

# Lützow-Holm 湾の Aurora

中 村 純 二\*

## AURORA OBSERVATION AT LÜTZOW-HOLM BAY

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### Abstract

On board the "Soya", expedition ship to Antarctica, visual observations of aurora australis were made during Feb. and Mar. 1957 at Lützow-Holm Bay. The results show that Lützow-Holm Bay lies just under the auroral maximum zone, and the main features of aurora australis are not different from those of borealis.

**Appearance of Aurora** In JARE I (the 1st Japanese Antarctic Research Expedition) the "Soya" stayed in the Antarctic Ocean from the beginning of Jan. 1957 to the first part of Mar. 1957. But till Feb. 17/18 the sky was too bright to observe aurora. Between Feb. 18/19 to Mar. 2/3, there were six fine nights on which we could always distinguish the aurora activity as shown in Table 1, which shows that Lützow-Holm Bay corresponds to the auroral maximum zone.

The  $\lambda$  5577 Å intensity was also measured by a photomultiplier prepared for the purpose of night airglow observation. Since aurora intensity was too big, our records usually scaled out which showed the intensity of  $\lambda$  5577 Å to be more than 2000 Rayleigh. In JARE II we intend to carry a logarithmic amplifier which will enable us to record both aurora and night airglow intensities.

**Results** Data from our visual observation are summarized in the Appendix. The following results are obtained.

a) SKY DISTRIBUTION The whole hemisphere was divided into 17 sections as shown in Fig. 1 and Table 2.

From these data we may conclude that the auroral maximum zone lies just above the Lützow-Holm Bay (about 65°S, 35°E) and across the bay from WSW to ENE.

b) TYPE DISTRIBUTION Type distribution of observed aurora is shown in Table 3. All of the known aurora types were observed in the southern hemisphere.

c) COLOUR, MOVEMENT AND OTHER FEATURES The colour of the visible aurora was mostly yellow-green corresponding to OI  $\lambda$  5577 Å. Only a few RB had red lower border corresponding to N<sub>2</sub> 1 P.G.  $\lambda$  6550 Å. It is supposed that under the maximum zone the red or violet auroras are not scarce in absolute abundance, but their relative frequency to the yellow-green aurora is very small compared with that of low frequency zone.

Movement takes place from south to north gradually during the display, and in a single aurora, very rapid motion from SW to NE is seen frequently, which direction coincides symmetrically with that of the northern

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hemisphere (inclined about  $10^\circ$  to the geomagnetic circles of longitude). Pulsations are also seen in RB, RA, HB and S, their periods being about 1/10 to 1 sec and lasting about 1 to 10 min.

The form of especially the lower border was not very clear. It is supposed by us that these circumstances occurred on account of our location being too near the aurora display.

All of the present work, however, is only preliminary. To investigate aurora australis more quantitatively, we intend wintering at the "Syowa Base" at  $69^\circ\text{S}$  and  $39^\circ\text{E}$  in 1958

(JARE II).

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1957 年の 2 月と 3 月, 我々 JARE I (第 1 次日本南極地域観測隊) の極光班は, Lützow-Holm 湾にあつて, 宗谷の船上で南極光を観測した. 此の結果, Lützow-Holm 湾一帯は, 丁度極光最頻度帯の真下に当つていることが判明した. ここで観測された極光の諸性質は, 本質的には北極光と相違はなかつた.

## 極 光 の 出 現

JARE I の遠征において, 宗谷は 1957 年 1 月初より 3 月上旬まで南氷洋にあつたが, 2 月 17/18 日までは空が明る過ぎて, 極光を見分けることは出来なかつた. 2 月 18/19 日から 3 月 2/3 日までの間に, 晴れた夜は 6 晩あつたが, そのいずれの夜にも極光は出現した. 第 1 表には, これら極光の出現した 6 夜について, 時間と位置を示してある. これから, Lützow-Holm 湾一帯は極光最頻度帯に属することが分かる.

