Development of Magnet and associated power supply system for g - factor measurement setup

Rajesh Kumar[1], Mansi Saxena[2], S.K. Suman[1] , S. Mandal[2], Soumen Kar[1], Mukesh Kumar[1] , A. Mandal[1]
[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:rajesh@iuac.res.in*

Introduction

The measurement of g factor is a crucial tool to understand the nuclear structure. The transient magnetic field is one of the technique to measure the g factor of nuclear states with lifetimes of the order of several pico second.

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There are various elements involved for success of such a measurement. The most important requirement is to generate transient magnetic field (of the order of MGauss) inside the ferromagnetic target. To achieve this transient magnetic field it is necessary to polarize the ferromagnetic target using a external magnetic field. To extract the information about the slope parameter [1] (which is directly connected to the g factor) a switching magnetic field is required. The duration of the magnetic field is also required to optimize the error associated with the slope parameter. These parameters should be programmable depending on the experiment.

A magnet and its power supply system has been designed, fabricated and developed in house at Beam Transport Lab, IUAC to meet the above requirements.

Design and Fabrication

The magnet power supply and control system has been designed with the following features.

- A bipolar magnetic field with a programmable amplitude.
- A programmable time interval of magnetic field for both polarities
- Logic signal output during the transition of the magnetic field.

To design such type of power supply system the magnetic time constant is an important parameter. To get a flat top (constant magnetic field) and to avoid the back emf, the transition time of the magnetic field from one polarity to other has been kept larger than the time constant of the magnet which is of the order of 200ms.

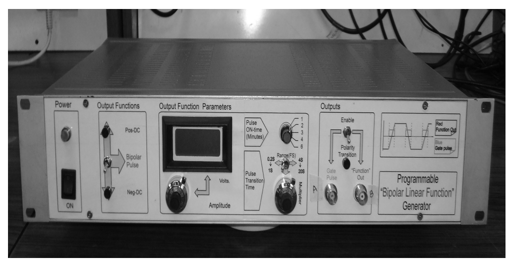

Fig. 1 Magnetic Power Supply control system.

A power supply controller has been developed to generate a control signal with the above mentioned characteristics, which is used to drive an indigenously developed Bipolar Current Regulated Power Supply (±5A; ± 50V)

Two gate signals were generated to specify the transition time. These signals were used to gate the data acquisition system for negative and positive polarity of the magnetic field. It was also used to veto the data collected during the transition time of the field. The characteristics of the control pulse along with the gate signals are shown in Fig.2.

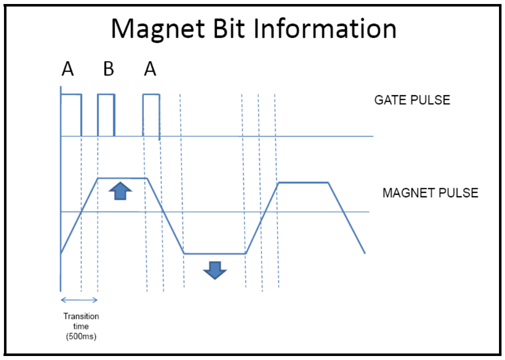

Fig. 2 Gate output and magnet pulse information. A and B are two separate TTL logic signal of 5μs width.

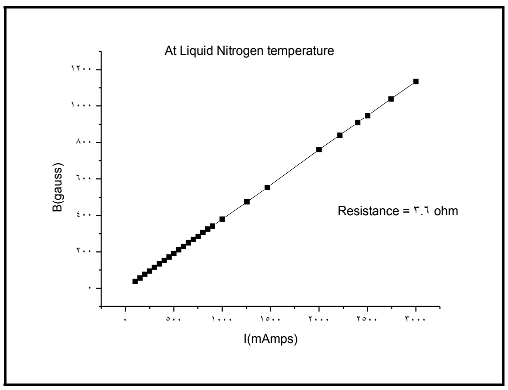

Fig. 3 Calibration curve for magnetic field vs current at liquid nitrogen temperature.

Magnet Design and Specifications

A compact solenoid electromagnet [2] has been designed and developed. The electromagnet can provide a field upto 1200Gauss. Super enameled copper wire (SWG 23) has been used for the coils of the magnet. To reduce the power dissipation the (SWG 23) has been used for the coils of the magnet. To reduce the power dissipation the magnet was cooled using liquid nitrogen. The resistance of the coils at room temperature was 18.8ohm and 8 ohm at liquid nitrogen temperature.

Summary

A magnet and its associated power control system has been developed and tested at IUAC, New Delhi. This power supply has been successfully installed to measure the g -factor of a nuclei.

References

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