UDC 330:53.09

STILIYAN ZH. STOYANOV
Space Research and Technologies Institute – Bulgarian Academy of Sciences

SPECTROPHOTOMETER FOR ATMOSPHERIC OZONE RESEARCH – RECEIVER REACTION OF IRRADIATION WITH COMPLEX SPECTRAL COMPOSITION*

One of the basic problems in elaboration of spectro-photometer for atmospheric ozone research at the Space Research and Technologies Institute – Bulgarian Academy of Sciences seems to be the necessity of calculation of output signal of the irradiating receiver by fixed spectral composition and intensity. The calculation wouldn't be difficult if the intensity values range is situated on the linear part of the irradiating receiver energetic characteristic. To the end, the absolutely spectral characteristic of receiver sensibility and spectral density of the treated receiver intensity has to be known.

The paper is dedicated to the elaboration and the obtained results by offering and creating a method for definition of the irradiating receiver output signal by fixed spectral composition and intensity

In the paper presents the obtained schemes and equations in the process of elaboration characterizing the reaction of the photo-receiver complex spectral composition with nonlinear energetic characteristic.

As spectrophotometer for atmospheric ozone exploration development at the Space Research and Technologies Institute – Bulgarian Academy of Sciences [1–7] come into being the necessity of calculation of the output signal of the irradiating receiver by fixed spectral composition and intensity. The calculation wouldn't be difficult if the intensity values range is situated on the linear pan of the irradiating receiver spectral characteristic. To the end, the absolutely spectral characteristic of receiver sensibility and spectral density of the treated receiver intensity has to b e known (r,λ) [8–11]:

$$N = \varphi(\lambda_0)\int_{\lambda} r_{\lambda}\varphi(\lambda)d\lambda , \qquad (1)$$

N – the irradiating receiver output signal;

$\varphi(\lambda_0)$ – the irradiating receiver sensibility in the maximum of the sensibility ;

$\varphi(\lambda)$ – relative spectral characteristic.

The paper is dedicated to the elaboration and the obtained results by offering and creating a method for definition the irradiating receiver output signal by fixed spectral composition and intensity. Because of that the irradiating receiv er energetic characteristic and sensibility relative spectral characteristic has to be known.

Consecutively it is calculated the irradiating receiver output signal in the wave lengths λ_0 and λ_1. According to [12] the receiver energetic characteristic can be made as follows:

$$\begin{aligned} N_0 &= \varphi'(\lambda_0)F_{\lambda}(\lambda_0)\Delta\lambda \\ N_1 &= \varphi'(\lambda_1)F_{\lambda}(\lambda_1)\Delta\lambda \end{aligned}, \qquad (2)$$

or

* *Друкується в авторській редакції.*

$$N_0 = (\lambda_0)[F_\lambda(\lambda_0)\Delta\lambda]^{\chi_0}$$
$$N_1 = (\lambda_1)[F_\lambda(\lambda_1)\Delta\lambda]^{\chi_1}, \qquad (3)$$

where: N_0 and N_1 – the treated receiver output signal with the respective fluxes $F_0 = F_\lambda(\lambda_0)\Delta\lambda; F_1 = F_\lambda(\lambda_1)\Delta\lambda$ and $F_\lambda(\lambda_0)$;

$F_\lambda(\lambda_1)$ – spectral density of the flux in wave length λ_0;

$\Delta\lambda$ – wave lengths range in the limits of which $F_\lambda(\lambda_0,\lambda_1) \approx const$;

$\varphi^I(\lambda_0),\varphi^{II}(\lambda_1)$ – the irradiating receiver sensibility to the irradiation in the wave lengths λ_0,λ_1 and intensity F_0,F_1;

$\varphi(\lambda_0),\varphi(\lambda_1)$ – the $\varphi^I(\lambda_0),\varphi^{II}(\lambda_1)$,limited values;

χ_0,χ_1 – index, characterizing the extent of the irradiating receiver energetic characteristic depends on the output signal level.

The phrase (3) is good for the spectral characteristics description of the irradiating receiver.

