

George H. Miley · S. Krupakar Murali

Inertial Electrostatic Confinement (IEC) Fusion

Fundamentals and Applications



Springer

Inertial Electrostatic Confinement IEC Fusion Fundamentals And Applications

Christian G. Meyer



Inertial Electrostatic Confinement IEC Fusion Fundamentals And Applications:

Inertial Electrostatic Confinement (IEC) Fusion George H. Miley, S. Krupakar Murali, 2013-12-12 This book provides readers with an introductory understanding of Inertial Electrostatic Confinement IEC a type of fusion meant to retain plasma using an electrostatic field IEC provides a unique approach for plasma confinement as it offers a number of spin off applications such as a small neutron source for Neutron Activity Analysis NAA that all work towards creating fusion power The IEC has been identified in recent times as an ideal fusion power unit because of its ability to burn aneutronic fuels like p B11 as a result of its non Maxwellian plasma dominated by beam like ions This type of fusion also takes place in a simple mechanical structure small in size which also contributes to its viability as a source of power This book posits that the ability to study the physics of IEC in very small volume plasmas makes it possible to rapidly investigate a design to create a power producing device on a much larger scale Along with this hypothesis the book also includes a conceptual experiment proposed for demonstrating breakeven conditions for using p B11 in a hydrogen plasma simulation This book also Offers an in depth look from introductory basics to experimental simulation of Inertial Electrostatic Confinement an emerging method for generating fusion power Discusses how the Inertial Electrostatic Confinement method can be applied to other applications besides fusion through theoretical experiments in the text Details the study of the physics of Inertial Electrostatic Confinement in small volume plasmas and suggests that their rapid reproduction could lead to the creation of a large scale power producing device Perfect for researchers and students working with nuclear fusion Inertial Electrostatic Confinement IEC Fusion Fundamentals and Applications also offers the current experimental status of IEC research details supporting theories in the field and introduces other potential applications that stem from IEC

Inertial Electrostatic Confinement Thruster (IECT) Yung-An Chan, 2022-09-19 This work summarizes the state of the art development of inertial electrostatic confinement IEC thruster which can be divided into two parallel lines of development the IEC plasma source and the corresponding electromagnetic nozzle EMN Both developing lines start from the establishment of the theory and modeling and evolve to the design implementation and experimental verification The IEC discharge model highlights a novel perspective on the IEC discharge physics and the impacts of the respective critical parameters which layouts the design for the IEC plasma source Experimental verification for the theory is demonstrated via the optical emission spectroscopy and collision radiative model The results provide conclusive evidence of forming a spherical double layer within the IEC plasma source which is the key to establishing the proposed IEC discharge theory in this work This work presents a comprehensive study on the magnetohydrodynamic theory for assessing the plasma acceleration in the magnetic nozzle Nevertheless the result shows a performance limitation of the magnetic nozzle An innovative invention is proposed to overcome the limitation known as the EMN Thorough descriptions of EMN and its working principle are summarized in this work including its effects on plasma confinement acceleration and detachment Investigation of the plasma plume properties by miscellaneous plasma

diagnostics tools further demonstrates EMN functionality and constitutes the first IECT prototype with proof of concept in literature

Fusion's Promise Matthew Moynihan, Alfred B. Bortz, 2023-03-24 For over 60 years scientists and engineers have been trying to crack a seemingly intractable problem how to build practical devices that exploit nuclear fusion Access to electricity has facilitated a standard of living that was previously unimaginable but as the world's population grows and developing nations increasingly reap the benefits of electrification we face a serious global problem burning fossil fuels currently produces about eighty percent of the world's energy but it produces a greenhouse effect that traps outgoing infrared radiation and warms the planet risking dire environmental consequences unless we reduce our fossil fuel consumption to near zero in the coming decades Nuclear fusion the energy producing process in the sun and stars could provide the answer if it can be successfully harnessed here on Earth it will produce electricity with near zero CO2 byproduct by using the nuclei in water as its main fuel The principles behind fusion are understood but the technology is far from being fully realized and governments universities and venture capitalists are pumping vast amounts of money into many ideas some highly speculative that could lead to functioning fusion reactors This book puts all of these attempts together in one place providing clear explanations for readers who are interested in new energy technologies including those with no formal training in science or engineering For each of the many approaches to fusion the reader will learn who pioneered the approach how the concept works in plain English how experimental tests were engineered the future prospects and comparison with other approaches From long established fusion technologies to emerging and exotic methods the reader will learn all about the idea that could eventually constitute the single greatest engineering advance in human history

