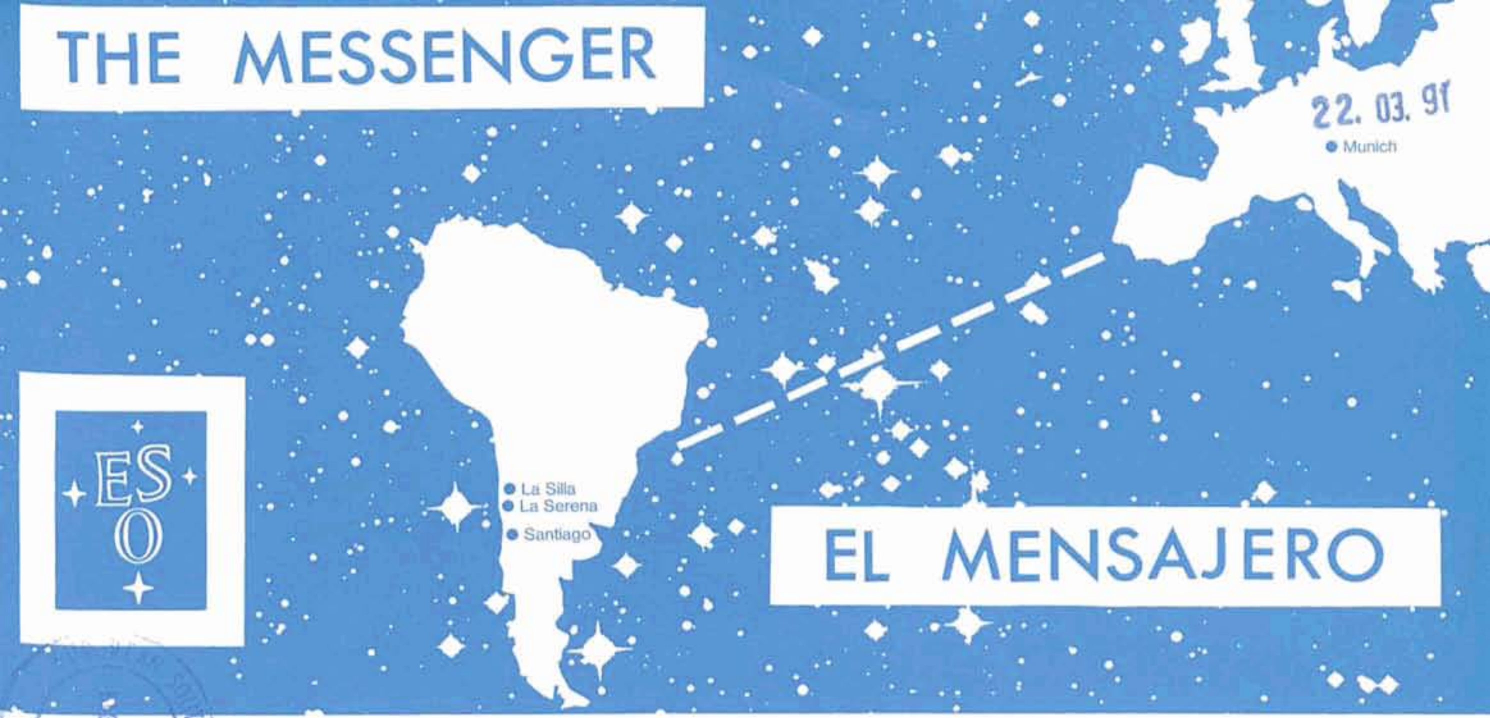

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A New Southern Hemisphere Galactic Extinction Map Based on Surface Brightnesses of External Galaxies

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1. Introduction

The precise surface brightness values listed for about 12,000 homogeneously selected galaxies in "The Surface Photometry Catalogue of the ESO-Uppsala Galaxies" (Lauberts and Valentijn 1989, hereafter ESO-LV; see also the *Messenger* **34**, 10, and **56**, 31, and this issue) have been used to derive galactic extinction values for a large part of the Southern Sky, cf. Figure 1. The new extinction measures are thought to reflect the effect of the diffuse interstellar

