candidates by means of simultaneous spectrographic and photometric observations.

Besides valuable information about β Cephei stars, our programme has yielded an enormous amount of data concerning other types of new variables. Until now at least 30 new bright, variable stars have been discovered, and we hope to be able to get complete light-curves in the near future. Further observation runs are planned for April 1978, December 1978 and April 1979.

At the time when this long-range programme will be accomplished, almost all northern and southern B0 – B2 stars brighter than magnitude 6.5 will have been checked for β Cephei membership, and a more homogeneous sample will then be available for statistical investigation.

Vertical Extinction on La Silla

H. Tüg

Among the many factors that determine the quality of an observatory site, two are crucial. These are the seeing *(how much the light from a celestial object is spread out during the passage through the Earth's atmosphere) and the* extinction *(how much the light is weakened during the passage). It has long been known that La Silla is among the best sites in the world what concerns seeing but it is only recently that a major study has revealed that the La Silla extinction is very small on good nights. Dr. H. Tüg from the Astronomical Institute of the Ruhr University in Bochum, FRG, spent several months on La Silla in 1974–76 with his "black-body" platinum oven which will still be remembered as the "new star" next to the water tanks, where the Swiss telescope is now situated. As a result of his work, we can now give quantitative figures for the extinction at ESO.*

"Bad data are better than no data!", says the desperate visiting astronomer attempting photometric work through clouds. Scheduled only for a few nights, weather always becomes important. The measurements of vertical extinction are the best indicator for the quality of a night. From this point of view we try to give an answer to the questions "What is a good night on La Silla?" and "How good is good?".

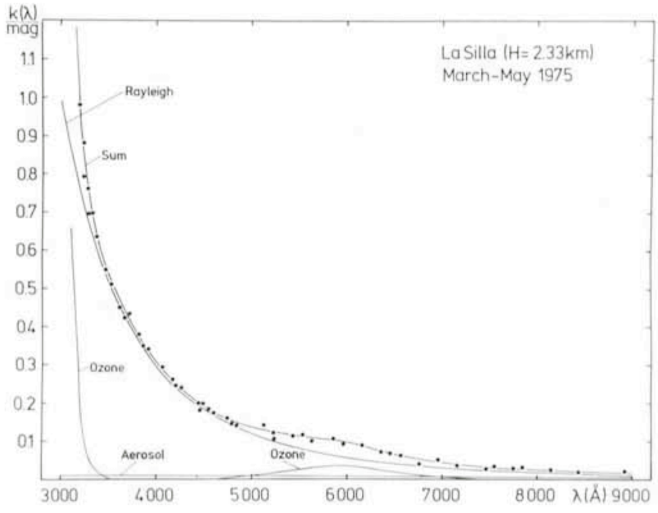
For the last decade, ESO meteorological reports show a mean of 225 photometric nights per year, which is 62 % of the total number of nights. A photometric night is characterized by ESO as "six or more hours of uninterrupted clear sky". For La Silla extinction coefficients were only known from measurements in common filter bandpasses (e. g. C. Sterken, M. Jerzykiewicz, *Astron. Astrophys. Suppl.* **29,** 319, 1977) but not over the whole optical region.

During calibration work from 1974 to 1976, when the spectral energy distribution of southern standard stars was measured by comparison with black bodies, extended extinction measurements were undertaken with the 61 cm Bochum telescope using a photoelectric rapid spectrum scanner. The high accuracy of the experiment demanded excellent nights. Normally three extinction stars of early type were observed between airmasses 1 to about 2.5, one star rising, one star setting, and a third star, close to $\delta = -60°$, observable almost the whole night and which passed the meridian at about midnight. The wavelength region was 3000–9000 Å with a bandpass of 10 Å in the blue und 20 Å in the red region. The extinction coefficients were calculated in steps of 50 Å using the Bouguer method. Regions with strong lines were omitted.

Neglecting also the absorption bands of atmospheric oxygen and water vapour, the total extinction of even a clear, cloudless sky consists of three components: Rayleigh scattering, ozone absorption and aerosol scattering. Each component has its own wavelength characteristic. The amount of Rayleigh scattering depends only on air pressure and therefore on the altitude of the observatory. The ozone is concentrated in the stratosphere between 10 and 35 km, so that its contribution is independent of the observatory point, but the concentration varies with latitude and season, sometimes over time scales of hours. The aerosol scattering is due to solid particles and liquid droplets of any size which remain suspended in the air. Most of these particles are small liquid droplets resulting from condensation of water on very small hygroscopic nuclei. Others are the solid or liquid products of combustion not acting as nuclei. The size of aerosol particles cover the range from 10^{-3} to 10 μ, which indicates that their behaviour in incident light cannot be described by a simple theory.

The extinction due to Rayleigh scattering and ozone can be calculated quite accurately for any observatory location. So the aerosol scattering is determined by subtracting these two amounts from the total observed extinction. This procedure, which is described in more detail by Hayes and Latham (*Astrophys. J.* **197,** 593, 1975) was applied for calculating the aerosol extinction for La Silla. The figure shows the extinction coefficient in mag/airmass for all three components separately against wavelength. The sum is given by a least square fit of the measured values. While the aerosol extinction changes slowly by wavelength, ozone shows a sharp cut-off at 3200 Å and an additional bump at 6000 Å. This bump deforms the resultant curve in a manner which cannot be seen in extinction curves resulting from filter measurements.

