

Species	T _s *	ISM-Gas	ISM-Dust	Most Comets	P/Halley	Hyakutake	Hale-Bopp	Implications
H ₂ O	152	100	100	100	100	100	100	-
CH ₃ OH	99	4-5	1	1-5	1.5	0.023	0.049	Consistent with grains in ISM cloud cores
HCN	95	2	-	0.02	0.1	-	-	-
NH ₃	78	1	10	0.1-2	0.1-2	0.25	-	Consistent with molecular clouds
CO ₂	72	10	0-3	-	2-4	5	-	-
H ₂ CO	64	0.2-1	-	0.5	0-5	0.002	-	Variable in P/Halley
CH ₄	31	0.2-7	0-5	0.02	-	0.7	-	First good detection in Hyakutake
CO	25	1000	13	1-7	7	5-5.8	6.4	Distributed source and nuclear source in Halley
N ₂	22	10-1000	-	0.1	5	-	-	-
S ₂	20	-	-	0.03	-	0.01	-	Seen in only 1 comet before
C ₂ H ₆	-	-	-	-	-	0.4	0.13	Could be a lower limit
CH ₄ :CO	-	0.001-0.003	0.13-2.4	-	-	0.12	-	-

* T_s = Sublimation Temperature

Observing Plans for Comet Hale-Bopp

Because the comet is expected to be very bright, a large number of astronomers are planning observations of the comet. When a comet is bright, a large number of different observing techniques in different wavelength regimes may be used to investigate different aspects of cometary physics. Below are selected programs from some of the major teams which routinely observe bright comets.

At the [Lowell Observatory](#) astronomers D. Schleicher, B. Millis and T. Farnham are undertaking an extensive long-term observing campaign of comet Hale-Bopp. Schleicher and Millis are experts in the photometric observation of bright comets, and were key observers in the campaign to determine the rotation period of comet P/Halley when it was near perihelion in 1986.

- Narrowband Photometry every 2 weeks to measure how much dust and how much of each of several gas species is being produced as a function of time. This will help astronomers determine if there are differences in composition and amount of gas produced when compared to other well-observed comets.
- Narrowband CCD imaging every 10 days will be used to study the structure in the coma. In particular they will be looking for the number and location of active areas called jets, and will use these observations to try to determine a rotation period for the comet.

A team of comet scientists, lead by M. Mumma (Goddard) has been very active at looking at comets in the infra-red wavelengths to try to discover the composition of the parent molecules in the comet. The team (consisting of: N. Dello Russo, M. DiSanti, M. Fomenkova, K. Magee-Sauer, B. Novak, D. Reuter, and Y. Pendleton) plans to use the NASA Infrared Telescope on Mauna Kea in late January, late February and mid-April to do the following:

- Detection and monitoring of the abundance of organic species and water molecules, as well as CO. The first detections of CO were made in June of 1996, and organics in September of 1996.
- Mumma and Vladimir Krasnopolsky have also been studying X-rays from the comet in an ongoing program to try to understand the mechanism which produces the X-rays.

Astronomer Harold Weaver, at the Johns Hopkins University has specialized in the observation of bright comets using the Hubble Space Telescope (HST) Facility. Since 1995 Weaver and his collaborators have been monitoring the comet with the HST which can achieve superior [resolution](#) compared to ground-based instruments, which allows astronomers to study jets in the inner coma. His specific observing plans include:

- In collaboration with M. A'Hearn, C. Arpigny, J. Brandt, P. Feldman and A. Stern, Weaver plans to resume his monitoring of the comet beginning in late-August 1997. It will not be possible to observe the comet near perihelion because the HST has [solar elongation](#) exclusion limits of 50 degrees. Originally the team had hoped to get an exception to this limit and point the telescope closer to the sun during the first two weeks of March, 1997, but it is unlikely that these will be allowed.
- In addition, Weaver will be collaborating with others (T. Brooke, G. Chin, S. Kim and J. Davies) to use the NASA Infrared Telescope Facility in early march to search for organic molecules (acetylene - C_2H_2 , ethylene - C_2H_4 , and methane - CH_4). The presence of these organic materials are strong indicators as to how much of the original interstellar material is preserved in the comet.

