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Hypercomputation and Negative Entropy

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Abstract

On the basis of a theorem, in which an evanescent photon is a superluminal particle, the author considers the possibility of realizing a high-performance computer system compared with conventional silicon processors, which can perform infinite steps of computation within the finite time. This is called a hypercomputer. This critical component for hypercomputing can be created using meta-material circuits with a non-linear refractive index. Based on this optical computer system, utilizing meta-material technology, it can be shown that superluminal computation, which is a new concept for an accelerated Turing machine, can be realized in the physical world. This system is related with the negative entropy which was introduced by Erwin Schrödinger. In this article, the author shows that negative entropy will appear in the computational steps by using superluminal particles.

Keywords: ***Hypercomputer; Negative entropy; Meta-material; Accelerated turing machine; Evanescent photon.***

1. Introduction

The concept and phrase "negative entropy" was introduced by Erwin Schrödinger in his 1944 popular-science book “What is Life?” [1] Later, Léon Brillouin shortened the phrase to negentropy [2]. In 1974, Albert Szent-Györgyi proposed replacing the term negentropy with syntropy. That term may have originated in the 1940s with the Italian mathematician Luigi Fantappiè, who tried to construct a unified theory of biology and physics. Buckminster Fuller tried to popularize this usage, but the concept of negentropy remains unclear. Ideas about the relationship between entropy and living organisms have inspired hypotheses and speculations in many contexts, including psychology, information theory, the origin of life, and the possibility of extraterrestrial life. This, Schrödinger argues, is what differentiates life from other forms of the organization of matter. In this direction, although life's dynamics may be argued to go against

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the tendency of the second law, life does not in any way conflict with or invalidate this law, because the principle that entropy can only increase or remain constant applies only to a closed system which is adiabatically isolated, meaning no heat can enter or leave, and the physical and chemical processes which make life possible do not occur in adiabatic isolation. Contrary to this principle, it can be shown that the computation by superluminal particles, negentropy will appear during the computation.

In this article, the negentropy by superluminal computation is considered and it is shown that the activity of the brain organism is associated with the superluminal computation.

2. Hypercomputation to Perform Infinite Steps of Computation

Hypercomputation, the term of which was introduced in 1999 by Jack Copeland and Diane Proudfoot [3], that can complete infinite computation steps, refers to models of computation that go beyond, or are incomparable to Turing computability. This includes various hypothetical methods for the computation of non-Turing-computable functions. The Church–Turing thesis states that any function that is algorithmically computable can be computed by a Turing machine. An accelerated Turing machine is included in the category of hypercomputer. It can compute functions that a Turing machine cannot do and which are not computable in the Church-Turing sense. In mathematics and computer science, an accelerated Turing machine is a hypothetical computational model related to Turing machines, which can perform a countable infinite number of computational steps within a finite time. It is also called a Zeno machine, a concept proposed independently by B. Russdel, R. Blake and H. Weyl, which performs its first computational step in one unit of time and each subsequent step in half the time of the step before, allowing an infinite number of steps of computation to be completed within a finite interval of time. However, such a machine cannot be physically realized, from the standpoint of the Heisenberg uncertainty principle, because the energy to perform the computation will be exponentially increasing as the computational speed is accelerating. Contrary to this conclusion, the author can show the possibility to realize a real accelerated Turing machine, by utilizing superluminal particles instead of subliminal particles, which are related to evanescent photons, and also a metamaterial circuit [4].

Feynmann defined the required energy per step for a computation as shown in Fig. 1, given by [5]

$$energy \;\; per \;\; step = k_B T \frac{f-b}{(f+b)/2} \qquad (1)$$

where k_B is Boltzmann's constant, T is a temperature, f is a forward rate of computation and b is backward rate.

