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David Varvel
Acting Centre Manager

Historical Perspective

- The first recorded reference to patents seems to be in Aristotle's "Politics", composed in 4th Century B.C.. According to Aristotle, Hippodamus of Miletos calls for a system of rewards to those who discover things useful to the state.
- The first regular administrative system to grant patent arose in Venice in the late fifteenth century. The Venetian senate's 1474 Act was the practice granting patents. This Venetian Act laid out all the essential features of a modern patent statute.
- Patent came to Britain by the middle of the 16th C, wherein Elizabeth I used patent grants as an inducement for foreign artisans to introduce continental technologies into England.

What is a patent?

- Government monopoly to protect ideas and inventions
- Valid for around 20 years
- Different countries require separate patents
- A patent is a legal document, hence the wording can become quite complex
- A typical patent can cost up to $200,000 over its life if filed in multiple countries, eg Europe, Australia, USA and Japan
- The protection key patents can offer can be worth millions of dollars. (50 years after inventing Dolby Noise Reduction systems Ray Dolby owns over 50 patents and is worth $2.4 Billion)

Who is an inventor?

- A person who made an inventive contribution to the invention as defined in the claims of the patent
- The inventive contribution must go to the conception of the claimed invention
- An inventor makes an inventive contribution to at least one claim
- A definition of an "inventor" can vary from country to country so patents filed in different countries may have different inventors
- Being an author on a publication does not mean you are an inventor

What is in a patent?

US007474010B2

(12) **United States Patent**
Freedman et al.

(10) **Patent No.: US 7,474,010 B2**
(45) **Date of Patent: Jan. 6, 2009**

(54) **SYSTEMS AND METHODS FOR PERFORMING QUANTUM COMPUTATIONS**

(75) Inventors: **Michael Freedman**, Redmond, WA (US); **Chetan Nayak**, Santa Monica, CA (US); **Kirill Shtengel**, Seattle, WA (US)

(73) Assignee: **Microsoft Corporation**, Redmond, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/673,213**

(22) Filed: **Feb. 9, 2007**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Division of application No. 11/207,508, filed on Aug. 19, 2005, which is a continuation of application No. 10/909,005, filed on Jul. 30, 2004, now Pat. No. 7,109, 593.

(51) **Int. Cl.**
H01L 23/58 (2006.01)

(52) **U.S. Cl.** **257/798**; 257/31; 257/32; 257/33; 257/34; 257/35; 706/29; 706/33

(58) **Field of Classification Search** 257/31–36, 257/798
See application file for complete search history.

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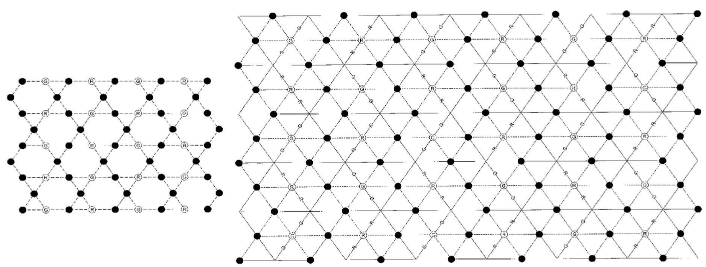
(57) **ABSTRACT**

Apparatus and methods for performing quantum computations are disclosed. Such apparatus and methods may include identifying a first quantum state of a lattice having a system of quasi-particles disposed thereon, moving the quasi-particles within the lattice according to at least one predefined rule, identifying a second quantum state of the lattice after the quasi-particles have been moved, and determining a computational result based on the second quantum state of the lattice.

10 Claims, 5 Drawing Sheets



The First page of a patent includes the;

- Name of the patent
- Inventor names
- Any prior publication information
- Filing date
- Assignee name
- Cited references
- Abstract of the patent
- 1 representative diagram of the patent
- Patent classification numbers

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SYSTEMS AND METHODS FOR PERFORMING QUANTUM COMPUTATIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a division of U.S. patent application Ser. No. 11/207,508, filed Aug. 19, 2005, which is a continuation of U.S. patent application Ser. No. 10/909,005, now U.S. Pat. No. 7,109,593 filed Jul. 30, 2004. The subject matter disclosed and claimed herein is related to the subject matter disclosed and claimed in U.S. patent application Ser. Nos. 10/930,640, 10/931,083, and 10/931,082, all of which were filed on Aug. 31, 2004. The disclosure of each of the above-referenced U.S. patent applications is incorporated herein in its entirety.