It is shown the energetic charact eristics of an irradiating receiver to its irradiation with lengths λ_0 and λ_1 on fig. 1.

For definition the irradiating receiver output signal through making an effect with total irradiation on it, it can put in wri ting:

$$F_\Sigma = F_0 + F_1, \qquad (4)$$

The F_0 flux respects of the energetic characteristic working point 1 for λ_0 (fig. 1). Through irradiation on receiver with additional flux F_1 with the length λ_1 the abscise working point relative to the F_1 value moves into the point 2.

The output signal value N_Σ corresponding to the ordinate point 4. The ratio of the intervals lengths 1–5 and 2–3 is $\varphi(\lambda_0)/\varphi(\lambda_1)$ and for N_Σ definition it can be used the energetic characteristic only:

$$N_\Sigma = \varphi(\lambda_0)\left[F_\lambda(\lambda_0)\Delta\lambda + F_\lambda(\lambda_1)\frac{\varphi(\lambda_1)}{\varphi(\lambda_0)}\Delta\lambda + \right]^{\chi_\Sigma}, \qquad (5)$$

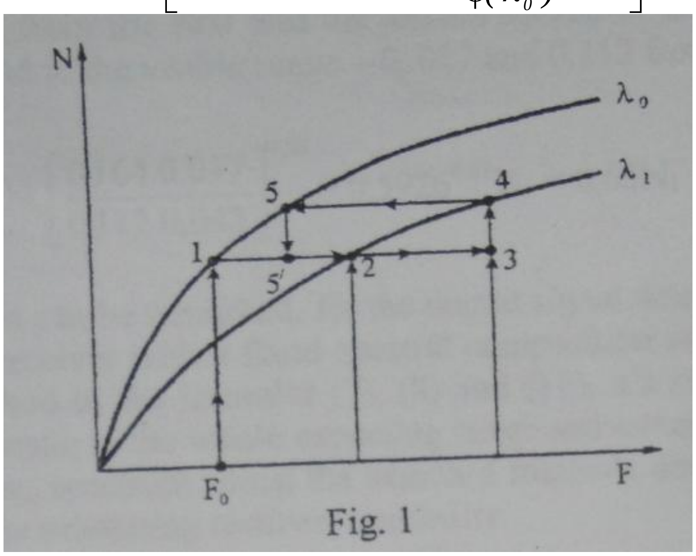

Fig. 1. Energetic characteristics of an irradiating receiver to its irradiation

With the increasing of the spectral parameters number and proceeding from $\Delta\lambda$ to $d\lambda$ is as follows:

$$N_{\Sigma} = \varphi(\lambda_0)\left[\int_{\lambda} F_{\lambda}(\lambda)\varphi d\lambda\right]^{\chi_{\Sigma}}, \qquad (6)$$

wbere: $\varphi(\lambda)$ – the relative sensibility spectral characteristic of a irradiating receiver;

χ_{Σ} – energetic characteristic index of λ_0 in a point of the abscise equal to $\varphi(\lambda_1)/\varphi(\lambda_0)$.

From phrases (5) and (6) can be made important practical conclusions:

1. A family of all wave lengths energetic characteristics from a total energetic characteristic can be replaced, in relative coordinates $N = \varphi(\lambda_0)$ constructed, where $F_e = \int_{\lambda} F_{\lambda}\varphi(\lambda)d\lambda$ falling on the receiver effective flux.

The output signal calculations N_i, of an irradiating receiver of with a fixed spectral composition and intensity F_{ii} irradiation are in the formula:

$$N_i = N_0 \frac{F_{e_i}^{\chi_i}}{F_{e_0}^{\chi_0}}, \qquad (7)$$

where N_0 of an irradiating receiver output signal from a standard source with effective flux $F_{i0.}$

If in a fixed range of the output signal change the index $\chi_i - \chi_0 = \chi = const$, so the formula (7) turns to

$$N_i = N_0 \left(\frac{F_{e_i}}{F_{e_0}}\right)^{\chi}, \qquad (8)$$

and the χ value characterizes a tangent-slope of the irradiating receiver energetic characteristic.

