Armenian Journal of Physics, 2020, vol. 13, issue 2, pp. 171-174

The Study of MF Electromagnetic Waves Radiation Caused by the Effects of Solar Radiation on Spacecraft

A.R. Aramyan

Institute of Applied Problems of Physics NAS RA, 25 Hr. Nersissian Str., Yerevan, Republic of Armenia, 0014
E–mail: aramyan.artur@gmail.com

Received 21 June 2020

Abstract: We present the investigation of the emission of electrons born from the outside of spacecraft under the influence of solar radiation. The results can be used to combat harmful noises, which can lead to the failure of devices. On the other hand, these results can be used to create new devices for studying solar activity.

Keywords: gas discharge; positive column; electron.

1. Preliminary results

The goal of the present paper is to study the radiation of electrons caused by solar rays in the Earth's magnetic field.

The work done in this field during the last years [1-4] give justification to assert that the radiation of the electromagnetic waves by electrons caused in the Earth atmosphere in the Earth magnetic field is quite interesting and could have wide practical interest. In particular, the MF electromagnetic waves caused by solar rays and registered by DEMETR spacecraft are of special interest. The purpose of the present work is to study this problem, discover the reasons of causes and reveal the possibility of the influence of this effect on electronic devices.

The object of the study is the radiation in the frequency range $1-2MHz$ registered by the French spacecraft DEMETR. The radiation frequency changes depending on the geographical latitude from $1.2MHz$ to $1MHz$ and again to $1.2MHz$ (see Fig.1a,b.). Near the poles, where the magnetic field is relatively strong, the radiation frequency is bigger than on the equator where the magnetic field is weak. As can be seen from Fig.1a,b, such radiation appears only on the sunny side. In the shadow side, such kind of radiation is absent. This indicates that the radiation is associated with the sun only.

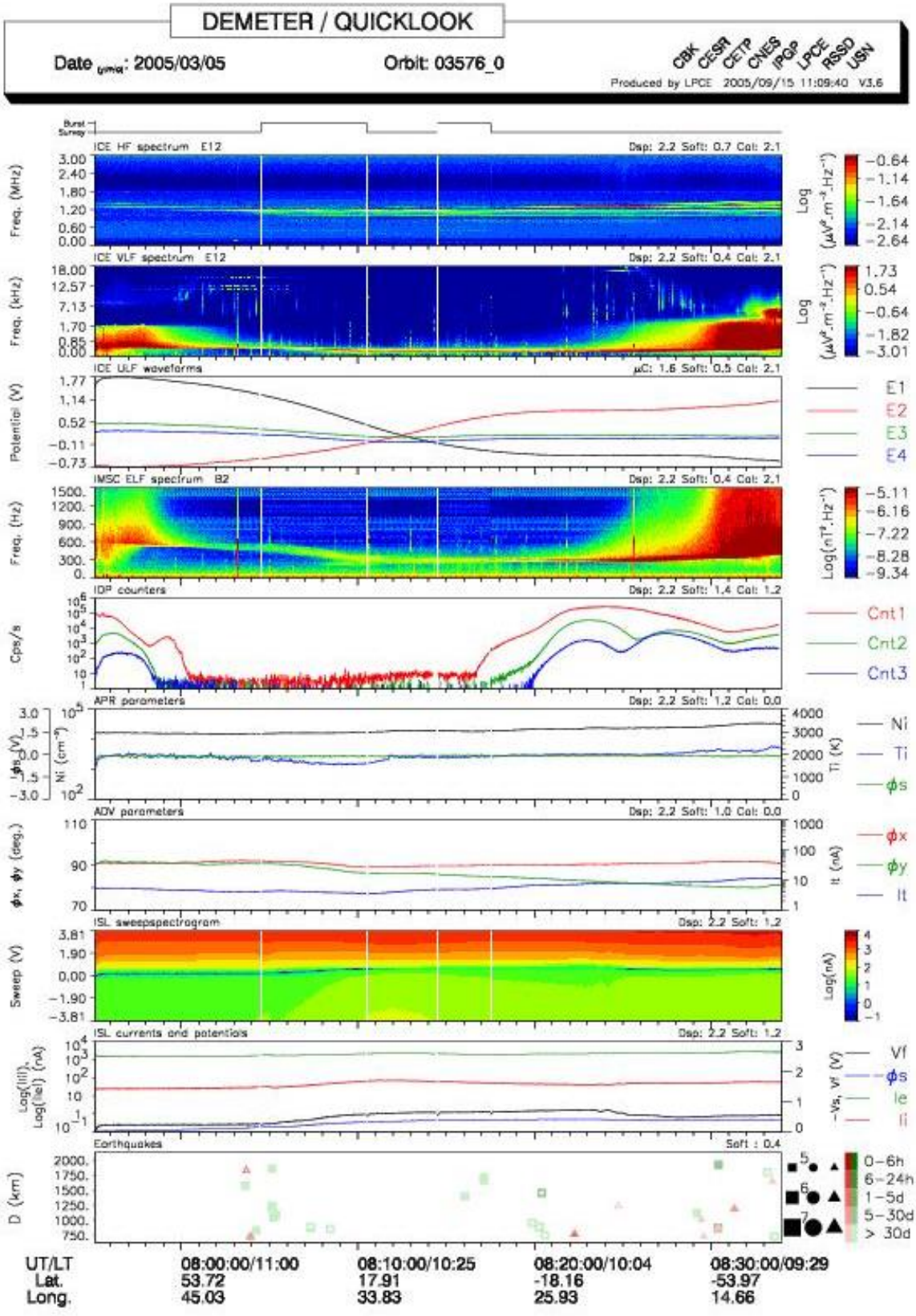
According to the preliminary estimates the frequencies of these radiations coincide rather well with the frequency of the electron radiation (cyclotron radiation). The preliminary evaluations have been done by the following formula.

