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Physical problems solving

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September 22, 2025

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About me...

In Brief:

- ▶ Cameroonian by birth
- ▶ Currently Professor and Head of Department of Physics at the University of Buea
- ▶ MSc in Mathematical Physics from the University of Yaoundé in Cameroon (1989)
- ▶ Doctorate in Mathematical Physics (Nonlinear Physics) from the University of Yaoundé in Cameroon (1993)
- ▶ PhD in Computational Condensed Matter Physics from the University of Sherbrooke in Canada (2004)

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About me...

Links with AIMS:

- ▶ AIMS-Cameroon: teaching (Fundamental concepts of Quantum Mechanics, and Physical Problems solving), and supervisions (> 40 students supervised) since 2013
- ▶ AIMS-Rwanda: taught "Physical Problems solving" in 2016 (first batch)
- ▶ AIMS-Ghana (supervisions)

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First batch of AIMS-Rwanda (Photo from October 2016)...



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Mentees at AIMS-Rwanda (2017)...

- 1 Charge transport in polymer based photovoltaic cells: The
- 2 non-equilibrium thermodynamics of photovoltaic effect

3 By

Thierry Uwanyirigira (thierry.uwanyirigira@aims.ac.rw)
Supervised by Prof. Dikande Alain Moïse (dikande.alain@ubuea.cm)
University of Buea (Cameroon).

4 June 2017

5 AN ESSAY PRESENTED TO AIMS RWANDA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF
6 MASTER OF SCIENCE IN MATHEMATICAL SCIENCES



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Mentees at AIMS-Rwanda (2017)...

Femtosecond laser inscription on optical devices: mathematical model and Benjamin-Feir instability of the continuous-wave laser

By 4

KAMENI NTEUTSE PEGUY (peguy.kameni@aims.ac.rw)

June 2017

6 AN ESSAY PRESENTED TO AIMS RWANDA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF
7 MASTER OF SCIENCE IN MATHEMATICAL SCIENCES



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Latest course at AIMS-Cameroon...



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Emma's essay (AIMS Ghana)...

JOURNAL OF MODERN OPTICS
2021, VOL. 68, NO. 21, 1211–1220
<https://doi.org/10.1080/09500340.2021.1983659>



[Check for updates](#)

Femtosecond laser inscriptions in Kerr nonlinear transparent media: dynamics in the presence of K-photon absorptions, radiative recombinations and electron diffusions

Emmanuel O. Akeweje^a, G. Bader^b, Alain M. Dikandé and P. Kameni Nteutse^d

^aAfrican Institute for Mathematical Sciences (AIMS-Ghana), East Legon Hills, Accra, Ghana; ^bInstitute of Mathematics, Brandenburg Technical University, Cottbus-Senftenberg, Germany; ^cDepartment of Physics, Faculty of Science, University of Buea, Laboratory of Research on Advanced Materials and Nonlinear Science (LaRAMaNS), Buea, Cameroon; ^dAfrican Institute for Mathematical Sciences (AIMS-Cameroun), Limbe, Cameroon

ABSTRACT

Femtosecond lasers interacting with Kerr nonlinear optical materials, propagate in form of filaments due to the balance of beam diffraction by self-focusing induced by the Kerr nonlinearity. Femtosecond laser filamentation is a universal phenomenon that belongs to a general class of processes proper to ultrashort lasers processing systems, associated with the competition between nonlinearity and dispersion also known to promote optical solitons. The present work considers a model describing femtosecond laser inscriptions in a transparent medium with Kerr nonlinearity. Upon inscription, the laser stores energy in the optical material which induces an electron plasma. The model consists of a cubic complex Ginzburg-Landau equation, in which an additional K -order nonlinear polarization of K -photon absorptions is considered. The nonlinear polarization-decay equation is coupled to a time first-order nonlinear ordinary differential equation, accounting for time evolution of the plasma density. The main objective of the study is to examine effects of the competition between multi-photon absorptions, radiative recombination and electron diffusion processes, on temporal profiles of the laser amplitude as well as of the plasma density. From numerical simulations, it is found that when the photon number (i.e. K) contributing to multiphoton ionization is large enough, taking the electron diffusion processes into account favours periodic structures in temporal profiles both of the laser and the plasma density. The notice repetition rate in the optical edition train.

ARTICLE HISTORY

Received 4 May 2021
Accepted 16 September 2021

KEYWORDS

Femtosecond laser inscription; Kerr nonlinear materials; complex Ginzburg-Landau equation; optical solitons; electron hole; radiative recombinations; multiphoton absorptions



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Hormisdas's submitted manuscript (AIMS Ghana)...

