with better spectral resolution, observations with the Boller and Chivens spectrograph attached to the ESO 3.6-m telescope were carried out last December. The grating, with 400 lines/mm and blazed at 5400 Å, provided a dispersion of 172 Å/mm in the first order. Using an RCA CCD having 30 μm square pixel in size, and a slit aperture of 2 arcseconds we achieved a final spectral resolution of 8 Å (FWHM) in the wavelength range λλ 4500–7000. These observations allowed us to confirm as C stars the candidates AR 1 and No. 25 which lie within 30 arcseconds of the centre of NGC 419, therefore having a high probability of cluster membership. The spectrum of the star AR 1 is displayed in Figure 2. Unfortunately, we were unable to observe other C star candidates lying in the core of NGC 419 because the seeing was not good enough to identify these objects with certainty.

From this study of NGC 419 we can conclude that our grism technique is able to survey the carbon stars both in the field and in the globular cluster cores of the Magellanic Clouds provided that a special photographic process is applied to copy the original plates. Concerning the clusters, the C star survey on positive masked plates seems to be complementary to, if not more efficient than, the JHK photometric method developed by Aaronson and Mould (1982), because it is less liable to errors due to the background brightness in cluster cores, and also because no preconceived colour criterion is necessary in preselecting the red stars.

The extension of the asymptotic giant branch (AGB) above the tip of the first giant branch can be used to estimate the age of the Magellanic Cloud clusters (see Aaronson and Mould (1985) and previous papers by these authors). Consequently, the luminosity function of the upper AGB in globular clusters can be used to calibrate in age the corresponding luminosity function for field stars, thus providing information on the star formation history of the Clouds. Therefore, a more complete sample of AGB stars, in the larger sample of clusters of intermediate age and older, is of special astrophysical interest. Using the available set of grism plates we are engaged in this work.

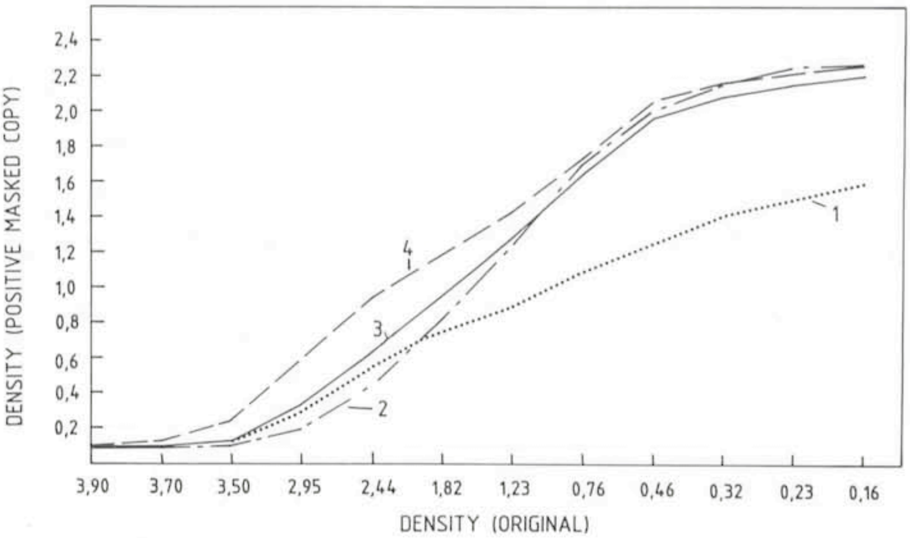


Figure 3: *Comparison of four positive plates obtained through a mask (4-minute exposure from an original grism plate) and the following photographic processing:*
*(1) mask developed 8 minutes; positive obtained in 12-minute exposure through the mask,*
*(2) mask developed 6 minutes; positive obtained in 6-minute and 9-second exposures with and without the mask, respectively*
*(3) mask developed 8 minutes; positive obtained in 12-minute and 9-second exposures with an without the mask, respectively*
*(4) mask developed 10 minutes; positive obtained in 18-minute and 9-second exposures with and without the mask, respectively.*
*Note the effect on the higher densities of the short exposure without mask.*

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# First Images of Globular Clusters Using a GEC CCD With UV Sensitive Coating


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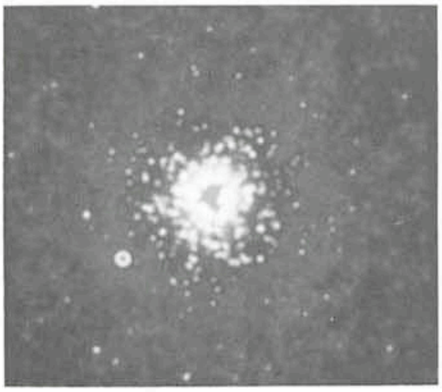
Two "blue coated GEC CCDs" were recently made available for visiting astronomers at La Silla (*The Messenger* No. 41 and No. 42). We used the ESO CCD No. 7 to obtain UBV images of central regions of globular clusters at the Cassegrain focus of the 2.2-m La Silla telescope. The scientific aim was primarily to monitor the error box of the NGC 1851 X-ray source in quasi simultaneous observations with EXOSAT. This programme was carried out in collaboration with L. Koch-Miramond and J.M. Bonnet-Bidaud (C.E.N. Saclay) and J.P. Cordoni (Montpellier). The X-ray source associated with NGC 1851 is located just outside the core of the cluster (12 arcseconds north of the centre). Following our identification of the optical counterpart of the northern M15 X-ray source (1984, *Astron. Astro-*



*Central field of NGC 1851 (1.′7 × 2.′3) in U with a coated GEC CCD at the 2.2-m telescope. North is up, east to the left.*

*phys.* **138,** 415; 1985, ESO preprint No. 400; IAU circular No. 4101 and No. 4146: AC211) we could expect to succeed again with one the most favourable targets of the southern hemisphere.

