ENERGY DISTRIBUTION FOR COMET HALLEY

(*Letter to the Editor*)

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Abstract. Thermal energy distribution of comet Halley have been obtained by using the data available from the Indian astronomical ephemeris. The magnitude vs wavelength, plots have also been enumerated and discussed.

1. Introduction

The infrared waveband spans a huge segment of the electromagnetic spectrum between visible light and radio waves. It is the region of the spectrum where bodies with temperatures between 3000 and 3 degrees Kelvin emit most of their thermal radiation. Perhaps not surprisingly, most of the radiative energy in the Universe ends up in this wavelength range and, consequently, it is an area of intense and growing interest for studies by observing in the infrared is star formation. Stars are born in clouds of interstellar gas. These clouds also contain much dust which is opaque to visible ligth; such dark clouds are an obvious feature of the Milky Way as seen by the naked eye. Because of this dust content the processes of star formation are obscured in the optical waveband; and it is necessary to observe at infrared wavelengths if new-born stars are to be detected at all. For example, the visible light from young stars currently being born in the giant molecular cloud in the constellation of Orion, OMC-1, suffers over 20 magnitudes of extinction by interstellar dust. In the infrared, however, the dust is far less opaque- at a wavelength of 2.2 μm, the K band of infrared astronomy, the extinction is only 2 magnitudes. Thus while the visible light of these objects (stars) is dimmed by a factor of 10^8 by the dust, the radiation at 2.2 μm is reduced by a factor of only 6. The dimming of radiation by dust is even smaller at longer wavelengths, and at 10 μm obscuration by even the thickest molecular clouds in our Galaxy is, for practical purpose, negligible.

As is well known, the Earth's atmosphere contains many molecules - CO, CO_2, O_3 and, most important, H_2O - which absorb radiation very strongly at infrared wavelengths. At certain wavelengths infrared radiation can, however, penetrate the atmosphere. These 'windows' occur at wavelengths of 1.2, 1.6, 2.2, 3.5, 3.8, 4.8, 10, 20, 35, 350, 450, and 650 μm.

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In the present study, we have obtained thermal energy distribution curve of comet Halley, assuming comet Halley is in the plane of the Sun.

2. Thermal Radiation

All objects with temperatures above absolute zero emit thermal radiation: this is illustrated in Figure 1. The curves rise rapidly at the short-wave end and peak at a wavelengthλ_{max} given (in μm) by the approximate expression $\lambda_{max} = 3000/T$ where T is the temperature of the body in degrees Kelvin. The amount of the radiation then decreases gradually to longer wavelengths.

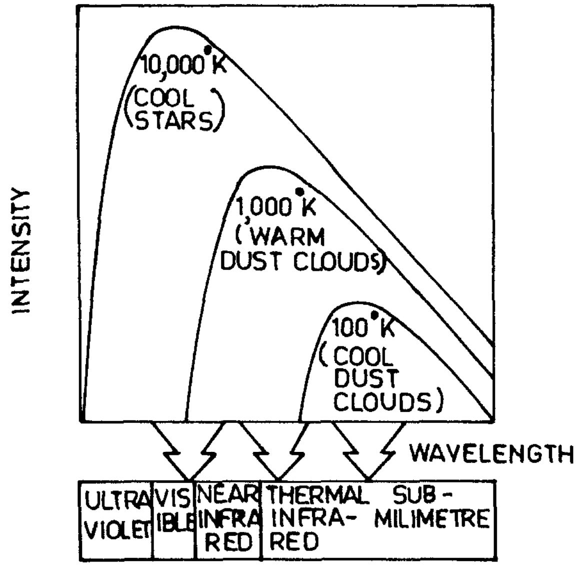

Fig. 1. The distribution of thermal radiation from objects at various temperatures (From Annual Report, Royal Observatory, Edinburgh, 1985).

A body at 10000 K emits radiation most strongly in the near ultraviolet (wavelength about 0.3 μm). The Sun, at 6000 K, emits most strongly in the green (visible) at about 0.5 μm - the wavelength to which our eyes are most sensitive (not by accident). The coolest stars, with temperatures of around 3000 K, emit most strongly in the near infrared at 1 μm. Dust clouds emit at a variety of wavelengths: those very near to stars, with temperatures of about 1000 K, peak at 3 μm, those with temperatures similar to that of the Earth (300 K) at about 10 μm, cool clouds at 100 K peak at around 300 μm. Still cooler material can be found in giant molecular clouds, large parts of which may have temperatures as low as 10 K or less. Their emission falls mostly in the submillimetre range from 300 μm to one millimetre, where the techniques of radio detection become important.

