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ELECTROMAGNETIC PARTICLE ACCELERATOR

Athania Abdul Rehman[1], Khan Mohammed[2], Manasia Aqib[3], Shaikh Mubashir[4], Ms. Divya Raut[5]

[1]Student of Mechanical Engineering Pravin Patil Polytechnic Bhayandar, India athaniaabdulrehman@gmail.com
[2]Student of Mechanical Engineering Pravin Patil Polytechnic Bhayandar, India me21mohammedkhan@gmail.com
[3]Student of Mechanical Engineering Pravi Patil Polytechnic Bhayandar, India me21aqibsajid@gma il.com
[4]Student of Mechanical Engineering Pravin Patil Polytechni, Bhayandar, India me21mubashirshaikh@gmail.com
[5]Faculty of Mechanical Engineering Pravin Patil Polytechnic Bhayandar, India prpdivyameb@gmail.com

ABSTRACT :

An apparatus known as a particle accelerator uses

electromagnetic fields to contain charged particles or ions in a well-defined beam and accelerate them to high speeds. In the field of high-energy physics, electromagnetic particle accelerators are essential instruments that facilitate the investigation of fundamental forces governing the universe and the study of subatomic particles. An overview of the concepts, elements, and uses of these accelerators is given in this abstract. It outlines the major advancements and technologies propelling the development of accelerators, emphasizing their use in particle physics research and therapeutic applications.

The abstract also discusses the prospects and difficulties that this field will face in the future, such as the need for more compact accelerator designs and higher energies. The electromagnetic accelerator can reach several hundred mph. Particles in the range of 10 to the minus 6th power were accelerated up to a few millimeters with the help of a driver. The tests exhibit excellent dependability and accuracy. This accelerator does not require a gaseous medium in order to transfer energy to the particle, allowing it to operate in high vacuum (i.e., without impurities). It is possible to automate both the driver and the particle transport; a computer simulation is presented..

Keywords- electromagnetic fields,electromagnetic particle,electromagnetic accelerator.

INTRODUCTION :

An apparatus known as a particle accelerator uses electromagnetic fields to contain charged particles or ions in a well-defined beam and accelerate them to high speeds. In the field of high-energy physics, electromagnetic particle accelerators are essential instruments that facilitate the investigation of fundamental forces governing the universe and the study of subatomic particles. An overview of the concepts, elements, and uses of these accelerators is given in this abstract. It outlines the major advancements and technologies propelling the development of accelerators, emphasizing their use in medical applications and particle physics research. The abstract also discusses the prospects and difficulties that this field will face in the future, such as the need for more compact accelerator designs and higher energies. Electromagnetic accelerators can reach hundreds of miles per hour. Particles in the range of 10 to the minus 6th power were accelerated up to a few millimeters with the help of a driver. The tests exhibit excellent dependability and accuracy. This accelerator does not require a gaseous medium in order to transfer energy to the particle, allowing it to operate in his, her, their, etc. high vacuum (i.e., without impurities). A computer simulation is presented, and it is possible to automate both the driver and the particle transport. The electromagnetic accelerator can reach several hundred mph. Particles in the range of 10 to the minus 6th power were accelerated up to a few millimeters with the help of a driver. The tests exhibit excellent dependability and accuracy

LITERATURE REVIEW :

The knowledge and discovery of electrical events, as well as the awareness that electrical charge is carried by individual particles in lumps, are closely linked to the construction and history of particle accelerators. It is said that the first person to observe electrostatic forces on amber was the Greek mathematician and philosopher Thales of Milet, who was born in 625 BC. The term "electron," which is Greek for "amber," is now used to refer to all electrical processes and associated fields of study. This observation was hardly more than a curiosity for over two millennia. However, electrostatic phenomena gained a lot of attention in scientific circles in the eighteenth century, and since then, they have been developed into a technology that today fully embraces and controls modern civilization. as it exists today. There have been several significant turning points in the research that have led to the discovery of elementary particles and to concepts for their acceleration. These turning points have occasionally established the course for future experimental and theoretical investigations. It is evidently fairly subjective to choose which discoveries have had the greatest impact. More than 150

