

# Fundamental experiment and numerical simulation of pre-ionized inert gas plasma MHD electrical power generation

Ork Kinsor | Yoshinobu Kodera | Yoshihiro Okuno

School of Engineering, Tokyo Institute of Technology, Midori-ku, Japan

## Correspondence

Yoshihiro Okuno, School of Engineering, Tokyo Institute of Technology, 4259, Nagatsuta-cho, Midori-ku, Yokohama 226-8502, Japan.  
Email: okuno.y.sae@er.titech.ac.jp

Translated from Volume 143 Number 8, pages 523–529.

DOI: 10.1541/eqe.2023.143.523 of IEES Transactions on Power and Energy (Denki Gakkaishi Ronbunshu B)

## Abstract

The experiments of pre-ionized inert gas plasma MHD electrical power generation are conducted, and the performance and plasma behavior in the experimental generator are examined through time-dependent  $r$ -two-dimensional numerical simulation. In the experiment, an enthalpy extraction ratio of 4.01% has been obtained with a disk-shaped MHD generator with radio-frequency pre-ionization. In the numerical simulation, at an assumed inlet electron temperature around 5600 K (inlet ionization degree  $0.10 \times 10^{-4}$ ), 6600 K ( $1.36 \times 10^{-4}$ ), the plasma structure is similar to the non-uniform structure observed in the experiment. An enthalpy extraction ratio around 2.5% matches well with that in the experiment. At a suitable inlet electron temperature of 7000 K ( $3.15 \times 10^{-4}$ ), 8000 K ( $1.79 \times 10^{-3}$ ), although non-uniform plasma structure still occurs, a high enthalpy extraction ratio over 10% is expected.

## KEYWORDS

inert gas plasma, MHD electrical power generation, power generation experiment, pre-ionization,  $r$ -two-dimensional numerical simulation

## 1 | INTRODUCTION

With MHD (Magneto-Hydro-Dynamics) power generation, magnetic field is applied to an electrically conductive fluid flowing through a channel; due to the electromotive force produced according to Faraday's law of induction, thermal energy of the fluid is converted directly to electric energy. Since such generators have no turbines or other moving structures, thermal constraints are relaxed to allow using working gases at higher temperatures (2200–2400 K); thus, one can expect electric power generation with an efficiency higher than that of conventional thermal power plants.<sup>1</sup> This study deals with closed-cycle MHD generation systems using inert gases; it was shown that in such systems, the MHD generator itself must have enthalpy extraction (ratio of generated output to thermal input) of about 30% and isentropic efficiency of about 80% in order

to achieve an overall efficiency (higher heating value) of 60%.<sup>2</sup>

Most previous studies dealt with seeded plasma generators, in which seed materials (alkali metals) were added to working gases (inert gases) to obtain high electrical conductivity through seed ionization. The high output of those generators was already confirmed via generation experiments using a shock tube<sup>3</sup>; besides, numerical analysis was conducted to propose shapes and operating conditions for high-efficiency commercial-scale generators.<sup>4</sup> On the other hand, such systems may become complex because it is difficult to add seed materials uniformly in time and space; moreover, they need to be collected and reused.

In contrast, a seed-free pre-ionized inert gas plasma system was recently proposed.<sup>5</sup> Particularly, current inside the MHD generator flows due to induced electromotive force to promote ionization; in this paper, we use the term

# A Fundamental Experiment

**RM Cervero**



## **A Fundamental Experiment:**

## Decoding **A Fundamental Experiment**: Revealing the Captivating Potential of Verbal Expression

In a time characterized by interconnectedness and an insatiable thirst for knowledge, the captivating potential of verbal expression has emerged as a formidable force. Its ability to evoke sentiments, stimulate introspection, and incite profound transformations is genuinely awe-inspiring. Within the pages of "**A Fundamental Experiment**," a mesmerizing literary creation penned with a celebrated wordsmith, readers attempt an enlightening odyssey, unraveling the intricate significance of language and its enduring effect on our lives. In this appraisal, we shall explore the book's central themes, evaluate its distinctive writing style, and gauge its pervasive influence on the hearts and minds of its readership.