第 1 表 極光出現時間と位置  
(観測はすべて宗谷船上で行われた)

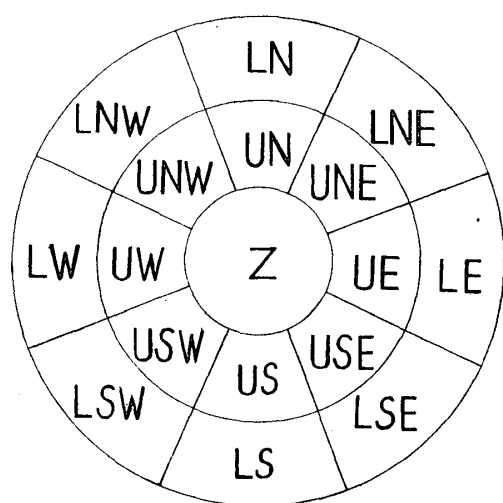
Table 1. Time and Location of Aurora Activity.  
(Site: On Board of the Soya.)

日 Date	時 刻 Time (G.M.T.)	位 置 Location	観 測 者* Observer*
Feb. 18 / 19	20 : 42 ~ 22 : 00	$68^\circ 22' \text{S}$ $38^\circ 42' \text{E}$	N. O. M.
21 / 22	19 : 55 ~ 23 : 00	$68^\circ 17' \text{S}$ $38^\circ 13' \text{E}$	N. O. M.
23 / 24	21 : 15 ~ 22 : 55	$68^\circ 14' \text{S}$ $36^\circ 58' \text{E}$	N. M.
26 / 27	21 : 50 ~ 22 : 00	$68^\circ 08' \text{S}$ $35^\circ 46' \text{E}$	N.
28 / 1	21 : 00 ~ 22 : 00	$68^\circ 06' \text{S}$ $35^\circ 00' \text{E}$	N. M.
Mar. 2 / 3	18 : 55 ~ 01 : 00	$60^\circ 17' \text{S}$ $28^\circ 38' \text{E}$	N. O. M.

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夜光の船上観測用の受光器によつて、極光出現時の  $\lambda 5577 \text{ \AA}$  強度も測定したが、今回は、直流増巾器の準備しなかつた為、記録計がスケールアウトして、絶対値を決めることは出来なかつた。2000 R 以上あることが分つただけである。JARE II には、対数増巾器を用意して、夜光と極光の関聯、並びに極光の絶対強度を調べる計画である。

## 結 果



第1図 天球の分割

Fig. 1. 17 Sections of the sky.

眼視観測の結果は付録に要約した通りで、高度・方位共精度は  $5^\circ$  である。これから引出される結果を以下要約する。

**a) 空間的分布** 第1図のように、高度的には天頂角  $28^\circ$  と  $58^\circ$  で3部分に区切り、方位は天頂を除いて8方位に分割した。極光の下縁の高さが100 km であるとすれば、天頂角  $28^\circ$  と  $58^\circ$  は、それぞれ観測点から30 哩及び90 哩の地帯を表わすことになり、例えば南北方向では、これによつて、緯度  $1^\circ$  おきの極光頻度分布が得られることになる。第2表には、これら17 区画に出現した極光の頻度を示してある。

第2表 極光の空間的分布

Table 2. Sky distribution of aurora.

方 位 Direction	N	NE	E	SE	S	SW	W	NW
高 度 (天頂角) Altitude*	$338^\circ \sim 22^\circ$	$23^\circ \sim 67^\circ$	$68^\circ \sim 112^\circ$	$113^\circ \sim 157^\circ$	$158^\circ \sim 202^\circ$	$203^\circ \sim 247^\circ$	$248^\circ \sim 292^\circ$	$293^\circ \sim 337^\circ$
L $90^\circ \sim 58^\circ$	67	89	132	78	63	60	65	57
U $58^\circ \sim 28^\circ$	56	68	74	46	58	68	70	56
Z $28^\circ \sim 0^\circ$	167							

\* Assuming the aurora's lower edge is about 100 km high,  $28^\circ$  and  $58^\circ$  of zenith distance correspond to 30 miles and 90 miles respectively from the observed place.