$$\nu_e = \frac{eH}{2\pi m_e c} \tag{1}$$

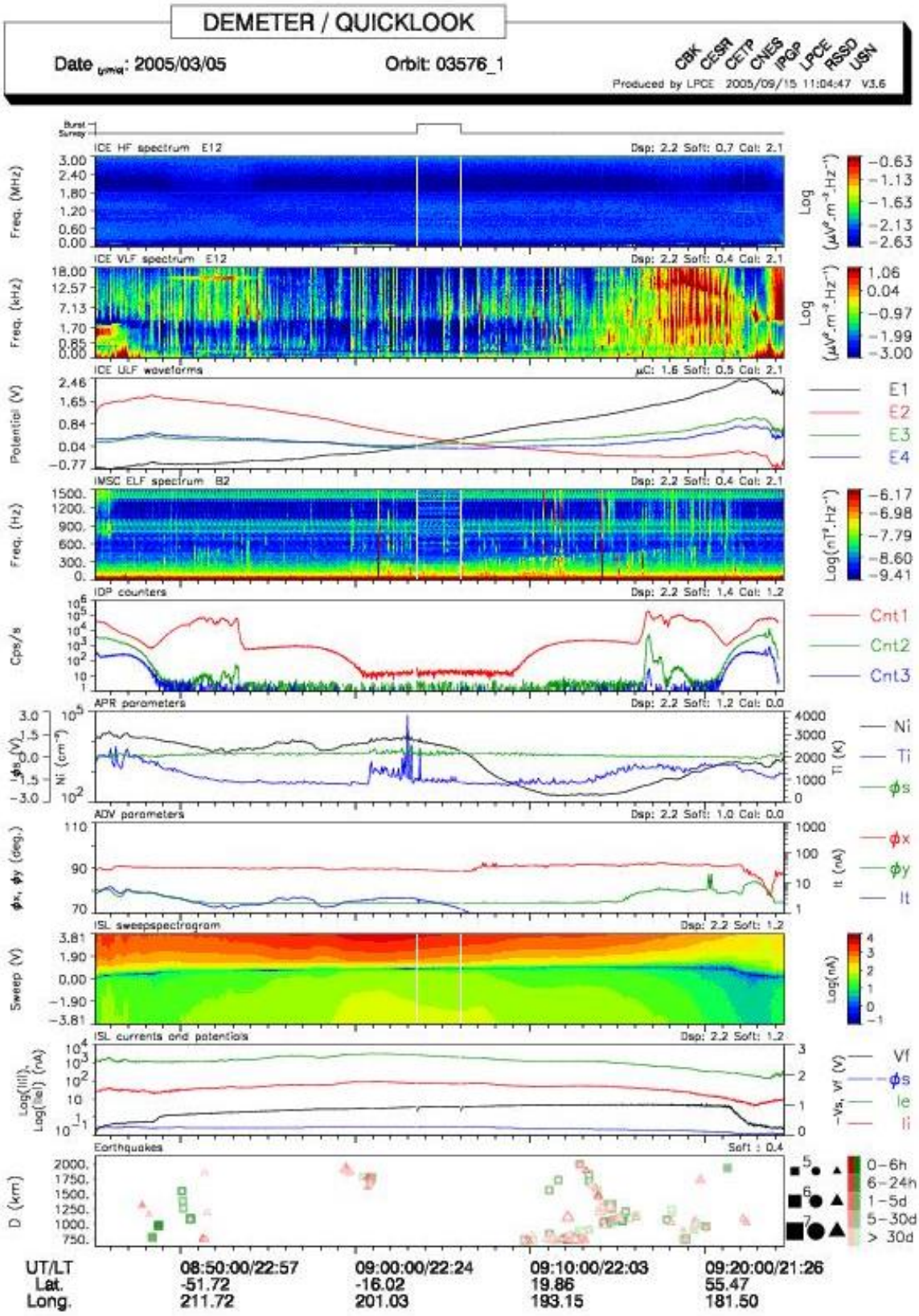
where ν_e is the cyclotron frequency, e and m_e are the electron charge and mass, respectively, H is the Earth magnetic field at the given point and c is the velocity of light.

