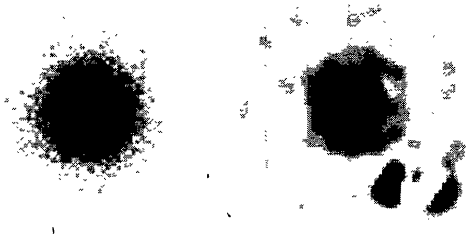
deconvolved 2/22 composite image. This work was supported by grants from STScI (GO-3769.01-91A), and NASA (NGL 12-001-057).



## 24.04

### Searches for CO and HCN in the Coma of 2060 Chiron

M. Womack (Penn State Erie) and S.A. Stern (Southwestern Research Inst)

We performed millimeter-wave observations of 2060 Chiron to search for the CO J=2-1 and HCN J=1-0 rotational transitions. The CO observations were made at 230 GHz during 25-26 February 1994 UT using the Caltech Submillimeter Observatory (CSO) 10.4-m on Mauna Kea with spectral resolutions of 50 and 500 kHz. We achieved $3\sigma$ upper limits for the CO 2-1 emission of 75 and 35 mk for the 50 and 500 kHz resolutions, respectively. Assuming (i) Chiron's coma fills the 30″ CSO beam and (ii) the gas excitation, rotational, and kinetic temperatures are all between 10 and 50 K, then for both resolutions we find production-rate upper limits of $Q(CO) < 7\text{-}15 \times 10^{27}$ s$^{-1}$ if CO is a parent molecule, and $< 9\text{-}36 \times 10^{27}$ s$^{-1}$ if CO is a product of an $H_2CO$ parent. If the coma is not expanding isotropically, and instead the CO J = 2-1 line widths are much narrower (e.g., about 1/3 the coma expansion velocity), then the derived column densities and CO production limits could be up to five times lower. The HCN J=1-0 observations were made at 89 GHz using the National Radio Astronomy Observatory (NRAO) 12-m telescope on 8-13 July 1994 UT with spectral resolutions of 30, 49 and 100 kHz. The spectra will be presented and constraints on models of Chiron's atmosphere discussed.

## 24.05

### The 1993 Nov 07 occultation of Ch02 by 2060 Chiron

R.L. Marcialis (Pima Comm. Col./LPL), W.B. Hubbard, R. Hill (LPL/U. Arizona), S.J. Bus, J.L. Elliot, C. Olkin, S. McDonald, J. Foust, L. Sopata, R. Bandyopadhyay, R. Meserole (MIT), M.W. Buie, J.R. Spencer, L.H. Wasserman, R. Millis (Lowell Obs.), E. Dunham (NASA Ames), C.A. Beichman, T.H. Jarrett, J. Young (JPL/Caltech), C. Ford (SETI Institute), T. Herter (Cornell)

The 1993 November 07 appulse of 2060 Chiron to the star Ch02 (Bus *et al.* 1994, *A.J.* **107**, 1814) was observed by five teams with high-speed photometers (Buie *et al.* 1993, *IAUC 5898*). An event lasting 4.5-6.0 sec, seen by the southernmost station (Tierra del Sol, CA) was the only clear solid-body occultation. A single chord yields only a minimum diameter (136-181 km), based on the relative sky-plane velocity of Earth and Chiron. However, assuming the Palomar station observed a grazing event fixes the nucleus size at 166 km. This value compares favorably with the 182±8 km determination based on thermal infrared measurements and the STM by Campins *et al.* (1994, submitted to *Icarus*) in 1991-94, and 168±40 km by Lebofsky *et al.* in 1984 (*Icarus* **60**, 532), as re-analyzed by Sykes and Walker (1991, *Science* **251**, 777).

A puzzling aspect of the Tierra del Sol observations is that the flux drop was not total, but only 80%. Proposed explanations for the residual 20% flux are either that the star Ch02 is double, or that differential refraction of starlight around the limb by an escaping atmosphere precluded total stellar extinction. The latter hypothesis is preferred based on subsequent spectral analysis of the star.