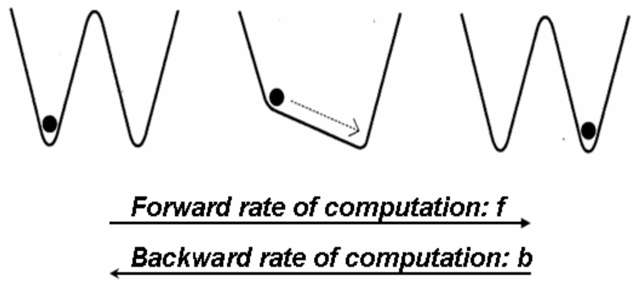

Fig. 1. Computational steps necessary to perform reversible computation**.**

Supposing that there is no energy supply and parameters f and b are fixed during the computation, we can consider the infinite computational steps given by

$$E_1 = kE_0,\ E_2 = kE_1,\ \cdots,\ E_n = kE_{n-1},\cdots \qquad (2)$$

where we let the initial energy of computation be $E_0 = k_B T$, $k = 2(f-b)/(f+b)$, and E_n is the energy for the n-th step computation.

From the above series of equations, we have $E_n = k^n E_0$, and the energy loss for each computational step becomes

$$\begin{aligned}\Delta E_1 &= E_0 - E_1 = (1-k)E_0\\ \Delta E_2 &= E_1 - E_2 = (1-k)kE_0\\ &\vdots \\ \Delta E_n &= E_{n-1} - E_n = (1-k)k^{n-1}E_0\end{aligned} \qquad (3)$$

E. Recami claimed in his paper [6] that tunneling photons traveling in evanescent mode can move with superluminal group speed inside the barrier. Chu and S. Wong at AT&T Bell Labs measured superluminal velocities for light traveling through the absorbing material [7]. Furthermore Steinberg, Kwait and Chiao devised an experiment measuring the tunneling time for visible light through an optical filter, consisting of a multilayer coating about 10^{-6} m thick, and confirmed superluminal speed [8]. The results obtained by Steinberg and co-workers have shown that the photons seemed to have traveled at 1.7 times the speed of light. Recent optical experiments at Princeton NEC have verified that superluminal pulse propagation can occur in transparent media [9]. These results indicate that the process of tunneling in quantum physics is indeed superluminal, as claimed by E. Recami.

From the relativistic equation of energy and momentum of the moving particle, given by

$$E = \frac{m_0 c^2}{\sqrt{1-v^2/c^2}}, \qquad (4)$$

and

$$p = \frac{m_0 v}{\sqrt{1 - v^2 / c^2}}\,, \qquad (5)$$

the relation between the energy and momentum can be shown as $p / v = E / c^2$.

From which, we have [10]

$$\frac{v\Delta p - p\Delta v}{v^2} = \frac{\Delta E}{c^2}\,. \qquad (6)$$

Supposing the approximation $\Delta v / v^2 \approx 0$ holds, Equation (6) can be simplified as

$$\Delta p \approx \frac{v}{c^2}\Delta E\,. \qquad (7)$$

This relation is also valid for a superluminal particle, which has an imaginary mass im_*. According to the paper by M. Park and Y. Park [11], the uncertainty relation for a superluminal particle can be given by

$$\Delta p \cdot \Delta t \approx \frac{\hbar}{v - v'}\,, \qquad (8)$$

where v and v' are the velocities of the superluminal particle after and before the measurement. By substituting Equation (7) into (8), we obtain the uncertainty relation for superluminal particles given by

$$\Delta E \cdot \Delta t \approx \frac{\hbar}{\beta(\beta - 1)}\,, \qquad (9)$$

when we let $v' = c$ and $\beta = v / c$.

From Equation (4), we have the following equation for superluminal particles;

$$E_n = \frac{m_* c^2}{\sqrt{v^2 / c^2 - 1}}\,, \qquad (10)$$

where E_n is the energy for the n-th step computation and m_* is a proper mass of the superluminal particle.

From which, the speed of superluminal particles becomes

$$v / c = \sqrt{1 + \frac{m_*^2 c^4}{k^{2n} E_0^2}} \qquad (11)$$

where n is the step number of the computation.

From this equation, the speed of superluminal particles can be obtained with the parameters of k and n.

From the calculation, it is seen that the computational speed is accelerated per steps.

Hence the total time required for the quantum system utilizing superluminal particles becomes [10]

$$T = \sum_{n=1}^{\infty} \Delta t_i = \frac{\pi\ \hbar}{2E_0} \sum_{n=1}^{\infty} \frac{1}{\beta_n(\beta_n - 1)(1 - k)k^{n-1}}\,, \qquad (12)$$

from Equation (4) and the uncertainty principle for superluminal particles given by Equation (9), where β_n can be given by

$$\beta_n = \sqrt{1 + \frac{m_*^2 c^4}{E_n^2}} = \sqrt{1 + \frac{m_*^2 c^4}{k^{2n} E_0^2}}\,, \tag{13}$$

which is derived from Equation (10).

