

MEASUREMENTS OF THE NON-IONIZING RADIATION SPECTRUM BETWEEN (1–1000) HZ AT ITA IN SÃO JOSÉ DOS CAMPOS, SP, BRAZIL

MEDIÇÕES DO ESPECTRO DE RADIAÇÃO NÃO IONIZANTE NA FAIXA DE (1–
1.000) HZ NO ITA, EM SÃO JOSÉ DOS CAMPOS, SP, BRASIL

MEDICIONES DEL ESPECTRO DE RADIACIÓN NO IONIZANTE EN EL RANGO
DE (1–1000) HZ EN EL ITA DE SÃO JOSÉ DOS CAMPOS, SP, BRASIL

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ABSTRACT

Electromagnetic waves between 1 to 1000 Hz exist on the surface of the Earth's atmosphere, created by various types of physical and chemical phenomena occurring naturally in the atmosphere. They carry out an electric power energy that varies at each frequency within the (1–1000) Hz range. This energy varies for each region of the Earth in terms of the latitude and longitude. At ITA (Instituto Tecnológico de Aeronáutica – Physics Department), this spectrum measurement was carried out several times just now, at different periods and under different meteorological conditions, with highly reliable and consistent results. The voltage carried out by the waves in this frequency range was found to be between 10 mV and 2.5 mV. This background noise curve existing in this region is important for all human activity projects to be developed at the site. It is also very important from a health perspective for all living beings in this region of planet Earth.

Keywords: Non-Ionizing. Radiation. Frequency. Atmosphere. Voltage.

RESUMO

Na superfície da atmosfera terrestre, existem ondas eletromagnéticas na faixa de 1 a 1.000 Hz, geradas por diversos tipos de fenômenos físicos e químicos que ocorrem naturalmente na atmosfera. Elas transportam energia elétrica que varia em cada frequência dentro da faixa de (1–1.000) Hz. Essa energia varia de acordo com a latitude e a longitude de cada região da Terra. No ITA (Instituto Tecnológico de Aeronáutica – Departamento de Física), essa medição do espectro foi realizada várias vezes recentemente, em diferentes períodos e sob diferentes condições meteorológicas, com resultados altamente confiáveis e consistentes. Verificou-se que a tensão

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transportada pelas ondas nessa faixa de frequência estava entre 10 mV e 2,5 mV. Essa curva de ruído de fundo existente nessa região é importante para todos os projetos de atividade humana a serem desenvolvidos no local. É também muito importante do ponto de vista da saúde para todos os seres vivos nessa região do planeta Terra.

Palavras-chave: Não Ionizante. Radiação. Frequência. Atmosfera. Tensão.

RESUMEN

En la superficie de la atmósfera terrestre existen ondas electromagnéticas con frecuencias comprendidas entre 1 y 1000 Hz, generadas por diversos fenómenos físicos y químicos que se producen de forma natural en la atmósfera. Estas ondas transportan energía eléctrica que varía en función de cada frecuencia dentro del rango de (1–1000) Hz. Esta energía varía en cada región de la Tierra en función de la latitud y la longitud. En el ITA (Instituto Tecnológico de Aeronáutica – Departamento de Física), esta medición del espectro se ha llevado a cabo en varias ocasiones recientemente, en diferentes momentos y bajo distintas condiciones meteorológicas, con resultados altamente fiables y consistentes. Se ha comprobado que la tensión transportada por las ondas en este rango de frecuencias oscila entre 10 mV y 2,5 mV. Esta curva de ruido de fondo presente en esta región es importante para todos los proyectos de actividad humana que se desarrollen en la zona. También es muy importante desde el punto de vista de la salud para todos los seres vivos de esta región del planeta Tierra.

Palabras clave: No Ionizante. Radiación. Frecuencia. Atmósfera. Tensión.



