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ACTUAL PROBLEMS OF TEACHING AND STUDYING PHYSICS IN HIGHER SCHOOL

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L. Gładyszewski

ON SOME INTERESTING LABORATORY EXPERIMENTS FOR UNIVERSITY STUDENTS

Institute of Physics, Maria Curie-Skłodowska University, Lublin, Poland

Introduction

The Institute of Physics conducts the students' education in the following areas:

theoretical physics, experimental physics, applied physics and biophysics.

The studies last 5 years. In the third year of studies students can also choose to study at the same time physics education to obtain qualifications to teach physics in junior high school.

There are also three-year studies (Bachelor's degree) for prospective teachers in senior high school in the two specializations: „chemistry and physics" as well as „physics and geography".

As the subject of studies and curricula cover two areas: „physics and astronomy" , the subject „astronomy education laboratory" was separated from „physics and astronomy education" in the teacher qualifying studies. The number of laboratory classes is 30 hours of astronomy education for the fifth year students of physics and 15 hours for the three-years studies (Bachelor's degree)..

Classes in the Astronomy Education Laboratory.

Among the subjects taught during these classes there are , as the example, the following:

1). Astronomical co-ordinates, sky atlases, revolwing map of the sky, localization of planets based on the „Astronomical Yearly". While discussing the revolwing maps of the sky, the attention is paid to „zodiac signs" (purely astrological term) and „zodiac constellation" .We point to absurdity of reading horoscopes printed by newspapers commercially. However, we emphasize the significant effect of the Sun activity on the phenomena on the Earth excluding the effect of stars and planets on the fate of Earth inhabitants.

2). Application of photography in professional astronomy and astronomy education. We discuss and demonstrate the ways of taking photographs. We encourage to make beautiful photos of the sky using the immovable camera with the wide-angle lens. We discuss the conditions and difficulties in photography of the Sun and the Moon.We demonstrate beautiful photos made in Lublin in the Polish Amateur Astronomical Society using the method of manual handling of the telescope even up to 40 minutes of exposure (Nebulae, Galaxies, Comets).

3). Determination of the temperature of the Sun photosphere using the Wien's law. We discuss and demonstrate the rule of measuring temperature of the Sun photosphere using the site of maximum spectrum light intensity found in the Sun spectrum..

Making use of the Sun spectrum from internet (http://mesola.obspm.fr) we scan the light intensity of individual spectrum ranges on the computer screen by means of the thermocouple equipped with a narrow scanning slit. We determine the length of optical wave at which the light intensity maximum occurs. This site is localized by means of identified absorption lines of the Sun spectrum.

We present a suggestion for a very simple construction of a spectroscope to demonstrate absorption lines in the Sun spectrum. We use a tube of the length equal to the „distance of good vision": at the beginning of the tube there is placed a narrow slit made of half-broken razor-blade. On the other end there is placed prism, so called „a direct vision".

We demonstrate the darkest, most distincts Fraunhofer's lines. We also show emission spectra of common gases and vapours: mercury, neon, argon, helium, sodium, using the Plucker's – Geissler's tubes and diffraction grating or spectroscopes.

4). Radiotelescope. The laboratory classes „radiotelescope" enjoy great popularity . This device was constructed by the author of this article in 1976 [1].

Since 1985 the radiotelescope has been working every day collecting information about intensity of the solar radio waves. The system consists of two aerials of the „long Yagi" type, connected in the interferometer system with the base of 18 lengths of wave (reception frequency is 220 MHz). The aerials are immobile. In one day from 7:00 universat time (UT) to 3 p.m. UT, about 18 to 20 interference maxima are observed.. We use the receiver called „selective microvoltmeter" of WMS-4 type, produced in Poland. After detection the signal is directed to the loudspeaker; it is possible to listen to the solar noise. However, the constant component of the detection is directed to the additional averaging circuit with the time-constant RC = 2 sec and to the recorder [2].

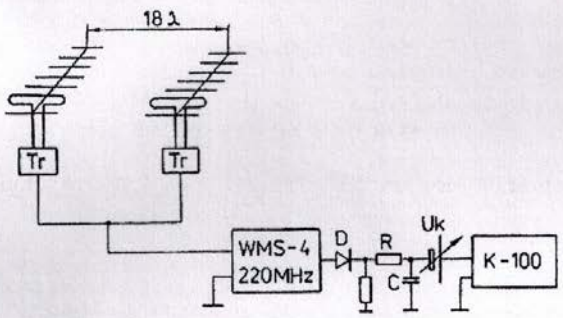

Fig.1. Block diagram of the radiotelescope.