Overall attenuation, presumably due to coma, also is seen near the time of the occultation in at least three of the data sets. These broad, shallow features decrease with increasing chord distance from Chiron. Sharp, unresolved dips (<10 km) in the Palomar, Table Mtn., and Mt. Hamilton light curves possibly are due to a dust jet, but this explanation is far from conclusive.

## 24.06

### Material near the Nucleus of 2060 Chiron from Stellar Occultation Observations

J. L. Elliot, C. B. Olkin (MIT & Lowell Obs.), E. W. Dunham (ARC), C. Ford (Seti Inst.), D. K. Gilmore, D. M. Rank, P. Temi (UCSC & Lick Obs.), D. Kurtz (U. Cape Town), R. M. Bandyopadhyay, S. J. Bus, S. W. McDonald (MIT), J. Barroso, D. Lazzaro, D. F. Lopes (Obs. Nacional), A. Barucci (Obs. Paris), A. S. Bosh, M. W. Buie, R. L. Millis, L. H. Wasserman (Lowell Obs.), C. C. Dahn (USNO), D. W. Foryta (UFPR), W. B. Hubbard (U. of Ariz.), R. L. Marcialis (Pima Com. Coll. and U. of Ariz.), H. Reitsema (Ball Aerospace), B. Sicardy (Obs. Paris & U. Paris 6), R. P. S. Stone (Lick Obs.)

The star Ch08 (R~11.5) was identified as a possible occultation candidate for Chiron last year by Bus *et al.* (AJ **107**, 1814). This event was of particular interest because the star is much brighter than a previous star occulted by Chiron in 1993 (Marcialis, *et al.*, this conference) which yielded puzzling results. Since the radius of Chiron's nucleus would subtend an angle of only about 0.01 arcsec, the prediction for this event was refined with astrometry from CCD strip scans taken at Lick Observatory. Observations were attempted from the KAO, SAAO, Observatório do Pico-dos-Dias, and three portable telescopes deployed in Brazil. Due to weather problems, light curves of the occultation were obtained only from SAAO and the KAO (simultaneously with visible and IR array detectors). The chords probed with the KAO and SAAO were only a few kilometers apart.

From an interpolation of measurements taken before and after the event at the USNO, the closest approach of the observed chords to Chiron's center of light was found to be 96 ± 16 km, but no nuclear occultation was observed. Occultations by other material were recorded, however. The sharpest feature has a maximum optical depth of 0.92 ± 0.02 at visible wavelengths and a projected width perpendicular to the line of sight of less than 10 km. Another feature has an average optical depth of 0.12 ± 0.02 and a width of about 63 km. These appear to be embedded in material of even lower optical depth that extends for over 600 km (approximately symmetric with respect to Chiron's center of light). One interpretation of these results is that the narrow features are due to jets, while the broader feature is due to coma material. Further analysis and interpretation of these results will be presented by Olkin *et al.* (this conference).

## 24.07

### Further Analysis of the Ch08 Occultation by 2060 Chiron using the KAO Observations

C. B. Olkin, J. L. Elliot (MIT & Lowell Obs.), E. W. Dunham (ARC), C. Ford (Seti Inst.), D. K. Gilmore, D. M. Rank, P. Temi (UCSC & Lick Obs.)

KAO observations of the Ch08 occultation probed the region near Chiron with very high spatial resolution (8.9 km in the optical and 17.8 km in the IR). In the higher signal-to-noise optical light curve (S/N = 52) three features are evident, while only the deepest feature is seen in the IR data (S/N = 5.8). This deep feature occurred less than 3 seconds before the closest approach to the star at 112 ± 16 km from Chiron (from USNO astrometry, see Elliot *et al.* this conference). In a 1-second integration, the optical depth of the deep optical feature is 0.52 ± 0.01, while in the IR it is 0.68 ± 0.24. Simple models of the features will be presented.

This work supported in part by NASA grant NAG 2-903.