between Be stars and X-ray sources. In particular, γ Cas is very similar in its optical characteristics to X Per (ref. 4), which has been associated with the regularly varying X-ray source 3U0352+30 (refs 6–8). The ratio of X-ray to optical luminosity of the two stars now differs by just over an order of magnitude[8]. No evidence is found for regular modulation in the present data between 2 and 40 min. The source is, however, comparatively weak, and any modulation of peak to mean amplitude <60% of the mean flux would have gone undetected. More sensitive observations will be necessary to explore further the possible parallels between γ Cas and X Per. Meanwhile, γ Cas provides yet another example of the growing number of intrinsically relatively weak X-ray sources being discovered which are associated with nearby stellar objects (see ref. 9).

We are grateful to P. A. Charles for discussions. K.O.M. and N.E.W. acknowledge support from the SRC.

K. O. Mason

Mullard Space Science Laboratory, University College London, and Mullard Radio Astronomy Observatory, Cavendish Laboratory, Cambridge, UK

N. E. White
P. W. Sanford

Mullard Space Science Laboratory, University College London, UK

Received February 12; accepted March 18, 1976.

1 Sanford, P. W., *Proc. R. Soc.*, A340, 411 (1974).
2 Jernigan, J. G. *IAU Circ.* No. 2900 (1976).
3 Giacconi, *et al.*, *Astrophys. J. Suppl.*, 27, 37 (1974).
4 Moffat, A. F. J., Haupt, W., and Schmidt-Kaler, Th., *Astr. Astrophys.*, 23, 433 (1973).
5 Maraschi, L., Treves, A., and van den Heuvel, E. P. J., *Nature*, 259, 292 (1976).
6 Hawkins, F. J., Mason, K. O., and Sanford, P. W., *Astrophys. Lett.*, 16, 19 (1975).
7 White, N. E., Mason, K. O., and Sanford, P. W., *IAU Circ.* No. 2854 (1975).
8 White, N. E., Mason, K. O., Sanford, P. W., and Murdin, P., *Mon. Not. R. astr. Soc.* (in the press).
9 Catura, R. C., Acton, L. W., and Johnson, H. M., *Astrophys. J. Lett.* 196, L47 (1975).

Radiometric diameter and albedo of the remarkable asteroid 1976AA

The minor planet 1976AA (Fast-Moving Object Helin), discovered on January 7, 1976, is the first asteroid found with an orbital period of < 1 yr (orbital elements $a=0.97$, $e=0.18$; $i=19°$; ref. 1). Although it seems to be a likely speculation that 1976AA is a former Apollo object that originally had its aphelion in the main asteroid belt, it is possible that this object is a member of a group of minor planets that is distinct in physical as well as orbital properties. Observations that reveal the physical nature (colour, albedo, texture, mineralogy) of its surface are needed to compare it with better studied objects in more orthodox orbits. This letter reports a determination by infrared radiometry of the diameter and albedo of 1977AA.

The radiometric technique of measuring diameters and albedos was first applied to asteroids in 1970 (ref. 2) and has recently been discussed in some detail[3,4]. Physically, it is based on the dependence on albedo of the balance between reflected and thermally emitted radiation for an airless body in thermal equilibrium with the sunlight striking it. The application reported here follows the formulation and calibration by Jones and Morrison[4], which has previously been used to determine the diameters of > 60 main-belt asteroids[5,6] and the Earth-approaching object 433 Eros[7].

The observations were made on January 26, 1976 in a broad spectral band centred at ~ 10 μm with the infrared photometer[8] of the 1.5-m telescope of the Lunar and Planetary Laboratory Catalina Observatory. The primary stellar standards were α Tau and β Gem, for which we adopted magnitudes of −3.1 and −1.3, consistent with the standard calibration assumed for the radiometric diameter technique[5]. Two groups of integrations, centred at UT dates 26.22 and 26.30, yielded a 10-μm magnitude of $+5.0\pm0.3$. At the time of observation, 1976AA was 0.150 AU from Earth and 1.075 AU from the Sun, and its phase angle was 50°. Although it is not clear exactly how the radiometric brightness should be reduced to full phase, both model calculations and observations of 433 Eros[7] suggest a correction of between −0.01 and −0.02 mag deg^{-1}, yielding an equivalent 10-μm magnitude at zero phase of $+4.3\pm0.5$. The value of $V(1,0)$, the zero-phase, unit-distance visual magnitude, is +17.6 from other observations made here (J.C.G., unpublished).

A straightforward solution for diameter and visual geometric albedo based on these observations yields $D=900\pm200$ m and $p_V=0.20\pm0.07$. This albedo is in satisfactory agreement with a preliminary polarimetrically derived value (J. C. Gradie, unpublished), and the diameter is the smallest ever measured for an asteroid.

On the basis of its albedo, 1976AA can probably be classed with the stony or silicaceous (S-class) group of asteroids[9]. These asteroids seem to have related surface mineralogies and to be the predominant type near the inner edge of the belt, although the much darker carbonaceous objects constitute the great majority of all asteroids. The previously studied Mars- and Earth-orbit-crossing objects—433 Eros, 887 Alinda, 1566 Icarus, and 1685 Toro—also belong to the broad S compositional class. Thus, on the basis of this preliminary physical datum, 1976AA appears similar physically to other small asteroids that approach the Earth.

This research was supported in part by grants from NASA. We thank E. Helin for informing us of the existence of 1976AA, and J. G. Williams for providing the ephemeris without which these observations could not have been made.

David Morrison*
Jonathan C. Gradie
George H. Rieke

Lunar and Planetary Laboratory, The University of Arizona, Tucson, Arizona 85721

Received February 10; accepted March 18, 1976.

*Permanent address: Institute for Astronomy, University of Hawaii, Honolulu.

1 Helin, E., *IAU Circ.* No. 2899.
2 Allen, D. A., *Nature*, 227, 158–159 (1970).
3 Morrison, D., *Icarus*, 19, 1–14 (1973).
4 Jones, T. J., and Morrison, D., *Astr. J.*, 79, 892–895 (1974).
5 Morrison, D., *Astrophys. J.*, 194, 203–212 (1974).
6 Morrison, D., and Chapman, C. R., *Astrophys. J.*, in the press.
7 Morrison, D., *Icarus* (in the press).
8 Low, F. J., and Rieke, G. H., in *Methods of Experimental Physics* 12, *Part A* (edit. by Carleson, N.), 415–462 (Academic, New York, 1974).
9 Chapman, C. R., Morrison, D., and Zellner, B., *Icarus*, 25, 104–130 (1975).

On simultaneous tilt and creep observations on the San Andreas Fault

The installation of an array of tiltmeters along the San Andreas Fault[1] has provided an excellent opportunity to study the amplitude and spatial scale of the tilt fields associated with fault creep. We report here preliminary results from, and some implications of, a search for interrelated surface tilts and creep event observations at four pairs of tiltmeters and creepmeters along an active 20-km stretch of the San Andreas Fault. We have observed clear creep-related tilts above the instrument resolution (10^{-8} rad) only on a tiltmeter less than 0.5 km from the fault. The tilt events always preceded surface creep observations by 2–12 min, and were not purely transient in character.

Although episodic fault creep has been observed at many locations of the San Andreas, Hayward, Calaveras, and other active faults in the San Andreas Fault System[2–8],