FIELD OF THE INVENTION

This invention relates in general to the field of quantum computing. More particularly, this invention relates to topological quantum computing.

BACKGROUND OF THE INVENTION

Since the discovery of the fractional quantum Hall effect in 1982, topological phases of electrons have been a subject of great interest. Many abelian topological phases have been discovered in the context of the quantum Hall regime. More recently, high-temperature superconductivity and other complex materials have provided the impetus for further theoretical studies of and experimental searches for abelian topological phases. The types of microscopic models admitting such phases are now better understood. Much less is known about non-abelian topological phases. They are reputed to be obscure and complicated, and there has been little experimental motivation to consider non-abelian topological phases. However, non-abelian topological states would be an attractive milieu for quantum computation.

It has become increasingly clear that if a new generation of computers could be built to exploit quantum mechanical superpositions, enormous technological implications would follow. In particular, solid state physics, chemistry, and medicine would have a powerful new tool, and cryptography also would be revolutionized.

The standard approach to quantum computation is predicated on the quantum bit (“qubit”) model in which one anticipates computing on a local degree of freedom such as a nuclear spin. In a qubit computer, each bit of information is typically encoded in the state of a single particle, such as an electron or photon. This makes the information vulnerable. If a disturbance in the environment changes the state of the particle, the information is lost forever. This is known as decoherence—the loss of the quantum character of the state (i.e., the tendency of the system to become classical). All schemes for controlling decoherence must reach a very demanding and possibly unrealizable accuracy threshold to function.

Topology has been suggested to stabilize quantum information. A topological quantum computer would encode information not in the conventional zeros and ones, but in the configurations of different braids, which are similar to knots but consist of several different threads intertwined around each other. The computer would physically weave braids in space-time, and then nature would take over, carrying out complex calculations very quickly. By encoding information in braids instead of single particles, a topological quantum computer does not require the strenuous isolation of the qubit model and represents a new approach to the problem of decoherence.

In 1997, there were independent proposals by Kitaev and Freedman that quantum computing might be accomplished if the “physical Hilbert space” V of a sufficiently rich TQFT (topological quantum field theory) could be manufactured and manipulated. Hilbert space describes the degrees of freedom in a system. The mathematical construct V would need to be realized as a new and remarkable state for matter and then manipulated at will.

In 2000, Freedman showed that some extraordinarily complicated local Hamiltonian H can be written down whose ground state is V. But this H is an existence theorem only, and is far too complicated to be the starting point for a physical realization.

In 2002, Freedman showed a Hamiltonian involving four-body interactions and stated that after a suitable perturbation, the ground state manifold of H will be the desired state V. This H is less complex than the previously developed H, but it is still only a mathematical construct. One does not see particles, ions, electrons, or any of the prosaic ingredients of the physical world in this prior art model. A Hamiltonian is an energy operator that describes all the possible physical states (eigenstates) of the system and their energy values (eigenvalues).

Freedman further defined the notion of d-isotopy, and showed that if it can be implemented as a ground state of a reasonable Hamiltonian, then this would lead to V and to topological quantum computation. Isotopy is defined a… deformation, and two structures that are isotopic ar… ered to be the same. As shown in the toruses … **1**A and **1**B, respectively, for example, X and X' are isotopic, because one may be gradually deformed into the other. In d-isotopy, small circles can be absorbed as a factor=d. Such closed curves are referred to as multicurves or multiloops. Loop X" in FIG. **1**C (winding around torus **3**) is not d-isotopic to X or X'. Loops that are unimportant (because, e.g., they comprise a contractible circle) are called trivial loops and it is desirable to remove, as well as count them. Whenever a trivial loop is removed, the picture is multiplied by “d”. In other words, if two multiloops are identical except for the presence of a contractible circle, then their function values differ by a factor of d, a fixed positive real number. It has been shown that $d=2\cos \pi/(k+2)$, where k is a level such as 1, 2, 3, etc. which is a natural parameter of Cherns-Simons theory.