Faster Than Light H. David Froning, Jr., 2019-11-12 An amazing book on faster than light flight H David Froning a 30 year veteran engineer who worked on several designs for future space travel propulsion gives us this exceptional compilation of his discoveries struggles and experiences in the realm of faster than light space travel Central to the concept of faster than light travel is that the vacuum of space itself the spacetime metric can be utilized in propulsion systems Engineering the vacuum as this is called involves discovering how space can be altered to provide energy thrust for future spacecraft Packed with diagrams some of which show how as a starship accelerates away from Earth it disappears and reappears in only seconds But during these seconds of disappearance the ship in effect leaps high above space time and over stupendous distances to reach speeds that are billions of times greater than light speed Lots of great material on quantum vacuum power anti gravity propulsion effects the velocity of light in spacetime altered regions effective mass in spacetime altered regions warp drives and tons more

Future Spacecraft Propulsion Systems and Integration Paul A. Czysz, Claudio Bruno, Bernd Chudoba, 2017-08-30 The updated and expanded third edition of this book focuses on the multi disciplinary coupling between flight vehicle hardware alternatives and enabling propulsion systems It discusses how to match near term and far term aerospace vehicles to missions and provides a comprehensive overview of the subject directly contributing to the next

generation space infrastructure from space tourism to space exploration This holistic treatment defines a mission portfolio addressing near term to long term space transportation needs covering sub orbital orbital and escape flight profiles In this context a vehicle configuration classification is introduced covering alternatives starting from the dawn of space access A best practice parametric sizing approach is introduced to correctly design the flight vehicle for the mission This technique balances required mission with the available vehicle solution space and is an essential capability sought after by technology forecasters and strategic planners alike

Interstellar Travel Les Johnson, Kenneth Roy, 2024-05-23 Interstellar Travel Propulsion Life Support Communications and the Long Journey addresses the technical challenges that must be overcome to make such journeys possible Leading experts in the fields of space propulsion power communication navigation crew selection safety and health provide detailed information about state of the art technologies and approaches for each challenge along with possible methods based on real science and engineering This book offers in depth up to date and realistic technical and scientific considerations in the pursuit of interstellar travel and will be an essential reference for scientists engineers researchers and academics working on or interested in space development and space technologies With a renewed interest in space exploration and development evidenced by the rise of the commercial space sector and various governments now planning to send humans back to the moon and to Mars there is also growing interest in taking the next steps beyond the solar system and to the ultimate destination planets circling other stars With the rapid growth in the number of known exoplanets people are now asking how we might make journeys to visit them Discusses the technical challenges that must be overcome to mount interstellar missions Features various aspects of interstellar travel by the world's recognized leading experts in the field Provides referenceable data and analysis for both new and experienced researchers in the interstellar and deep space exploration fields

Space Technology and Applications International Forum - STAIF 2004 American Institute of Physics, 2004-02-18 Albuquerque New Mexico 8 11 February 2004

Fusion Technology, 1994

Government Reports Announcements & Index, 1993 **International Aerospace Abstracts**, 1993 **Issues for Development of Inertial Electrostatic Confinement (IEC) for Future Fusion Propulsion** G. H. Miley, 1999 **Two Dimensional Modeling of a Radially Convergent Cylindrical Inertial Electrostatic Confinement (IEC) Fusion Device** Roberts Andrew Stubbers, 2002 **Inertial Electrostatic Confinement Fusion as an Undergraduate Teaching Laboratory** Douglas Tallmadge, 2018 **Inertial Electrostatic Confinement** Ryan Meyer, 2007