第2表から、極光最頻度帯は我々の観測地点( $68^\circ \text{S}$ ,  $36^\circ \text{E}$ )の僅かに北方を WSW から ENE にかけてよぎつていくことが結論される。

**b) 型及び強度の分布** Lützow-Holm 湾でも、北半球で見られるすべての型の極光が出現した。その頻度分布、並びに強度による分布は第3表の通りである。

第3表 極光の型並びに強度から見た頻度分布

Table 3. Type and intensity distribution.

型 Type		G	A <i>or</i> H A	H B	R	R A	R B	G	D	F	S	
強 度	Intensity*	w	8	17	116	44	0	24	0	8	34	47
		m	3	50	268	110	0	150	15	0	32	43
		b or vb	0	0	90	51	4	84	58	18	0	0
計 Total		11	67	474	205	4	258	73	26	66	90	

- \* w : 弱い極光 (銀河程度の明るさ)  
weak or faint (brightness of Milky Way)  
m : 中程度の極光 (月に照された巻雲程度の明るさ)  
medium (brightness of moonlit cirrus cloud)  
b : 明るい極光 (月に照された積雲程度の明るさ)  
bright (brightness of moonlit cumulus cloud)  
vb : 極めて明るい極光 (b より明るく輝くもの)  
very bright (much brighter than b)

c) 色, 運動, 其他の特性 出現した極光の殆どすべては, OI の 5577 Å 線を主調とした黄緑色を呈し, 僅かに数回だけ  $N_2$  の 1P. G. (6500 Å) に基づくと思われる下縁の赤い RB が現われた. 極光最頻度帯では, 中緯度地方に比べて赤や紫の極光の絶対頻度は決して少くはないが, 黄緑色極光に対する相対頻度が極めて少いので, このような結果になったものと考えられる.

一連の現象全体としては, 南から北へ, あるいは SE から NW への移動が見られるが, 個々の極光については, SW から NE への極めて急速な運動が見られる. この運動の方向は磁氣的経線に約  $10^\circ$  傾いており, 北半球における運動方向と丁度点対称の関係にある.

RB, RA, HB や S の場合には, 顕著な脈動が屢々観測され, 周期は  $1/10 \sim 1$  秒, 継続時間は  $1 \sim 10$  分であつた.

形の特徴として, 下縁のはつきりしないものが多かつたが, これは, 観測点が極光の活動場所に余りにも近過ぎた為であると思われる.

特に, 北半球の極光に対して著しい相異はないらしい. しかし, もつと詳しく調べ, 分光的観測もしなくては, 正確なことは云えない. 我々は来る 1958 年の第2次日本南極観測の際, 一年間昭和基地に滞在して, 定量的な測定をも行う計画である.

最後に, この仕事を行うに当つて, 絶えず激励し推進して頂いた日本南極観測隊隊長永田教授, 並びに有益な御忠告や御援助を頂いた東京天文台の古畑教授に, 心から感謝の意を捧げたいと思います. また現地の観測の手伝いをして下さった小口・百瀬両隊員の労に対しても, 厚く御礼申し上げます.

## APPENDIX

Observed Aurora Data in JARE I, 1957.