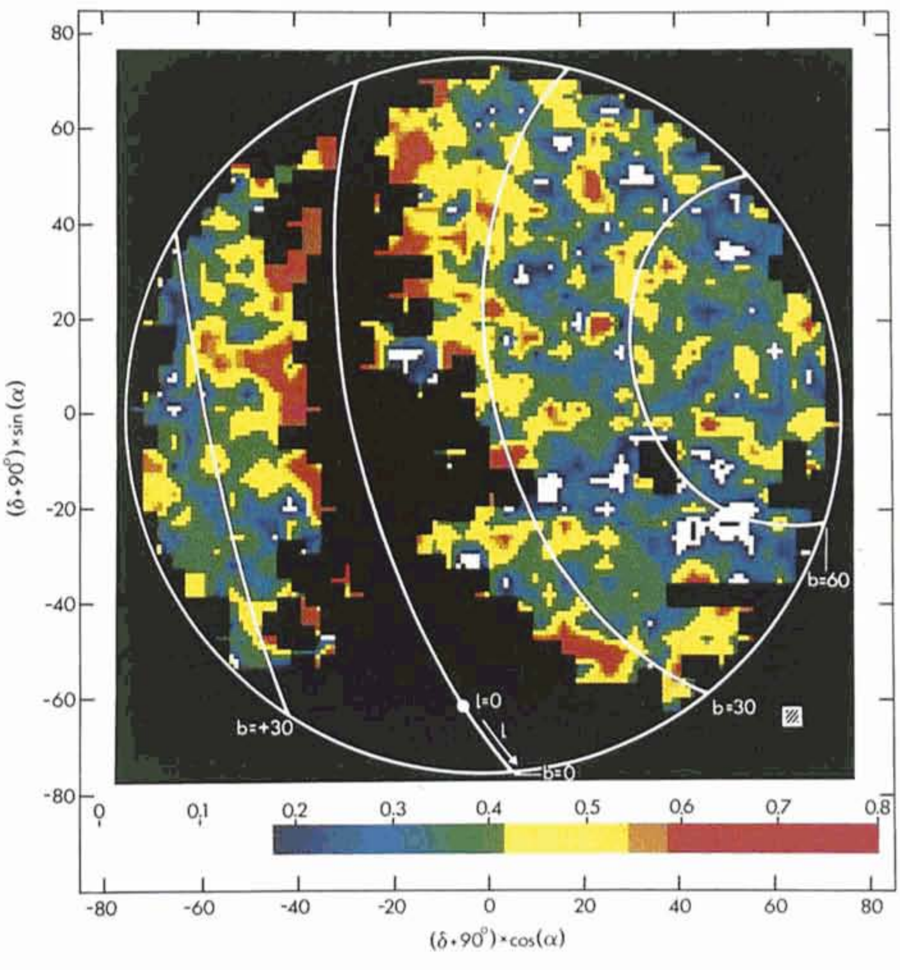

Figure 1: *A map of the relative extinction in the B band in polar equatorial coordinates. The derived extinction values have been averaged inside 3°×3° pixels and are here displayed using 1.°5×1.°5 pixels – some interpolation has been applied to fill pixels without data (~5% of total). The credibility of apparent structures can be assessed by using the following information: the uncertainty of A_B inside one resolution element (inset box at the lower right) is 0.13^m, roughly corresponding to one colour step on the map. The zero point is somewhat arbitrary, but a lower limit could be deduced by avoiding negative extinctions in regions with a minimum extinction (not at the South Pole) and a deconvolution of the observed frequency distribution of A_B with the measurement error function.*

