lution and (c) double or multiple systems. It is for example possible that nuclear activity, chaotic star formation and merging are responsible for the blue colours in compact, irregular and multiple systems, respectively. Spectra of blue, low-surface-brightness arcs will provide us with the redshift distance of these objects and possibly with some indications of their physics.

Acknowledgements

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Diffuse Bands and Peculiar Interstellar Clouds

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1. Introduction

The Diffuse Interstellar Bands or DIBs, as they are usually called, are absorption features which are generated in the interstellar medium by a still unidentified set of carriers. The DIBs were firstly mentioned by Heger (1921), while their stationary character and their interstellar origin was confirmed by Merrill (1936). The most extensive survey has been published by Herbig in 1975, on the basis of photographic plate spectra: he reported 39 DIBs in the spectral range 4400–6700 Å, 24 of which were observed for the first time. By now six more DIBs have been discovered beyond 6700 Å.

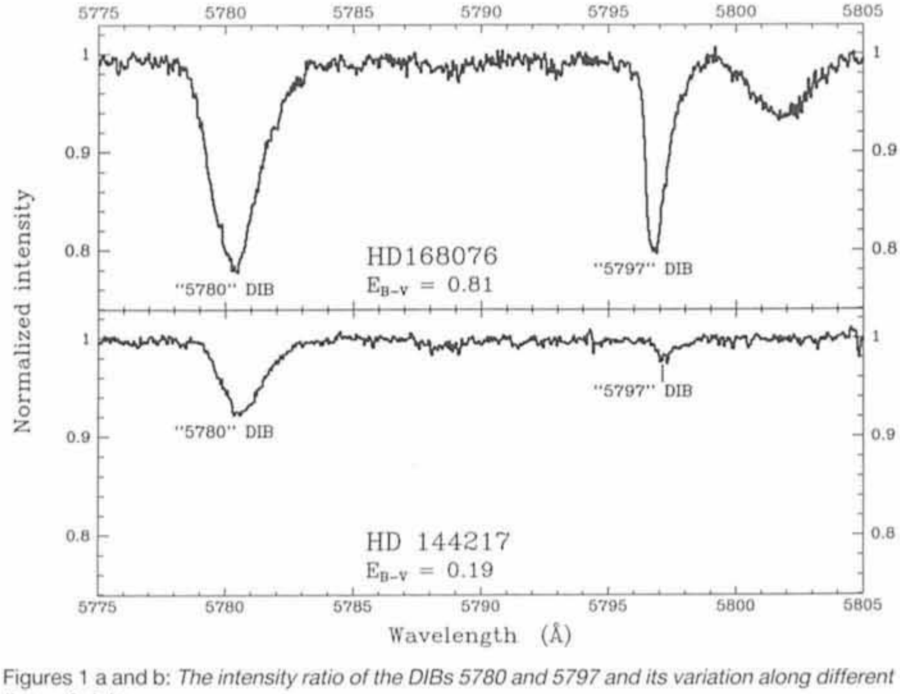
During the past years the interest for the DIBs has grown considerably, particularly because the new observing techniques and the improved quality of the spectra allowed a deeper analysis of their profiles, highlighting more and more details on their behaviour and therefore making them an interesting candidate as markers of the physical and chemical status of the interstellar medium. However, in spite of the higher resolution and the excellent high S/N ratio which can be obtained from modern spectrographs coupled to CCD detectors, the nature of the carriers of the DIBs remains a mistery: their long lasting challenge may indeed be among the reasons for the continuing interest in them. Comprehensive reviews on the DIBs' topic, together with extensive bibliography, have been published by Bromage (1987) an Krelowski (1989).

In this short paper we discuss our approach to the study of these interstellar features and present some of the results we have obtained so far.

