# Development of a setup to measure g factor of a nucleus using Transient Field Technique

M.Saxena[1],* S.Mandal[1], A.Mandal[2], J.Chacko[2]
[1]Department of Physics and Astrophysics, University of Delhi, Delhi - 110007, INDIA
[2]Inter University Accelerator Centre, Aruna Asaf Ali Marg, New Delhi - 110067, INDIA
. * email:mansi.aqua@gmail.com

## Introduction

Measurements of g factor or magnetic moments provide substantial information on the microscopic structure of the nuclei as the magnetic moment of a nuclei is described by the wave function of one state only. The g factor of neutron and proton are given by

$g(\nu) = -3.8263\mu_N$ and $g(\pi) = 5.5845\mu_N$

where $\mu_N$ is the nuclear magneton. Since the g factor is very different in sign and magnitude for neutrons and protons, therefore they can serve as a good indicator as to which nucleon contributes most to the wave function of that state.

There are different techniques available for measuring g factors depending on the lifetime of the state involved. Advances in technology have now made it possible to accurately measure g factors of stable or unstable nuclei with states having lifetime of the order of hundreds of femto seconds. Because of such small lifetime, large magnetic fields of the order of 10kT are required. But it is extremely difficult to create such high magnetic field on a macroscopic level.

To generate such strong magnetic fields , MIT group proposed a new idea[1].In this method , a very high transient magnetic field can be generated by the hyperfine interactions at ions traversing magnetic solids. Therefore the transient field technique can be used for measuring the g factors of such states[2].

The transient magnetic field is an effective magnetic field created at the nucleus of a moving ion by its electronic cloud and is of the order of several kilo Tesla for the inner ns electrons. To measure the g factor of low lifetime states we have designed and fabricated a setup based on the Transient Field Technique Measurement.

## Design and fabrication of the setup

The setup essentially consists of a target chamber made of aluminium with a built in magnet and a liquid nitrogen dewar. The thickness of the outer chamber is about 4mm and has two ports for alignment purposes. The magnet used is a C frame electromagnet which can be produce a magnetic field of the order of 1000gauss.

Super enameled copper wire of diameter 0.611mm (SWG 23) has been to build coils of the magnet. The coils are wound over a yoke made of soft iron material. Before the making of the yoke and pole pieces for the electromagnet the carbon content of the material used was checked using a Carbon Hydrogen Nitrogen Analyzer at University Of Delhi. The carbon content was found to be less than 0.0001%.

Further the magnetization of the soft iron was also investigated, Fig.1, using a Vibrating Sample Magnetometer and it was to be found appropriate. The magnetic field thus produced will also be reversed every 100sec.

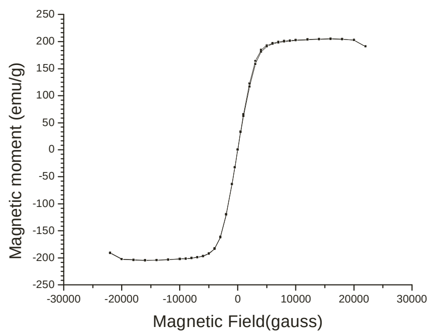


**Fig. 1** Hysteris curve plotted for the soft iron material

The pole pieces are designed in a special way with a slit so that the target can be placed between them and will face the maximum uniform magnetic field. The distance between pole tips is 6mm.This distance can be changed as the pole tip is attached to the yoke with a screw. Since we are using Gadolinium as a ferromagnet, it is necessary to keep it at liquid nitrogen temperature because of its low Curie temperature. For this purpose an arrangement has been made inside the target chamber to cool the target and also the coils of the magnet. This will also minimize the beam heating of the target. The set-up design is shown in Fig. 2.

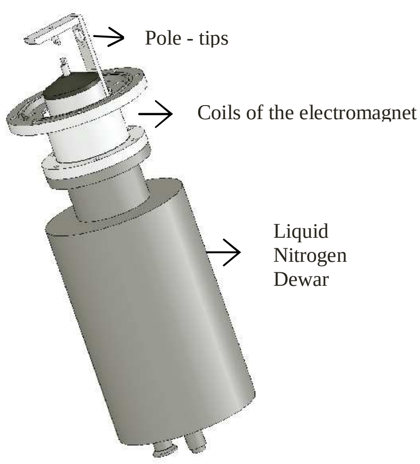


**Fig. 2** The g factor set up .

The liquid nitrogen dewar is a double walled cylinder made from SS(304) of thickness of about 3mm. It has a capacity of about 8litres. The liquid nitrogen will cool the target through the copper block which is placed inside the target chamber. The dewar is fitted with a 19mm diameter port for filling liquid nitrogen and with a KF25 to create the vacuum.

## Summary

Currently we are in the process of testing our setup at University of Delhi. The setup will then be used at Inter University Accelerator Centre to perform our proposed experiment of “Investigation of Mixed symmetry States in even –even isotopes of Tellurium using transient Field technique.

## Acknowledgments

We would like to give special thanks to Prof. K.H.Speidel for his fruitful discussions. We would also like to acknowledge Prof. H.J.Wollersheim and Dr. J. Leske for their several interesting discussions.

One of the authors (MS) greatly acknowledges the financial support from CSIR, New Delhi for this research work.

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