CIMP-5-25-00381.pdf
3
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5
6 Leapfrogging of a deterministic model for
7 microeconomic systems in competitive markets
8
9
10 Alain M. Dikandé^{1*} and H. Ntahombagana Matabaro^{2†}
11
12 ¹Laboratory of Research on Advanced Materials and Nonlinear
13 Science, Department of Physics, Faculty of Science, University of Buea,
14 PO Box 63, Buea, Cameroon.
15
16 ²African Institute for Mathematical Sciences (AIMS), Summerhill
17 Estates, East Legon Hills, Santeet, Accra, Ghana.
18
19
20 *Corresponding author(s). E-mail(s): dikande.alain@ubuea.cm;
21 Contributing authors: hormisdas@aims.edu.gh;
22 †This author contributed equally to this work.
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Abstract
The Behrens-Esichtinger model provides a deterministic picture for the co-evolution of sales of two firms, producing the same goods and competing in a common market. The model involves an active investment strategy such that the temporary investment of each of the two firms depends on its relative position in the market. In this work we are interested in a specific regime of evolution referred to as leapfrogging regime, in which each firm has the possibility to dominate the market alternately during some finite period of time. We examine conditions



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Kadidja's essay AIMS-Cameroon (2025)...



**Complex Dynamics of a Driven Dissipative Oscillator with a
Double-Well Substrate of Deformable Shape**

Kadija LIBEME KOUOTOU (kadija.kouotou@aims-cameroon.org)
African Institute for Mathematical Sciences (AIMS)
Cameroon

Supervised by: Alain M. DIKANDE
University of Buea, Cameroon

28 May 2025
Submitted in Partial Fulfilment of a Structured Master's Degree at AIMS-Cameroon



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What I do...

I am farmer by default...



☰ ⌂ ⌂ ⌂

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What I do...

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What I do...

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What I do...

and Physicist by accident!!!

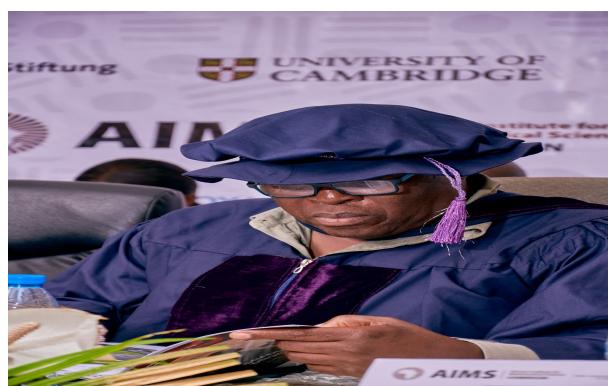


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What I do...

and Physicist by accident!!!



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My pride...

Accompanying young Africans in achieving their dreams!!!



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Personal achievement...

The Dikandé-Kofané double-well (DKDW) hierarchy!!!

The screenshot shows the presentation information for a session at the 84th JSAP Autumn Meeting 2023. The session is titled "Noise-robust logic gate based on double-well Dikandé-Kofané potential". The presentation was given by DZhiqiang Liao¹, Keying Huang¹, Siyi Tang¹, Hiroyasu Yamahara¹, Munetoshi Seki¹, Hitoshi Tabata¹ (1.Utn. of Tokyo). The presentation took place on Wednesday, September 20, 2023, from 9:00 AM to 12:30 PM JST in C401 (Int'l Ctr.). The abstract discusses a noise-robust logic gate based on a double-well potential, which is a Dikandé-Kofané potential. The presentation is categorized under "Novel technologies and interdisciplinary engineering". The page also includes a sidebar with general information, schedule, program, and timetable.

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Personal achievement...

The Dikandé-Kofané double-well (DKDW) hierarchy!!!

20a-C401-4

第84回応用物理学会秋季学術講演会 講演予稿集 (2023 熊本城ホールほか3会場)

Noise-robust logic gate based on double-well Dikandé–Kofané potential

University of Tokyo, School of Engineering, Zhiqiang Liao¹, Keying Huang¹, Siyi Tang¹, Hiroyasu

Yamahara¹, Munetoshi Seki¹, Hitoshi Tabata¹

E-mail: liao@bioxide.t.u-tokyo.ac.jp

Logic gates serve as fundamental building blocks in digital circuits, enabling logical operations such as AND, OR, and NOT. These gates are essential for performing computations, making decisions, and executing algorithms. However, real-world logic gates often encounter noise and uncertainties that can impact their performance. To ensure accurate information processing and minimize errors, designing noise robust logic gates is important. Moreover, the majority of previous logic gates were electronic. With the advancement of neuromorphic devices, the development of logic gates based on other physical media holds significant value.