[https://kmsbrunchlive.gobrunch.com/files/virtual-library/Download\\_PDFS/Contemporary%20Studies%20In%20Romance%20Linguistics.pdf](https://kmsbrunchlive.gobrunch.com/files/virtual-library/Download_PDFS/Contemporary%20Studies%20In%20Romance%20Linguistics.pdf)

### **Table of Contents A Fundamental Experiment**

1. Understanding the eBook A Fundamental Experiment
  - The Rise of Digital Reading A Fundamental Experiment
  - Advantages of eBooks Over Traditional Books
2. Identifying A Fundamental Experiment
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an A Fundamental Experiment
  - User-Friendly Interface
4. Exploring eBook Recommendations from A Fundamental Experiment
  - Personalized Recommendations
  - A Fundamental Experiment User Reviews and Ratings

- A Fundamental Experiment and Bestseller Lists
- 5. Accessing A Fundamental Experiment Free and Paid eBooks
  - A Fundamental Experiment Public Domain eBooks
  - A Fundamental Experiment eBook Subscription Services
  - A Fundamental Experiment Budget-Friendly Options
- 6. Navigating A Fundamental Experiment eBook Formats
  - ePub, PDF, MOBI, and More
  - A Fundamental Experiment Compatibility with Devices
  - A Fundamental Experiment Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of A Fundamental Experiment
  - Highlighting and Note-Taking A Fundamental Experiment
  - Interactive Elements A Fundamental Experiment
- 8. Staying Engaged with A Fundamental Experiment
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers A Fundamental Experiment
- 9. Balancing eBooks and Physical Books A Fundamental Experiment
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection A Fundamental Experiment
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine A Fundamental Experiment
  - Setting Reading Goals A Fundamental Experiment
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of A Fundamental Experiment
  - Fact-Checking eBook Content of A Fundamental Experiment
  - Distinguishing Credible Sources

13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

### **A Fundamental Experiment Introduction**

In the digital age, access to information has become easier than ever before. The ability to download A Fundamental Experiment has revolutionized the way we consume written content. Whether you are a student looking for course material, an avid reader searching for your next favorite book, or a professional seeking research papers, the option to download A Fundamental Experiment has opened up a world of possibilities. Downloading A Fundamental Experiment provides numerous advantages over physical copies of books and documents. Firstly, it is incredibly convenient. Gone are the days of carrying around heavy textbooks or bulky folders filled with papers. With the click of a button, you can gain immediate access to valuable resources on any device. This convenience allows for efficient studying, researching, and reading on the go. Moreover, the cost-effective nature of downloading A Fundamental Experiment has democratized knowledge. Traditional books and academic journals can be expensive, making it difficult for individuals with limited financial resources to access information. By offering free PDF downloads, publishers and authors are enabling a wider audience to benefit from their work. This inclusivity promotes equal opportunities for learning and personal growth. There are numerous websites and platforms where individuals can download A Fundamental Experiment. These websites range from academic databases offering research papers and journals to online libraries with an expansive collection of books from various genres. Many authors and publishers also upload their work to specific websites, granting readers access to their content without any charge. These platforms not only provide access to existing literature but also serve as an excellent platform for undiscovered authors to share their work with the world. However, it is essential to be cautious while downloading A Fundamental Experiment. Some websites may offer pirated or illegally obtained copies of copyrighted material. Engaging in such activities not only violates copyright laws but also undermines the efforts of authors, publishers, and researchers. To ensure ethical downloading, it is advisable to utilize reputable websites that prioritize the legal distribution of content. When downloading A Fundamental Experiment, users should also consider the potential security risks associated with online platforms. Malicious actors may exploit vulnerabilities in unprotected websites to distribute malware or steal personal information. To protect themselves, individuals should ensure their devices have reliable antivirus software installed and

validate the legitimacy of the websites they are downloading from. In conclusion, the ability to download A Fundamental Experiment has transformed the way we access information. With the convenience, cost-effectiveness, and accessibility it offers, free PDF downloads have become a popular choice for students, researchers, and book lovers worldwide. However, it is crucial to engage in ethical downloading practices and prioritize personal security when utilizing online platforms. By doing so, individuals can make the most of the vast array of free PDF resources available and embark on a journey of continuous learning and intellectual growth.