## TYPE

G : Glow    A : Arc    HA : Homogeneous Arc    HB : Homogeneous Band

R : Solitary Ray or Bundle of Rays    RA : Arc with Ray Structure

RB : Band with Ray Structure    C : Corona    D : Drapery

F : Flaming Aurora    S : Surface or Patched Aurora    PS : Pulsating Surface

## COLOUR

YG : Yellow-green    W : White    G : Grey    RL : Red Lower Border

Y : Yellow

Time (G.M.T.)	Type	Altitude	Direction	Intensity	Colour	Motion
Feb. 18/19 20:42-20:45	A	60°-00°	210°- 40°	w	G	W to N
20:45-20:50	HB	80°-60°	50°- 75°	m	YG	E to S
	A	30°-00°	240°- 40°	w	W	W to N
20:50-20:55	2 RB	80°-60°	50°-130°	m	YG	N to S
	A & R	50°-10°	210°- 30°	w	Y	W to S
20:55-21:00	RB	80°-60°	100°-135°	m	YG	
	4 HB	60°-10°	225°-300°	b	YG	W to S
21:00-21:05	HB	80°-65°	50°- 70°	b	YG	
	5HB & RB	70°-15°	200°-300°	b	YG	W to S
21:05-21:07	HB	80°-60°	50°-100°	w	W	E to S
	C	75°-30°	220°-300°	b	YG	W to S
21:07-21:10	HB & S	80°-30°	50°-115°	m	YG	E to S
	S	75°-35°	230°-290°	w	W	
21:10-21:15	RA	80°-70°	85°-130°	b	RL & YG	E to S
	HB & R	65°-30°	90°-135°	m	YG	E to S
21:15-21:20	C & HB	80°-65°	75°-130°	b	RL & YG	
	R	60°-30°	90°-120°	m	W	
21:20-21:25	HB & RA	80°-65°	70°-160°	b	YG	E to S
21:25-21:30	HB	80°-65°	80°-120°	m	YG	
21:30-21:45	HB	75°-65°	60°-120°	w	W	
21:45-22:00	HB	80°-70°	70°- 90°	w	W	
Feb. 21/22 19:55-19.56	3 HB	80°-67°	70°-170°	w	G	
19:56-19:57	HB	72°-67°	50°-130°	m	G	
19:57-19:59	3 HB	80°-65°	50°-120°	m	G	
19:59-20:00	RB	80°-60°	50°-110°	m	Y	to Upper
20:00-20:01	2HB & RB	85°-70°	50°-100°	m	YG	E to N
20:01-20:02	3 HB	85°-75°	70°-120°	w	G	E to S
20:02-20:03	C & 3 HB	80°-65°	80°-110°	m	YG	to Upper
20:03-20:04	D & 5 HB	85°-60°	50°-120°	b	YG	to Upper
20:04-20:05	R & D	85°-55°	50°-110°	b	YG	E to S
20:05-20:06	S & HB	85°-65°	80°-120°	w	W	E to S
20:06-20:10	S	80°-70°	100°-120°	w	G	
20:10-20:12	RB	80°-65°	70°- 90°	m	Y	
20:12-20:16	HB	80°-65°	80°-120°	w	Y	
20-16-20:18	R & 3 HB	80°-65°	80°-130°	m	Y	

