THE McWILLIAMS MAGNETOMETER

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Abstract

The construction of a device for measuring magnetic disturbances is described.

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The Solar Division of the AAVSO has long been interested in observing the terrestrial effects of Solar Flares. One terrestrial effect that is easy to detect is the ionospheric disturbance usually associated with flares. An AAVSO Indirect Flare Patrol has been observing ionospheric disturbances since 1956. These data are reported to the National Oceanic and Atmospheric Administration, NOAA, which has encouraged and supported our efforts since the beginning.

The ionospheric disturbances are detected by monitoring the propagation characteristics of the "D" layer of the ionosphere. The "D" layer is disturbed by ultraviolet and x-radiation from flares. Flares also produce particle streams which interact with the earth's magnetic field and change its intensity. Detection of particle radiation from flares therefore requires some means of monitoring the intensity of the earth's magnetic field. Such a device is called a magnetometer.

A simple mechanical magnetometer designed by Prof. Alexander McWilliams of the University of Minnesota can be built from easy to obtain materials and is sensitive enough to record the effects of solar activity on the earth's magnetic field. These data are useful to anyone interested in radio propagation and in predicting possible aurora.

A large magnetic compass needle is suspended on a torsion spring. The spring is wound to give sufficient torque to rotate the needle 90 degrees so it points East and West instead of its normal North and South direction. A change in the horizontal component of the earth's magnetic field will then change this East-West direction by a slight amount. This small rotation of the needle is measured electronically using two cadmium sulfide photocells to detect movement of a shade attached to one end of the needle. The shade moves horizontally across the photocells between them and a light source which is a 6.3 v lamp powered by a 5 volt regulated power supply. The lamp should be mounted about 2 inches above the photocells, and the shade should be as close to the photocells as possible. As the shade moves from one photocell to the other, it increases the shading on one cell as it decreases the shading of the other. The resistance of the cells increases from about 1000 ohms when fully exposed to the lamp to about 100,000 ohms when fully shaded. The photocells are connected in series across a 1.5 volt battery, and their midpoint therefore sweeps almost the full battery voltage to give an output signal that is about 0 to 1 1/2 volts depending on the position of the shade which in turn depends on the strength of the horizontal component of the earth's magnetic field. This voltage signal is fed to the gate of a field-effect transistor which drives a 0-100 microampere Rustrak chart recorder. The chart speed of the Rustrak recorder is 1/4 inch per hour, and it produces a graphic record of any changes in the magnetic field 24 hours per day.

The photocells and the field effect transistor can be bought in Radio Shack, and the cost is 99¢ and $1.29 respectively. The guitar string can be bought in any music store for less than $1.00. The batteries are ordinary "D" cells from the supermarket and will last for many months. The regulated 5 volt power supply can also be bought from Radio Shack in kit form for under $10.00. It is necessary to use a regulated supply because otherwise line voltage fluctuations would show up on the chart recording. The lamp draws too much current to be economically powered by batteries.

The magnetometer will work best if it is placed in the basement on a cement floor as far as possible from iron or steel objects such as furnaces, hot-water heaters or washing machines. Some means of excluding extraneous light from the photocells is necessary. It is also a good idea to protect the needle from drafts although the damper consisting of a piece of wire dipping in a cup of oil is very effective in damping out unwanted excursions of the needle.

The Solar Division would like to establish a small group of observers to record the occurrence of aurora using magnetometers to predict when they are apt to occur. Magnetic recordings also correlate with certain interesting phenomena seen on AAVSO Solar Division ionospheric disturbance recordings.

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VARIABLE AND POTENTIALLY VARIABLE STARS IN THE BRIGHT STAR CATALOGUE

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Abstract

The fourth edition of the Bright Star Catalogue, now being compiled jointly at the Yale and Strasbourg Observatories, will contain 610 confirmed and 1261 suspected variable stars. This amounts to 20% of the Bright Stars and is up 12% over the numbers in the 1964 edition. Among the stars with late M-type or peculiar A-type spectra high percentages have been found to be variable. In these categories it is noted that relatively few variables confirmed by 1969 have amplitudes under 0.5 visual magnitude, whereas the vast majority of those discovered and verified subsequently do have amplitudes well under 0.5 mag. Most of these are either slowly varying irregular variables of class Lb, or αCVn stars with periods less than 2 days. Lists have been prepared of the potentially variable stars with these spectral characteristics. They should be monitored photoelectrically, the Ap types frequently, the M stars occasionally. AAVSO members who have photoelectric equipment might well enjoy the thrills of discovery by observing these stars.

The following tables give peculiar A stars and M-type stars (1st line) that are potential candidates for small amplitude variability. Comparison stars (2nd and 3rd lines) are also listed. Asterisks next to the GC number indicate notes at the end of the table.

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