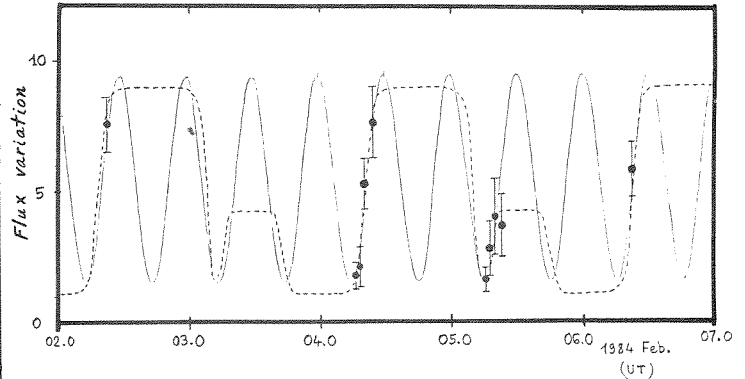


ROTATION OF COMET P/HALLEY

Prime-focus electronographic photometry of Comet P/Halley's nucleus was carried out during the nights of February 2 to 6, 1984 by O. Le Ferre, J. Lecacheux, G. Mathez, G. Lelièvre, J. Baudrant, and J.P. Lemonnier. The mean heliocentric distance of the comet was $r_h = 7.95$ AU. The observations were restricted to zenith distances smaller than 40° and to the standard B band. The automatic guider was used, but the position was actualized every 1.5 minutes to fit with the predicted topocentric motion. The comet was successfully identified on twelve plates and properly measured on ten plates. Typical exposure durations were 45 min. on Kodak KO 139 and Ilford K5 electron-sensitive plates, giving a signal-to-noise ratio of ~ 6 for an untrailed star of $B = 24.4$ (KO 139 plates); typical image quality was 1.3 arc seconds.

The measured amplitude in B was 1.7 magnitudes (between $B = 24.5 \pm 0.3$ and $B = 22.8 \pm 0.15$), but the true amplitude possibly exceeded 2 magnitudes. Sudden rapid increases were measured at least twice and the phenomenon seemed to recur at constant time intervals.

Such brightness variations very likely reflect the rotation of the nucleus. Using all measurements available between January 1984 and March 1984, it seems that the best candidate spin-period in the range of 8-48 h is around 16 hours. This result, assumes (1) that the brightness modulation is caused by the transit of bright areas of albedo 0.4, against darker material of albedo 0.02, and (2) that the spin axis is roughly perpendicular to the line of sight.



Data obtained at CFH and possible light curves.

SEEING CONTROL MEASURES AT CFHT

Excellent seeing has become the trademark of our telescope. Although image stabilization and processing techniques are around the corner, there is no substitute for intrinsically good images; from the very start our observatory was designed so as not to degrade the superb seeing that prevails on Mauna Kea.

Mauna Kea is a very windy site and the telescope must be protected against buffeting for winds up to 40 knots if one is not to lose too much observing time. Therefore our observatory dome is of traditional design with an up-and-over shutter and windscreen, in contrast to the present trend of wide open domes and low thermal inertia exemplified by the Multi-Mirror-Telescope. A very complete insulation and ventilation system protects the telescope against solar radiation and ambient daytime temperature rise, as well as from the heat generated within the building. An active cooling system absorbs the remaining calories so as to always maintain the telescope and its massive optics at a temperature appropriate to nighttime observing. This concept works well on Mauna Kea because of its high altitude and because of the permanence of weather in the Pacific tropics; the average temperature change during the night is only about 1.3°C , and the change from one night to the next is usually less than 1°C .

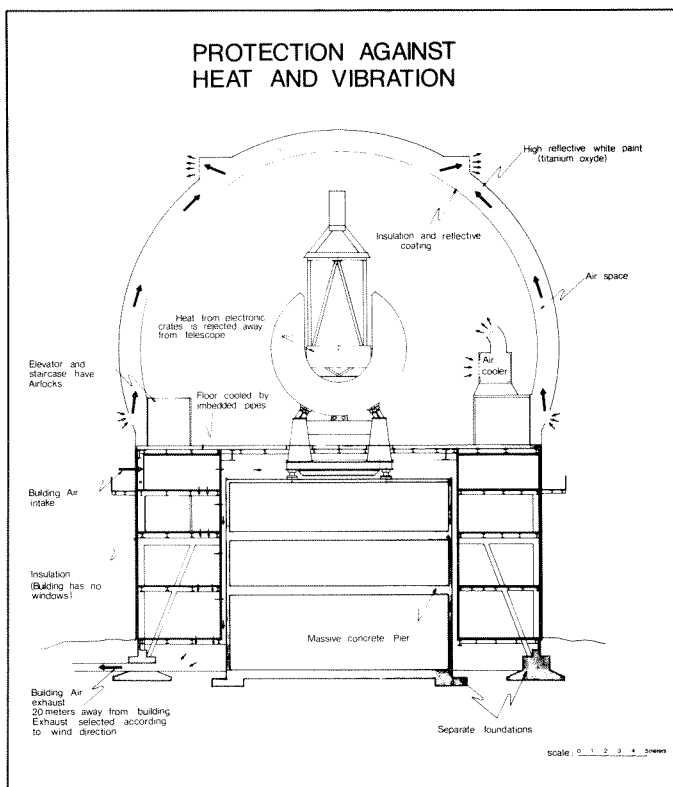
Of course, when we had our first light in 1979 these simple principles were far from being fully implemented, let alone optimized. One of the most difficult tasks was the elimination of heat leaks, and it is only now that we have really achieved the status envisaged originally.