In Fig.2 the spectrogram registered by the French spacecraft DEMETR is presented. As it is seen, the radiation frequency changes depending on the geographical latitude. White dots

correspond to the cyclotron radiation frequencies calculated by (1) with the magnetic field measured by the DEMETR spacecraft. As seen from Fig.2, there is a rather good agreement.



a



b

Fig.1. The measurement results from the spacecraft DEMETR.
a) measurement from the sunny side, b) measurement from the shadow side.

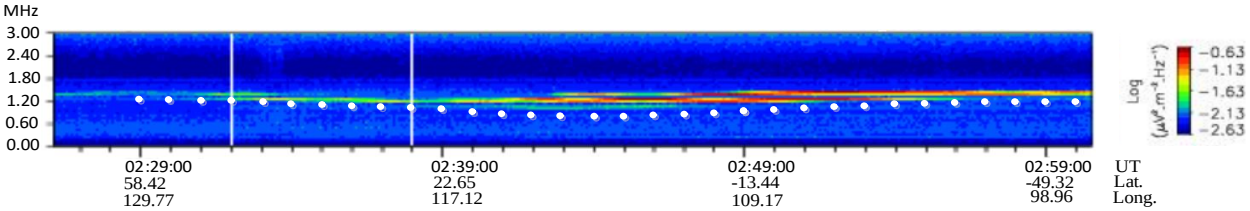


Fig.2. The spectrogram registered by the French spacecraft DEMETR. As it is seen, the radiation frequency changes depending on the geographical latitude. The white dots correspond to the cyclotron radiation frequencies calculated by using the value of the magnetic field measured by the DEMETR spacecraft.

2. Conclusion

Finally, the following conclusions can be made.

In spaceships under the influence of solar radiation from solar converters occurs megahertz radiation of electromagnetic waves. The frequency of this radiation is determined by the Earth's magnetic field. The radiation frequency is greater near the poles (where the magnetic field is stronger) and it is less near the equator (where the magnetic field is weak). Based on this, we can conclude that this radiation corresponds to the cyclotron radiation in the Earth's magnetic field.

Funding

The paper has been supported from Basic financing of IAPP NAS RA.

Acknowledgments

The authors are grateful to the Vardan Sargisyan for his technical support.

References

[1] R. Aramyan, G. R. Aramyan, K. P. Haroyan, G. A. Galechyan, A. A. Vardanyan, G.A. Danielyan, H.B. Nersisyan, S.G. Bilén, Acoustical Physics, **57** (2011) 432.

[2] R. Aramyan, S.A. Aramyan, S.G. Bilén, The 31st International Conference on Phenomena in Ionized Gases, (Granada Spain 14–19 July 2013) (2013) 494.

[3] A.R. Aramyan, S. A. AramyanS.A., S.G. Bilén, L.Sh. Grigoryan, H.F. Khachatryan, Chin. Phys. Lett., **32** (2015) 034101-1.

[4] A.H. Mkrtchyan, L. Sh. Grigoryan, H. F. Khachatryan, S. G. Bilén, M. Parrot, A. V. Sargsyan, and A. R. Aramyan, IEEE Transactions on Plasma Science, **47** (2019) 118.