According to Freedman, the parameter d can take on only the “special” values: 1, root**2**, golden ratio, root**3** . . . 2 cos $\pi/(k+2)$ (where k is a natural number). At $d=1$, the space V becomes something already known, if not observed in solid state physics. For $d>1$, V is new to the subject. Freedman, et al., later showed that d-isotopy is explicable by field theory and that multiloops as domain walls can be alternately interpreted as Wilson loop operators. Thus, d-isotopy is a mathematical structure that can be imposed on the multiloops, and is based on Cherns-Simons theory.

An exotic form of matter is a fractional quantum Hall fluid. It arises when electrons at the flat interface of two semiconductors are subjected to a powerful magnetic field and cooled to temperatures close to absolute zero. The electrons on the flat surface form a disorganized liquid sea of electrons, and if some extra electrons are added, quasi-particles called anyons emerge. Unlike electrons or protons, anyons can have a charge that is a fraction of a whole number.

The fractional quantum Hall fluids at one-third filling (of the first Landau level) are already a rudimentary (abelian) example of the V of a TQFT. To effect quantum computation,

The specification may (but is not required to) include a "background section", which is used to describe the state of the art before the arrival of the current invention and often describes the challenges or problems with the prior art that the current invention seeks to solve.

it would be desirable to construct states more stable and more easily manipulated than FQHE (fractional quantum Hall effect) fluids.

One property of anyons is that when they are moved around each other, they remember in a physical sense the knottedness of the paths they followed, regardless of the path's complexity. It is desirable to use anyons in a system with complex enough transformations, called non-abelian transformations, to carry out calculations in a topological quantum computation system.

In view of the foregoing, there is a need for systems and methods that overcome the limitations and drawbacks of the prior art.

SUMMARY OF THE INVENTION

Apparatus and methods according to the invention may include identifying a first quantum state of a lattice having a quasi-particle disposed thereon, moving the quasi-particle within the lattice according to at least one predefined rule, identifying a second quantum state of the lattice after the quasi-particle has been moved, and determining a computational result based on the second quantum state of the lattice. The quasi-particle may be a non-abelian anyon, for example.

The quasi-particle may be an excitation of a least energy state of a system of real particles. The least energy state and the quasi-particle may be determined by a Hamiltonian operator that is defined from interactions of real particles. The Hamiltonian operator may induce a process on the multi-loops that induces rules for creating, deforming, and annihilating loops. The real particles may define a first dimer covering of an underlying lattice (perhaps the triangular lattice), which, in combination with a second, fixed, background dimer covering, defines one or more multi-loops. The least energy state may be a superposition of the multi-loops, and the quasi-particle may be a canonical excitation of the superposition.

The lattice may be the triangular lattice whose edge center for a Kagome lattice comprises a plurality of hexagons. Each hexagon may contain exactly one real particle. The Kagome lattice may include a plurality of triangular sub-lattices, wherein edges of the triangular sub-lattices are sites of the Kagome lattice. The lattice may include a plurality of lattice sites, where none of the lattice sites hosts more than one dimer.

The predefined rules may include one or more combinatorial moves. The combinatorial moves may include, without limitation, a bow-tie move, a triangle move, and a rhombus flip. Moving the quasi-particle may include moving the quasi-particle relative to a second quasi-particle to cause a quantum braid to be formed in the 2D+1-dimensional space-time of the lattice. The computational result may be based on the quantum braid, which may provide an indication as to how the quasi-particle was moved relative to the second quasi-particle.