### FAQs About A Fundamental Experiment Books

**What is a A Fundamental Experiment PDF?** A PDF (Portable Document Format) is a file format developed by Adobe that preserves the layout and formatting of a document, regardless of the software, hardware, or operating system used to view or print it. **How do I create a A Fundamental Experiment PDF?** There are several ways to create a PDF: Use software like Adobe Acrobat, Microsoft Word, or Google Docs, which often have built-in PDF creation tools. Print to PDF: Many applications and operating systems have a "Print to PDF" option that allows you to save a document as a PDF file instead of printing it on paper. Online converters: There are various online tools that can convert different file types to PDF. **How do I edit a A Fundamental Experiment PDF?** Editing a PDF can be done with software like Adobe Acrobat, which allows direct editing of text, images, and other elements within the PDF. Some free tools, like PDFescape or Smallpdf, also offer basic editing capabilities. **How do I convert a A Fundamental Experiment PDF to another file format?** There are multiple ways to convert a PDF to another format: Use online converters like Smallpdf, Zamzar, or Adobe Acrobats export feature to convert PDFs to formats like Word, Excel, JPEG, etc. Software like Adobe Acrobat, Microsoft Word, or other PDF editors may have options to export or save PDFs in different formats. **How do I password-protect a A Fundamental Experiment PDF?** Most PDF editing software allows you to add password protection. In Adobe Acrobat, for instance, you can go to "File" -> "Properties" -> "Security" to set a password to restrict access or editing capabilities. Are there any free alternatives to Adobe Acrobat for working with PDFs? Yes, there are many free alternatives for working with PDFs, such as: LibreOffice: Offers PDF editing features. PDFsam: Allows splitting, merging, and editing PDFs. Foxit Reader: Provides basic PDF viewing and editing capabilities. How do I compress a PDF file? You can use online tools like Smallpdf, ILovePDF, or desktop software like Adobe Acrobat to compress PDF files without significant quality loss. Compression reduces the file size, making it easier to share and download. Can I fill out forms in a PDF file? Yes, most PDF viewers/editors like Adobe Acrobat, Preview (on Mac), or various online tools allow you to fill out forms in PDF files by selecting text fields and entering information. Are there any restrictions when working with PDFs? Some PDFs might have restrictions set by their creator, such as password

protection, editing restrictions, or print restrictions. Breaking these restrictions might require specific software or tools, which may or may not be legal depending on the circumstances and local laws.

### **Find A Fundamental Experiment :**

#### **contemporary studies in romance linguistics**

contribution to the knowledge of the epi

contrario de uno el

#### **contemporary italy politics economy and society since 1945**

#### **contemporary cooking volume 1**

contribution of peoples participation evidence from 121 rural water supply projects

*contemporary discussion series sampler*

continent in turmoil

#### **contributions to kayak studies**

contemporary financial management

*contemporary diagnosis prevention and management of influenza*

#### **contract suretyship**

*eentest mania*

#### **contemporary mathematics in context a unified approach**

#### **contemporary literary criticism volume 82**

### **A Fundamental Experiment :**

Realidades Practice Workbook 3 - 1st Edition - Solutions ... Our resource for Realidades Practice Workbook 3 includes answers to chapter exercises, as well as detailed information to walk you through the process step by ... Realidades Guided Practice Activities For Vocabulary And ... Our resource for Realidades Guided Practice Activities For Vocabulary And Grammar Level 3 Student Edition includes answers to chapter exercises, as well as ... Practice Workbook Answers 3B-3. Answers will vary. Here are some probable answers. 1. Sí, el tomate es ... Realidades 1. Capítulo 6B Practice Workbook Answers el garaje, la cocina, la ... Realidades 2 capítulo 3a conversaciones answer key pdf ... Answers Practice Workbook: 3A-9 Answers REALIDADES para. Spanish Realidades Practice Workbook Level 1 1st Edition. 02. tatiana: Viene el invierno. 6a ... Get Realidades 3 Guided Practice Answers Complete Realidades 3 Guided Practice Answers online with US Legal

