Observation of Aurora Noise at Syowa Base

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昭和基地におけるオーロラノイズの観測

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要　旨

1. 目　的　オーロラが出現したとき，その部分の高層大気中に局部的に電子密度の高い領域があると考えられている．その高電離気体から輻射される電波の性質を知ることはオーロラの発光機構を説明する一つの手がかりとなるので，或る角度に向け固定されたパラボラアンテナと3000 MCの受信機によりノイズレベルを連続記録し，他部門のデータと比較研究する．

2. 結　果　今回は記録装置に打点式を使用したこと，基地内部のノイズレベルが予想外に高かったため，必ずしも満足なデータを得られなかったが，オーロラおよび擾乱を受けた高層大気から輻射される 3000 MC 帯の電波の存在が大略実証され，その地磁気，オーロラ強度，E_s電離層の突抜周波数の急変との相互相関もかなり良く，その詳細なる解析を続行中である．

1. Introduction

At the appearance of aurora, the local domain of high electron density will be assumed in the troposphere the aurora occupies. To investigate the property of radio waves radiated from the highly ionized gas gives a clue to the explanation of mechanism of aurora luminescence and to the analization of the phenomenon of troposhere caused by proton beams from the sun. The electromagnetic wave radiated from ionized gas is in the first place considered to come from the oscillation, caused by spin of electrons or NO^-, O_2^-, N_2^-, ions from terrestrial magnetism, where the frequency is expected to equal to that of the spin. Generally the gyro frequency of the ionosphere is about 1.0–1.4 Mc, but inside of aurora, because of the local domain of high electron density, they are supposed to be one or two figures Mc.

Next, the oscillation of higher frequency band is expected from plasmic oscillation of high electron density domain. According to the report[1] by FORSYTH and others, in Saskatoon, CANADA in 1949, they succeeded in receiving aurora noise at 3000 Mc. So we recorded noise level continuously by means of beam antenna set at certain direction, and carried out comparative research with other sections.

2. Observation apparatus

Choosing the wave of higher frequency brings more sharp directivity to a smaller antenna dimentions; enough results are expected with less materials from the plan

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of 30 tons air transport; a wave of low frequency is apt to be interfered with from in or outside the base. Considering these conditions and our materials on hand, we decided to observe at 3000 Mc mainly, and 60 Mc sometimes.

The circuit blockdiagram is shown in Fig. 1. A parabollic antenna is fixed on the roof of a dwelling cabin at a definite angle. The wave is converted to 44 Mc with

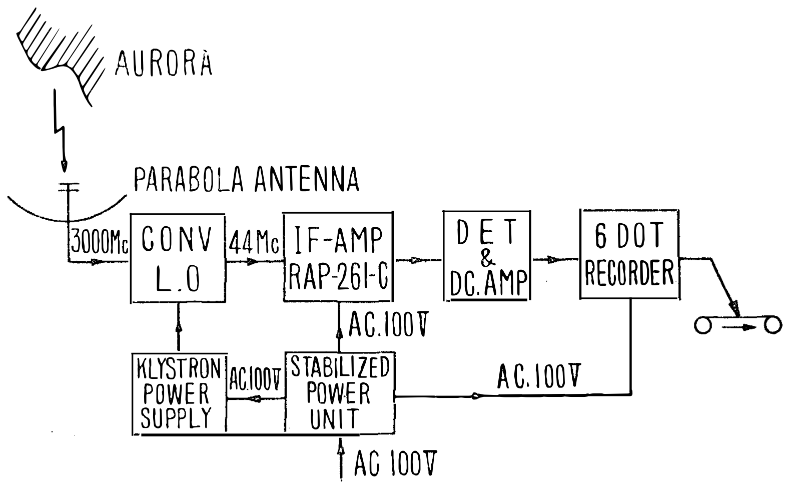

Fig. 1. Circuit blockdiagram of Aurora noise observation apparatus.

converter, amplified with communications receiver made by Nippon Denki type RAP-261-C, took out IF signal, let it pass through DC amplifier after detection, and record with 6 dot recording type dc milli-ampere meter made by Yokogawa, used in the section of terrestorial magnetism. Klystron 707B is oscillated independently with stabilized power unit.

The ability of this apparatus is shown in Table 1.

Table 1. The ability of observatory Apparatus of aurora noise.