The telescope pedestals, which are resting in a warm area, were transmitting heat to the observing floor and had to be heavily insulated.

Generation of heat inside the building has been reduced and only essential rooms are heated and lit. Critical doors have been sealed and heated areas isolated by additional "air locks". Gaps around the telescope pedestals and cable trays have been plugged. Perfect and complete sealing of such a large building is almost impossible in practice. We have therefore increased the negative pressure in the building to ensure that hot internal air will not plume out of the remaining numerous leaks in the observing floor, telescope base, access doors and building curtain wall. The extracted air which now reaches the enormous flow of 14 cubic meters per second is exhausted away from the building through a large underground duct.

A better seal has recently been installed on the dome skirt, and an inflatable seal will be installed this summer on the shutter. In addition to preventing leaks during storms, this will minimize entry of warm air during the day.

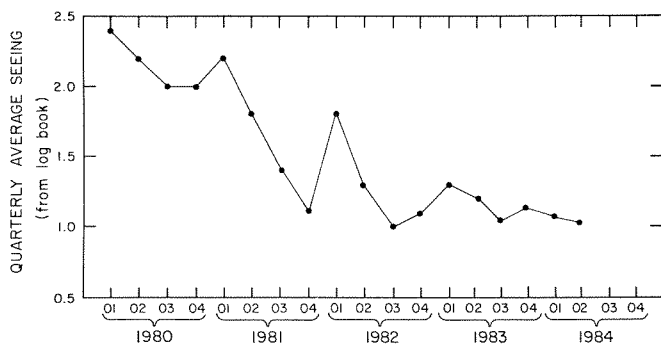
PROTECTION AGAINST HEAT AND VIBRATION



We have also used an infrared camera to hunt for heat sources inside the dome. This search revealed a few unexpected sources like electrical equipment left powered when not in use (crane brakes, control transformers) and heat dissipation from the oil feeding the hydrostatic pads supporting the 250-ton weight of the telescope. An additional oil cooler will soon be installed.

Last but not least, seeing control has become a state of mind for the entire staff; even those who are not directly in contact with observers are aware of the importance of good seeing and willingly put up with the freezing working environment.

The result of our efforts so far has been dramatic, as shown in the figure below.



Although dome seeing is still undoubtedly present, it has now reached such a low level that "common-sense" measures are not sufficient any more. Any further improvement will require a better understanding of the dome heat balance and aerodynamics and of the local site seeing.

The schematic section of the observatory shown at left illustrates the basic principles used to maintain at all times the telescope close to the nighttime ambient temperature. The dome is well insulated and is painted with a special coating which efficiently reflects the sun's radiation during the day. The dome's double skin design allows additional extraction of heat by natural convection. At night, the natural flow in the air space is reversed (downwards) and helps maintain the outer skin close to the ambient temperature. Otherwise the outer skin would become too cold because of radiation emitted to the sky and would cause cold air to fall on the telescope through the slit. The chilled observing floor acts as a barrier against heat flow from the lower floors and also contributes to the cooling of the telescope during the day. Finally, the large air cooling fans are used during the day to stir up the air in the dome and provide additional cooling.

Fortunately, research in the field of atmospheric turbulence has made giant steps in the last two decades on both theoretical and experimental grounds, thanks in particular to military requirements and the fight against air pollution. Seeing models are now well established and measuring equipment is available commercially.

We have installed probes on the telescope to measure the local temperature structure constant to which the optical turbulence is directly related. This allows us to monitor the internal dome seeing on a continuous basis and to optimize parameters like the adjustment of the cooling floor temperature.

Similar probes have been mounted on a tethered balloon to explore the atmospheric turbulence in the first few hundred meters above the ground in order to obtain a better understanding of the "boundary layer" seeing.

We have also made recent wind-tunnel studies to characterize the air motion inside the dome as a function of the wind direction and the positioning of the shutter and windscreen.

Finally, we are attempting to determine and predict the upper atmospheric seeing using the basic meteorological data recorded nightly by the Hilo Weather Bureau radiosondes.

In spite of the difficulty and frustrations at pinning down a phenomenon that is affected by temperature differences as small as a 1/10th of a degree and minute orographical disturbances we progress slowly and hope that our present efforts will soon bear new fruits.

We are proud of our reputation for having the best seeing on earth: we work harder at it!

Pierre Yves Bely