years ago, significant historical discoveries that led to modern particle accelerator physics began to occur: 1815: W. Proust, a physician and scientist, first makes the anonymous hypothesis that all atoms are made of hydrogen atoms, and that all atomic weights are multiples of one hydrogen atom's weight. 1867: L. Lorenz develops the idea of delayed potentials, but not yet for moving point charges, while working concurrently with J.C. Maxwell on the theory of electromagnetic fields. 1871: According to C.F. Varley's theory, cathode rays are particle rays 1900: E. Wiechert finds an expression for moving point charges with retarded potentials. In 1901, W. Kaufmann measured the increase in electron mass with energy alone for the first time, and he and A.H. Bucherer did so again in 1907. The first experiment to validate the special relativity hypothesis. 1913: J. Franck and G. Hertz conduct the first experiment using accelerated electrons to stimulate atoms.The knowledge and discovery of electrical events, as well as the awareness that electrical charge is carried by individual particles in lumps, are closely linked to the construction and history of particle accelerators. It is said that the first person to observe electrostatic forces on amber was the Greek mathematician and philosopher Thales of Milet, who was born in 625 BC. The term "electron," which is Greek for "amber," is now used to refer to all electrical processes and associated fields of study. This observation was hardly more than a curiosity for over two millennia. However, electrostatic phenomena gained a lot of attention in scientific circles in the eighteenth century, and since then, they have been developed into a technology that today fully embraces and controls modern civilization. as it exists today. There have been several significant turning points in the research that have led to the discovery of elementary particles and to
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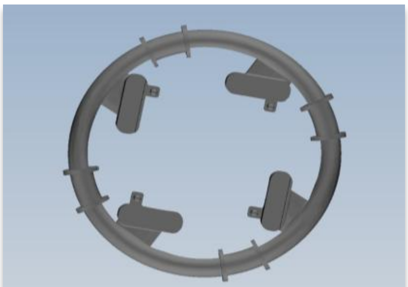
WORKING PRINCIPLE :

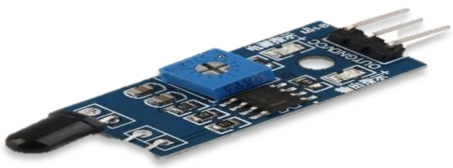
An electromagnetic particle accelerator operates on the basis of accelerating charged particles, like protons or electrons, to extremely high speeds using electric and magnetic fields. The acceleration takes place in a vacuum in order to reduce interference. After being injected into the accelerator, the particles are forced forward by alternating electric fields. In order to keep the particles from straying, magnetic fields are applied simultaneously to direct them along a predefined path. Particles can reach extraordinarily high energy by repeatedly going through this process, which allows scientists to examine fundamental particles and processes.

Components:



3D Printed Model

Varnished Copper wire of 0.90 mm



Ir Sensor

Relay

Connection Wire

Bread Board

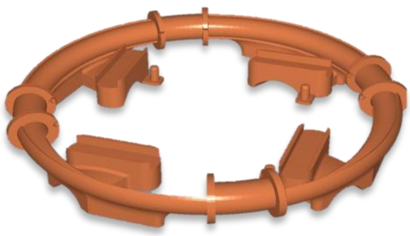
DESIGN

Electromagnetic Particle Accelerator track is design on Fusion 360 software, And was 3d Printed. The material was FDM which can sustain up to 80 degree Celsius. The 3D printing took 16 hours to print. The 3d model has a track, 4 Ir-Sensor slot & 4 Slots on which copper wire to be wind on it.

ANALYSIS

The electromagnetic accelerator can reach several hundred mph. Particles in the range of 10 to the minus 6th power were accelerated up to a few millimeters with the help of a driver. The tests exhibit excellent dependability and accuracy. This accelerator does not require a gaseous medium in order to transfer energy to the particle, allowing it to operate in high vacuum (i.e., without impurities). A computer simulation is presented, and it is possible to automate both the driver and the particle transport.In order to support continued advancement, there will also be new technological innovations and research contributions pertaining to particle accelerator technology.

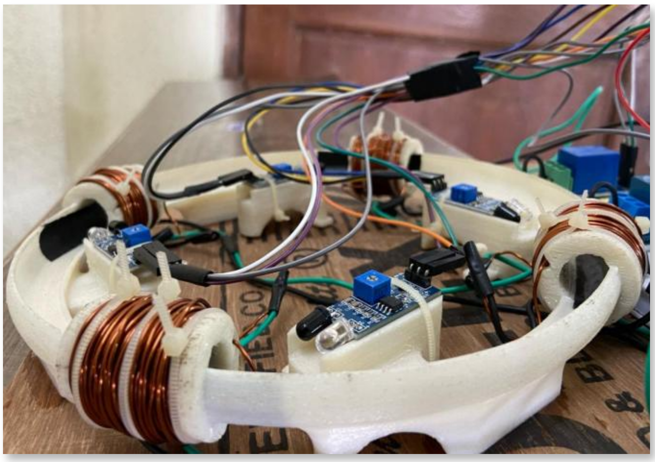
Developing a design with the intention of maximizing the accelerator acceleration force and Ring accelerators have the advantage of repeatedly using the same path, which can result in higher energies with a smaller footprint than linear accelerators. In order to optimize performance and dependability, we give careful consideration to a few key elements when designing the prototype electromagnetic particle accelerator ring. The electromagnet assembly, a critical component, is tuned to maximize magnetic field strength while reducing power consumption and heat generation by carefully selecting materials and coil winding configurations. More attention is focused on creating efficient heat dissipation systems, like fans or heat sinks, to maintain operational integrity.