Sensitivity	140 db
Maximum band width (3rd 1F)	±12 Kc (6 db down)
Antenna gain	17 db (3000 Mc)
Stability of 1st local oscillater (+10°-+30°)	8×10^{-6}
Turning of 1st local oscillater	Cavity
Circuit of 1st mixer	Coaxial cavity with 1N23B
S/N ratio	1 μV/10 db
Deflextion of the recorder according to 1 μV at the receiver input	1.31 mm/75 Ω

3. Result of observation

March 15, 1959.	Into routine, continuing adjustment and waiting the apparatus become stable.
March 26, 1959.	The first noise signal of +2 db received.
From September 1959.	Noise of the base increased.
September 10, 1959.	Antenna directed to zenith.

December 17, 1959.	The observation stopped, having no nights.
December 26, 1959.	The observation reopened for investigation of the effect of white night.
January 15, 1960.	The observation stopped. The apparatus put off and packed.

Miss-observation during this term amounts to 776 hours.

Fig. 2 shows the direction of antenna.

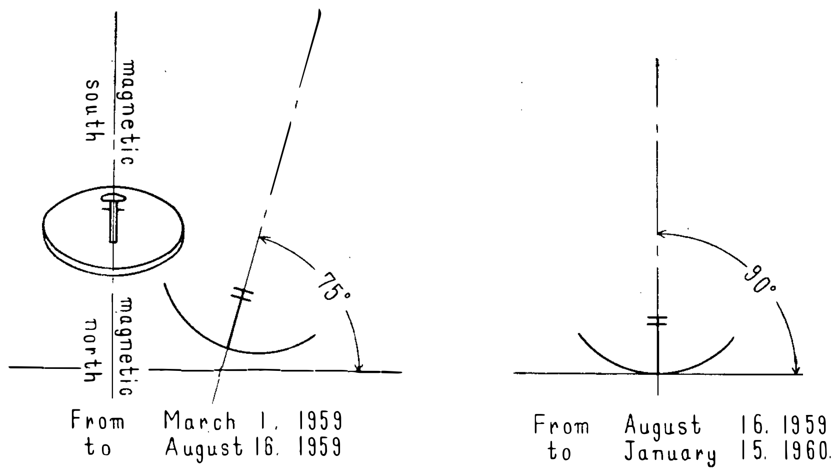

Fig. 2. Direction of Antenna.

Fig. 3 shows some examples of the results of our observations obtained simultaneously with the data of terrestorial magnetism, the strength of aurora glow and the critical frequency of the ionosphere; and the mutual good correlation. The noise signal from the aurora is a shorter periodic pulse, and regrettably no correct wave figure was received in record by means of the dot recorder with period of about one minute and half. For this reason, we often miscaught the noise signal of ray-structure which removed much, and so we obtained most data on those of homogeneous structure.

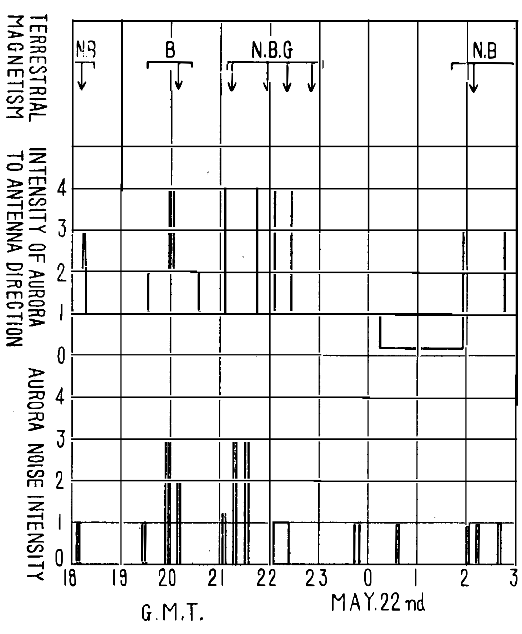

Fig. 3. An example of observation obtained simultaneously with the data of terrestorial magnetism and intensity of aurora grow.

On the ray-structure, the record was obtained symultaneously by both visual observation by Wild and reading of output level meter, from 23:20, Aug. 1st 1959. till 0:53, Aug. 2nd, L. T. at Syowa Base.

The result shown in Fig. 4.

As the figure shows, fairly good correspondence can be recognized between the brightness of aurora and the noise pulse signal.