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INTRODUCTION

In the ground level of the Earth's surface, ambient ionizing gamma radiation is mainly composed with ground telluric radiation, primary and secondary cosmic ray radiation. However, it is difficult to separate over time the intensity of ionizing gamma radiation emanating from each component as the energies overlap. Telluric radiation is given by ^{238}U , ^{235}U , ^{40}K and ^{232}Th that is constant for each region. Radon gas coming from the disintegration of ^{238}U on the earth's crust to ^{226}Ra and ^{222}Rn that arrives in the ^{214}Pb , ^{214}Po and ^{214}Bi stable isotopes, generating alpha and gamma radiation. Primary cosmic radiation consists mainly of galactic and extragalactic protons and those from the Sun, with energy that interacts with the Earth's atmosphere producing Extensive Air Showers (EAS). Another possible source of ionizing radiation in the Earth's lower atmosphere is produced by lightning strikes between earth-clouds and clouds-earth. The lightning cone forms x-rays, gamma rays, neutrons and beta particles. In non-ionizing radiation present

near surface of Earth, the lightening produce in the atmosphere of earth should be the main source of that radiation. Lightning is a ubiquitous phenomenon on Earth with around 50 lightning strikes per second, paths of higher conductivity or moisture there existent (e.g., plants and soil). The energy contained within lightning strikes causes rapid heating of Earth's surface environment, whereby temperatures may exceed 2500 K. Aside from direct effects on biology, it is thus conceivable that these electric currents and associated energy inputs can bear relevance for biology. Even being in a region where lightning never occurs, nevertheless, the presence of this non-ionizing radiation is always there.

MEASUREMENTS AND DISCUSSIONS

To carry out measurements of non-ionizing radiation (1 to 1000 Hz) at any chosen Earth surface location, we adopted the best versatile and precise equipment available to date on the international market. This is the Spectran NF-5035 from the German company Aaronia [8,9]. This detector allows precise measurements in the continuous range from 0 to 1000 kHz with a resolution bandwidth (RBW) of 1 Hz and sample time from (0.5 to 1000) milliseconds (ms). Figure 1 shows the detector connected to a Dell Vostro computer. In these measurements, it is used (RBW) of 1 Hz and sample time of 500 ms were adopted. It was observed that if the measurements are made near electric power transmission lines and voltage transformers, the measured voltage is always higher. In the cases of measurements taken far from power transmission lines, the measured electrical voltage is always lower. The presence of fog and rain alters the measured voltage very little. There are also small differences between the measurements taken at night and during the day. It has not been measured whether there are significant variations when moving north and south, relative to latitude, and also in relation to movement west and east, within Brazil.

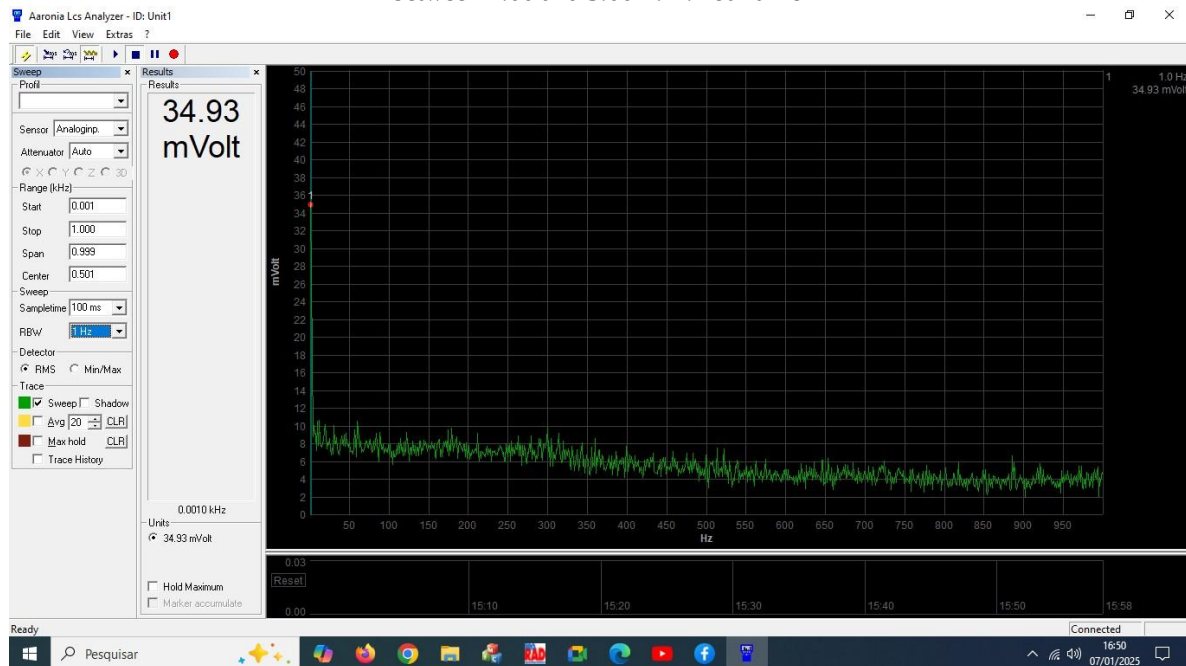
Figure 1 - View of the Spectran NF-5035 detector, used in this work.



