relied upon as the basis for an amendment to the claims and, if the references support such an amendment, whether they could provide the basis for a non-excluded invention.
- 44 I will deal with the latter point first. The passages highlighted by the Applicants illustrate how Dr Miller’s CQM theory can be used to predict a whole host of parameters and effects associated with atoms and ions. These include the electron g factor, the electron magnetic moment, electron Larmor precession in a magnetic field, the Stark shift of spectral lines, orbital and spin splitting effects, selection rules for spectral emission and absorption, linewidths and line shapes, the Knight shift, fine structure, hyperfine transitions, excited states of atomic helium and electron scattering from helium atoms. The submission suggests that because some of these effects are significant in determining the properties of practical devices then these disclosures could somehow form the basis of a patentable claim.
- 45 In particular, the submission highlights that some of the effects are relevant to

laser applications - for example the excited states of helium play a role in the pumping of the Helium-Neon laser and the hyperfine transition defines the emission wavelength of the hydrogen maser. It is suggested that these are practical applications of the invention and could be patentable.

- 46 Whilst the predicted effects may indeed be relevant to laser applications, that does not mean that the document discloses any patentable application of Dr Mills' theorem. The highlighted passages provide a range of examples where predictions made using Dr Mills' CQM theorem are favorably compared to experimentally observed parameters. That the verification involves predicting a property that is significant in a device such as a laser makes no difference. The passages provide nothing more than verification of the accuracy of Dr Mills' model. Those are not patentable applications of the otherwise excluded invention.
- 47 Thus even if the contents of the "incorporated by reference" documents could be used to support an amendment of the claims, I do not consider they could support a patentable claim in this case.
- 48 Having reached that conclusion it is not necessary for me to decide whether the disclosure of the documents incorporated by reference in the present application could be used as support for an amendment to the claimed invention. It is however a point I feel I should comment on.
- 49 As far as I am aware, the allowability of cross references to other documents was last considered by the UK courts in *Halliburton*<sup>5</sup>. The issue in that case was whether the content of prior art documents mentioned in the introduction to the specification could be used to overcome an insufficiency challenge. In deciding that one particular document could not be so used, Pumfrey J decided that the cross reference in that case was not a proper one since it did not expressly point the addressee to the reference paper to supplement the disclosure of the patent.
- 50 The facts in the present case are somewhat different. The issue here is not sufficiency, rather it is whether a claim incorporating a feature mentioned in the cross-referenced document would be supported. Thus the *Halliburton* judgment is not directly relevant to the issue in this case. Furthermore there is an express cross reference to the document the Applicants are relying on here of the sort *Halliburton* says is necessary. That might suggest that the cross referenced document could be relied upon to support an amendment.
- 51 That though is not the full picture. Headnote 24 of the judgment conveniently summarises the court's view on cross references taking account of EPO practice on this point. It states:

"(8)A patent specification when read like any other document, should be complete in itself. In general cross-referencing for the purpose of supplementing the disclosure was highly undesirable. If the disclosure was essential to the patent, that fact should be made abundantly clear. Although it was not permissible to exclude the possibility of a cross-reference for

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<sup>5</sup> *Halliburton Energy Services Inc v Smith International (North Sea) Ltd* [2006 RPC 2

essential material, the court must ensure that the cross reference was a proper one.”

- 52 If cross referencing in general is highly undesirable, then I seriously doubt whether the court would consider it acceptable to rely on passages plucked from within the 1000 plus pages of a document which is itself but one of some 40 or so cross referenced documents in a patent specification to support an amendment. That is particularly so given the absence of any indication that the particular document provided anything other than the background theory to CQM. As I have said however, it is not a point I need decide here and I shall say no more about it.

### **Conclusion**

- 53 I have found that however the claims might be amended so as to distinguish the version of CQM here from that disclosed in Dr Mills’ previous publications, claims to a system or method of computing and rendering the nature of bound atomic and atomic ionic electrons using that theorem are excluded. Furthermore I have been unable to identify any saving amendment that could form the basis of a patentable invention.
- 54 I therefore refuse the application as failing to comply with section 1(2).

### **Appeal**

- 55 Under the Practice Direction to Part 52 of the Civil Procedure Rules, any appeal must be lodged within 28 days.

**A BARTLETT**

Deputy Director acting for the Comptroller

Annex:

Claim 1 of GB 0614467.9

1. A system of computing and rendering the nature of bound atomic and atomic ionic electrons from physical solutions of the charge, mass, and current density functions of atoms and atomic ions, which solutions are derived from Maxwell's equations, the means for computing and rendering the nature of bound atomic and atomic ionic electrons comprising:

processing means for processing and solving the equations for charge, mass, and current density functions of electron(s) in a selected atom or ion; and

a display in communication with the processing means to display information relating to the current and charge density representation of the electron(s) of the selected atom or ion; and wherein:

the solutions of charge, mass, and current density functions of atoms and atomic ions comprise a solution of the classic wave equation

$$\left[ \nabla^2 - \frac{1}{v^2} \frac{\partial^2}{\partial t^2} \right] \rho(r, \theta, \phi, t) = 0$$

wherein the boundary constraint of the wave equation solution is nonradiation of the bound electron.

Claim 1 of 0705155.0

1. A method for computing and rendering the nature of bound atomic and atomic ionic electrons from physical solutions derived from Maxwell's equations, the method including inputting data into processing means comprising;

a) inputting electron functions that are derived from Maxwell's classic wave equation

$$\left[ \nabla^2 - \frac{1}{v^2} \frac{\partial^2}{\partial t^2} \right] \rho(r, \theta, \phi, t) = 0$$

using a constraint that the bound electron(s) does not radiate under acceleration;

b) inputting a trial electron configuration;

c) inputting the corresponding centrifugal, Coulombic, Diamagnetic and paramagnetic forces;

d) forming the force balance equation comprising the centrifugal force equal to the sum of the Coulombic, Diamagnetic and paramagnetic forces;

e) solving the force balance equation for the electron radii;

f) calculating the energy of the electrons using the radii and the corresponding electric and magnetic energies;

g) repeating steps a-f for all possible electron configurations;

h) outputting the lowest energy configuration and the corresponding electron radii for that configuration; and

i) displaying the solutions from step h) on display means associated with the processing means.