To address the above challenges, we propose a noise-robust logic gate based on the Dikandé–Kofané (DK) potential. This potential is characterized by a double-well shape, which provides a natural way to handle noise and uncertainty. By leveraging the unique properties of the DK potential, we can design logic gates that are more robust to noise than traditional electronic logic gates. Specifically, we focus on the AND gate, which is a fundamental building block in digital circuits. We compare the performance of the proposed DK-based AND gate (DKLG) with a quadstable logic gate (QLG) using a bionic optimizer. The results show that DKLG exhibits superior noise robustness compared to QLG. Notably, in the presence of Gaussian white noise, the noise margin for robust logical operations in DKLG is comparable to that of QLG. Additionally, when discontinuous noise pulses are combined with thermal noise, DKLG demonstrates superior robustness compared to QLG, as shown in Figure 2.

(a) AND





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Personal achievement...

The Dikandé-Kofané double-well (DKDW) hierarchy!!!

Eur. Phys. J. B (2022) 95:8
<https://doi.org/10.1140/epjb/s10051-021-00266-w>

THE EUROPEAN
PHYSICAL JOURNAL B



Regular Article - Statistical and Nonlinear Physics

Quantum-tunneling transitions and exact statistical mechanics of bistable systems with parametrized Dikandé–Kofané double-well potentials

F. Naha Nzoupe^{1,a}, Alain M. Dikandé^{1,2,b}, and S. E. Mkam Tchouobiap^{1,c}

¹ Laboratory of Research on Advanced Materials and Nonlinear Science (LaRAMaNS), Department of Physics,

Faculty of Science, University of Buea, PO Box 63, Buea, Cameroon

² Present Address: Max-Planck Institute for the Physics of Complex Systems, Nöthnitzer Strasse 38, 01187 Dresden, Germany

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Personal achievement...

The Dikandé-Kofané double-well (DKDW) hierarchy!!!



Chaos, Solitons & Fractals
Volume 169, April 2023, 113250



Weak signal detection based on variable-situation-potential with time-delay feedback and colored noise

Guojiang Yang¹, Hao Ai¹, Wei Liu, Qiubao Wang^{2,✉}

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<https://doi.org/10.1016/j.chaos.2023.113250> ↗

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Highlights

- A chaotic signal detection method based on variable situation potential well is proposed.
- Chaotic detection of weak signals under colored noise has been discussed.
- Both colored noise and time-delay feedback have certain effects on chaotic threshold.



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HOW DO YOU UNDERSTAND THE FOLLOWING STATEMENTS:

- ▶ Imagination is more important than knowledge
- ▶ Scientific thought is a common heritage of mankind
- ▶ The creation of Physics is a common heritage of all mankind.
East and West, North and South have equally participated in it

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WHAT IS PHYSICS?

Physics is the branch of science concerned with the structure and evolution of matter, as well as the connection of matter with energy. Physics uses mathematical laws and principles for this purpose.

- ▶ Structure of matter: refers to how constituents of matter, i.e. atoms and/or molecules, are arranged and how they interact within matter.
- ▶ Evolution of matter: refers to how the state of matter changes with time and/or in space.

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Matter and Energy...

- ▶ Matter is anything that has mass (weight) and occupies space (i.e. volume). This encompasses all objects in nature including solids, liquids and gases.
- ▶ Energy is the physical quantity that expresses the ability to do work.

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Some unsolved problems in Physics

It is believed that less than one percent of nature is understood to an acceptable level.

Here are some physical problems that are unsolved:

- ▶ Can we expect a theory of all and nothing, also referred to as "theory of everything"? (general Physics).
- ▶ Could we assume that all universal constants have already been identified? (general Physics)

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Some unsolved problems in Physics

- ▶ Will it be possible to build quantum computers capable of operating in Africa, given the continent's specific temperature conditions? (quantum computing)
- ▶ Is there a universal limit to the capacity of a quantum channel? (quantum computing)
- ▶ How does the quantum description of reality, which involves principles like the superposition of states, wavefunction collapse or quantum decoherence, gives rise to the reality we perceive? (quantum mechanics)

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Some unsolved problems in Physics

- ▶ What constitutes a "measurement" which apparently causes the wave function to collapse into a definite state?
- ▶ Unlike classical physical processes, some quantum mechanical processes (such as quantum teleportation arising from quantum entanglement) cannot be simultaneously "local" and "causal", making it difficult to perceive their reality. However it is not obvious which of these properties must be sacrificed for a proper understanding of quantum mechanics.

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Some unsolved problems in Physics

- ▶ Do quantum mechanical phenomena, such as entanglement and superposition, play an important part in the brain's function and can they explain critical aspects of consciousness? (quantum neuroscience)
- ▶ Under what circumstances are non-local phenomena observed? (quantum mechanics)
- ▶ What does the existence or absence of non-local phenomena imply about the fundamental structure of space-time? How does this elucidate the proper interpretation of the fundamental nature of quantum physics? (quantum mechanics)

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Some unsolved problems in Physics

- ▶ Can algorithms be written to predict the 3D structure of a protein from its sequence? (biophysics)
- ▶ What are the basic building blocks of immune system networks? (biophysics)
- ▶ How do animals (e.g. migratory birds) sense the Earth's magnetic field? (biophysics)