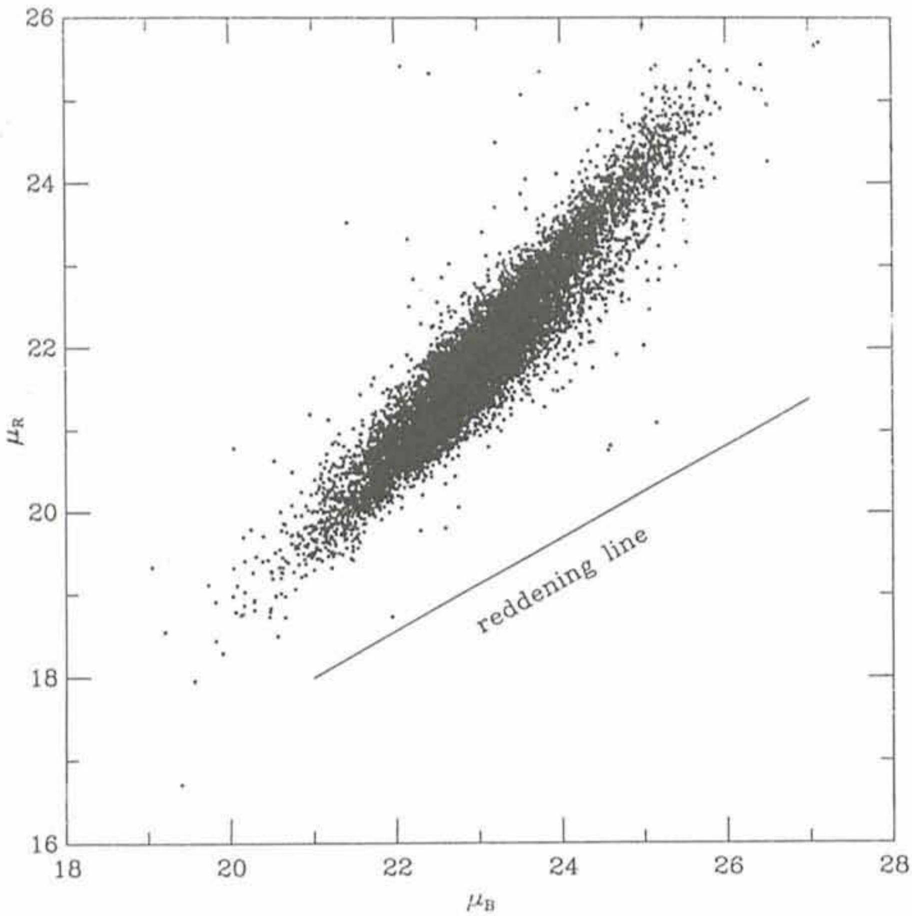

Figure 2: *Surface brightness (measured at the effective isophote) of ESO-LV galaxies in B and R bands.*

medium in our own Galaxy and the technique we have employed should trace the same component as has been studied before in so-called 'reddening' studies. The current analysis uses parameters of *detected* galaxies, in similarity with previous reddening studies, and is not sensitive to those regions of the sky that may be so heavily obscured that we start to miss objects located behind these regions. These heavily obscured regions can be better traced by galaxy counts, a separate project, which is still in progress. Here, we announce some first results of our extinction studies, in particular a 3-degree resolution extinction map of the Southern Sky with a σ (A_B) $\approx 0.13^m$ and σ (E(B − V)) $\approx 0.06^m$.

2. The Technique

The hitherto most frequently used model for the extinction in the Southern Galactic hemisphere (Burstein, Heiles) is exclusively based on the mapping of neutral hydrogen. Since this mapping was done with a rather poor spatial sampling, the resulting extinction map was grossly dominated by interpolations of data. Furthermore, using HI data relies on a constant HI-to-extinction ratio. The overall value of this ratio is uncertain by at least a factor two, and is thought to deviate more locally. This motivated Burstein and Heiles to include also galaxy counts, when deriving their extinction model for the Northern Hemisphere, but this could unfortunately not be done for the South. Motivated by the recent availability of the photometric data in the ESO-LV catalogue, we have undertaken some statistical experiments to see whether the data would allow an improvement of this situation.