Additional features and advantages of the invention will be made apparent from the following detailed description of illustrative embodiments that proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of preferred embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings exemplary constructions of the invention; however,

the invention is not limited to the specific methods and instrumentalities disclosed. In the drawings:

FIGS. **1**A, **1**B, and **1**C are diagrams useful in describing isotopy;

FIG. **2** is a diagram of an exemplary Kagome lattice in accordance with the present invention;

FIG. **3** is a diagram of an exemplary Kagome lattice in accordance with the present invention;

FIG. **4** is a diagram of an exemplary lattice that is useful for describing aspects of the present invention;

FIG. **5** is a diagram of an exemplary lattice useful for describing dimer moves in accordance with the present invention; and

FIG. **6** is a block diagram showing an exemplary computing environment in which aspects of the invention may be implemented.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Apparatus and methods according to the invention identifying a first quantum state of a lattice having particle disposed thereon, moving the quasi-particle the lattice according to at least one predefined rule, identifying a second quantum state of the lattice after the quasi-particle has been moved, and determining a computational result based on the second quantum state of the lattice.

In accordance with the present invention, "realistic" microscopics can be provided for d-isotopy, wherein "realistic" refers to atoms and electrons, for example, as opposed to loops and curves. More particularly, realistic means physical degrees of freedom, with local interaction (the particles are nearby to each other and know of each other's presence). The interactions are potential energy costs of bringing atoms near each other. Existing physical relationships, such as van der waals forces, may be used, along with other physical characteristics, such as tunneling amplitudes. It is desirable to obtain a physical embodiment of the mathematical construct of d-isotopy. In other words, it is desirable to turn the abstract description of the d-isotopy into known physical processes (e.g., tunneling, repulsion, Coulomb interaction).

To go from abstract d-isotopy to real physics, multiloops (i.e., multicurves) are implemented. These multiloops are desirably implemented as broken curves (i.e., "dimer covers", which is a standard term of art in physics). The following rules are desirably implemented as well: (1) isotopy rule—the amplitude of a picture (or a portion of picture) does not change as it is bent; and (2) d rule—to account for the value associated with a small loop. The rules are turned into "fluctuations", which are terms in the Hamiltonian that relate to different states (e.g., flickering between two states).

An exemplary embodiment is directed to an extended Hubbard model with a two-dimensional Kagome lattice and a ring-exchange term, described further below. A dimer cover (such as a one-sixth filled Kagome lattice) along with a topology (such as loops) and rules (such as the d-isotopy rule) are desirably comprised within an exemplary extended Hubbard model. Exemplary particles used in conjunction with an exemplary extended model can be bosons or spinless fermions.

At a filling fraction of one-sixth, the model is analyzed in the lowest non-vanishing order of perturbation theory. For a lattice populated with a certain percentage of particles (e.g., electrons), the particles will naturally dissipate to form the "perfect" arrangement. Thus, if one-sixth of the edges of the

From a researcher's perspective, the **specification** preceding the claims is the most interesting part of a patent. It shows how the invention works and how it is made and used. The chief legal requirements for the specification is that it must "describe" the claimed invention in sufficient detail to "teach others how to make and use the invention". These are referred to as the **written description** and **enablement** requirements, respectively. The written description and enablement must match the breadth of the claims. If a claim includes devices/compositions/processes which are not described or are not enabled by the specification, that claim is invalid.

Additionally, the description must disclose the **best mode** for carrying out the invention, as known by the inventors at the time the patent application is filed. The idea is that a person cannot gain the monopoly of a general patent while keeping secret their best embodiment of the invention.

PC, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer **110**, although only a memory storage device **181** has been illustrated in FIG. **6**. The logical connections depicted include a LAN **171** and a WAN **173**, but may also include other networks. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the internet.

When used in a LAN networking environment, the computer **110** is connected to the LAN **171** through a network interface or adapter **170**. When used in a WAN networking environment, the computer **110** typically includes a modem **172** or other means for establishing communications over the WAN **173**, such as the internet. The modem **172**, which may be internal or external, may be connected to the system bus **121** via the user input interface **160**, or other appropriate mechanism. In a networked environment, program modules depicted relative to the computer **110**, or portions thereof, may be stored in the remote memory storage device. By way of example, and not limitation, FIG. **6** illustrates remote application programs **185** as residing on memory device **181**. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

As mentioned above, while exemplary embodiments of the present invention have been described in connection with various computing devices, the underlying concepts may be applied to any computing device or system.