2. DIBs: What Do We Know?

The most recent high-quality (high resolving power as well as very high signal-to-noise ratio) observational data (Snell and Van de Bout 1981, Massa et al. 1983, Seab and Snow 1984, Krelowski and Walker 1987, Westerlund and Krelowski 1988, Benvenuti and Porceddu 1989, Crawford 1990, Le Bertre 1990, Porceddu et al. 1991), and the parallel theoretical studies (Douglas 1977, Van de Zwet and Allamandola 1985, Léger and d'Hendecourt 1985, Allamandola et al. 1989, Cossart-Magos and Leach 1990) allow us to define some constraints on the DIBs' problem:

- the presence of DIBs is *related* to the colour excess, in the sense that the lack of reddening implies the absence of the DIBs: but the DIBs' intensity along one line of sight is only loosely correlated to the value of the



Figures 1 a and b: *The intensity ratio of the DIBs 5780 and 5797 and its variation along different lines of sight.*

reddening in that direction. This fact becomes particularly evident for low reddening values which implies obscuration by a single interstellar cloud. For higher values, the *averaging* effect over several clouds tends to flatten out the differences;

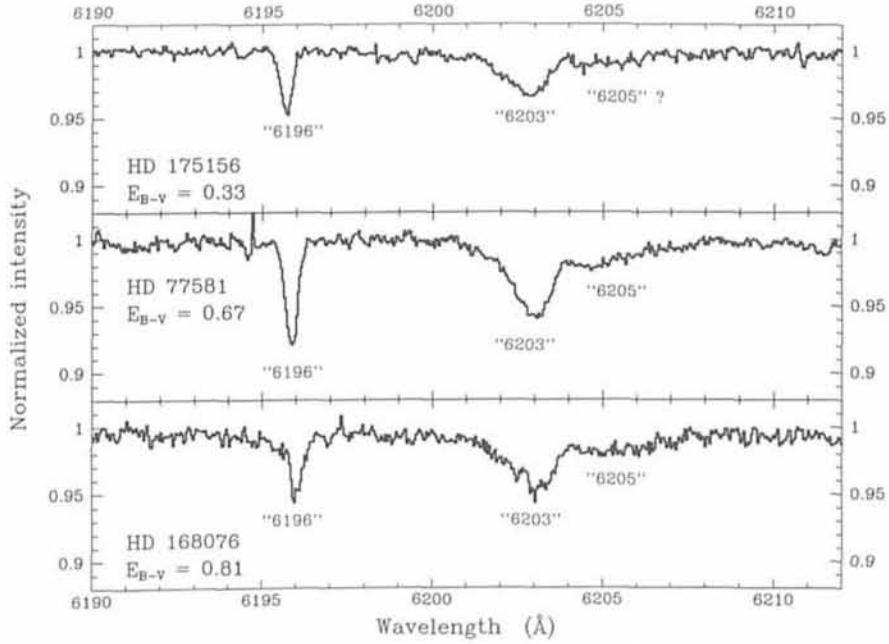
- similarly, the DIBs intensity is not strongly correlated with the 2200 Å extinction bump: dust and carriers of the DIBs, although coexisting in the interstellar medium, have an independent history;
- the line profile of the DIBs seem quite stable, both for the narrow and shallow features. With the exception of an intriguing case which is discussed below, the observed broadening of the profile can be explained in terms of Doppler shifts due to the different velocities of the intervening clouds;
- the DIBs seem to be generated not by a single agent but by several carriers: they can therefore be grouped into "families", the components of which show well-defined intensity ratios;
- the most recent theoretical works indicate the Polycyclic Aromatic Hydrocarbons (PAHs) as a strong candidate for a molecular carrier of the DIBs: but the laboratory results have still to be confirmed by the observations.

These facts have modified the previous hypothesis of an interstellar medium producing everywhere the same whole set of diffuse bands. Therefore, a good strategy for further investigation is to concentrate the observational effort on lines of sight along which some components of the Interstellar Medium (including the DIBs) deviate from the *average* behaviour.