Extinction measurements were made during three observing periods with a total number of 41 photometric



nights. No clouds were detected during these nights, except low sea-level clouds above the Pacific, which do not affect the sky above La Silla.

Year	Period	Photometric nights
1974	August 15–September 2	4
1975	March 20–May 12	19
1976	November 1–December 10	18
	Total:	41

But the determination of nightly extinction coefficients revealed that only 27 of them (~ 65 %) were of the required quality. The extinction for these so-called "good nights" did not differ by more than 2 % (at 5000 Å) from the curve given in the figure. This was determined from the mean of 19 "good nights" during the period March 20 to May 12. The mean of the other two observing runs agreed with this result to ± 0.005 mag/airmass (at 5000 Å). The points are measured values to illustrate the typical fluctuations for only one star in a "good night". Fourteen nights showed higer values of extinction and were not useful. Because Rayleigh scattering could not have changed (constant air pressure) and the ozone is limited to fixed wavelength regions from the shape of the total extinction curve, it was obvious that this was definitely due to aerosol scattering.

The most surprising result is that the contribution of aerosol in "good nights" is only 0.01–0.02 mag/airmass, although the soil on La Silla is dry and the wind is sometimes rather strong. No observatory is known in the northern hemisphere with a comparably low extinction. The best observing sites in California and Arizona show 0.05–0.10 mag/airmass aerosol extinction. Considering the number of photometric nights and the observed transparency of the sky, La Silla is one of the best observing places in the world.

We can summarize our experience with extinction measurements by the following statements:

1. If a cloud was visible during the daytime, either before or after a clear night, this night had to be omitted.
2. Condensation trails from aircraft visible on a blue sky, even for seconds, indicated unstable layers in the higher atmosphere and gave rise to uncertain nights.
3. No correlation was found between the extinction coefficients and the direction of observation.
4. Sometimes cloudless nights showed higher extinction but good stability. In this case the aerosol must be spread out uniformly around the sky.

The author wishes to express his gratitude to Dr. W.A. Sherwood, Dr. A.F.J. Moffat and Prof. J. Hardorp, who were helpful in collecting the extinction data during the calibration work.

High-dispersion Investigation of the Nucleus of NGC 253

M.-H. Ulrich

Dr. Marie-Hélène Ulrich is a well-known authority on emission-line galaxies and comes originally from the Observatoire de Paris, France. She has worked for a long period in the USA, at the University of Texas, Austin, and recently came back to Europe to join the ESO Scientific Group in Geneva. She here discusses the nearby galaxy NGC 253 and shows how optical, infrared and radio observations come together in a model of this very interesting object.

The nearby galaxies are particularly interesting because they are the ones which can be studied with the best linear resolution. Among the galaxies which are at distances less than ~ 5 Mpc, there are a few galaxies which are truly exceptional such as M82 = NGC 3034 and NGC 5128 = Centaurus A. Other galaxies show mild cases of activity which may represent normal but short stages of the evolution of galaxies. For example, M81 has a very compact, flat-spectrum central radio source of low absolute luminosity; in M31 the ionized gas shows non-rotational motions of small amplitudes. Another very informative case of activity in a galactic nucleus is provided by the Sc galaxy NGC 253 (fig. 1). The main signs of activity are (i) motions of the gas indicating that gas is escaping from the central region and (ii) extremely intense infrared radiation emitted by the nucleus. The results of recent spectrographic observations of NGC 253 (M.-H. Ulrich, 1978, in press) are briefly outlined below.

NGC 253 is at 3 Mpc and its heliocentric systemic velocity is 250 km s^{-1}.

Spectrograms of the central region of NGC 253 were obtained with the RC spectrograph of the 4 m telescope at Kitt Peak National Observatory, Arizona, USA. One of the spectrograms is shown in figure 2. On the original plate the dispersion is 54 Å/mm^{-1} and the scale perpendicular to the dispersion is 25 arcsec/mm^{-1}. The set of spectrograms reveals departures from rotational motions in the south-east quadrant with apex at the nucleus. In particular on spectra taken along the minor axis, the velocity of the gas is definitely smaller than the systemic velocity indicating that gas is flowing out of the nucleus and towards us. The velocity field observed from measurements along the emission lines of the ionized gas is in excellent agreement with the velocity field mapped by interferometry of H I 21 cm observed in absorption in front of the continuum source (S. Gottesman et al., 1976, *Ap. J.* **204,** 699). No velocity larger than the systemic velocity is observed in the atomic gas, ionized or neutral. In contrast, the molecular lines of H_2CO and OH show both higher and smaller velocities than the systemic velocity. This suggests a model for the gas in the nuclear region where the gas in its densest form, i. e. molecular gas, is expanding but is still in the region emitting the radio continuum whereas the atomic gas is outside the continuum source. In this model, the part of the atomic gas flowing out of the nucleus and away from us is behind the continuum source and therefore cannot be seen in H I 21 cm absorption, nor can it be seen in the optical emission lines because of the absorption by dust in the equatorial plane.