RESULTS

The Particle Accelerator provide an adaptable and flexible solution for a range of technical uses. It is a cost effective and easy to use. Particle

Accelerator is a quick responsive which uses DC power source as power. Their usefulness in engineering systems where accurate and responsive Industries deliver adaptive, as well as their versatility and appropriateness for a variety of their customers. All things considered, Particle Accelerator are essential for improving system stability, comfort, and performance while providing an environmentally and economically friendly solution.
They can increase occupant safety and time effectives for industries and Transport agencies. It can also be used in space
Launching, which eliminate wastages gallons of fuels and promotes sustainability and energy conservation.



LIMITAIONS :

- Cost: Building and maintaining particle accelerators can be extremely expensive. The construction costs alone can run into billions of dollars, and operating expenses are also substantial. This limits the number of facilities that can be built and the scale of experiments that can be conducted.
- Size and Energy Limitations: Accelerators need to be large to achieve high energies. As particles are accelerated, they require longer and more powerful accelerator structures to gain speed. This necessitates the construction of massive facilities, such as the Large Hadron Collider (LHC).
- Energy Consumption: Particle accelerators consume enormous amounts of energy. Facilities like the LHC require the electrical power of a small city to operate. This high energy consumption not only adds to the operational costs but also raises environmental concerns regarding sustainability and carbon footprint.
- Particle Losses: Despite sophisticated designs, particle accelerators inevitably experience losses of particles due to scattering, collisions with residual gas molecules, and other factors. These losses can limit the efficiency and effectiveness of experiments, requiring compensatory measures or multiple runs to collect sufficient data.
- Safety Concerns: The high energies involved in particle accelerators pose safety risks. Accidental releases of energy or radiation can have severe consequences for both personnel and the surrounding environment. Therefore, strict safety protocols and containment measures are necessary, adding to operational complexity and costs.

FUTURE SCOPE :

Because it includes the following features that make it easier to use, this program has a wide range of applications to do the ongoing study required for safety precautions and cost effectiveness.
Possibility of novel scientific findings and medical interventions.Advanced computer tools are increasingly being employed with particle accelerators for data processing and simulations.
Improved electronic parts for increased manipulation Particle accelerator components are useful for environmental monitoring, including the analysis of contaminants and pollutants in the air and water.
Accelerators that accelerate particles can mimic the harsh circumstances present in astronomical phenomena like black holes and supernovae. deployment scenarios and use cases may lead to new developments in the field of MR damper technology.

CONCLUSION :

Particle accelerators are among the most amazing
developments in contemporary science and engineering,to sum up. Scientists have uncovered the mysteries of the universe and explored the underlying properties of matter and energy thanks to these enormous instruments. Particle accelerators continue to push the frontiers of human knowledge and invention, from solving the secrets of the subatomic universe to improving disciplines like health,
materials research, and energy generation. There is still a great deal of room for experimental and theoretical particle physics study, with ever-more effective accelerators being developed and new boundaries being explored. Particle accelerators are evidence of our species' unquenchable curiosity and

unwavering quest for cosmic comprehension.

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REFERENCES :

1. Joshi, C. 2007 The development of laser- and beam-driven plasma accelerators as an experimental field Phys. Plasmas 14, 055501. (doi:10.1063/1.2721965).
2. M. Swan, “Sensor mania! the internet of things, wearable computing, objective metrics, and the quantified self 2.0,” Journal of Sensor and Actuator Networks, vol. 1, no. 3, pp. 217–253, 2012.
3. Bingham, R. 2006 Basic concepts in plasma accelerators. Phil. Trans. R. Soc. A 364, 559–575.(doi:10.1098/rsta.2005.1722)
4. Bingham, R., Mendonc¸a, J. T. & Dawson, J. M. 1997 Photon Landau damping.Phys. Rev. Lett.78,247–249. (doi:10.1103/PhysRevLett.78.24
5. Blumenfeld, I. et al. 2007 Energy doubling of 42 GeV electrons in a metre-scale plasma Wake field accelerator. Nature 445, 741–744. (doi:10.1038/nature0553