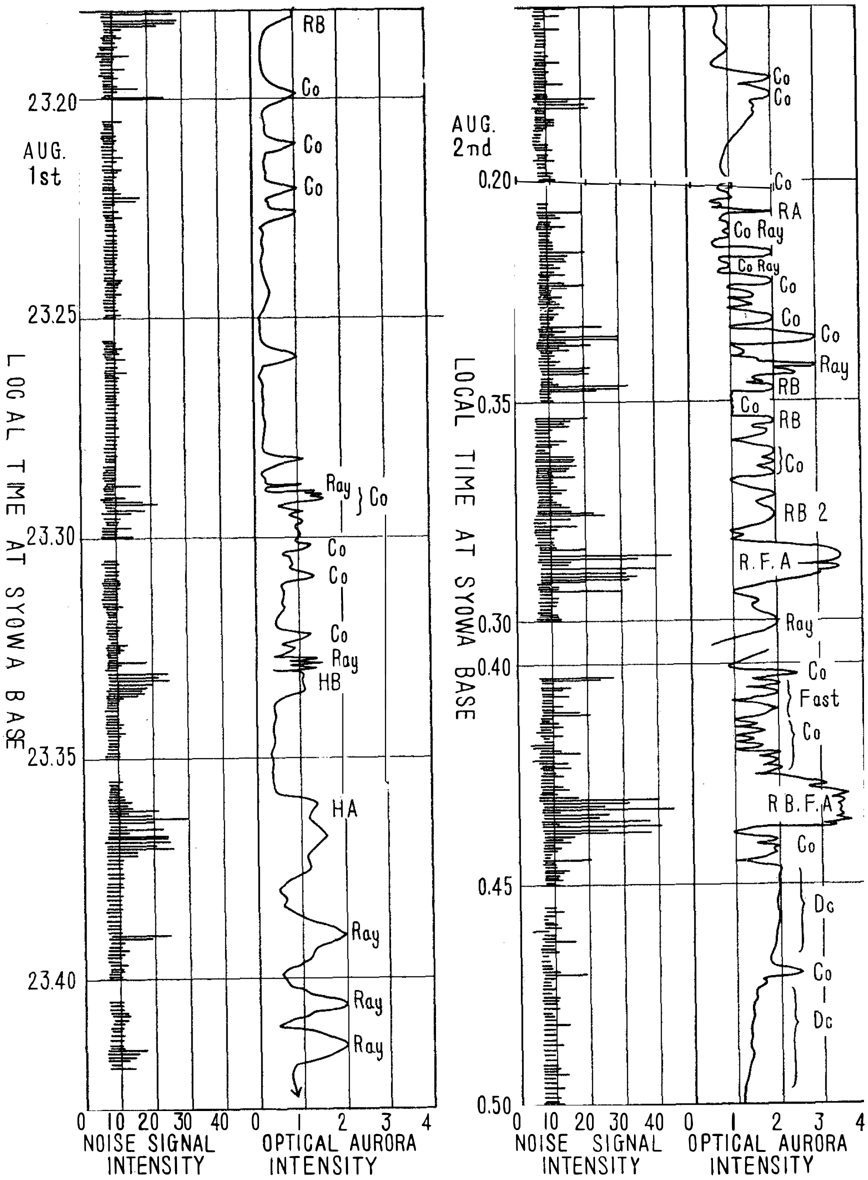

Fig. 4. Record was obtained symultaneously by both visual observation by Wild and reading of output level meter.

4. Conclusion

To analyze the result of the present observations, a simultaneous comparison will be needed, with data of terrestorial magnetism, earth current, strength and optical spectrum of aurora and ionosphere. We have accomplished it for the data of May 23rd, 1959, and are now proceeding with the rest, in collaboration with the other sections. Much more time may be needed for further analysis in detail, so we offer the present paper as an interim report.

Our poor experiences and lack of materials bought insufficient data. More sufficient data should be expected by the following improvements:

1. Adopt single IF stage and expand its band (to more than ±500 Kc).
2. Record continuously the strength of aurora glow with setting the photo-sell

pararelly directed to the parabolic antenna.

3. Improve the recorder to a continuous type, and increase the paper speed to about 3 cm/min.
4. Prevent the interference of artificial noise.
5. Observe the wave figure with a wide band syncro-scope.

Here I wish to express many thanks to Prof. NAGATA, Univ. of Tokyo, and to 13 members, who helped and encouraged me the whole year I spent together with them.

Reference

1) Nature, **164**, 453 (1950).