3. Calculations

The temperature of comet Halley have been computed by equation given by Seti (1968) and wavelength, by equation $\lambda_{max} = 3000/T$ (where T in degrees Kelvin) using the data available in ephemeris (1986). Table I list the various quantities.

TABLE I

Temperature and Wavelength of Comet Halley (1986)

Date		ϒ (a.u)	Magnitudes (m)	Without rotation		With rotation	
				Mean T (K)	λ_{max} (μm)	Mean T (K)	λ_{max} (μm)
Jan.	0	1.14	5.9	367.14	8.17	265.05	11.32
	5	1.24	5.7	352.03	8.52	254.14	11.80
	10	1.32	5.4	341.19	8.79	246.32	12.18
	15	1.40	5.1	331.30	9.06	239.18	12.54
	20	1.47	4.8	323.32	9.28	233.41	12.85
	25	1.52	4.5	317.95	9.44	229.54	13.07
	30	1.55	4.2	314.86	9.53	227.31	13.20
Feb.	4	1.56	4.0	313.85	9.56	226.58	13.24
	9	1.55	4.1	314.86	9.53	227.31	13.20
	14	1.51	4.1	319.01	9.40	230.30	13.03
	19	1.45	4.2	325.54	9.22	235.02	12.76
	24	1.37	4.3	334.91	8.96	241.78	12.41
March	1	1.27	4.4	347.84	8.62	251.12	11.95
	6	1.16	4.5	363.96	8.24	262.76	11.42
	11	1.04	4.5	384.39	7.80	277.50	10.81
	16	0.91	4.5	410.93	7.30	296.66	10.11
	21	0.79	4.4	441.03	6.80	318.40	9.42
	26	0.66	4.3	482.52	6.22	348.35	8.61
	31	0.55	4.1	528.57	5.68	381.60	7.86
April	5	0.46	4.0	577.97	5.19	417.26	7.19
	10	0.42	4.0	604.87	4.96	436.68	6.87
	15	0.44	4.3	590.96	5.08	426.64	7.03
	20	0.52	4.8	543.61	5.52	392.45	7.64
	25	0.64	5.4	490.00	6.12	353.75	8.48
	30	0.77	6.0	446.73	6.72	322.51	9.30
May	5	0.92	6.5	408.69	7.34	295.05	10.17
	10	1.08	7.0	377.20	7.95	272.32	11.02
	15	1.24	7.4	352.03	8.52	254.14	11.80
	20	1.41	7.8	330.12	9.09	238.33	12.59
	25	1.57	8.2	312.85	9.59	225.86	13.28
	30	1.74	8.5	297.17	10.10	214.54	13.98
June	4	1.90	8.8	284.39	10.55	205.31	14.61
	9	2.06	9.1	273.12	10.98	197.18	15.21

Table I (continued)