From Equations (12) and (13), it is seen that the computation time can be given as shown in Fig. 2.

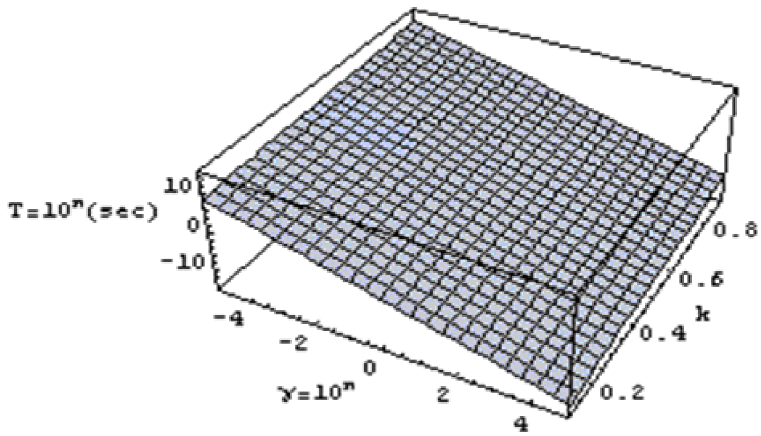

Fig. 2. Computational required time for superluminal particles**.**

By numerical calculation, it can be shown that the infinite sum of Equation (12) converges to a certain value satisfying $0 < k < 1$, as shown in Fig. 2.

In this figure, the horizontal line is for the parameter $\gamma = m_* c^2 / E_0$ and the vertical line is for the time to complete infinite calculation steps.

These calculation results indicate that an accelerated Turing machine, which is called a hypercomputer, can be realized, utilizing superluminal particles instead of subluminal particles, in accordance with Feynman's computational model.

Thus, contrary to the conclusion that an accelerated Turing machine cannot be physically realized from the standpoint of the Heisenberg uncertainty principle, it can be seen that superluminal particles permit the construction of a real, accelerated Turing machine.

3. Entropy of Superluminal Computation

As shown in Fig.1, the ratio of the forward to backward rate of computation becomes

$$r = \exp[(E_1 - E_2) / k_B T]\,, \tag{14}$$

where k_B is the Boltzman constant and T is an absolute temperature.

According to Feynman, entropy of the computation can be given by [5]

$$\Delta S = S_2 - S_1 = k_B \log r\,, \tag{15}$$

Then we have $\Delta S = \Delta E / T$, where $\Delta E = E_1 - E_2$.

From which, the energy loss per step is equal to the entropy generated in that step.

If we suppose γ is

$$\gamma = 1/\sqrt{1-(u/c)^2}\,, \qquad (16)$$

where u is the relative speed of the observer to the observed system and c is the light speed.

If we suppose the energy of the particle to be E, the energy E' which is the energy of the particle measured by the observer can be given by

$$E' = \gamma\left(1 - \frac{u}{c}\beta\right)E, \qquad (17)$$

From the equation, $\Delta S = \Delta E / T$ and Eq. (15), the increased rate of entropy by the one step computation is given for subliminal particles as

$$\Delta S = \frac{\pi \hbar \gamma}{2\Delta t T}\left(1 - \frac{u}{c}\beta\right), \qquad (18)$$

where $\beta = v/c$ (v: speed of the particle for computation).

The calculation result of Eq.(18) for the case of 50MPS (i.e. $\Delta t = 20 \times 10^{-9}$ sec) and $T = 293°K$ is shown in Fig.3.

