01 Dec 1972

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Yu Bong Hahn

Robert E. Hebner

Daniel R. Kastelein

Kaare J. Nygaard
Missouri University of Science and Technology

Recommended Citation
Y. B. Hahn et al., "Channeltron Gain In Magnetic Fields," *Review of Scientific Instruments*, vol. 43, no. 4, pp. 695 - 696, American Institute of Physics, Dec 1972.
The definitive version is available at https://doi.org/10.1063/1.1685730

RESEARCH ARTICLE | NOVEMBER 04 2003

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Rev Sci Instrum 43, 695–696 (1972)
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involved reworking the hydraulic control valve to closer tolerances, using flexible hydraulic lines from the high pressure source, and applying acoustic damping materials in the load train. None of these techniques have been completely successful, and in fact, some machines have been deemed "unusable" for high gain acoustic emission testing.

We have found a very simple and inexpensive method for modifying any MTS machine and eliminating all measurable machine noise. We simply removed the hydraulic control walve from the actuator assembly, fabricated two face plates with appropriate holes and O-ring seals to mate with the actuator and control valve, and finally connected the face plates with 2 m lengths of flexible high pressure hydraulic hose. The control valve was placed in an arbitrary position not in physical contact with the main load frame.

Although some high rate control of the ram was lost because of the remote location of the control valve, a 1 cps square wave could still be maintained and constant strain rate tests suffered no loss in controlling sensitivity.

Tests have been performed on our modified MTS system and no machine noise can be detected with commercially available acoustic emission equipment.

THE REVIEW OF SCIENTIFIC INSTRUMENTS VOLUME 43, NUMBER 4 APRIL 1972

Channeltron Gain in Magnetic Fields*

Yu Bong Hahn, Robert E. Hebner, Jr.†, Daniel R. Kastelein, and Kaare J. Nygaard
Department of Physics, University of Missouri—Rolla, Rolla, Missouri 65401

(Received 15 October 1971; and in final form, 13 January 1972)

The gain and total count rate of electron channel multipliers depend strongly on applied magnetic fields. We report experimental results for Channeltrons operated in magnetic fields of up to 300 G, and find that the applied voltage must be increased to about 4000 V to maintain a sufficiently high gain. Slightly higher count rates are observed if the magnetic field is parallel to the plane of the Channeltron, as compared to perpendicular to that plane.

Channel electron multipliers have been used with great success for detection of electrons,[1–7] ions,[4,7,8–10] metastable[11] and fast[12] ground state atoms,[6] vuv photons,[13] and γ rays.[1] The low background count rate,[14] high gain,[3] and reasonably narrow pulse height distribution[1,3,15] are all properly documented in the literature. Unfortunately, difficulties arise when these detectors are located inside the magnetic fields required in a number of atomic and nuclear physics experiments.

The objective of the present work has been to study the operation of channel electron multipliers in magnetic fields up to 300 G by measuring pulse height distributions and total count rates as functions of applied voltage and magnetic field. This investigation was performed using a Bendix Channeltron model 4010 whose curved channel extends through an arc of 270°. Because the channel itself lies completely in one plane, it is convenient to study Channeltron operation as a function of the relative orientation of this plane and the applied magnetic field. In this work we studied two different orientations; one was with the magnetic field parallel to ($B_{\parallel}$) and the other was the magnetic field perpendicular to ($B_{\perp}$) the plane of the channel. A radioactive source (^{57}Co) was used to produce the measured counts. With this source count rates of 10–1000 sec^{-1} were obtained thereby avoiding fatigue effects that have been reported[4] when the count rate exceeds 10^4 sec^{-1}. The Channeltron was mounted in a vacuum chamber with pressure well below 10^{-7} Torr, and the magnetic field, uniform to within $\pm 5\%$, was produced by an external magnet. The potential difference between the electron collector and the end of the channel was 10% of the total applied voltage. The electron pulses at the collector were amplified with a Nuclear Data PAD ND 520, and eventually analyzed with a Nuclear Data multichannel analyzer model 2200. The lower discriminator was set at a level to eliminate amplifier noise when the radioactive source was removed.