Time (G.M.T.)	Type	Altitude	Direction	Intensity	Colour	Motion
Feb. 21/22 20:18-20:20	2 HB	80°-72°	70°-110°	w	Y	
20:20-20:21	R B	80°-75°	95°-110°	m	Y	E to S
20:21-20:22	HB & S	85°-70°	90°-110°	m	YG	
20:22-20:24	R B	85°-60°	80°-100°	m	YG	
20:24-20:26	HB	80°-70°	80°-100°	w	G	
20:26-20:28	R B	80°-60°	80°-110°	w	G	
20:28-20:29	R & R B	85°-45°	60°-110°	m	Y	To Upper
20:29-20:31	2 HB	85°-60°	90°-190°	m	Y	S to W
	R B	80°-70°	70°-150°	m	YG	
20:31-20:32	HB	90°-65°	80°-200°	w	G	
20:32-20:33	R & HB	85°-00°	70°-110°	m	Y	To Upper
20:33-20:34	R, R B & HB	85°-00°	45°-110°	m	Y	E to S
20:34-20:36	S & HB	90°-20°	60°-180°	m	G	E to S
20:36-20:38	HB	85°-60°	85°-170°	w	G	
20:38-20:39	R & 3 HB	90°-60°	55°-110°	m	Y	
20:39-20:40	3 HB	90°-60°	90°-120°	m	YG	
	C	90°-55°	50°- 85°	b	YG	
20:40-20:41	C & 5 HB	90°-40°	45°-110°	b	YG	
20:41-20:42	H & 2 R B	90°-30°	45°-125°	m	YG	
20:42-20:44	3 R B	90°-55°	45°-120°	m	YG	E to S
20:44-20:45	R, R B & 4 HB	90°-25°	45°-120°	m	YG	E to S
20:45-20:46	R & HB	90°-00°	45°-190°	m	YG	N to W
20:46-20:48	C	60°-00°	260°- 90°	b	YG	N to W
	HB	90°-60°	70°-190°	m	Y	S to W
20:48-20:50	R	75°-05°	340°- 70°	m	Y	
	3 HB	85°-20°	80°-180°	b	YG	
20:50-20:51	R & 4 HB	85°-05°	350°-150°	b	W	
20:51-20:53	R B & B B	85°-55°	85°-130°	m	W	
20:53-20:56	HA	70°-20°	260°- 60°	m	YG	
	3 HB	85°-40°	80°-185°	m	Y	
20:56-20:57	S & R	65°-50°	0°- 10°	w	G	
	HB	90°-60°	80°-190°	w	G	
20:57-21:00	HB & R	85°-60°	80°-190°	m	G	
21:00-21:02	R B	80°-50°	70°-200°	m	Y	
21:02-21:03	R	70°-00°	320°- 40°	w	YG	
	R B	85°-40°	70°-200°	m	Y	
21:03-21:06	R B & 2 HB	80°-20°	0°-170°	m	Y	To Upper
21:06-21:07	R B & 2 HB	85°-00°	340°-120°	m	YG	N to W
21:07-21:10	R B & 3 HB	80°-00°	200°-120°	b	YG	
21:10-21:12	HA & HB	85°-00°	210°- 80°	m	YG	
21:12-21:15	R & HB	85°-10°	210°- 50°	m	Y	
21:15-21:17	2 HB & C	80°-55°	220°-100°	m	W	
21:17-21:20	R	80°-60°	130°-150°	w	G	
	5 HB	80°-50°	210°-100°	w	W	
21:20-21:21	HB	80°-60°	225°- 10°	w	W	N to E
	S	80°-60°	40°- 80°	w	G	N to E