The value $\varphi(\lambda_0)$ is not depending on the effective flux F_i, value.

At recording an irradiation of the optical spectrum visible and u range the output signal value in the ultraviolet range N and Φ in the visible range as follows:

$$\begin{cases} N_1 = \varphi(\lambda)_{max}\left[\int_{\lambda} F_{1\lambda}\varphi(\lambda)d\lambda\right]^{\chi_1} \\ N_2 = \varphi(\lambda)_{max}\left[\int_{\lambda} F_{2\lambda}\varphi(\lambda)d\lambda\right]^{\chi_2} \end{cases}, \qquad (9)$$

$$\begin{cases} \Phi_1 = k(\lambda)_{max}\int_{\lambda} F_{1\lambda}k(\lambda)d\lambda \\ \Phi_2 = k(\lambda)_{max}\int_{\lambda} F_{2\lambda}k(\lambda)d\lambda \end{cases}, \qquad (10)$$

where: $k(\lambda)$ – the relative spectral characteristic of the receiver sensibility in the visible range;

$\varphi(\lambda)$ – the relative spectral characteristic of the irradiating recent sensibility in the ultraviolet range;

$k(\lambda)_{max}$ – the absolute spectral sensibility of the irradiating receiver in the visible range;

$\varphi(\lambda)_{max}$ – the absolute spectral sensibility of the irradiating receiver in the ultraviolet range.

Solving the equations system in respect of N_2:

$$N_2 = N_1 \left[\frac{\int\limits_{\lambda} F_{1\lambda} k(\lambda) d\lambda}{\Phi_1 \int\limits_{\lambda} F_{1\lambda} \varphi(\lambda) d\lambda} \right]^{\chi_1} {}_1 \left[\frac{\Phi_2 \int\limits_{\lambda} F_{2\lambda} k(\lambda) d\lambda}{\int\limits_{\lambda} F_{2\lambda} \varphi(\lambda) d\lambda} \right]^{\chi_2}, \qquad (11)$$

Reporting on the effectiveness coefficient [13] of the receiver sensibility the ultraviolet range $k_1(F)$ and in the visible range $k_2(F)$, then for N_2 it is getting:

$$N_2 = N_1 \frac{\left[\dfrac{\Phi_2 k_1(F_2)}{k_2(F_2)} \right]^{\chi_2}}{\left[\dfrac{\Phi_1 k_1(F_1)}{k_2(F_1)} \right]^{\chi_1}}, \qquad (12)$$

For the examining receiver $\chi_1 = \chi_2 = 0{,}83$. The effectiveness coefficient of tb< receiver sensibility from the first and the second source in the ultraviolet range is 0,042 and 0,164 and in the visible range – 0,017 and 0,112 from where

$$N_2 = N_1 \left[\frac{0{,}164}{0{,}112} \frac{0{,}017}{0{,}042} \right]^{0{,}83} = 0{,}5926^{0{,}83} N_1 = 0{,}65 N_1$$

It can be concluded that the output signal determination of the irradiating receiver with a fixed spectral composition and a fixed intensity in the presented method in the formulas (7), (8) and (11), it's enough to be found its energetic characteristic in the whole expecting range and intensity of the source with a known irradiating spectrum using the standard methods and the relative spectral characteristic of the irradiating receiver sensibility.

References

1 Boychev B. Small Two-channel photomers for the Projects «Active» «APEKS» / B. Boychev //Aerospace Research in Bulgaria Journal. – 1998. – No 14. – P. 92–97.

2 Getsov P. Space, Ecology, Security / P. Getsov // New Bulgarian University. – Sofia, 2002. – 211 p.

3 Getsov P. Seminatural Construction of Systems for Flight Control of Unmanned aircraft / P. Getsov // SRI – BAS. – Sofia, 2002. – 380 p.

4 Iliev I. Spectrophotometric System for Solar and Atmospheric Research / I. Iliev // Electronics and Electrotechnics. – 2000. – № 3–4. P. 43–47.