The various techniques described herein may be implemented in connection with hardware or software or, where appropriate, with a combination of both. Thus, the methods and apparatus of the present invention, or certain aspects or portions thereof, may take the form of program code (i.e., instructions) embodied in tangible media, such as floppy diskettes, CD-ROMs, hard drives, or any other machine-readable storage medium, wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the invention. In the case of program code execution on programmable computers, the computing device will generally include a processor, a storage medium readable by the processor (including volatile and non-volatile memory and/or storage elements), at least one input device, and at least one output device. The program(s) can be implemented in assembly or machine language, if desired. In any case, the language may be a compiled or interpreted language, and combined with hardware implementations.

The methods and apparatus of the present invention may also be practiced via communications embodied in the form of program code that is transmitted over some transmission medium, such as over electrical wiring or cabling, through fiber optics, or via any other form of transmission, wherein, when the program code is received and loaded into and executed by a machine, such as an EPROM, a gate array, a programmable logic device (PLD), a client computer, or the like, the machine becomes an apparatus for practicing the

invention. When implemented on a general-purpose processor, the program code combines with the processor to provide a unique apparatus that operates to invoke the functionality of the present invention. Additionally, any storage techniques used in connection with the present invention may invariably be a combination of hardware and software.

While the present invention has been described in connection with the preferred embodiments of the various figures, it is to be understood that other similar embodiments may be used or modifications and additions may be made to th described embodiments for performing the same function the present invention without deviating therefrom. The the present invention should not be limited to a embodiment, but rather should be construed in scope in accordance with the appended claim

What is claimed is:

1. A quantum computing system, com

a lattice having a plurality of non-A anyons disposed thereon, wherein said non-Abelian anyons are excitations of least energy states of a system of real particles that form the lattice;

means for identifying a first quantum state of the lattice;

means for moving the non-Abelian anyons within a 2D+1 space-time of the lattice;

means for identifying a second quantum state of the lattice after the non-Abelian anyons are moved; and

means for determining a computational result based on the first and second quantum states of the lattice.

2. The system of claim **1**, wherein the plurality of non-Abelian anyons are arranged on the lattice to satisfy a predefined excitation above a least energy state of the system of real particles.

3. The system of claim **2**, wherein the real particles are arranged to form a first superposition of multi-loops and arcs, said first superposition defining the first quantum state of the lattice.

4. The system of claim **3**, wherein the second quantum state is defined by a second superposition of multi-loops and arcs formed on the lattice after the non-Abelian anyons are moved.

5. The system of claim **1**, wherein the lattice has a number of lattice sites, and the plurality of non-Abelian anyons are distributed among only a subset of the lattice sites.

6. The system of claim **5**, wherein the plurality of non-Abelian anyons are distributed dilutely and the real particles are distributed on an edge lattice in proportion to a valence of the edge lattice.

7. The system of claim **6**, wherein the edge lattice is a triangular lattice and the proportion is ⅙.

8. The system of claim **1**, wherein the non-Abelian anyons are set on bonds of a triangular sub-lattice formed within a Kagome lattice.

9. The system of claim **1**, wherein the real particles are bosons.

10. The system of claim **1**, wherein the real particles are fermions.

* * * * *

The **claims** are the most important component of a patent. The claims are what define the scope of the patent—which devices/compositions/processes its monopoly will cover, and which devices/compositions/processes are outside the monopoly. Infringement cases always revolve around the claims, not the specification, although the specification can be used to clarify the meaning of terms appearing in the claims. Despite any language in the specification to the contrary, (such as "The invention is ..." or "The invention includes ..."), only the claims determine the scope of the monopoly right.

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Priority and Invention

- All countries now utilise the **first to file** rule for patents.
- The act of invention has two parts, "conception" and "reduction to practice." Conception is the formulation in the mind of the inventor of the complete means for solving a problem in such a way that a person skilled in the relevant art could practice the invention by following the inventor's conception.
- "Reduction to practice" is the earliest date where the inventor can prove that they produced or applied the product or process successfully.
- Filing for a patent is considered to be the legal equivalent of reducing to practice if no earlier date can be proven.
- Even though a publication is not a patent, a prior publication by either the inventor **OR** by any other person can invalidate a patent
- Putting an idea onto a web page is considered publishing even if it can be proved that no-one has read the particular webpage.