The major difficulty that arises when an electron channel multiplier is operated in a magnetic field is that the finite radius of gyration of the electrons decreases their kinetic energy at impact, leading to a reduction in the effective secondary emission coefficient. The accompanying macroscopic effects such as pulse height distribution and count rate are illustrative of the loss of gain in the device.

Figure 1 shows that in both the $B_{\perp}$ and $B_{\parallel}$ cases the total count rate decreases as the applied magnetic field increases. The work of Barnett and Ray[12] is also shown in this figure. Their work was different from ours in that their channel

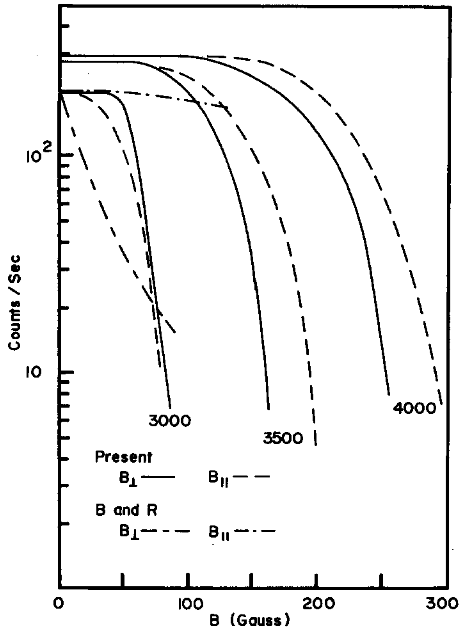

FIG. 1. Total Channeltron count rate as a function of magnetic field with applied voltages of 3000, 3500, and 4000 V. The results of similar measurements performed by Barnett and Ray (B and R) (Ref. 12) using a Model B 419 BL Mullard channel electron multiplier are included for comparison. Their results are normalized to the present data at 3000 V and zero magnetic field. The symbols $B_{\perp(\parallel)}$ indicate that the measurements were taken with the magnetic field perpendicular (parallel) to the plane of the Channeltron.

electron multiplier was manufactured by Mullard (model B 419 BL) and so has a somewhat different geometry, and in that they investigated a smaller range of applied voltages and magnetic field strengths. It should be noted that Barnett and Ray found a pronounced difference in count rate between $B_{\parallel}$ and $B_{\perp}$ cases, the former being the more favorable for magnetic fields up to 120 G.

On the other hand, for the Channeltron investigated in the present work, the functional dependence of count rate vs magnetic field appears to be the same for $B_{\perp}$ and $B_{\parallel}$, although the latter orientation yields a higher count rate for applied voltages of 3500 and 4000 V.

The major conclusion of this study is that Channeltrons can be used in environments of magnetic fields up to 300 G when the applied voltage is increased up to the maximum recommended by the manufacturers. However, great care should be taken when comparing devices with different input electron optics and geometry of the amplifying channel.

The authors are indebted to K. C. Schmidt of the Bendix Electro Optics Division for making available some of the Channeltrons used in this experiment.

* Supported in part by the National Science Foundation and the Office of Naval Research.

† Present address, NBS, Washington, D.C. 20234.

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THE REVIEW OF SCIENTIFIC INSTRUMENTS VOLUME 43, NUMBER 4 APRIL 1972

Comment on Density Determination of Nozzle Beams*

R. S. GRACE,† D. P. MORROW, J. P. ALDRIDGE, AND J. G. SKOFRONICK
The Florida State University, Tallahassee, Florida 32306

(Received 27 September 1971; and in final form, 17 January 1972)

A method of measuring the scattering gas density in a molecular beam is described. The relative beam profile is normalized to the center line density determined by a probe connected to an absolute manometer. Reference is made to a nozzle beam system, but the technique is more general. Considerations of design parameters and probe location are given.

Determination of absolute cross section values using crossed nozzle beams requires a measurement of the scattering gas density in the interaction volume. One method of making this measurement is to determine the beam profile relatively and to normalize this to the central density in the interaction region determined by a probe which mea-