3. Observational Material and Discussion

In 1986 we started a wide survey on the DIBs in the spectral range 5700–6700 Å. The whole data set comes from observations obtained with the ESO CAT/CES telescope equipped with the Short Camera and the RCA CCD #9. Given the relative brightness of our targets, the CAT/CES instrumentation is the most suited for such a survey, also because it offers the possibility of obtaining the necessary observing time. The quality of the data, as it can be seen from the figures, is excellent: some limitations arise from the limiting magnitude, which is about 8 for the Short Camera at a resolving power of 50,000.

Our current database includes about one hundred lines of sight in the direction of bright stars; for all of them we observed the DIBs at 5780, 5797, 6196, 6203, 6269 and 6284 Å, while for a subset of the targets we observed also the DIBs at 5705, 5850 and 6614 Å.



Figures 2 a–c: *The intensity ratio and its variation for the DIBs around 6200 Å. The two overlapping components at 6203 and 6205 Å are clearly seen.*

Some of the observations have been done by remote control from Garching. The experience with this new observing style has been generally positive, although we sometimes felt the need for a closer and more extended checking of the instrumental set-up (. . . as well as a longing for the midnight snack!).

In the following, we describe some of the most peculiar situations we found in our data, in particular: the varying intensity ratios between features belonging to different families, the lack of some of the diffuse bands along peculiar lines of sight, and the apparent absence of DIBs when the reddening is mainly due to circumstellar matter.

3.1. The varying intensity ratios I: 5780 vs. 5797

The 5780 band is a relatively strong and narrow feature, showing an asymmetric profile, while the band at 5797 is very narrow and weaker than the 5780 one. Only recently has it been shown that these two diffuse bands do not share the same carrier (Chlewicki et al. 1986, Krelowski and Walker 1987, Benvenuti and Porceddu 1989); all these papers also report that the variation of relative intensity of the two diffuse features is not usually accompanied by any profile change. Moreover, their intrinsic profiles, i.e. the ones which originate in a single cloud, were found to be the same also in clouds producing different extinction curves (Westerlund and Krelowski 1988, Porceddu et al. 1991 a).

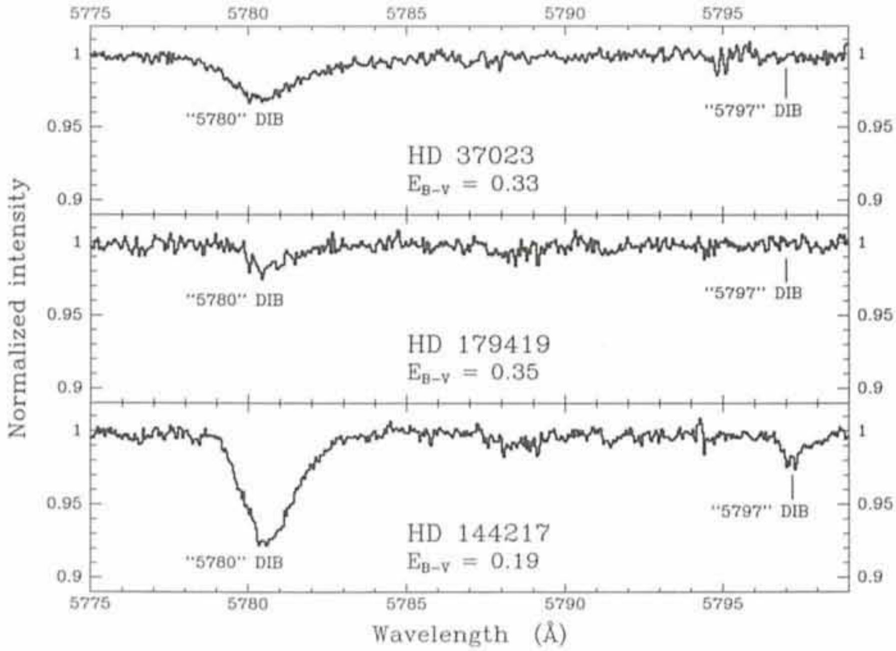
Figures 1 a and 1 b show the varying behaviour of the two features in two selected cases. Their belonging to different "families" is evident from the independent intensity variation.