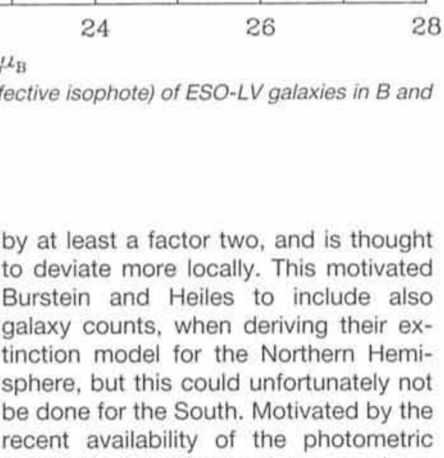

Figure 3: *The idea of extinction measurements using the surface brightness of galaxies in two bands.*

Although the surface brightness of an external galaxy at a particular single band should respond in a linear way to the extinction in the Galaxy, such single-band surface brightness values are not good extinction indicators, since they have a too large scatter around the mean value ($\sigma \approx 0.6$ mag). If however, we have a sample of galaxies with measured surface brightness in *two* bands (B and R for ESO-LV), then we can take into account the fact that they are strongly correlated with each other (Fig. 2); as a measure of extinction of each individual galaxy, we can use its distance from the average regression curve of unreddened surface brightnesses, measured along the direction of the reddening vector (see Fig. 3).

However, in order to obtain this distance we have to know the location of the curve describing the unreddened surface brightnesses, but to obtain this curve we must know the extinction for each galaxy – just the set of values we are looking for. The only solution to this difficulty is to obtain *both* the extinctions and the location of the curve simultaneously – in one step. This is possible with help of the "analysis of variance" statistical technique. This technique reproduces the well documented ratio $A_R/A_B = 0.565$ and in the further processing this value has been adopted. In constructing the unreddened curve we made use of the parameter Q which is independent of extinction but dependent on surface brightness. In short, the statistical analysis solves the function f(Q) and A_B(l,b) in one step. The introduction of the Q parameter is closely related to a similar parameter used for the analysis of the reddening of stars.

The full description of the above method and its application to ESO-LV is expected to be published soon (Chołoniewski and Valentijn, 1991, in preparation).

The uncertainty of the derived extinction in the B band is $\sigma(A_B) \approx 0.4^m$ *per galaxy*. This corresponds to σ(E(B − V)) $\approx 0.1^m$ which is comparable to the accuracy of extinction estimates deduced from the photometry of stars. When averaging over larger areas (ESO-LV has about one galaxy per square degree) a formally much more accurate value for such an area can be obtained. For instance, the average A_B over one ESO sky survey plate has been deduced with an error of 0.1^m, which corresponds to an uncertainty in E(B − R) ≈ 0.04. Such values are useful to evaluate the large scale distribution of the extinction, but indeed, we do not know how much spatial structure is present within these averaged areas, a problem inherent in this sort of research.

3. The Map

In Figure 1 we present a map of the relative extinction in the Southern Hemisphere. The photometry of external galaxies cannot provide absolute extinction, or in other words, it cannot provide the zero point. Formally, the technique provides the relative extinction compared to an overall mean of $A_B = 0$. We have not finalized the constant yet (our work on this is still in progress) but we can easily deduce a lower limit for it. We cannot allow negative extinctions to occur (the white and blue regions in Fig. 1) and more formally, we can deconvolve the observed frequency distribution of A_B with the formal σA_B error function. This way, we derive a lower limit to the zero point of 0.4^m, which has been included in the scale of Figure 1.

Our understanding of Figure 1 is that most of the structures that can be seen are real. We checked that they do not correlate with the spatial distribution of the target galaxies, while around the Southern Galactic pole we could observe a good spatial correspondence with the IRAS cirrus maps of Boulanger et al. We can also compare the extinction in a small, but still significantly large, part of the Northern Galactic Hemisphere (92 ESO survey plates) with that in the Southern Galactic Hemisphere. In the regions of absolute galactic latitute in the range 10°–30°, we find on average about 0.1^m more extinction (A_B) in the South. If our evaluation of the lower limit on the zero-point is correct, then the average extinction at low galactic latitudes (<70°) should be $A_B > 0.25^m$.