Exploitation of Patents

- Because patents are a property right, they may be owned or transferred to another much like any other property right.
- To transfer ownership of a patent, one "assigns" the patent to another.
- A patent may also be licensed. A license provides permission for another party to engage in conduct that would otherwise be infringing.

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Who approves a patent within CoEPP?

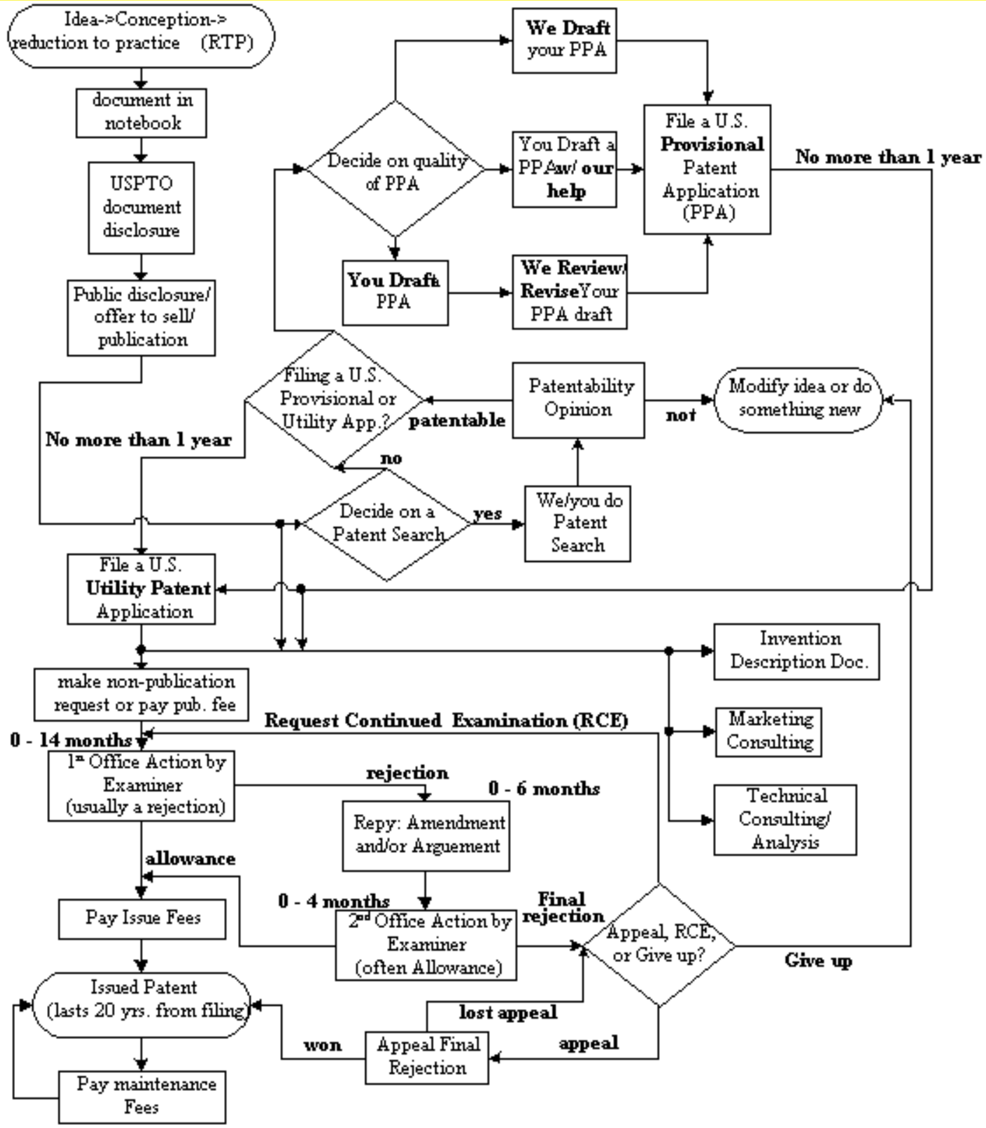
- All potential invention disclosures should be reported to the relevant Node Director
- The Node Director will then report this notification to the Executive Committee
- All invention disclosures should be prepared on an Intellectual Property Disclosure form identifying, inventors, literature searches, funding sources and description of the IP.
- Such forms, if required will be available through the Centre Manager
- The Director with the Executive Committee or the relevant Node Director will evaluate the Invention Disclosure and determine if the Intellectual Property should be patented. There is no obligation to patent. The evaluation is solely based on its merit for commercialisation.
- If a patent is to be filed it must be approved within CoEPP and then lodged with the relevant University IP office who will make a further evaluation.