Forms. Easily fill out PDF blank, edit, and sign them. Save or instantly send your ready ... Realidades: Level 3 Practice Workbook... by Boyles, Peggy ... Realidades: Level 3 Practice Workbook with Writing, Audio & Video Activities (Spanish Edition). Spanish Edition. 4.3 4.3 out of 5 stars 28 ... ANSWER KEY - WORKBOOK 3. 2 Do you do a lot of sport, Kiko? Yes, I do. 3 Do the students in your class live near you? No, they don't. 4 Do you and Clara like Italian food? Realidades 3 Guided Practice Answers Jul 16, 2004 — Realidades 3 Guided Practice activities typically ask students to answer questions and complete exercises related to Spanish grammar, vocabulary ... Get Realidades 3 Guided Practice Answers Complete Realidades 3 Guided Practice Answers online with US Legal Forms. Easily fill out PDF blank, edit, and sign them. Save or instantly send your ready ... Humble Apologetics: Defending the Faith Today Stackhouse begins by acknowledging the real impediments to Christian testimony in North America today and to other faiths in modern societies around the world. Humble Apologetics - Paperback - John G. Stackhouse Stackhouse begins by acknowledging the real impediments to Christian testimony in North America today and to other faiths in modern societies around the world. Humble Apologetics: Defending the Faith Today Stackhouse begins by acknowledging the real impediments to Christian testimony in North America today and to other faiths in modern societies around the world. Humble Apologetics - John Stackhouse Humble Apologetics: Defending the Faith Today. Humble Apologetics. Humble Apologetics. Buy Now. Paperback, Ebook. Used in classrooms around the world, including ... Humble Apologetics: Defending the Faith Today Free Shipping - ISBN: 9780195138078 - Hardcover - Oxford University Press - 2002 - Condition: VERY GOOD - Light rubbing wear to cover, spine and page edges. Humble Apologetics: Defending the Faith Today Read 19 reviews from the world's largest community for readers. Is it still possible, in an age of religious and cultural pluralism, to engage in Christian... HUMBLE APOLOGETICS: Defending the Faith Today Classic Christian apologetics involved a defense ( apologia ) of the faith, often in the face of questions generated by non-Christians. Humble Apologetics - Hardcover - John G. Stackhouse Stackhouse begins by acknowledging the real impediments to Christian testimony in North America today and to other faiths in modern societies around the world. Humble Apologetics: Defending the Faith Today Stackhouse begins by acknowledging the real impediments to Christian testimony in North America today and to other faiths in modern societies around the world. Humble Apologetics: Defending the Faith Today (Hardcover) Nov 14, 2002 — Stackhouse begins by acknowledging the real impediments to Christian testimony in North America today and to other faiths in modern societies ... Introduction to Information Systems: 9780073376882 ISBN-10. 0073376884 · ISBN-13. 978-0073376882 · Edition. 16th · Publisher. McGraw Hill · Publication date. January 19, 2012 · Language. English · Dimensions. 7.4 x 1 ... Introduction to Information Systems - Loose Leaf Get the 16e of Introduction to Information Systems - Loose Leaf by George Marakas and James O'Brien Textbook, eBook, and other options. ISBN 9780073376882. Loose Leaf by Marakas, George Published by McGraw-Hill ... Introduction to Information Systems - Loose Leaf by Marakas, George Published by McGraw-Hill/Irwin 16th (sixteenth) edition (2012) Loose Leaf · Book overview.

Introduction to Information Systems ... Introduction to Information Systems Introduction to Information Systems (16th Edition). by James A. O'Brien, George Marakas Professor. Loose Leaf, 768 Pages ... Introduction to Information Systems 16th edition Introduction to Information Systems 16th Edition is written by Marakas, George; O'Brien, James and published by McGraw-Hill Higher Education. Introduction to Information Systems - Loose Leaf: 16th Edition Title, Introduction to Information Systems - Loose Leaf: 16th Edition. Authors, George Marakas, James O'Brien. Publisher, McGraw-Hill Higher Education, 2012. Introduction to Information Systems - Loose Leaf | Rent Rent Introduction to Information Systems - Loose Leaf 16th edition (978-0073376882) today, or search our site for other textbooks by George Marakas. ISBN 9780073376882 - Introduction to Information Systems Find 9780073376882 Introduction to Information Systems - Loose Leaf 16th Edition by George Marakas at over 30 bookstores. Buy, rent or sell. Introduction to Information Systems - HIGHER ED Introduction to Information Systems - Loose Leaf. 16th Edition. By George Marakas and James O'Brien. © 2013. | Published: January 19, 2012. Introduction to information systems Introduction to information systems ; Authors: George M. Marakas, James A. O'Brien (Author) ; Edition: 16th ed View all formats and editions ; Publisher: McGraw- ...