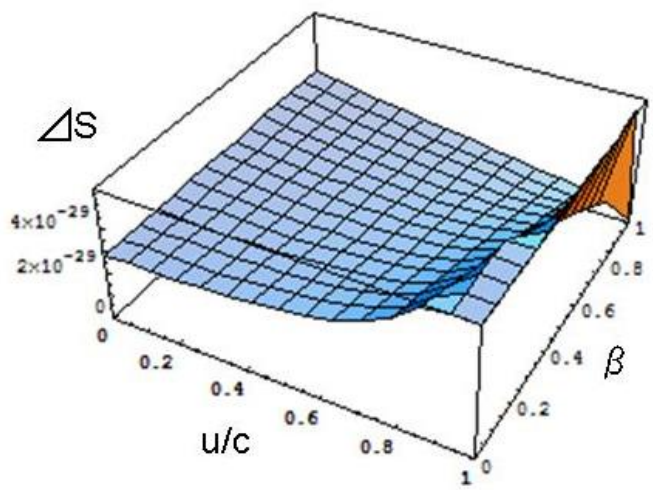

Fig. 3. Increase rate of entropy for the subliminal particle**.**

From which, it is seen that entropy of a conventional computation is increased per steps by the computation using subluminal particles such as electrons.

For superluminal particles, we have the following equation from Eq. (9) as

$$\Delta S = \frac{\hbar \gamma}{\beta(\beta-1)\Delta t T}\left(1 - \frac{u}{c}\beta\right), \qquad (19)$$

By this equation, the increase rate of entropy per steps of computation by using superluminal particles can be shown as Fig.4.

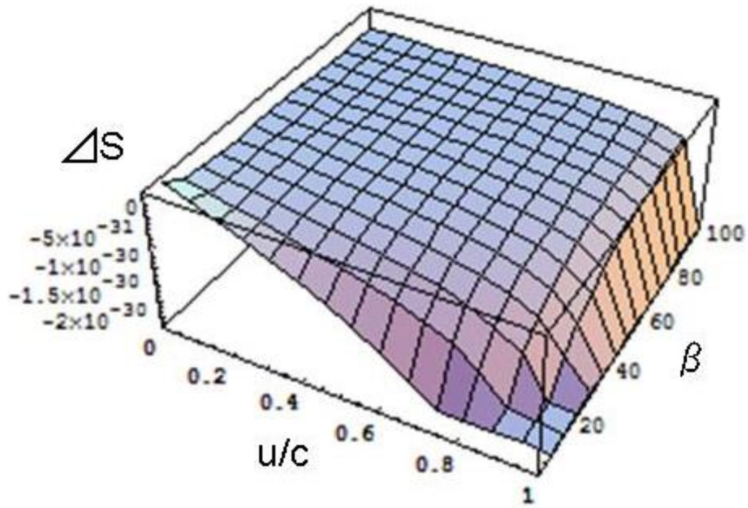

Fig. 4. Increase rate of entropy for the superluminal particle.

From this figure, it is seen that negative entropy is appeared for the superluminal particle. For the point $\beta = 100$, the increase rate of entropy can be shown as

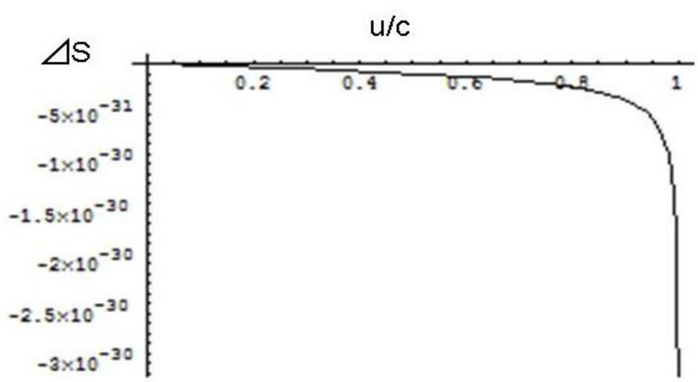

Fig. 5. Increase rate of entropy for the superluminal particle at $\beta = 100$.

From these figures, it is seen that entropy becomes negative value for the observer when we use superluminal particles for computation.

4. Possibility of Hypercomputating Process in the Living System

S.R. Hameroff suggested in his paper that a centriole cylinder composed of microtubules functions as a waveguide for evanescent photons, which can allow quantum signal processing [12]. Georgiev also proposed the idea that consciousness can be the result of quantum computation via applied laser-like pulses in quantum gates within the brain cortex [13], [14]. Musha and Caligiuri have shown that super-radiant emissions could be used to signal qubits in a fashion similar to standing wave lasers in an ion trap computation by using evanescent photons and metamaterial [15].