4. Availability of the Data

Our results for the relative extinction in the B band (A_B) in our Galaxy will be available in the following forms:

1. In our paper we anticipate a printed list of overall extinction values for each of the 404 ESO sky survey plates that were assessed in the ESO-LV project.
2. A computer programme AEJ (in MIDAS environment) which fills two columns of the digitized version of the ESO-LV catalogue (the MIDAS table PCAT): column # 102 which contains A_B 'per galaxy' and column # 105 which contains the average A_B per plate. It is distributed, on request, by the data archivist of ESO.
3. An ASCII file which contains three columns: R. A., Decl. and A_B for each of 10,930 galaxies. It is distributed, on request, by J. Chołoniewski (Astronomical Observatory of the Warsaw University, Aleje Ujazdowskie 4, 00-478 Warszawa, Poland) on 5.25 or 3.5 floppy disk.

The Recent Outburst of (X-Ray) Nova Muscae 1991

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Discovery

The transient X-ray source, GRS 1121-68 (Nova Muscae 1991), was almost simultaneously detected by the WATCH all-sky X-ray camera installed on the Soviet GRANAT satellite on January 9 and the All Sky X-ray Monitor aboard Ginga on January 8, 1991. Lund and Brandt (IAU Circ. 5161) reported that this new X-ray source was at that time about twice as bright as the well-known X-ray emitting Crab Nebula. The search for a possible optical counterpart began on La Silla on January 11, using the GPO astrograph without success.

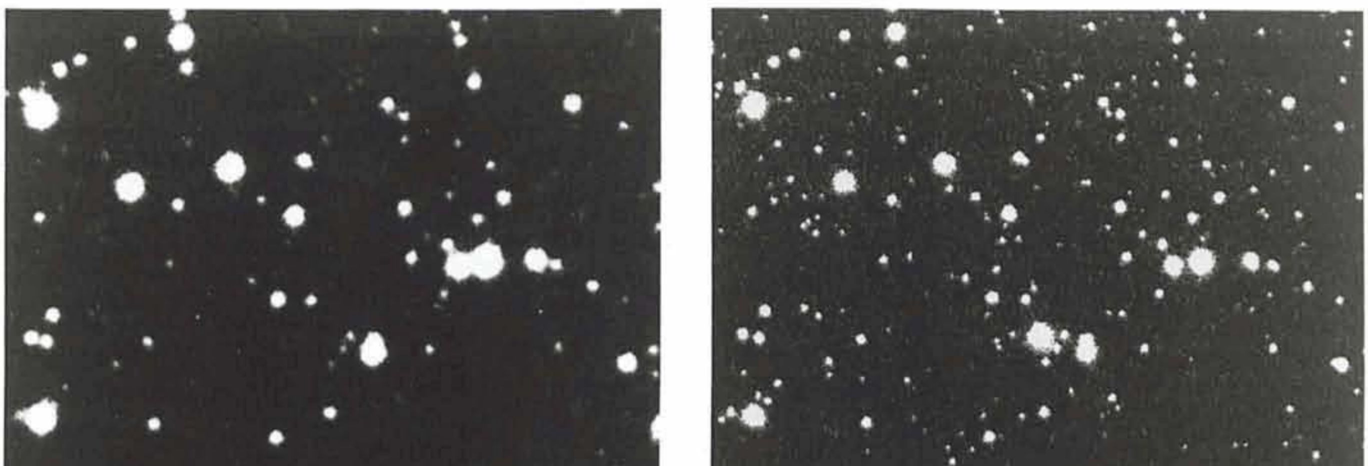

Figure 1: *This photo shows Nova Muscae 1991 which flared up in early January 1991 in the southern constellation Musca (the Fly). The left frame is a reproduction of an earlier red-sensitive ESO Schmidt plate (120-min exposure on IIIa-F + RG630; 29 January 1976; observer G. Pizarro). To the right is the same sky field, observed with the ESO New Technology Telescope (EMMI + CCD, 5-sec exposure in R; 15 January 1991, 7:22 UT; seeing 0.9 arcsec; observers M. Della Valle and B. Jarvis); here the nova can be seen as the bright object at the centre. The pre-nova is faintly visible at the same position in the left frame.*