Source: author

It was decided to measure between (1 to 1000) Hz in frequency because it is in this range, near the Earth's surface, that the voltage in millivolts (mV) interacts with human body health. It is possible, at any point on Earth, to determine the voltage value in (mV) as a function of frequency and location, for studies on the influence of electrical energy and its variations over time. In **figures** (2–5), the results of these measurements are shown here on the ITA campus and at the author's house, which is localized about 5 km to the east of ITA. Many other measurements in 2023 and 2024 it was made in the same region and confirm very well the values reported in this article of 2024 and 2025, using the same electromagnetic power detector Spectran NF-5035.

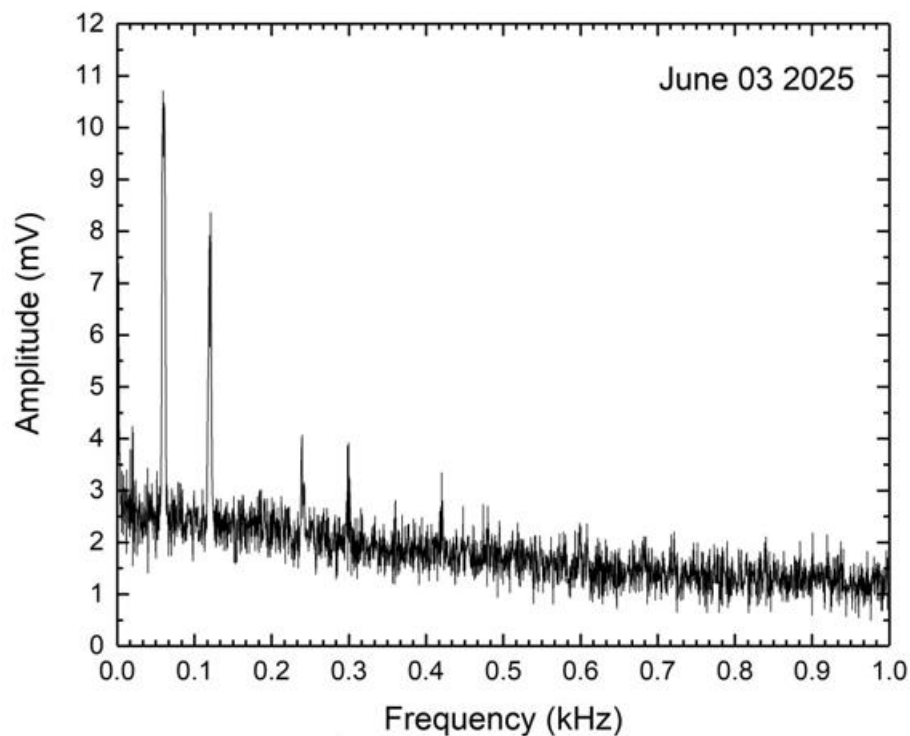
Figure 2 - Voltage amplitude curve in (mV) versus frequency from (1 to 1000) Hz on January 7, 2025, at home between 4:00 and 5:00 P.M. hour time



Source: author

In these measurements it begins near 4 (mV) near 1 Hz and finished near 2.5 (mV) at 1000 Hz. The value of 34.93 mV listed above in that figure is the first one and no correspond exact the first experimental value points.