Specifically, the characteristic of a negative refractive index, in which the generation of evanescent photons is enhanced, and they can propagate lossless inside the neurons, according to these properties of the metamaterial [16], [17].

From analysis of the amplification of evanescent waves through a rectangular waveguide filled with a metamaterial, of cross section size "a", J.D.Baena et al.[18] has shown that the propagation of electromagnetic waves along this wave guide is only possible if $\omega < \omega_c$, where $\omega_c = (\pi / a) / \sqrt{\varepsilon\mu}$.

From this equation, the wavelength for the case where electromagnetic waves propagate through the waveguide becomes

$$\lambda > 2a . \qquad (20)$$

As the average size of microtubules is about $1\mu m$, we can see Eq. (20) is satisfied for photons of super radiant emission. Each microtuble is a hollow cylindrical tube of tublin proteins as shown in Fig. 6, which outer core diameter is 25 nm. Microtubules are comprised of subunits of the protein, named tubulin [12]. Proteins contain hydrophobic (water repellent) pockets and these pockets contain atoms with electrons called π electrons. Microtubules are one of the cytoskeletal filament systems in eukaryotic cells. The microtubule cytoskeleton is involved in the transport of material within cells, carried out by motor proteins that move on the surface of the microtubule.

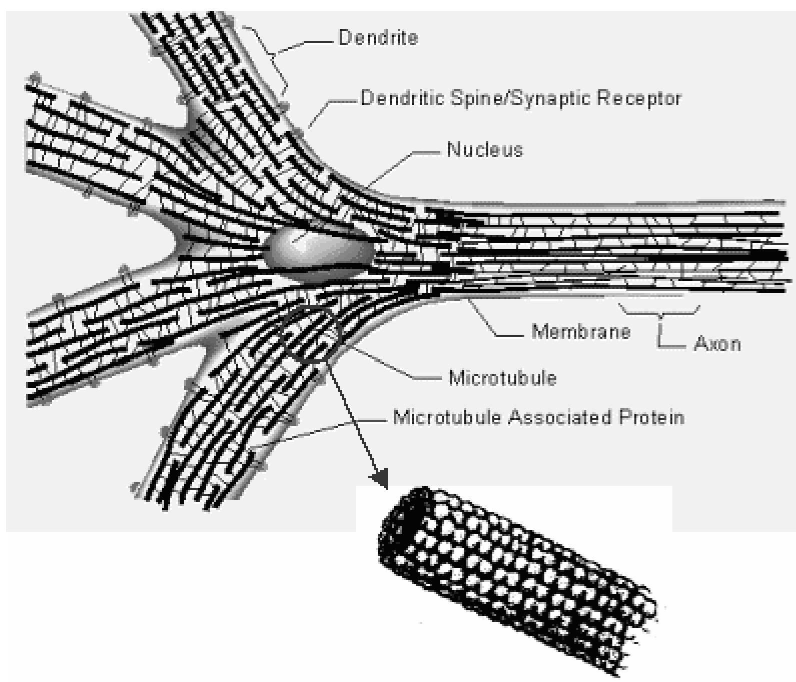

Fig. 6. Microtuble inside the cytoskeletal filament systems in eukaryotic cells.

Microtubules are very important in a number of cellular processes. They are involved in maintaining the structure of the cell and, together with microfilaments and intermediate filaments, they form the cytoskeleton. They also make up the internal structure of cilia and flagella. They provide platforms for intracellular transport and are involved in a variety of cellular processes, including the movement of secretory vesicles, organelles, and intracellular macromolecular assemblies.

If the microtubules are composed of a metamaterial, the super-radiant emission can be used similar to the use of standing wave lasers in ion trap computation and they can be applied for the manipulation of water qubits inside the microtubule.

According to their hypothesis of quantum brain, microtuble quantum states link to those of other neurons by quantum coherent photon tunneling through membranes in biological systems, functioning in a way that resemble to an ion trap computer.

Therefore, it seems highly plausible that macroscopic quantum ordered dynamic systems of evanescent photons in the brain could play an essential role for quantum computations by superluminal particles to exist in the brain. From this result, it is seen that negative entropy will appear inside the brain when it functions as shown in the preceding calculations.

By using metamaterial circuit, we can construct a hypercomputing system like a brain in a physical world [19].