5 Combined Satellite Monitoring of the Temperature Anomaly in August 1998 / [Manev A., Palazov K., Raykov S., Ivanov V.] // Journal of IX National Conference with International Participation «Basic Problems of the Solar-Terrestrial Interferences», CLSR – BAS. – Sofia, 2002. – P. 153–156.

6 Tsanev V. Correlation analysis of the quantities characterizing the absorption by atmospheric water vapor and oxygen / V. Tsanev, L Iliev // Compt. rendue de L Academie bulg. des Sci. – 2001, – № 5, vol. 54. – P. 15–20.

7 Satellite Absorption Ozonemeter Aerospace research in Bulgaria / [L. Hristov, J. Jekov, G. Mardirossian, D. Ivanova]. – 1999. – № 15. – P. 27–32.

8 S. Gushkin L S. Theory of optimum radioreceiving methods by fluctuational noises / S. Gushkin L S. – Moskow: Nauka, 1998 (in Russian).

9 Ivanov K. I. Optical signals determination / K. I. Ivanov. – Moskow: Nauka, 1998 (in

Russian).

10 Petit R. C. Nour Rev / R. C. Petit // Opt. – 2002. – Vol. 38. – 986 p.

11 H. Kiahor H. A., Nevrether A. K. IOSA. – 2001. – Vol. 176. – P. 29.

12 Novitzki P. V. Information theory of the measuring devices base , P. V. Novitzki // L., "Energia 1988 (in Russian).

13 Kogelnik H.R. Bell. Syst. Techn. J. – 1995. – Vol. 38. – P. 322–349.

14 Bauer G Appi. Opt. – 1998. – № 6, vol 7. – P. 1017–1021.

УДК 330:52.1

Б. Я. ПАНАСЮК
Науково-методичний і координаційний центр з наукових проблем розвитку агропромислового комплексу України Національної академії аграрних наук України

ВЧЕННЯ В. ВЕРНАДСЬКОГО ТА ПІЗНАННЯ ПРИРОДИ

Розглядаються дискусійні питання, що стосуються складних кліматичних та інших природних процесів, а також перспектив їх розвитку.

Ключові слова: земля, природні ресурси, вчення В. І. Вернадського, стадія розвитку, сталий розвиток.

Contemporaries increasingly wonder: what happens on Earth and what are the prospects. Similar questions appear difficult periods in a society where people are troubled with defective mentality that encourages people throughout the trust. Research and many practical examples show that in the universe, the solar system and the Earth dominates total balance in all things, which is to the same degree observed between all parts of living matter , ie living organisms flora and fauna from the cell. Thus harmony - it is the law of nature, the violation of which leads to disasters and unpredictable natural and economic outcomes. Balance maintains a constant amount of living matter, which, in the opinion of Academician V. Vernadsky, unchanged since the beginning of the Cambrian era.

Key words: land, natural resources, the theory of Vernadsky, stage of development, sustainable development.

Постановка проблеми. На планеті Земля відбуваються складні кліматичні й інші природні процеси. Перед сучасниками все більше постає завдання з'ясувати суть усіх процесів та перспективи їх розвитку.

Аналіз останніх досліджень та публікацій. Людина інтуїтивно відчуває певні порушення в природі, відсутність рівноваги, що викликає у неї сумнівні роздуми і запитання, котрі ґрунтуються на об'єктивних процесах. Наукові дослідження та деякі реальні приклади свідчать, що у Всесвіті, Сонячній системі і на планеті Земля панує повна рівновага в усьому, яка так ою ж мірою притаманна складовим живої речовини, тобто живим організмам рослинного і тваринного світу, починаючи з клітини. Таким чином, рівновага – це закон природи, порушення якого призводить до катаклізмів і непередбачуваних природних та економічних наслідків. Рівновага підтримує постійну кількість живої речовини, яка, на думку академіка В. Вернадського, залишається незмінною, починаючи з кембрійської епохи.

Мета статті полягає у виявленні взаємозв'язку між природою і людським суспільством. Подолати розрив між можливостями природи і