Lab Books

- Provide documentary evidence of the inventive process which can be dated
- Can identify who was involved in the generation of the invention
- Can be used to assist in resolving inventorship disputes
- Should include written notes, experiment results, references to data location, minutes of meetings, etc.
- Guidelines on best practice for lab books are available
- Information from lab books can be used to write the patent specification and claims

Publish or Patent?

- If you want to retain your IP rights, it is important that your intellectual property (IP) is not disclosed prior to it being adequately protected. It is important to understand that patenting means that you will have to delay but not prevent publication.
- Patents are only granted on ideas that are not publicly known. So if you want to patent an idea you cannot publicly disclose the idea until you have filed for patent protection.
- A public disclosure can include a journal paper, poster presentation or oral presentation at a conference, PhD Thesis, or even disclosure to a single individual. (However confidential disclosure under agreement is allowed, ie discussion with a patent attorney)
- All publications within the Centre which may involve the potential for patenting of the technology should be referred to the relevant Node Director for review before the publication is submitted to any Journal or conference.



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United States Patent Office

3,303,426
Patented Feb. 7, 1967

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3,303,426
STRONG FOCUSING OF HIGH ENERGY PARTICLES IN A SYNCHROTRON STORAGE RING

Richard A. Beth, Bonn, Germany, assignor to the United States of America as represented by the United States Atomic Energy Commission

Filed Mar. 11, 1964, Ser. No. 351,255
7 Claims. (Cl. 328—235)

This invention relates to high energy beams of charged particles having substantially the same momentum and to means for strong focusing and bending said beams.

In high energy physics it has been desirable to provide strong focusing of high energy beams of charged particles having substantially the same momentum. Various proposals have been made and used to this end and while these arrangements used heretofore have been useful and can accomplish strong focused proton beams, they have required the manufacture and assembly of magnets in which the magnetic fields have been limited due to the bad

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In the drawings where like parts are numbered alike:

FIG. 1 is a graphic representation of the variation of the field gradient integral (or dF/dx) across the aperture of a conventional rectangular strong focusing magnet with hyperbolic pole faces;

FIG. 2 is a graphic view of magnetic characteristics of strong end focusing magnets compared with conventional strong focusing magnets;

FIG. 3 is a partial cross-section of a magnet having strong end focusing in accordance with this invention;

FIG. 4 is a partial top view of the strong end focusing magnet of this invention showing a portion of the circumference of a particle confining ring therefor;

FIG. 5 is a graphic representation of the variation of the field integral F or field gradient integral across the aperture of the uniform gap magnet of FIG. 3 having straight ends slanting oppositely to each other;

FIG. 6 is a partial isometric view of the "wedge" strong end focusing magnet of FIG. 3 whose characteristics are illustrated in FIGS. 2 and 5;

(12) **United States Patent**
Olcott et al.

(10) **Patent No.: US 8,258,480 B2**
(45) **Date of Patent: Sep. 4, 2012**

(54) **HIGH ENERGY PHOTON DETECTION USING PULSE WIDTH MODULATION**

(75) Inventors: **Peter D. Olcott**, Stanford, CA (US); **Craig S. Levin**, Palo Alto, CA (US)

(73) Assignee: **The Board of Trustees of the Leland Stanford Junior University**, Stanford, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 394 days.