References

Mumma, M. J., M. A. DiSanti, M. Fomenkova, K. Magee-Sauer, N. R. Russo, D. X. Xie and C. D. Kaminski, 1996, "Discovery of Abundant Ethane and Methane in C/1996 B2 Hyakutake: Implications for Cometary and Interstellar Organic Chemistry", BAAS 28, 09.14.

Mumma, M. *et al.*, 1996, *Science*, in press.

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Hot Idea

posted February 14, 1997 (updated March 11, 1997)

1997 Apparition of Comet Hale-Bopp Observing Comet Hale-Bopp

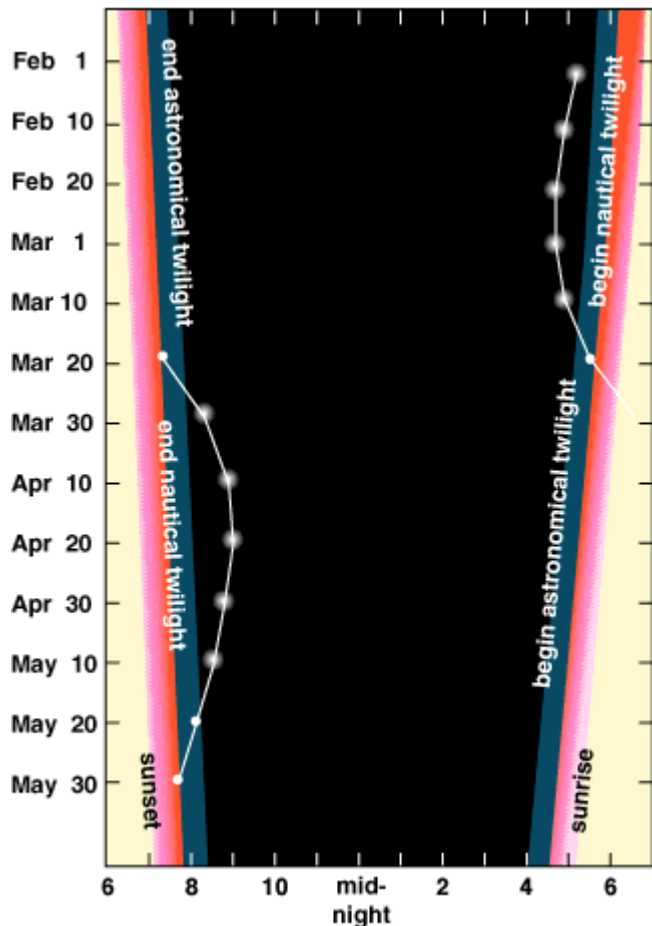
by Karen Meech

Binocular and naked-eye views of the sky from the darkest location possible should result in some satisfying comet-watching. Consult local astronomy groups and newspapers for details on viewing comet Hale-Bopp where you live. Or link now to **PSR Discoveries** visibility tables for [Denver](#) or [New Orleans](#).

A Comet Hale-Bopp Positions generator [was] also available on-line from the United States Naval Observatory, Astronomical Applications Department. The position of the comet during twilight can be obtained for any location in local time.

Observing Opportunities from Hawaii

The comet moves fairly far north when it is at its brightest, and will not therefore be optimally placed for viewing from Hawai`i, however, it should be visible in the morning skies in February and March, and in the evening skies during April and May. The figure and table, below, show the visibility from Hawai`i.



(Karen Meech, Univ. of Hawaii.)

In the figure, solid circles indicate when the comet rises (in the morning) and sets in the evening. The sunrise and sunset on each date are shown as heavy lines, and the other 2 lines represent the beginning (in the morning) or end (evening) of [nautical twilight](#) (NTwi) and the beginning (morning) or end (evening) of [astronomical twilight](#) (ATwi). The comet should be easily visible during the astronomical twilight, and may be visible well into the nautical twilight (note, civil twilight is not plotted).