3.2. The varying intensity ratios II: the DIBs around 6200 Å

The group of diffuse features around 6200 Å (at 6196, 6203 and 6205 Å), is slightly different from the previous case. The spectra and related conclusions which have been presented by several authors (Chlewicki et al. 1987, Krelowski and Walker 1987, Benvenuti and Porceddu 1989) do not allow us to assign in a definite way these features to a single DIB's family. Our observational data (Benvenuti and Porceddu 1989, and Porceddu et al. 1991) show that the broad, asymmetric DIB absorption at 6203 Å can be resolved into two overlapping features, the second one being centred at about 6205 Å. As it can be seen from Figures 2 a–c the intensity ratio between the two components at 6203 and 6205 Å is not constant. Analysis of the complete data set indicates that the 6196 and 6203 Å DIBs may share the same family of the 5780 feature, but the 6205, if present, does not.

3.3. Missing DIBs and profile broadening

As it has been seen from the previous examples, the relative intensity ratios of the DIBs which are members of different



Figures 3 a–c: *Missing DIBs: the 5797 feature disappears and the 5780 intensity is strongly reduced along "peculiar" lines of sight.*

families are strongly variable: we can think of the lacking of one or more diffuse bands as the extreme case of such a variability. We found cases in which the 5797 Å DIB is strongly reduced or completely absent: for instance, the star β Sco (HD 144217, Fig. 1 b and 3 c), presents a strong reduction of the 5797 feature in comparison to the 5780 one. But probably the most representative case of lacking of the 5797 DIB is the Trapezium star HD 37023 (θ^1 Ori D), Figure 3 a. Indeed, all the Trapezium stars share this peculiarity, as they are evidently embedded in and seen through the same cloud, whose nature should also be responsible for the weakness of the 5780 Å DIB in relation to the value of E(B-V) = 0.33. The same behaviour is shared by a few more stars, as, for example, by HD 179419 (E(B-V) = 0.35) which is shown in Figure 3 b: in this case, despite the relatively high value of the reddening, the 5780 feature is extremely weak and the 5797 is not seen at all.

The medium in the direction of the Orion Trapezium stars is interesting for another reason, i.e. the observed unusually large broadening of the 5780 band. The observations of interstellar sodium lines by Hobbs (1978) indicate that several components are present toward the line of sight of the Trapezium stars. These components have recently been confirmed by our high-resolution (R=100,000) spectra (Porceddu 1991, in preparation) and from them the velocity of the clouds can be accurately measured. However, a Doppler broadening of a "single-cloud" 5780 DIB profile, obtained by using the velocity information from the sodium spectra, is not large enough to justify the observed width in the case of the profile of HD 37023, supporting the hypothesis that the broadening is intrinsic (Porceddu et al. 1991 b). If this fact is confirmed, and, more important, observed in other well-defined interstellar clouds, it may be used in further constraining the nature of the absorbing carrier of the 5780 DIB.

3.4. Where the DIBs seem not to live: the case of the Be stars

The last interesting example we have included in our gallery of peculiar cases is that of the spectrum of a Be star, in which the observed reddening is mainly due to circumstellar matter. As it can be seen from Figure 4 b, the 5780 and 5797 DIBs are completely absent, despite the relatively high value of the reddening (compare the spectrum of the "normal" star HD 44458 in Figure 4 a). This absence may indicate that these DIBs cannot be generated or survive in an environment such as the circumstellar shell of a Be star. Indeed, other studies, e.g. on the behaviour of the 2200 Å feature, indicate that the circumstellar material may be quite different from the diffuse medium, particularly in the dust grain composition. It seems therefore promising to further investigate how this "environmental" differences, including the irradiation by the central star, affect the various "families" of DIBs.