5). Statistical elaboration of seventeen-years long measurements of solar radio waves intensity (from 1 January 1985 to 31 December 2001).

Students obtain three sets of the data: a).daily average data concerning radio intensity – 6209 data in the units: „s.f.u" (solar flux unit), 1 s.f.u. = 10^{-22} W/m^2 Hz, b). average monthly data – 204 numbers, c). average yearly data – 17 numbers.

Students must prepare:

- distribution of probability of occurence of a given value fluctuation stream,
- Fourier spectra of contribution individual components of various periods.

Exemplary results are given in the diagrams below.

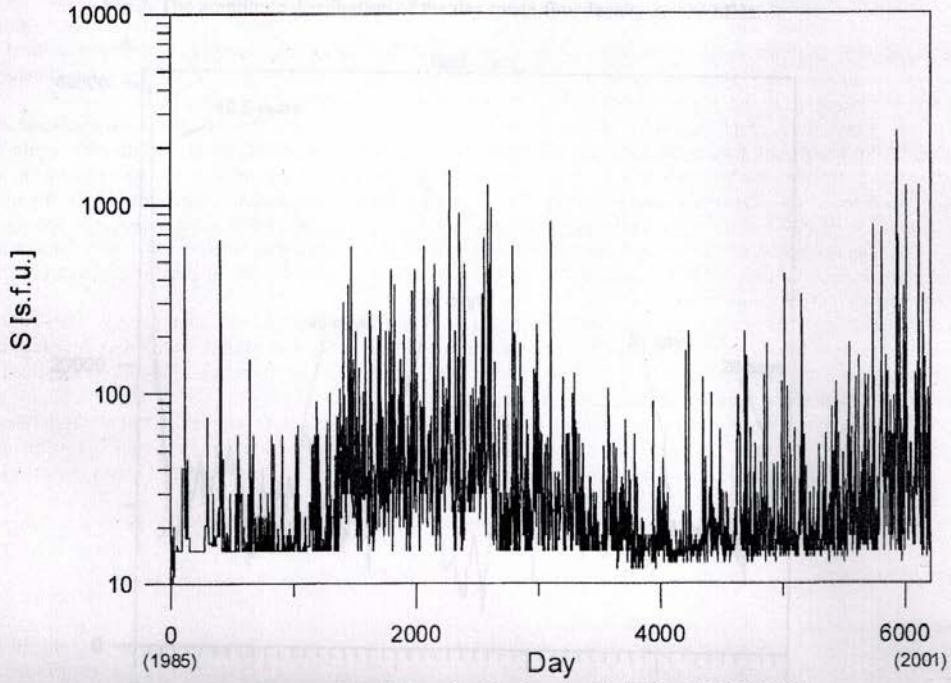

Fig.2. Daily mean values of the solar flux density (1.I.1985 – 31.XII.2001).

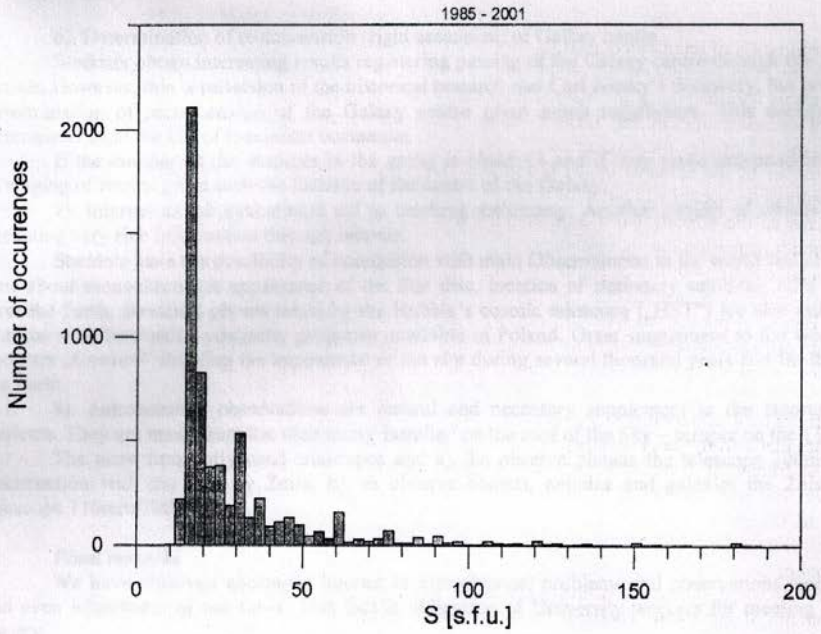

Fig.3. The amplitude distribution of the day mean flux density at 220 MHz.