Date		ϒ (a.u)	Magnitudes (m)	Without rotation		With rotation	
				Mean T (K)	λ_{max} (μm)	Mean T (K)	λ_{max} (μm)
	14	2.22	9.4	263.09	11.40	189.94	15.79
	19	2.38	9.6	254.10	11.81	183.44	16.35
	24	2.53	9.9	246.45	12.17	177.92	16.86
	29	2.68	10.1	239.45	12.53	172.87	17.35
July	4	2.83	10.3	233.02	12.87	168.23	17.83
	9	2.97	10.5	227.46	13.19	164.21	18.27
	14	3.11	10.6	222.28	13.50	160.47	18.69
	19	3.24	10.8	217.78	13.78	157.22	19.08
	24	3.37	11.0	213.54	14.05	154.16	19.46
	29	3.50	11.1	209.53	14.32	151.27	19.83
Aug.	3	3.61	11.3	206.32	14.54	148.95	20.14
	8	3.73	11.4	202.97	14.78	146.53	20.47
	13	3.83	11.5	200.30	14.98	144.61	20.75
	18	3.93	11.7	197.74	15.17	142.75	21.02
	23	4.02	11.8	195.51	15.34	141.15	21.25
	28	4.11	11.9	193.36	15.52	139.59	21.49
Sept.	2	4.19	12.0	191.50	15.67	138.25	21.70
	7	4.26	12.1	189.92	15.80	137.12	21.88
	12	4.33	12.2	188.38	15.92	136.00	22.06
	17	4.39	12.2	187.09	16.03	135.07	22.21
	22	4.44	12.3	186.03	16.13	134.31	22.34
	27	4.49	12.4	185.00	16.22	133.56	22.46
Oct.	2	4.53	12.5	184.18	16.29	132.97	22.56
	7	4.56	12.5	183.57	16.34	132.53	22.64
	12	4.58	12.6	183.17	16.38	132.24	22.69
	17	4.60	12.7	182.77	16.41	131.95	22.74
	22	4.61	12.7	182.57	16.43	131.81	22.76
	27	4.62	12.8	182.37	16.45	131.66	22.79
Nov.	1	4.62	12.8	182.37	16.45	131.66	22.79
	6	4.61	12.8	182.57	16.43	131.81	22.76
	11	4.60	12.9	182.77	16.41	131.95	22.74
	16	4.58	12.9	183.17	16.38	132.24	22.69
	21	4.56	13.0	183.57	16.34	132.53	22.64
	26	4.53	13.0	184.18	16.29	132.97	22.56
Dec.	1	4.50	13.0	184.79	16.23	133.41	22.49
	6	4.46	13.0	185.62	16.16	134.00	22.39
	11	4.43	13.1	186.24	16.11	134.46	22.31
	16	4.39	13.1	187.09	16.03	135.07	22.21
	21	4.35	13.1	187.95	15.96	135.69	22.11
	26	4.31	13.1	188.82	15.89	136.32	22.01
	31	4.27	13.1	189.70	15.81	136.95	21.91
	36	4.24	13.1	190.37	15.76	137.44	21.83

4. Discussion

Figure 2 shows the variation of wavelength with the magnitudes and indicates that the cometary molecules are excited by solar radiation and solar wind. As shown by lines *AB* and *A'B'*. *B* to *C* and *B'* to *C'*, the magnitude is approximately constant but decrease in λ (in μm) indicates that the excited molecules are ionized; and these ionized molecules are accelerated by electromagnetic force from inner coma of a comet and formed a tail. The maximum length of tail can be seen at points *C* and *C'*. The lines *CD* and *C'D'* show the increase in magnitude with wavelength, and indicate that the Sun–comet distance is relatively on the increase.

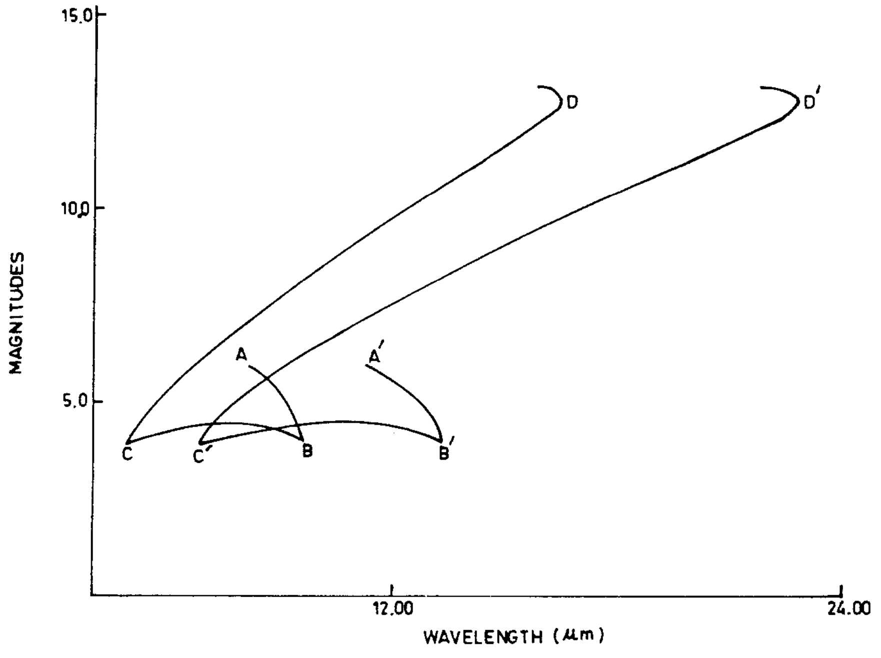

Fig. 2. Variation of magnitudes with corresponding wavelength.

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