The choice of the coated GEC CCD was driven by 3 of its properties (when compared with a classical RCA chip):

(1) A higher and flatter response in the U band which would make it possible to obtain shorter exposures and a better fit of the U bandwidth.

(2) Very good cosmetic properties.

(3) A smaller pixel dimension giving a better sampling of the point spread function, which is important when doing stellar photometry in a crowded field.

On the other hand saturation by bright stars should be avoided because remanence effects could affect the photometry of the fainter stars in the following frames.

We actually obtained valuable observations in the 3 nights from December 30, 1985, to January 2, 1986, with seeing of about 1 arcsecond. The figure shows one 10-minute exposure frame in the U passband, of a 1.7 × 2.3 arcminute field on the central part of NGC 1851. Due to crowding the limiting magnitude is about U = 17.

# RR Lyrae, Delta Scuti, SX Phoenicis Stars and the Baade-Wesselink Method[1]

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## 1. RR Lyrae Stars as Primary Distance Indicators

Our general representation of the universe which surrounds us rests on the determination of the distances of the nearest galaxies by using primary distance indicators, all of them stellar and calibrated in our own Galaxy through parallaxes or photometric methods. The construction of the distance scale up to the most remote galaxies is built up via secondary and tertiary distance indicators (e.g., respectively supergiants and integrated luminosity of the brightest galaxy of the considered cluster).

As primary distance indicators, the RR Lyrae variable stars play, as do also the cepheids, an essential role in the determination of the extragalactic distance scale. Appearing numerous in the field as in globular clusters, they are easily observable, being about 55 times as luminous as the sun, and readily identifiable through their photometric and spectroscopic properties. They serve to calibrate the distance of the globular clusters in our Galaxy and in its nearest neighbours, globular clusters used themselves as secondary distance indicators. But the distance determination of these star clusters appears always indirect, not being based on estimations of mean absolute visual magnitude $\overline{M}_v$ of individual RR Lyrae cluster members, but assuming them to have the same mean absolute visual magnitude as the RR Lyrae field stars. Unfortunately, the influence of metallicity on the absolute magnitude of RR Lyrae stars is still controversial, different studies using various methods (statistical parallaxes, moving groups, cluster main sequence fitting, and Baade-Wesselink) giving very different results. Thus, the determination of numerous individual radii of RR Lyrae stars, in the field as in globular clusters, by use of the most direct approach, i.e. the Baade-Wesselink method, appears the best way to solve the problem of the absolute luminosity of RR Lyrae stars.

In other respects, RR Lyrae stars appear as fundamental chemical, kinematical and dynamical probes for the knowledge of the halo of the Galaxy. For example, the observation of a very distant and fast RR Lyrae star (d = 59 kpc and $V_r$ = −465 ± 27 km/s) allows Hawkins (1984) to attribute to our Galaxy a total mass $M_G = 1.4 \times 10^{12} M_\odot$. Finally, they offer observational constraints on stellar evolution models and pulsation theories.

## 2. RR Lyrae Star Classification

Radially pulsating A-F giants, RR Lyrae stars are grouped in different families, following the characteristics of their luminosity curves. The present classification is an updated version of the former one established by Bailey as early as in 1895.

RRab Lyrae stars are variables with *asymmetric* light curves (steep ascending branch), periods from 0.3 to 1.2 days and amplitudes from 0.5 to 2 magnitudes, pulsating in the fundamental mode (see Figure 1 for an example of such an asymmetric light curve, with the case of RR Cet).

RRc Lyrae stars are variables with nearly *symmetric,* sometimes sinusoidal light curves with periods from 0.2 to 0.5 day and amplitudes not greater than 0.8 magnitude, pulsating in the first harmonic.

The classification of RRs variable stars, also called dwarf cepheids, has been revised during the past few years, owing to the conclusions of Breger (1979, 1980):

(i) The majority of dwarf cepheids resemble the population I Delta Scuti stars in nearly all respects. Those stars are now classified as variables of Delta Scuti type by Kholopov et al. (1985). Delta Scuti stars are pulsating variable A0-F5 III-V stars with light amplitude from 0.003 to 0.9 magnitude and period from 0.01 to 0.2 day (see Figure 5 for an example of such a more symmetric light curve, with the case of BS Aqr).

(ii) A small group of short period variables (a few field stars and 3 blue stragglers in ω Cen) shows low metallicities, high space motions and low luminosities. They are population II short-period variables, of the spherical component or of the old disk galactic population, classified as variables of SX Phoenicis type by Kholopov et al. (1985). SX Phoenicis stars, with spectral types A2-F5, resemble phenomenologically Delta Scuti.

## 3. The Baade-Wesselink Method

Baade (1926) noticed that the theory of pulsating stars could be tested by use of measurements in magnitude, colour

[1] Based on simultaneous observations from La Silla Observatory (Chile) in photometry and from the Haute-Provence Observatory (France) in radial velocity.

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