(21) Appl. No.: **12/397,195**

(22) Filed: **Mar. 3, 2009**

(65) **Prior Publication Data**

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(60) Provisional application No. 60/067,905, filed on Mar. 3, 2008.

(51) **Int. Cl.**
G01T 1/161 (2006.01)

(52) **U.S. Cl.** **250/363.02**

(58) **Field of Classification Search** 250/362, 250/363.01–363.1, 370.01–370.15
See application file for complete search history.

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(57) **ABSTRACT**

Methods and systems for processing an analog signal that is generated by a high energy photon detector in response to a high energy photon interaction. A digital edge is generated representing the time of the interaction along a first path, and the energy of the interaction is encoded as a delay from the digital edge along a second path. The generated digital edge and the delay encode the time and energy of the analog signal using pulse width modulation.

24 Claims, 17 Drawing Sheets

Useful patent?

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(54) **TECHNICAL AND THEORETICAL SPECIFICATIONS FOR WARP DRIVE TECHNOLOGY**

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(57) **ABSTRACT**

The present invention relates to the use of technical drive systems, which operate by the modification of gravitational fields. These drive systems do not depend on the emission of matter to create thrust but create a change in the curvature of space-time, in accordance with general relativity. This allows travel by warping space-time to produce an independent warp drive system. Differentials electron flow through a body in rotation is directed so as to simultaneously pass through a said body In its direction of

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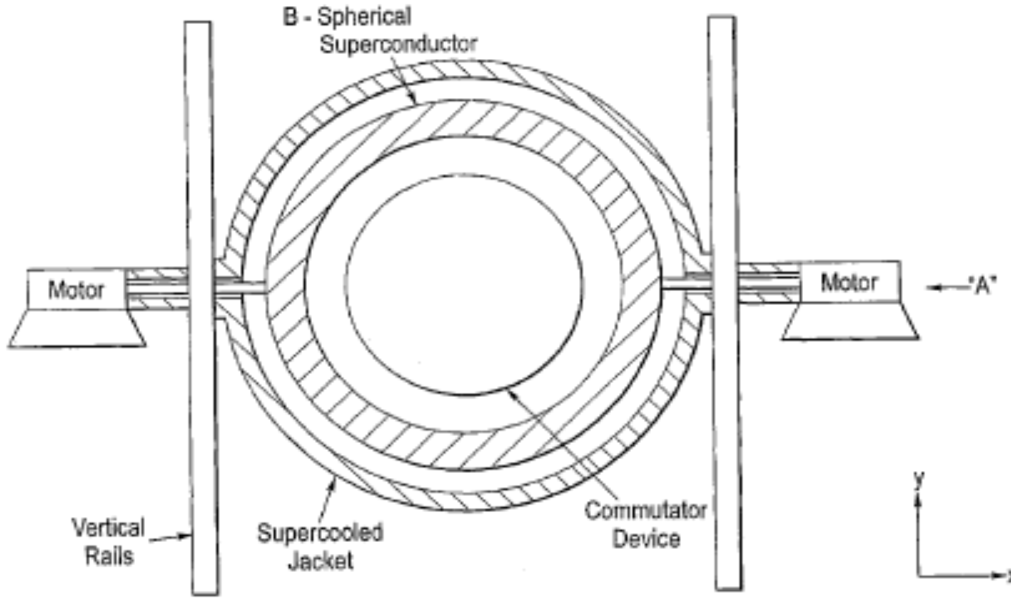

Spherical Superconductor
Sphere = 0.25m external radius
Sphere = 0.20m internal radius

Figure 1 & 2
B = Superconductor

Direction of Motion
y vector (vertical rails)

A few final points

- Safety Policy for Centre – Documentation and data collection
- OH&S Audit Wednesday 17 July for Melbourne Node
  - Note will be issued, please read
  - The auditor can stop anyone in The School and ask safety related questions. Please familiarise yourself with details on the websites listed before Wednesday.
- Centre KPI data for Annual reporting to ARC
- Publications to be listed on the CoEPP web pages – project starting later this year