Inertial Electrostatic Confinement IEC is a means to confine ions for fusion purposes with electrostatic fields in a converging geometry Its engineering simplicity makes it appealing when compared to magnetic confinement devices It is hoped that such a device may one day be a net energy producer but it has near term applications as a neutron generator We study spherical IECs SIECs both theoretically and experimentally Theoretically we compute solutions in the free molecular limit and map out regions in control parameter space conducive to the formation of double potential wells In addition several other observables

are mapped in the control parameter space. Such studies predict the threshold for the phenomena of core splitting to occur when the fractional well depth FWD is 70%–80%. With respect to double potential wells, it is shown that an optimal population of electrons exists for double well formation. In addition, double well depth is relatively insensitive to space charge spreading of ion beams. Glow discharge devices are studied experimentally with double and single Langmuir probes. The postulated micro channeling phenomenon is verified with density measurements along a micro channel and along the radius where micro channels are absent. In addition, the measurements allow an evaluation of the neutrality of micro channels and the heterogeneous structure of Star Mode. It is shown that despite visual evidence, micro channeling persists well into Jet mode. In addition, the threshold for the Star mode to Jet mode transition is obtained experimentally. The studies have revealed new techniques for estimating tangential electric field components and studying the focusing of ion flow.

Confinement Limitations in Gridded Inertial Electrostatic Confinement Fusion Devices Thomas J. McGuire, 2003

Can Inertial Electrostatic Confinement Work Beyond the Ion-ion Collisional Time Scale?, 1995 Inertial electrostatic confinement systems are predicated on a non equilibrium ion distribution function. Coulomb collisions between ions cause this distribution to relax to a Maxwellian on the ion ion collisional time scale. The power required to prevent this relaxation and maintain the IEC configuration for times beyond the ion ion collisional time scale is shown to be at least an order of magnitude greater than the fusion power produced. It is concluded that IEC systems show little promise as a basis for the development of commercial electric power plants.

Development and Characterization of an Inertial Electrostatic Confinement Device for Space Propulsion Applications Constanze Syring, 2023

Virtual Cathode in a Spherical Inertial Electrostatic Confinement Device Hiromu Momota, George H. Miley, 2001

Multiple Potential Well Structure in Inertial Electrostatic Confinement Devices Ryan Meyer, 2004 Inertial Electrostatic Confinement (IEC) devices are of interest as neutron generators for many applications. An essential part of these devices is the formation of a multiple potential well structure within the devices. In this paper, previous analyses of the formation of these wells are reviewed and extended. Three types of IEC systems are classified and analyzed according to the arrangement of electrodes and the species within the system. These systems are the uni polar cathode anode UCA system, the bi polar cathode anode BCA system, and the bi polar anode cathode BAC system. Results of extensive parametric studies are reported through an efficient solution of the Poisson's equation. These results delineate the conditions most conducive for double potential well formation in different systems and may aid in the future design of IEC systems.

Atomic Processes in Inertial Electrostatic Confinement (IEC) Devices, 1993 Inertial Electrostatic Confinement (IEC) is one of the earliest plasma confinement concepts having first been suggested by P. T. Farnsworth in the 1950s. The concept involves a simple apparatus of concentric spherical electrostatic grids or a combination of grids and magnetic fields. An electrostatic structure is formed from the confluence of electron or ion beams. Gridded IEC systems have demonstrated neutron yields as high as 2×10^1 neutrons/sec. These systems have considerable potential as small

inexpensive portable neutron sources for assaying applications Neutron tomography is also a potential application Atomic physics effects strongly influence the performance of all of these systems Important atomic effects include elastic scattering ionization excitation and charge exchange This paper discusses how an IEC system is influenced by these effects and how to design around them Theoretical modeling and experimental results are presented

Reviewing **Inertial Electrostatic Confinement Iec Fusion Fundamentals And Applications**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is truly astonishing. Within the pages of "**Inertial Electrostatic Confinement Iec Fusion Fundamentals And Applications**," an enthralling opus penned by a very acclaimed wordsmith, readers attempt an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve into the book's central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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