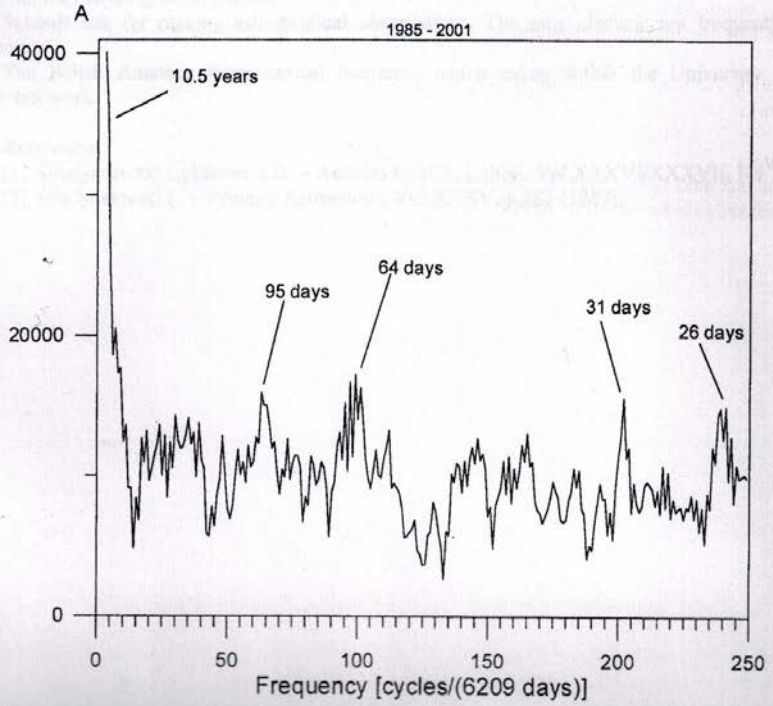

Fig.4. Fourier spectrum of the daily flux densities. (A- intensity of the Fourier component).

6). Determination of rectascension (right ascension) of Galaxy centre.

Students obtain interesting results registering passing of the Galaxy centre through the „vision field" of the aerials. However, this is reflection of the historical research and Carl Jansky's discovery, but possibility of accurate determination of rectascension of the Galaxy centre gives much satisfaction. This coordinate can be easily determined from the UT of maximum occurence.

If the number of the students in the group is about 15 and if they make independent measurements, the averaging of results gives accurate location of the centre of our Galaxy.

7). Internet as the educational aid in teaching astronomy. Another subject of classes are possibilities of obtaining very rich information through internet.

Students have the possibility of connection with main Observatories in the world and of obtaining everyday data about monochromatic appearance of the Sun disc, location of stationary satellites, GPS satellites and other over the Earth. Beautiful photos taken by the Hubble's cosmic telescope („HST") are also available. Students get familiar with interesting computer programs available in Poland. Great supplement to the work with maps is the program „Cosmos" showing the appearance of the sky during several thousand years and for the optional place on the Earth.

8). Astronomical observations are natural and necessary supplement to the laboratory work done by students. They are made from the obsevatory installed on the roof of the Sky – scraper on the 11 th floor.

The most frequently used telescopes are: a). To observe planets the telescope 200mm/3000mm of own construction with the lens by Zeiss, b). to observe comets, nebulae and galaxies the Zeiss short focal point telescope 110mm/700mm.

Final remarks

We have observed enormous interest in astrophysical problems and observations among students, pupils and even inhabitants of our town. This fact is obligation of University workers for meeting expectations of the society.

The author of this paper proposed lectures and observations for the students of philosophy. The lectures are optional but they enjoy great popularity.

Schools ask for making astronomical observations. The only obstacle are frequently bad atmospheric conditions.

The Polish Amateur Astronomical Society , which exists within the University is very helpful in popularizing work.

References

[1]. Gładyszewski L, Usowicz B. – Annales UMCS, Lublin, Vol.XXXVI/XXXVII, No 7, p.89 (1981/1982)

[2] Gladyszewski L. – Postępy Astronomii, Vol.XXXV, p.281 (1987).