5. Result and Discussion

From the theoretical analysis, it can be seen that superluminal particles permit the construction of a real accelerated Turing machine. If we apply this result for microtubles, it is considered that superluminal particles are related with the activity of the living system such as a brain.

Schrödinger considered negative entropy, contrary to the general tendency dictated by the second law of thermodynamics, which states that the entropy of an isolated system tends to increase or keeps constant its value and never decrease. The problem of organization in living systems decreasing its entropy despite the second law is known as the Schrödinger paradox. Schrödinger asked the question: "How does the living organism avoid decay?" Organisms inherit the ability to create unique and complex biological structures; it is unlikely for those capabilities to be reinvented or to be taught to each generation.

But, from the theoretical analysis, negative entropy will appear inside the living systems if the activity of them is relate to superluminal evanescent photons. If this assumption is true, the activity of living systems has negative entropy as claimed by E. Schrödinger.

6. Conclusion

The author has shown that the hypercomputer can be realized by using evanescent photons which propagates inside the tube consisted of metamaterial and also considered on the negative entropy and it is seen that the negentropy can be observed in the computational steps by using superluminal particles. If the microtuble structure inside the living systems can operate as a quantum computer by using superluminal evanescent photons, the living system such a human brain can perform hypercomputation which generates negative entropy as claimed by Schrödinger in his book.

REFERENCES

1. Schrödinger E. What is life – the physical aspect of the living cell, Cambridge University Press, 1944.
2. Brillouin L. Negentropy principle of information. J Applied Phy. 1953;24(9):1152–1163.
3. Copeland BJ, Proudfoot D. Alan Turing's forgotten ideas in computer science. Scientific American, April 1999; pp.99-103.
4. Musha T. Possibility to realize an accelerated Turing machine. Comput Rev J. 2019;3:203-217.
5. Feynman RP. Feynman Lectures on Computation, Penguin Books, London, 1999.
6. Recami E. A bird's-eye view of the experimental status-of-the-art for superluminal motions. Found Phys. 2011;32:1119-1135.
7. Brown J. Faster than the speed of light. New Scientist. 1995;146:26-30.
8. Steinberg AM. Kwait PG, and Chiao RY. Measurement of the single-photon tunneling time. Phys Rev Lett. 1993;1(5):708-711.
9. Wang LJ. Kuzmich A, and Dogariu A. Gain-assisted superluminal light propagation. Nature. 2000;406:277-279.
10. Musha T. Possibility of hypercomputation by using superluminal elementary particles. Adv Comput Sci Eng. 2012;8(1):57-67, also in; Possibility of hypercomputation from the standpoint of superluminal particles Theory Applications Mathematics Compu Sci. 2013;3(2):120-128.
11. Park M and Park Y. On the foundation of the relativistic dynamics with the tachyon. Nuovo Cimento. 1996;111B (N.11):1333-1368.
12. Hameroff SR. Information processing in microtubules. J Theor Biol. 1982;98:549-561.
13. Georgiev DD. Bose-Einstein condensation of tunneling photons in the brain cortex as a mechanism of conscious action, 2004. [Online]. Available: http://cogprint/3539/01/tunneling.pdf
14. Georgiev DD. Quantum computation in the neuronal microtubules: quantum gates, ordered water and superradiance, 2004. [Online]. Available: arxiv.org/abs/quant-ph/0211080
15. Musha T, Caligiuri LM. Possible existence of superluminal photons inside microtubles and resulting explanation for brain mechanism. Amer J Oprics Photonics. 2015;3(5):54-57.
16. Caliguiri LM. Musha T. Quantum vacuum dynamics, coherence, superluminal photons and hypercomputation in brain microtubles. Proc of the 1th Int Conf Theor Applied Phys. 2014, 105-115p.
17. Caligiuri LM, Musha T. Superradiant coherent photons and hypercomputation in brain microtubles considered as metamaterials. Int J Circuits Syst Signal Process. 2015;9:192-204.
18. Baena JD, Jelinek L, Marques R, et al. Near-perfect tunneling and amplification of evanescent electromagnetic waves in a waveguide filled by a metamaterial: Theory and experiments. Phys Rev. 2005;72(7):075116.
19. Musha T. Superluminal particles and hypercomputation, Lambert Academic Publishing, Germany, 2013.

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