The table indicates that the comet will not be very high above the horizon while the sky is quite dark, *i.e.* during astronomical twilight. The best time to see the comet from Hawai`i from this point of view will be near Feb 20 in the morning (between 5-5:30) and again in mid April in the evening at the end of twilight. The times in the table should be accurate to about 5 minutes, but will depend on the geometry of the observer's horizon. The magnitudes were based on an early extrapolation of the lightcurve. However, after the brightness seemed to stagnate from July through October 1996, again brightening in November, some astronomers are being more conservative in the maximum brightness prediction, suggesting it may reach between -0.5 and -1.0.

Visibility of Comet Hale-Bopp from Hawaii

(revised on 11 March 97)

* see below for other localities

Date	Comet Rise	Beg ATwi	Altitude	Beg NTwi	Altitude	Sunrise	Mag
Feb 01	5:15 am	5:41 am	11.4 deg	6:07 am	17.4 deg	6:47 am	
Feb 10	4:58 am	5:39 am	14.8 deg	6:05 am	20.8 deg	6:45 am	
Feb 20	4:44 am	5:33 am	16.0 deg	5:59 am	21.7 deg	6:39 am	
Mar 01	4:42 am	5:29 am	15.1 deg	5:54 am	20.2 deg	6:33 am	
Mar 10	4:54 am	5:22 am	10.7 deg	5:48 am	15.5 deg	6:25 am	-0.1
Mar 20	5:32 am	5:14 am	-	5:40 am	06.7 deg	6:17 am	-0.5
Mar 30	-	5:03 am	-	5:30 am	-	6:09 am	-0.6
Date	Comet Set	End NTwi	Altitude	End ATwi	Altitude	Sunset	Mag
Mar 20	7:14 pm	7:21 pm	-	7:46 pm	-	6:41 pm	-0.5
Mar 30	8:14 pm	7:23 pm	12.8 deg	7:50 pm	08.3 deg	6:46 pm	-0.6
Apr 10	8:48 pm	7:28 pm	19.5 deg	7:53 pm	14.6 deg	6:47 pm	-0.4
Apr 20	8:55 pm	7:31 pm	21.1 deg	7:58 pm	15.5 deg	6:51 pm	0.0
Apr 30	8:43 pm	7:35 pm	18.8 deg	8:03 pm	12.9 deg	6:53 pm	0.5
May 10	8:25 pm	7:39 pm	14.5 deg	8:07 pm	08.2 deg	6:57 pm	1.1
May 20	8:02 pm	7:45 pm	08.1 deg	8:14 pm	-	7:02 pm	1.7
May 30	7:36 pm	7:49 pm	-	8:20 pm	-	7:07 pm	2.2

Visibility of Comet Hale-Bopp from [Denver](#) or [New Orleans](#)

Where to Find Comet Hale-Bopp

Click on the buttons below to bring up the finder chart for the desired month.



February. The comet should reappear after [solar conjunction](#) in the morning skies in late January. It will be difficult to observe during early February, accessible only during the early morning twilight hours. At the beginning of the month, the comet will have a [declination](#) of only +15 degrees, and be found just north of the constellation Aquila. During the month the comet will brighten rapidly and move north.



March. During the month of March, the comet will brighten to something easily accessible to the general public, as it moves closer to the sun. It will move toward being visible in the evening sky late in March. The comet will be passing south of the prominent constellation of Cygnus towards Andromeda. On the date of its closest approach to Earth, March 22, the comet will be just NW (by several degrees) of the Andromeda nebula (M31) which will just be rising in the twilight.



April. During late March and early April the comet will be visible in the northwest sky just after sunset, and it should be approaching its maximum brightness. During the month, the comet will move from Andromeda to Perseus and Taurus, and during the last week it will be located just east of the star cluster the Pleiades. During late April the moon will interfere with observations as the comet fades.



May. The dust tail development should peak during May and June, but the comet will probably be lost to observation by the general public during the month. The comet begins to move south, by late June passing south of the [celestial equator](#). During the fall, the comet will be accessible by binocular or small telescope to southern hemisphere observers only, as it reaches a maximum southern declination of -65 degrees during January 1998.

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