A more detailed analysis, based on a wider sample of Be southern stars from which we picked the above example, is in preparation. In this case, a well-known problem in the interpretation of the data is the difficulty of disentangling the circumstellar from the diffuse medium contribution in the total reddening. We could overcome this problem by observing an open cluster in which normal B and Be coexist and for which the diffuse medium reddening is obviously the same: if we get the necessary observing time!

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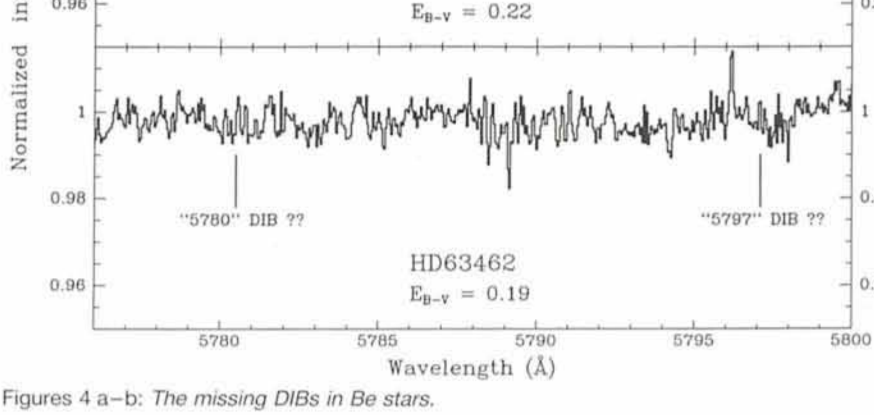

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Exhibition in Berlin

The ESO exhibition opened at the Zeiss Großplanetarium in (East-) Berlin on November 1, 1991. The City of Berlin was represented by Mr. Arndt, Staatssekretär für Schule, Berufsbildung und Sport and the Mayor of Berlin-Prenzlauer Berg, Dr. Dennert.

This planetarium is one of the world's largest and was inaugurated in 1987 on the occasion of the 750th anniversary of Berlin.

It has the latest Zeiss projector with all possible technical finesses.

Already on the opening day there were lots of visitors and many more are expected during the 3 months' duration of the exhibition.

ESO is particularly pleased to make its exhibition available at an institution which only recently was incorporated into the Federal Republic, at the time of the German re-unification. There is little doubt that it will be of particular interest to the inhabitants of the parts of Berlin surrounding the Planetarium.

Mr. Arndt, Undersecretary of State for Education, Vocational Training and Sports, opens the ESO Exhibition in Berlin.

Looking for Optical Emission from Gamma-Ray Bursters

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A. SMETTE, ESO, La Silla

1. Gamma-Ray Bursts: a 20-Year-Old Mystery

Discovered some 20 years ago [1] gamma-ray bursts (hereafter GRB) remain mysterious: these transient sources emit only during times ranging from a few milliseconds to several minutes, and they are observed only in the X-ray/Gamma-ray range, from 1 keV to more than 100 MeV. They have no obvious counterparts, either transient or quiescent, in other spectral regions, e.g. optical [2] or in soft X-rays [3] [4]. Furthermore, their light curves, and their energy spectra are extremely diverse: there is no "typical" gamma-ray burst and among the 600 bursts observed until now, not even a general classification has been established. With 3 notable exceptions, none has been observed to repeat. The exceptions are the soft repeaters SGR 1806-20 [5] [6], SGR 1900+14 [7] and the GBS 0526-66 [8] March 5b, 1979 GRB, which is located in the direction of the LMC).

Until recently, there was a general agreement on the galactic neutron star origin of these sources, based on the characteristic time scales of the events (sometimes less than a millisecond) and on the presence of strong magnetic field signatures in their energy spectra. In that case, with more than 600 detections to date (and an actual detection rate of 1 per day), GRBs would have been the most common manifestation of neutron stars in our galaxy. However, recently the situation became quite confused with the announcement by the