Time (G.M.T.)	Type	Altitude	Direction	Intensity	Colour	Motion
Feb. 21/22 21:21-21:22	HB & RB	80°-50°	260°-100°	w	Y	E to S
21:22-21:25	4 HB & RB	85°-55°	230°-180°	m	YG	
21:25-21:27	4 HB	90°-10°	270°-110°	w	G	
21:27-21:28	3 HB	80°-00°	0°-130°	w	Y	
21:28-21:29	RB & HB	75°-25°	270°-110°	m	Y	
21:29-21:31	C	55°-20°	190°-270°	b	YG	W to N
	R	65°-25°	10°-40°	m	YG	W to N
	4 HB	80°-20°	190°-90°	m	Y	W to N
21:31-21:32	RB & HB	80°-50°	280°-120°	b	YG	N to E
21:32-21:34	C	80°-50°	260°-280°	b	YG	W to N
	PRB	80°-60°	270°-70°	vb	YG	N to E
	R	85°-30°	30°-80°	m	YG	
21:34-21:35	HB & S	85°-10°	180°-90°	m	Y	W to N
21:35-21:37	RB	80°-60°	320°-360°	vb	YG	W to N
	HB	80°-30°	270°-80°	m	YG	W to N
	C	70°-40°	220°-270°	b	RL & YG	W to N
21:37-21:40	C	85°-60°	210°-280°	b	RL & Y	W to N
	2HB & 2RB	80°-10°	200°-90°	m	YG	
21:40-21:42	5 HB	85°-25°	170°-360°	m	YG	
	HB	85°-65°	55°-110°	w	Y	
21:42-21:46	3RB & 2HB	80°-65°	(260°-20°) (80°-170°)	b	YG	W to N
21:46-21:49	HB	80°-65°	(260°-300°) (40°-130°)	w	W	
21:49-21:50	RB	85°-55°	90°-350°	b	YG	
	R	80°-10°	0°-110°	b	YG	
21:50-21:53	RB & HB	80°-65°	90°-180°	m	YG	S to W
21:53-21:55	C & RB	85°-45°	250°-340°	b	YG	W to N
	HB	80°-60°	50°-90°	m	Y	
	R	75°-50°	180°-190°	m	Y	
21:55-21:56	D & RB	80°-55°	210°-280°	b	YG	S to W
	R	70°-40°	250°-260°	m	Y	
	S	50°-40°	220°-240°	w	G	
	HB	75°-45°	180°-225°	w	W	
21:56-21:59	HB	80°-60°	(45°-100°) (200°-280°)	m	YG	S to W
	R & PS	80°-60°	300°-360°	m	Y	
21:59-22:00	C & S	80°-50°	190°-240°	m	YG	
22:00-22:02	C & R	80°-20°	180°-220°	b	YG	
	HB	70°-45°	260°-290°	m	W	
22:02-22:03	R	75°-45°	320°-330°	m	W	
22:03-22:06	PR	80°-60°	(290°-305°) (40°-60°)	w	G	
22:09-22:11	S	80°-60°	260°-280°	w	G	N to W
	HB	77°-30°	180°-190°	m	Y	S to N
22:11-22:13	HB	70°-00°	(170°-190°) (350°-10°)	m	YG	E to W

Time (G.M.T.)	Type	Altitude	Direction	Intensity	Colour	Motion
Feb. 21/22 22:13-22:15	HA	80°-10°	180°-340°	m	YG	S to N
22:15-22:17	RB	80°-70°	20°- 50°	m	YG	W to N
22:17-22:19	RB	75°-65°	335°- 15°	m	Y	
22:19-22:21	C & RB	85°-65°	345°- 20°	b	YG	
22:21-22:22	RB	85°-65°	350°- 20°	m	YG	
22:22-22:24	HB	90°-60°	310°- 50°	m	YG	N to E
22:24-22:25	HB & RB	85°-50°	0°- 40°	m	YG	N to E
22:25-22:26	2 HB	85°-65°	10°- 45°	w	Y	
22:26-22:29	HB	70°-65°	10°- 40°	w	G	To Upper
22:29-22:32	HB	70°-50°	270°-300°	w	G	To Upper
22:32-22:33	S	70°-30°	270°-290°	w	G	W to E
22:36-22:38	HA	30°-00°	280°- 90°	m	YG	
22:40-22:41	R	70°-45°	300°-310°	w	G	
Feb. 23/24 21:15-21:20	HA	80°-60°	180°-220°	m	Y	
21:20-21:25	A & RB	80°-25°	160°-210°	w	W	
21:25-21:30	HB	50°-10°	160°-210°	m	Y	
21:30-21:35	HB	60°-30°	200°-235°	m	Y	
21:35-21:40	HA	80°-50°	170°-190°	m	YG	
22:00-22:05	3 HB	80°-60°	210°-240°	w	Y	
22:20-22:25	R	60°-10°	330°- 30°	w	Y	
22:50-22:55	R	60°-30°	220°-240°	w	W	
Feb. 26/27 21:50-22:00	A	60°-55°	150°-190°	m	YG	
Feb. 28/Mar. 1						
21:00-21:05	3 RB	80°-10°	200°-230°	m	YG	W to N
21:10-22:00	HB	80°-40°	210°-300°	w	G	
Mar. 2/3 18:55-19:00	R	80°-50°	210°-240°	w	Y	
19:05-19:00	R	80°-30°	250°-270°	w	Y	
19:10-19:15	R	80°-50°	210°-240°	w	Y	
	HB	80°-50°	90°-120°	w	Y	
19:20-19:25	R	60°-20°	90°-110°	m	Y	To Upper
19:25-19:30	5 R	75°-30°	190°-250°	b	YG	
19:40-19:45	HB	70°-60°	20°- 90°	w	Y	
19:50-20:30	cloudy					
20:35-20:40	HA	10°-00°	330°- 90°	w	W	
20:40-20:45	HB	60°-40°	100°-120°	m	YG	E to S
20:45-20:50	R	60°-40°	110°-120°	b	YG	
20:50-20:55	RB	60°-10°	40°-150°	w	G	
20:55-21:00	RB	90°-00°	10°-200°	m	YG	
	HB	80°-70°	200°-210°	m	Y	
21:00-21:07	HB & R	80°-60°	200°-250°	m	Y	
21:15-21:20	5 R	80°-70°	200°-230°	m	YG	
21:20-21:25	R & RB	82°-70°	190°-210°	m	YG	
21:25-21:30	G	70°-00°	290°-350°	w	G	
21:40-21:50	R	60°-30°	210°-240°	m	YG	
	S	90°-45°	150°-220°	w	W	