Figure 3 - Voltage amplitude ITA curve in (mV) versus frequency from (1 to 1000) Hz on June 03, 2025, at home, between 9:00 and 10:00 A.M. time hour (author).



Source: author

In these measurements the amplitude value begins near 3 (mV) and follow until near 1,5 (mV), at end. The 60 Hz and 120 Hz peak of power electric power line that surround just in the street of rue appear very clearly in these measurements.

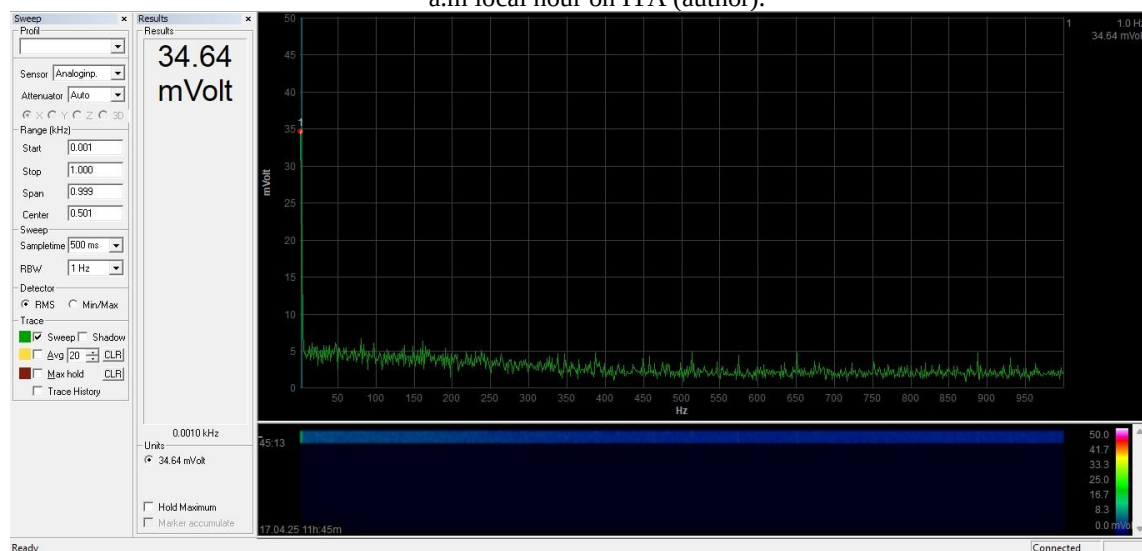
Figure 4 - Voltage curve in mV versus frequency from 1 Hz to 1000 Hz on June 10, 2025, at ITA between 10:00 and 11:00 A.M. (author).



Source: author

The Voltage curve begin near 3 mV and arrives about 2.0 mV at the end in 1000 Hz.

Figure 5 - Voltage curve in mV versus frequency from 1 Hz to 1000 Hz on April 17, 2025 from 09:00 to 10:00 a.m local hour on ITA (author).



Source: author

The voltage curve plotted in figure 5 begin in 3.5 mV and goes down to 1.8 mV at 1000 Hz. Depending of the local time during days or even nights the measurements results change on values very small quantity in these regions.

CONCLUSION

In this work, the non-ionizing radiation spectrum as a function of frequency was measured in the region of São José dos Campos, SP, Brazil (23° 10' 47" S and 45° 53' 14" W) within the 1 Hz to 1000 Hz range. Voltage (mV) was recorded at two distinct locations (ITA and the author's residence) during 2024 to 2026 using a portable Spectran NF-5035 detector [9], which provides high precision in both voltage and frequency. The variation in voltage relative to frequency was observed at both measurement sites. The recorded curves show a smooth decline from 1 Hz to 1000 Hz: at the residence, values typically started at 10 mV and dropped to 2 mV, while at the ITA Physics Department, they ranged from 4 mV to 1.5 mV. This discrepancy is attributed to the presence of power transmission lines near the measurement sites. Minimal variations in voltage were observed during rainfall. Furthermore, only slight differences were noted between measurements taken during high solar intensity and those conducted at night. It is concluded that a larger dataset is necessary for each location to improve statistical reliability. Whether this local radiation intensity (mV) interferes with human health is a question currently being investigated by the authors.

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