JSS MAHAVIDYAPEETHA

JSS ACADEMY OF TECHNICAL EDUCATION NOIDA

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROJECT SYNOPSIS

GROUP NO: 39

STUDY OF TWO FREQUENCY PAUL TRAP

Name of the Group Leader: Shivansh Srivastav

Email ID: shivansh.nov9@gmail.com

Group Members:

ROLL NO	NAME	MOBILE NO	EMAIL ID
1709131140	Shivansh Srivastav	8318404975	shivansh.nov9@gmail.com
1709131142	Shivi Bisht	7827616967	shivibb.99@gmail.com
1709131141	Shivendra Singh	9267952837	shivendrasingh983842@gmail.com

Recommended/ Not-Recommended

(DEC)

1. OBJECTIVE:

To design an Ion Trapping System using two frequency Paul Trap which shows the movement of ion particles placed in alternating electric field in presence of LASER beam in dark/ black surrounding.

2. SCOPE OF THE PROJECT:

This ion trapping system can be used in Ion Spectroscopy and Mass Spectroscopy as the electric field oscillates between two configurations at a frequency of 60 Hz.
This setup can also be used to demonstrate the physics behind ion trapping, as well as serve as a potential oscillating system.

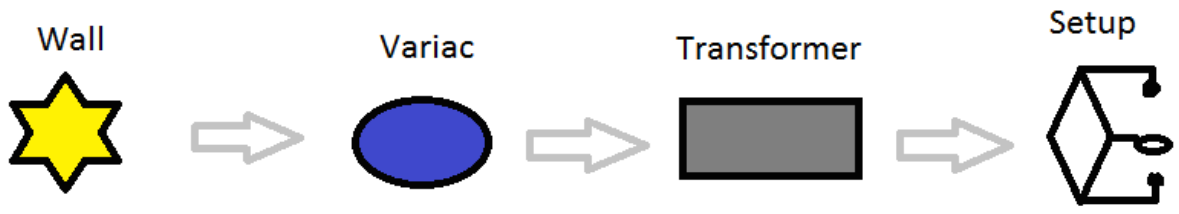
3. PROJECT BACKGROUND AND LITERATURE REVIEW:

Electrodes are strategically shaped and placed for desired electric field interactions. In this setup, the spherical brass balls are at the opposite potential of the ring electrode. The electric field then oscillates between two configurations at a frequency of 60 Hz, which is the frequency of the wall voltage. One of the configurations stretches the particles that are outside the centre of the ring in the vertical direction and provides a restoring force towards the centre in the horizontal direction, and the other configuration is the opposite, the particles are stretched horizontally, and there is a restoring force toward the centre in the vertical direction. The rapid oscillation of the electric field between the two configurations provides an average confining force in all directions, because the trap field oscillates faster than the particles can escape the trap. Once particles settle into a place, they essentially oscillate in a fixed position very quickly. The oscillating and stretching in the horizontal and vertical directions cause the shape of the dust that we observe.

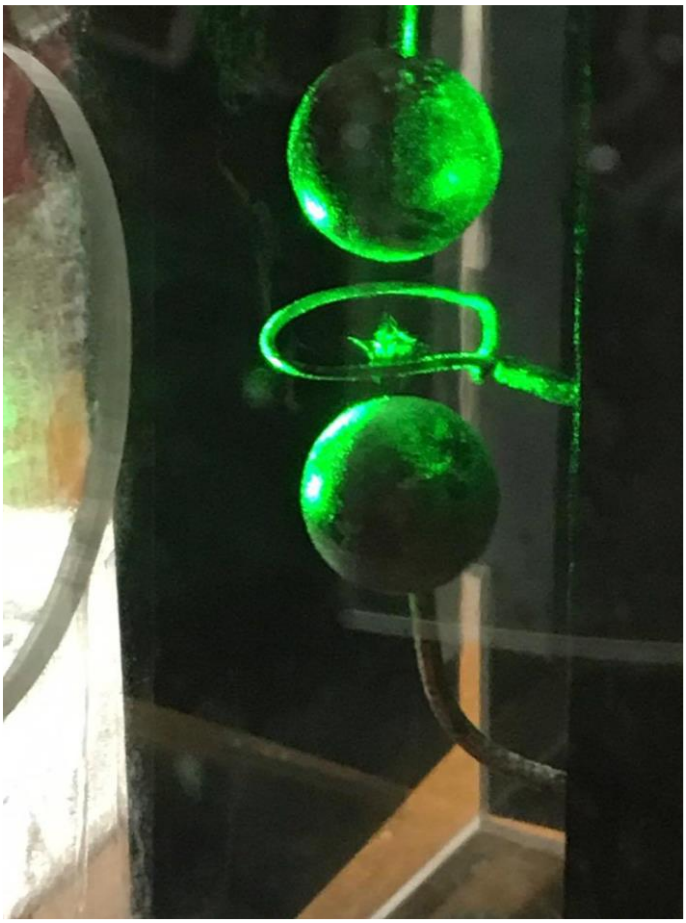
4. CHALLENGES:

- Bombardment of focused LASER beam on electrode.
- Placing of ion particle in between the ring when alternating electric field applied.
- Regulation of applied voltage through variac.

5. BLOCK DIAGRAM OF THE PROJECT:



Order of Setup



Ion Trap with trapped particles

6. COMMPONENTS REQUIRED:

- A source of high voltage. We used a standard wall output and a 15X step-up transformer to achieve a working voltage of 2 kV AC at 60 Hz. High-voltage transformers might be difficult to find, and is perhaps the most challenging part of the set up.
- Current limiting resistors for the purpose of safety.
- An acrylic box. Our box's dimensions are 6” * 6” * 8”.
- A Variac.
- Small particles to be trapped.
- A laser pointer to illuminate trapped particles. We used a 30mW laser.
- Copper wires.
- 2 metal spheres (1-2 cm diameter) to be used as electrodes.
- High speed camera.
- Black spray paint and black construction paper.
- Wooden stand to mount electrodes.

7. REPONSIBILITY OF EACH MEMBER:

Divide as per convenience and knowledge.

8. GRANT CHART:

Tasks	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Research	**X**	**X**						
Component Arrangement		**X**	**X**					
Placing of Components			**X**	**X**				
Testing				**X**	**X**			
Error Correction and Modification					**X**	**X**	**X**	
Completion						**X**	**X**	
Report Writing							**X**	**X**

9. REFERENCES / LIST OF ACCESSED RESOURCES:

- 1. Werth, G. Basics of Ion Traps. Johannes Gutenberg University.
- https://www.icts.res.in/media/uploads/Old Talks Lectures/Document/ 1265634974GWerth lecture notes.pdf
- 2. March, R.E. (1997) An Introduction to Quadrupole Ion Trap Mass Spectrometry. Journal of Mass Spectrometry 32, 351-369
- http://www.wiley.com/legacy/wileychi/ms/articles/351 a.pdf
- 3. Paul, W. (1990). Electromagnetic traps for charged and neutral particles. Rev. Mod. Phys. 62:3
- http://journals.aps.org.ezp-prod1.hul.harvard.edu/rmp/pdf/ 10.1103/RevModPhys.62.531
- Trapping and Cooling. Humboldt University of Berlin. https://www.physik.hu-berlin.de/de/nano/lehre/quantenoptik09/chapter13
- https://en.wikipedia.org/wiki/Quadrupole ion trap
- https://en.wikipedia.org/wiki/Ion trap