Time (G.M.T.)	Type	Altitude	Direction	Intensity	Colour	Motion
Mar. 2/3 21:50-21:55	R & S	85°-30°	140°-180°	w	W	
21:55-22:00	R & 2 H B	70°-30°	160°-200°	w	Y	
22:00-22:05	R	85°-00°	160°-200°	w	W	
22:05-22:10	R	80°-00°	150°-210°	b	Y G	S to N
22:10-22:15	R	60°-30°	150°-200°	m	Y	S to NW
22:15-22:20	G	60°-20°	150°-200°	m	Y G	S to N
22:20-22:25	C	20°-00°	0°-360°	B	Y G	To N
	A	80°-70°	210°-240°	m	Y	
22:25-22:30	F	80°-00°	190°-350°	w	G	SE to NW
22:30-22:35	F	70°-00°	30°-330°	m	Y	SE to NW
22:35-22:45	F	80°-00°	180°-350°	w	W	SE to NW
22:45-22:50	S	90°-00°	60°-110°	m	W	E to W
		70°-50°	210°-250°	m	W	E to W
22:50-23:00	R B	60°-30°	110°-240°	m	Y G	S to N
23:00-23:10	R	60°-20°	180°-270°	m	Y G	S to N
23:05-23:10	R	70°-30°	140°-180°	m	Y G	S to N
	R	60°-20°	180°-230°	w	Y	SW to NE
23:10-23:15	R	90°-00°	90°-240°	m	Y G	S to N
23:15-23:20	R	85°-00°	50°-210°	b	Y G	SW to NE
23:20-23:25	4 R B	40°-20°	40°-270°	b	Y G	
23:25-23:30	C	20°-10°	300°-340°	b	Y G	
	D	75°-45°	270°- 40°	b	Y G	
23:30-23:35	D	75°-30°	270°- 50°	w	Y	
23:35-23:40	R	60°-45°	220°-260°	m	Y	
23:45-23:50	C	30°-00°	0°-360°	b	Y G	
23:50-23:55	R B	60°-20°	250°-300°	m	Y	
23:55-24:00	H B	60°-50°	250°-280°	w	Y	
00:15-00:20	S	60°-00°	300°- 40°	w	W	
00:20-00:25	F	50°-10°	200°-280°	w	W	SW to NE
00:25-00:30	S	50°-10°	200°-300°	w	W	SW to NE
00:30-00:35	F	90°-30°	180°-240°	m	Y G	SW to NE
00:35-00:40	F	30°-00°	180°-240°	m	Y G	SW to NE
00:40-00:50	F	70°-10°	180°-270°	m	Y G	SW to NE
00:50-01:00	P S	70°-10°	180°-300°	w	W	